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VOLUME 24, NUMBER 1
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43-12 SELECTED * WATER * RESOURCES * ABSTRACTS *

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 24, NUMBER 1
JANUARY 1991

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 24, NUMBER 1
JANUARY 1991

W91-00001 -- W91-01004

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge Index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water In Soils; Lakes; Water In Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

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ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

HYDROLOGY PAST AND PRESENT.
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
J. C. I. Dooge.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 1, p 5-26, 1988. 4 fig, 6 tab, 81 ref.

Descriptors: *Comprehensive planning, *Future planning, *History, *Hydrology, *Reviews, Water cycle.

Within the context of scientific disciplines, hydrology can be discussed either in relation to the other sciences dealing with water or in relation to its sister disciplines in geophysics and in the general context of the earth sciences. Until comparatively recently the approach to hydrology was essentially a pragmatic one. Development of continuity theory has guided the development of hydrology as a science. Deterministic approaches have dominated hydrology, although statistical mechanics and system theory are having a significant impact. Scientific hydrology is considered against the background of the classical development of scientific knowledge and applied hydrology is considered in the context of the many diverse factors relevant to providing water for health and for food throughout the world. Water cycles, health aspects of water supplies, and the use of water for irrigation focus attention on the social importance of hydrology. Future developments will include addressing hydrologic problems at the meso-scale, but progress will depend upon cooperation and communication among practitioners in the field. (Tappert-PTT)
W91-00066

MODELING INFILTRATION IN HYSTERETIC SOILS.
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W91-00118

ONE-DIMENSIONAL INTERACTIVE SOIL-ATMOSPHERE MODEL FOR TESTING FORMULATIONS OF SURFACE HYDROLOGY.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
R. D. Koster, and P. S. Eagleson.
Journal of Climate JLCLEL, Vol. 3, No. 6, p 593-606, June 1990. 10 fig, 18 ref. National Aeronautics and Space Administration Grant NAG 5-743.

Descriptors: *Atmospheric circulation, *Climatology, *Hydrologic models, *Model studies, *Parametric hydrology, *Surface-groundwater relations, Boundary conditions, Climatic data, Precipitation, Radiation.

The longterm climate of an atmospheric general circulation model (GCM) is defined by the GCM's discretization of the fundamental conservation and state equations, its application of initial and boundary conditions, and its parameterizations of the various atmospheric and surface processes affecting the general circulation. A successful model climate matches the earth's observed climate and responds realistically to changes in boundary conditions. A model representing a soil-atmosphere column in a GCM was developed for offline testing of GCM soil hydrology parameterizations. Repeating three representative GCM sensitivity experiments with this one-dimensional model demonstrates that, to first order, the model reproduces a GCM's sensitivity to imposed changes in parameterization and therefore captures the essential physics of the GCM. The experiments also show that by allowing feedback between the soil and atmosphere, the model improves on offline tests that rely on prescribed precipitation, radiation, and other surface forcing. (Fish-PTT)
W91-00145

RADAR RAINFALL FORECASTING METHOD DESIGNED FOR HYDROLOGICAL PURPOSES.
Ecole Nationale des Ponts et Chaussees, Paris (France).
For primary bibliographic entry see Field 7B.
W91-00156

ESTIMATING GROUNDWATER RECHARGE USING A SURFACE WATERSHED MODEL: SENSITIVITY ANALYSES.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W91-00161

SPATIALLY CONTINUOUS DETERMINATION OF GROUNDWATER FLOW TO SURFACE WATER BODIES: APPLICATION TO THE CONNECTING CHANNELS BETWEEN LAKES HURON AND ERIE.
Wisconsin Univ.-Milwaukee. Dept. of Geosciences.
D. S. Cherkauer, and R. W. Taylor.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 349-369, May 1990. 8 fig, 2 tab, 24 ref. U.S. Environmental Protection Agency Great Lakes Research Program.

Descriptors: *Geophysical surveys, *Great Lakes, *Groundwater budget, *Groundwater movement, *Lake sediments, *Surface-groundwater relations, Conductance, Hydraulic properties, Hydrologic properties, Resistivity, Seepage, Seismic properties, Stream gages.

The International Joint Commission on the Great Lakes has sponsored an intensive, binational program to define the mass budgets, both water and chemical, of the channels connecting Lakes Huron and Erie. One of the more difficult components of the budgets to define is the quantity of water which enters or leaves a surface water body via the subsurface or groundwater route, usually because of a lack of information on the hydraulic properties of the materials beneath the surface water body. In order to quantify the total inflow of groundwater and its distribution in the channels, electrical resistivity and seismic data were collected along over 200 km of survey lines to allow definition of the thickness, general composition and hydraulic properties of the sediment column. The geophysics provided a measurement of electrical longitudinal conductance of the sediment column at 40-m intervals along the survey line. This parameter has been empirically related to the hydraulic leakage of the sediment column at discrete calibration points where seepage meters were installed. Groundwater discharges calculated using the geophysically-derived hydraulic properties compare very favorably with those calculated directly from the seepage measurements and others calculated independently from analysis of stream gaging records, thereby confirming the reliability of the hydrogeophysical approach. This approach offers the advantage of higher resolution of lateral variations in hydraulic properties and relatively low monetary and time expenditures when compared to a drilling program. However, calibration to direct hydraulic measurements is necessary. (Author's abstract)
W91-00163

RAINFALL-REAERATION EFFECTS.
Florida Inst. of Tech., Melbourne. Dept. of Chemical and Environmental Engineering.
T. V. Belanger, and E. A. Korzun.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 582-587, July/August 1990. 1 fig, 17 ref.

Descriptors: *Aeration, *Everglades, *Model studies, *Oxygenation, *Rainfall disposition, *Rainfall intensity, *Rainfall-reaeration relations, Florida, Instream aeration, Kinetic energy, Rainfall-runoff relationships, Wave action, Wind waves.

Many investigators have studied the reaeration process in streams, and numerous predictive equations are available. In the case of lentic systems, unlike flowing streams where turbulence generated by moving water is the major factor affecting reaeration, wind/wave action is the dominant force, and relatively little information is available regarding the resulting surface reaeration effects. The calculation of wind/wave effects on reaeration rates requires a knowledge of the mechanisms affecting the different wave formations and the transfer of kinetic energy from the atmosphere to the surface. While wind/wave interactions are currently being investigated, the effect of rainfall on reaeration needs to be quantified. Rainfall may be an important contributor of oxygen, particularly in undersaturated systems in geographic regions where frequent rainfall events occur. A study was undertaken to provide preliminary data on the rainfall intensity/reaeration relationship from small-scale field and lab pool studies. In oxygen budget and reaeration rate investigations, rainfall is usually neglected as a reaeration mechanism. Data show that the effect of rainfall on reaeration is quite significant, and imply that in geographic regions where frequent rainfall events occur, this effect can be very important and can provide a significant source of additional oxygen to an aquatic system. Calculations showing expected increases in reaeration rates for two areas in the Florida Everglades at various rainfall intensities support this conclusion. (Fish-PTT)
W91-00175

ENVIRONMENTAL ISOTOPE-AIDED STUDY ON RIVER WATER AND GROUNDWATER INTERACTION IN THE REGION OF SEOUL AND TAEGU.
Korea Advanced Energy Research Inst., Daeduk (Republic of Korea).
J. S. Ahn, I. S. Suh, J. S. Hahn, B. Payne, and P. Airey.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 371-384, 21 fig, 3 tab, 15 ref.

Descriptors: *Geohydrology, *Groundwater recharge, *Korea, *Seoul, *Surface-groundwater relations, *Taegu, *Tritium, Crystalline rocks, Han River Basin, Infiltration, Limestone, Paleohydrology, Percolation, Tracers.

Environmental isotope aided studies on river water and groundwater interaction in the Han River Basin, Korea, in areas composed of crystalline rocks and limestone, were conducted. The results indicate that the groundwater in the Seoul area is recharged by the Han River. In non-urban areas, the groundwater is recharged by infiltration and precipitation. The crystalline rock aquifers are recharged by downward percolation of shallow groundwater stored in overlying alluvium. Older groundwater has a low concentration of tritium ranging from 0-2 TU, and is observed at the lower Han River Basin near Bupyeong. This may indicate that the water sampled was recharged at a much earlier time than other groundwater that was sampled; possibly as early as the pre-thermonuclear period. The interaction study conducted in the karst area showed that there was no systematic difference in tritium levels between surface water and groundwater, and that the residence time of groundwater in limestone is probably not longer than a few months. The area recharged by water from the overlying alluvium into the sedimentary rock aquifer was restricted only along the Kumho River channel and its tributaries in a classic sedimentary rock area. Bedrock groundwater whose tritium level and stable isotope composition was less than 14 TU and -6.8 respectively and was observed in the central part of Taegu. (See also W91-00215) (Lantz-PTT)
W91-00257

NATIONAL WATER INFORMATION SYSTEM USER'S MANUAL VOLUME 2, CHAPTER 3. AUTOMATED DATA PROCESSING SYSTEM.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W91-00442

Field 2—WATER CYCLE

Group 2A—General

REMOTE SENSING AND LARGE-SCALE GLOBAL PROCESSES.
For primary bibliographic entry see Field 7B.
W91-00454

HYDROLOGICAL REMOTE SENSING RESEARCH WITH LARGE-SCALE APPLICATIONS IN WESTERN EUROPE.
Zurich Univ. (Switzerland). Remote Sensing Labs.
For primary bibliographic entry see Field 7B.
W91-00455

RELATIONSHIPS BETWEEN THE HYDROLOGIC BALANCE OF A SMALL WATERSHED AND REMOTELY SENSED SOIL MOISTURE.
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
E. T. Engman, G. Angus, and W. P. Kustas.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 75-84, 7 fig, 1 tab, 9 ref.

Descriptors: *Microwaves, *Model studies, *Rainfall-runoff relationships, *Remote sensing, *Soil water, Aircraft, Catchment areas, Drainage patterns, Evaporation, Evapotranspiration, Hydrologic budget, Streamflow.

The water balance of a small drainage basin has been simulated using a simple storage model. Aircraft microwave measurements of soil moisture were used to construct two dimensional maps of the spatial distribution of the soil moisture. Using data from flights on different dates also provided the temporal changes resulting from soil drainage and evapotranspiration. The remotely sensed soil moisture appears to be a valuable new data form for verifying model performance and identifying areas of the basin contributing to streamflow. (See also W91-00454) (Author's abstract)
W91-00463

RADAR DATA PROCESSING FOR HYDROLOGY IN THE CEVENNES REGION.
Laboratoire Central des Ponts et Chaussees, Bouguenais (France).
For primary bibliographic entry see Field 7B.
W91-00466

BASIS OF HYDRO-CLIMATIC TIME SERIES IN GREENLAND.
Greenland Technical Organization, Copenhagen (Denmark). Section of Hydro-Technical Investigation.
For primary bibliographic entry see Field 7C.
W91-00469

HYDROLOGICAL EFFECTS OF CATCHMENT CHARACTERISTICS AND LAND USE CHANGES DETERMINED BY SATELLITE IMAGERY AND GIS.
Ruhr Univ., Bochum (Germany, F.R.). Inst. for Hydrology, Water Resources and Environmental Engineering.
P. Neumann, and G. A. Schultz.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 169-176, 5 fig, 8 ref.

Descriptors: *Geographic information systems, *Hydrologic models, *Land use, *Model studies, *Rainfall-runoff relationships, *Remote sensing, *Satellite technology, Flood flow, Germany, Infiltration, Landsat images, Mathematical models, Seasonal variation, Surface runoff, Vegetation, Volme River.

A hydrological rainfall-runoff model uses satellite data in combination with data from a Geographic Information System for model parameter estimation. The model is based on the concept of 'source areas' contributing to surface runoff. Infiltration was computed on the basis of the Green and Ampt concept. All computations were carried out for grid cells, into which the catchment was subdivided, of Landsat TM pixel size (30 x 30 m). The model is being applied to the Volume River catchment in North West Germany. From GIS data the slope of each pixel within the catchment was computed and direction and velocity of flow to the pixel below determined. Landsat data were used for land use classification and estimation of vegetation indices. This information forms the (partial) basis for the estimation of infiltration and other hydrologically relevant parameters. Special emphasis of the research work, which is not yet completed, is placed on two aspects: the influence of the seasonally varying vegetation status on flood flows and the effect of land use changes over the years on runoff. Both effects were identified with the aid of Landsat data and introduced into the mathematical model. (See also W91-00454) (Author's abstract)
W91-00472

RAINFALL-RUNOFF RELATIONS DERIVED FROM THE PROBABILITY THEORY OF STORAGE.
IBM Research Lab., Yorktown Heights, NY.
For primary bibliographic entry see Field 2E.
W91-00592

ASSESSMENT OF A CONCEPTUAL RAINFALL-RUNOFF MODEL'S ABILITY TO REPRESENT THE DYNAMICS OF SMALL HYPOTHETICAL CATCHMENTS: 1. MODELS, MODEL PROPERTIES, AND EXPERIMENTAL DESIGN.
Washington Univ., Seattle. Dept. of Civil Engineering.
T. Y. Gan, and S. J. Burges.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1595-1604, July 1990. 4 fig, 42 ref. National Science Foundation Grant CES 8515250.

Descriptors: *Flow models, *Model studies, *Rainfall-runoff relationships, *Streamflow forecasting, Evapotranspiration, Mathematical models, Slopes, Soil moisture, Streamflow, Watershed management, Watersheds.

A set of tests is proposed to determine the reliability of soil moisture accounting rainfall-runoff models for prediction beyond the calibration experience and for extreme event forecasts under dry and wet antecedent conditions. The tests are developed for small (less than 0.5 square km) hypothetical hillslope catchments whose hydrologic response to rainfall and evapotranspiration fluxes is modeled with an accurate previously published physically based model (S-H) developed by Smith and Hebbert (1983). The tests are based on the assumption that the climatic and resulting S-H streamflow time series are error free. The conceptual model explored is a modified version of the Sacramento model (used by the U.S. National Weather Service) reprogrammed for inputs at various time increments as small as 1 min. A direct search optimization scheme is also included in this modified model (denoted SMA) to assist in model calibration. The set of tests is designed to illuminate differences in modeled evapotranspiration fluxes, streamflow time series, and the relative amounts of Hortonian and saturated overland flow and subsurface flow under a wide variety of climate and hillslope combinations. Differences in S-H and SMA model structures were predicted for subsurface moisture in dry periods, surface moisture in wet periods, evapotranspiration rates, percolation process, and mass balance determinations. The SMA model was found to oversimulate flows during dry periods and to accurately simulate flows when rain falls on a wet catchment. (See also W91-00605) (Author's abstract)
W91-00604

ASSESSMENT OF A CONCEPTUAL RAINFALL-RUNOFF MODEL'S ABILITY TO REPRESENT THE DYNAMICS OF SMALL HYPOTHETICAL CATCHMENTS: 2. HYDROLOGIC RESPONSES FOR NORMAL AND EXTREME RAINFALL.
Washington Univ., Seattle. Dept. of Civil Engineering.
T. Y. Gan, and S. J. Burges.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1605-1619, July 1990. 3 fig, 6 tab, 14 ref. National Science Foundation Grant CES 8515240.

Descriptors: *Flow models, *Model studies, *Rainfall-runoff relationships, *Streamflow forecasting, Climatic changes, Evapotranspiration, Flood forecasting, Hydrologic data, Mathematical models, Numerical analysis, Slopes, Soil water, Streamflow, Watershed management, Watersheds.

Five numerical experiments were conducted to test a conceptual rainfall-runoff model (the soil moisture accounting component, SMA, used by the U.S. National Weather Service), comprising combinations of three sets of input data (hourly precipitation and evapotranspiration data) and four hypothetical two-layered small catchments (areas less than or equal to 0.2 sq km, saturated hydraulic conductivity from 0.02 to 0.2 m/h, soil depth from 0.8 to 1.6 m, hillslope from 100 to 250 m, and slope from 0.04 to 0.10), representing a wide range of flow mechanisms. The calibrated SMA model could simulate flow volumes corresponding to broad-scale flow mechanisms but generally performed poorly during dry to wet catchment transitions. SMA was unreliable in forecasting extreme floods, especially under dry antecedent moisture conditions, and for catchments where calibration data comprised primarily base flow. For each case, the sum of the SMA conceptual storages differed from the maximum physical water storage capacity of the hypothetical small catchment. The calibrated SMA model parameters were climate dependent indicating that a calibrated SMA model should be used with caution when predicting hydrologic response to a changed climate. (See also W91-00604) (Author's abstract)
W91-00605

GAS EXCHANGE RATES FOR A FIRST-ORDER STREAM DETERMINED WITH DELIBERATE AND NATURAL TRACERS.
Lamont-Doherty Geological Observatory, Palisades, NY.
R. Wanninkhof, P. J. Mulholland, and J. W. Elwood.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1621-1630, July 1990. 5 fig, 3 tab, 30 ref. U.S. Department of Energy Contract DE-AL05-84OR 21400, NASA Contract NAGW 895.

Descriptors: *Aeration, *Air-water interfaces, *Environmental tracers, *Gas exchange, *Radioactive tracers, *Reaeration, *Streams, *Surface-groundwater relations, Groundwater movement, Oxygen, Radon, Stream discharge, Tennessee, Tritium, Walker Branch.

The rate of gas exchange between streams and the atmosphere is an important factor for water quality. Gas transfer velocities have been determined for a first-order stream, the West Fork of Walker Branch in eastern Tennessee, by performing a 3-hour release of the volatile tracer sulfur hexafluoride and the nonvolatile tracer tritiated water. The average gas transfer velocity for the 292-m reach was 29 cm/h which corresponds to a reaeration coefficient for oxygen at 25 C of 134/day. Groundwater inflow along the stream was corrected for by measuring the downstream dilution of the tritiated water spike. Downstream discharge increased from 0.5 L/s, 2 m downstream of the point of tracer release, to 19.3 L/s at a point 292 m downstream. As an alternative to using (radioactive) tritiated water, the possibility was investigated of using natural radon, Rn-222, as a groundwater tag and using the variation of sulfur hexafluoride and Rn-222 along the stream to determine gas exchange rates and groundwater inflow. The method yielded an average transfer velocity of 21 cm/h and underestimated the groundwater inflow by a factor of three. This large discrepancy is attributed to a doubling of stream discharge between the time the stream was sampled for radon and the tracer experiment and the limited number of radon samples. (Author's abstract)
W91-00606

COMPARATIVE DEVELOPMENT OF BOGS AND FENS IN CENTRAL SWEDEN: EVALU-

ATING THE ROLE OF CLIMATE CHANGE AND ECOSYSTEM DEVELOPMENT.
Harvard Univ., Petersham, MA. Harvard Forest.
For primary bibliographic entry see Field 2H.
W91-00641

POREWATER MIXING BY MICROORGANISMS, MONITORED BY A RADIOTRACER METHOD.
Stockholm Univ. (Sweden). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W91-00693

SEASONAL SOIL WATER DYNAMICS IN THE JARRAH FOREST, WESTERN AUSTRALIA. I: RESULTS FROM HILLSLOPE TRANSECT WITH COARSE-TEXTURED SOIL PROFILES.
Water Authority of Western Australia, Perth.
For primary bibliographic entry see Field 2G.
W91-00863

SEASONAL SOIL WATER DYNAMICS IN THE JARRAH FOREST, WESTERN AUSTRALIA. II: RESULTS FROM A SITE WITH FINE-TEXTURED SOIL PROFILES.
Water Authority of Western Australia, Perth.
For primary bibliographic entry see Field 2G.
W91-00864

NEW DIRECTIONS FOR SURFACE WATER MODELING.
For primary bibliographic entry see Field 7C.
W91-00961

REAL-TIME INTERCOMPARISON OF HYDROLOGICAL MODELS.
World Meteorological Organization, Geneva (Switzerland).
A. J. Askew.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 125-132. 4 tab, 5 ref.

Descriptors: *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Streamflow, Comparison studies, Simulation.

From 1985 to 1988 the World Meteorological Organization undertook a project designed to compare the performance of hydrological models in a simulated real-time environment. A total of 14 models from 11 countries were run using four data sets. The results of the project include comparative descriptions of the models and their updating procedures, a comprehensive data set and the compilation of a series of comparative graphical and numerical verification criteria. (See also W91-00961) (Author's abstract)
W91-00974

MODELLING OF HYDROLOGICAL PROCESSES FOR A MOUNTAINOUS BASIN.
Tokyo Metropolitan Univ. (Japan). Dept. of Civil Engineering.
Y. Ando.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 143-147. 4 fig, 1 tab, 3 ref.

Descriptors: *Hydrologic models, *Model studies, *Mountain streams, *Rainfall-runoff relationships, *River basins, Groundwater storage, Hydrographs, Japan, Shiozawa Experimental Basin.

A new hydrological model without trial-and-error parameter calibration is proposed, based on a model developed for mountainous basins. It is simple, relatively clear in its physical meaning, and includes all hydrological components. The suitability of the model was examined by applying the model to the Shiozawa experimental basin in Japan. Computation of hydrographs and groundwater storages for 5 years showed good agreement with observed values. (See also W91-00961) (Sand-PTT)
W91-00976

REGIONALIZATION OF MODEL PARAMETERS FOR A LARGE WATERSHED.
Seoul National Univ. (Republic of Korea). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00979

ANALYTICAL RELATIONSHIPS BETWEEN RAINFALL AND RUNOFF FOR A PROBABILITY-DISTRIBUTED MODEL OF BASIN RESPONSE.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
For primary bibliographic entry see Field 2E.
W91-00980

MODELING SNOWFALL-TO-SNOWMELT DELAY.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2C.
W91-00982

CHARACTERISTICS OF STREAMFLOW DROUGHT.
Ohio Univ., Athens. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00994

DEVELOPMENT AND APPLICATION OF SIMPLE WATER BALANCE MODELS TO UNDERSTAND THE RELATIONSHIP BETWEEN CLIMATE AND WATER RESOURCES.
National Oceanic and Atmospheric Administration, Washington, DC.
J. C. Schaake, and L. Chunzhen.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 343-352. 6 fig, 5 ref.

Descriptors: *Climates, *Climatology, *Global warming, *Hydrologic budget, *Hydrologic models, *Model studies, *Precipitation, Evapotranspiration, Greenhouse effect, High flow, Low flow, Reservoir yield, Running waters, Runoff, Safe yield, Soil water, Temperature, Water resources.

An attempt was made to find a simple scientific basis, using water balance models, to calculate how the change in incoming water, outgoing evaporation and changed temperatures will change the water stored in soil and running in rivers. Simple water balance models, one linear and analytic and the other nonlinear and numerical, show that runoff is highly sensitive to the range of climatic change expected to be caused by increasing greenhouse gases in the atmosphere. In the southeastern quadrant of the U.S. arid places will be much more affected than humid, and low flow more affected than high. Water resources are more sensitive to precipitation change than to potential evapotranspiration. The safe yields, which are a measure of reliable water supply, were calculated as a percent of annual streamflow, by simulating reservoir operation with both the observed historical monthly streamflow and with estimated historical streamflow computed by the nonlinear model from historical climate data. Safe yields from the observed and estimated streamflow for 50 basins agreed within 20% error limits. (See also W91-00961) (Sand-PTT)
W91-00995

OBJECT-ORIENTED HYDROLOGICAL MODELLING (MODELISATION HYDROLOGIQUE ORIENTEE OBJECT).
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural.
B. Adebnego, P. Meylan, and A. Musy.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 387-395. 8 fig, 5 ref. English summary.

Descriptors: *Decision making, *Expert systems, *Geographic information systems, *Model studies, *Water management, Hydrologic models, Simulation, Watersheds.

Hydrological studies for water management systems very often imply the use of hydrological modeling concepts for their design as well as for their management and their environmental assessment. Potentially, the various existing models can be applied, but they need some compromise between their flexibility and their possibility of utilization. Object oriented modeling proposes an alternative. It gives the possibility of treating each catchment component separately with a chosen existing model, in combination with the new tools for numerical geographical information systems. An expert system guides this choice and assists the user in his task, according to his objectives, and to the data and methods available. (See also W91-00961) (Author's abstract)
W91-00999

ENVIRONMENTAL GEOGRAPHIC INFORMATION SYSTEM IN FINLAND.
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 7C.
W91-01003

2B. Precipitation

FOURIER AND MOMENT METHODS APPLIED TO TWO-DIMENSIONAL RAINDROP IMAGES.
Alabama Univ. in Huntsville.
V. Chandrasekar, Y. Golestani, J. Turk, and V. N. Bringi.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 7, No. 2, p 199-205, April 1990. 12 fig, 1 tab, 21 ref, append.

Descriptors: *Cloud physics, *Data interpretation, *Fourier analysis, *Instrumentation, *Mathematical studies, *PMS probes, *Rain, Convective storms.

Two-dimensional PMS (Particle Measuring Systems, Inc.) probes are widely used in cloud physics research. PMS precipitation probes mounted with a horizontal optical axis have been previously used to study the shapes of hydrometeors such as raindrops and graupel. Fourier and moment descriptors have been applied to such images for the purposes of parameter estimation (axis ratio, canting angle) of raindrops, and for classifying raindrops in a raindrop/graupel mixture. Simulations have been used to evaluate these techniques. The results show that axis ratios of raindrops can be accurately estimated using both Fourier and moment methods. The canting angle of the raindrop image can be accurately estimated using the moment method. The moment method of image classification was applied to data collected from below the melting level in a convective storm during the MAYPOLE experiment held in 1983 near Boulder, Colorado. However, the fluctuations in raindrop fall speed (relative to airspeed) and axis ratio can produce a wide scatter in the image canting angle so as to mask any feature of the intrinsic canting angle, which is known from theoretical consideration to be very small. The application of Fourier and moment descriptors to simulated data to classify elliptical raindrops and conical graupel was compared to the results of a visual classification scheme performed on data from 2D-PMS probes. Among the two schemes, the Fourier descriptor-based technique performed approximately 14% better than the moment-based technique, with an 82% acceptance ratio for raindrops in a raindrop/graupel mixture. (Tappert-PTT)
W91-00055

MEASUREMENT OF RAINDROP SIZE DISTRIBUTIONS USING A SMALL DOPPLER RADAR.
Atmospheric Environment Service, Downsview (Ontario).
B. E. Sheppard.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 7, No. 2, p 255-268, April 1990. 19 fig, 19 ref.

Descriptors: *Cloud physics, *Data acquisition, *Radar, *Rain, *Rainfall, *Remote sensing, *Water properties, Data interpretation, Statistical methods, Wind.

Knowledge of raindrop size distributions is necessary to model the microphysics of precipitation, to establish empirical relationships between radar measurements and rainfall parameters, and to determine atmospheric attenuation of electromagnetic radiation. A small X-band bistatic Doppler radar originally developed for use in automated weather stations as a Precipitation Occurrence Sensor System (POSS) can also measure real time raindrop size distributions. In contrast to large-scale pulsed Doppler radars this system is continuous wave and the measurement volume is relatively small. The sampling requirements for a representative average power spectrum are estimated using a Poisson probability distribution. The effect of winds on the measurement results in a redistribution of the power in the Doppler frequency spectrum, generating an increase in the mode diameter of the normalized weighting functions. The POSS measures rates that are consistent with conventional gauges assuming a 6 dB transmission loss due to water on the radomes. Average drop size distributions measured in stratiform rain are typically negative exponential for diameters greater than 0.7 mm. One-minute averages in rain showers show the multimodal character of the distribution. (Tappert-PTT)
W91-00056

MODELLING LONG-TERM RAINFALL PATTERNS IN NORTH-EAST ENGLAND.
D. Wheeler.
Meteorological Magazine MTMGA5, Vol. 119, No. 1413, p 68-74, April 1990. 7 fig, 4 tab, 11 ref.

Descriptors: *Climatology, *England, *Meteorology, *Model studies, *Rainfall, *Rainfall distribution, Climatic data, Computer models, Geography, Regression analysis.

Rainfall is one of the most important climatological elements. Despite a traditional reliance on raingauge data it must not be forgotten that they provide only point sample data from a geographically continuous population. The underlying character of that population can only be established by statistical inferential methods that model and generalize its behavior, often in relation to other variables of which the three spatial dimensions of height and location (defined by Cartesian coordinates) are the most important. The utility of such models insofar as they are able to reproduce and, by inference, explain the geography of rainfall is examined. Mean annual and monthly rainfalls from 133 gauges in northeast England have been used to study the variation of rainfall with height and location in this area. The results clearly demonstrate that, in this case at least, order in rainfall regimes and distributions can be both recognized and quantified to the advantage of hydrologists and climatologists. Spatial (trend-surface) models of quadratic and cubic form are preferred to regression models using spot heights, but the most efficient methods combine all three dimensions: height, latitude and longitude. It has also been shown that monthly models might be preferred to annual models when detailed reconstruction interpretations are sought. (Mertz-PTT)
W91-00099

SPATIAL AND TEMPORAL VARIABILITY OF PRECIPITATION ACROSS KENTUCKY.
Louisville Univ., KY. Dept. of Geography.
D. A. Howarth.
Transactions of the Kentucky Academy of Science TKASAT, Vol. 51, No. 12, p 69-73, March 1990. 7 fig, 1 tab, 11 ref.

Descriptors: *Climatology, *Kentucky, *Meteorology, *Precipitation, *Precipitation mapping, *Weather data collections, Fluctuations, Geography, Seasonal variation, Spatial variation, Temporal distribution, Temporal variation.

Many areas in the U.S. have experienced abnormally dry conditions during the current decade. At the same time, temperatures have been above normal for much of the 1980s. This study makes use of divisional precipitation data for Kentucky to examine seasonal and annual precipitation during this century. Primary emphasis is directed toward ascertaining differences in precipitation regimes across the state in both the spatial and temporal dimensions. Precipitation records available from the National Climatic Data Center were used to analyze spatial and temporal variability in Kentucky's four climate divisions for the period 1895-1983. A statistically significant decrease in winter precipitation was noted for division 3 with similar, but not significant, trends noted in the other divisions for that season. These decreases are balanced by long-term increases in precipitation during the other three seasons. No statistically significantly trends in long-term variability were evident. A shift in the month of maximum precipitation from March to July occurred from west to east across Kentucky. Seasonal variability also decreased eastward across the state. (Mertz-PTT)
W91-00110

SPATIAL ORGANISATION OF DAILY RAINFALL IN WALES DURING AUTUMN-WINTER.
Saint David's Univ. Coll., Lampeter (Wales). Dept. of Geography.
G. Sumner, and M. Bonell.
Weather WTHRAL, Vol. 45, No. 5, p 174-183, May 1990. 7 fig, 2 tab, 14 ref.

Descriptors: *Climatology, *Meteorology, *Precipitation, *Precipitation forecasting, *Rainfall distribution, *Spatial distribution, *Wales, Geography, Weather data collections, Weather forecasting, Weather patterns.

Perched on the western extremity of southern Britain, and exposed to the prevailing rain-bearing winds from the North Atlantic Ocean, Wales' precipitation is, at all time-scales, often both copious and persistent. The spatial organization of precipitation amounts, however, is much influenced by the relatively high relief and altitude of a large part of the country and by resultant exposure to (or shelter from) rain-bearing winds. Over time-scales of a day or less, the interaction between near surface airflow at the time of precipitation and topography can induce notable spatial variations in precipitation amount and intensity. Historically, local administrative units within Wales have developed in response to topographic controls. These form convenient areal forecasting units currently used in media and telephone forecasts, since most members of the public related more easily to such political divisions. A pilot study of Welsh daily precipitation aimed at investigating the various methods of deriving daily precipitation areas attempted to derive daily precipitation affinity areas using data from 121 gauge sites for a sample data period between September and January from 1982/83 to 1986/87. Results showed that existing forecasting divisions may be too broad. Revision and subdivision of the presently used forecasting areas might be in order. The use of a simple visual grouping mechanism in conjunction with a simple statistical technique has afforded a subdivision of Wales into a number of daily precipitation affinity areas for the autumn/winter season. The form and location of the derived areas is such that the division between them may be explained in topographic terms, relating often to easily-defined catchment and administrative areas, in common current use for purposes other than precipitation forecasting. (Mertz-PTT)
W91-00115

EFFECT OF IRREGULARITIES IN T'IE DIAMETER CLASSIFICATION OF RAINDROPS BY THE JOSS-WALDVOGEL DISDROMETER.
Atmospheric Environment Service, Downsview (Ontario).
B. E. Sheppard.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 7, No. 1, p 180-183, February 1990. 4 fig, 12 ref.

Descriptors: *Disdrometers, *Instrumentation, *Joss-Waldvogel Disdrometer, *Measuring instruments, *Precipitation, *Rain, Cloud liquid water, Electromagnetics, Model studies, Rainfall.

Measurements of raindrop size are needed to model the microphysics of precipitation, to establish empirical relationships between radar measurements and rainfall parameters, and to determine atmospheric attenuation of electromagnetic radiation. The Joss-Waldvogel Disdrometer (JWD) is an electromechanical counter designed to measure raindrop size distributions for the purpose of calculating radar reflectivities. It has performed this function successfully for 20 years. Recently, JWD measurements have been used by cloud physicists to assess the predictions of models based on raindrop coalescence-breakup processes. The models show that the cloud-base drop size distribution (DSD) evolves with time and fall distance to an equilibrium distribution with secondary maxima. A number of researchers using the JWD have noted peaks in DSDs measured in a large range of rainfall rates. The JWD signal processing electronics sized the raindrops in 20 channels of diameter intervals. Laboratory calibration of the transfer function of the electronics (model RD-69) indicates that the boundaries of these channels differ from their specified diameter values. The effect of this discrepancy is demonstrated by applying the measured channel boundaries to a Marshall-Palmer distribution. The resultant DSD shows secondary maxima occurring in the channels with diameter boundaries 0.6-0.7, 1.0-1.2, and 1.8-2.1 mm. It is recommended that conclusions drawn from secondary maxima in DSDs measured by the JWD consider this artifact. (Author's abstract)
W91-00141

ONE-DIMENSIONAL INTERACTIVE SOIL-ATMOSPHERE MODEL FOR TESTING FORMULATIONS OF SURFACE HYDROLOGY.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2A.
W91-00145

EMPIRICAL DATA ON CONTEMPORARY GLOBAL CLIMATE CHANGES (TEMPERATURE AND PRECIPITATION).
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
K. Y. Vinnikov, P. Y. Groisman, and K. M. Lugina.
Journal of Climate JLCLEL, Vol. 3, No. 6, p 662-677, June 1990. 11 fig, 11 tab, 33 ref.

Descriptors: *Air temperature, *Climatic changes, *Climatic data, *Climatology, *Global warming, *Precipitation, Carbon dioxide, Model studies, USSR, Weather data collections.

Meteorological data have been recorded over the Northern Hemisphere and a part of the Southern Hemisphere over the last 100-150 years, and are sufficient to detect not only regional but also global changes in climate typical of the modern epoch. Principal among the climate elements most influencing the biosphere and man's activities are surface air temperature and precipitation. New analyses of global surface air temperature and annual precipitation over extratropical continents of the Northern Hemisphere differ from analogous earlier research both by initial database, which is more full and reliable for the USSR territory, and the spatial averaging methods considered to be most appropriate for the problem. Global warming occurred during the last century with a mean trend of 0.5 C per 100 years. For the same period the annual precipitation over the land in the 35-70 degrees North zone increased by 6%. The observed variations of precipitation coincide with the results of general circulation modeling of doubled

CO2 equilibrium climate change by sign but contradict by scale. Observed changes in precipitation for the USSR and United States territories considerably exceed those that could be explained by the indicated climate change modeling results. Measurement data on precipitation requires further analysis concerning their homogeneity; however, the real process of climate change in the current century strongly differs from the modeled one. (Fish-PTT)
W91-00146

RAINFALL INTERCEPTION IN THE TAI FOREST, IVORY COAST: APPLICATION OF TWO SIMULATION MODELS TO A HUMID TROPICAL SYSTEM.
Groningen Rijksuniversiteit (Netherlands). Dept. of Physical Geography.
R. W. A. Hutjes, A. Wierda, and A. W. L. Veen.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 259-275, May 1990. 5 fig, 3 tab, 40 ref.

Descriptors: *Forest hydrology, *Forest watersheds, *Humid climates, *Interception, *Ivory Coast, *Model studies, *Rain forests, *Simulation, *Throughfall, Africa, Effective precipitation, Error analysis, Evaporation rate, Meteorological data, Rain gages, Rainfall distribution, Tropical regions.

Forest greatly influences hydrology through runoff, erosion, evaporation, precipitation, and global climate. The special hydrological significance of forest is its high total evaporation. It has been shown that the large aerodynamic conductance of forest, causing a strong coupling between canopy and atmosphere, is the primary cause of this phenomenon. In recent years attempts have been made to apply modeling to the study of evaporation in the tropical rain forest. Field estimates of net precipitation in primary evergreen forest in Ivory Coast, West Africa, were compared with estimates given by two models: the Gash model, which assumes all rain on a single day to have fallen in one shower, and the Mulder model, which uses a more realistic, equalized rainfall distribution. Meteorological data were collected in a clearing of about two hectares. Throughfall, measured using a roving gage technique, was 90.8% of gross rainfall (1022 mm in five months). Both models simulated this figure well within the error range of the field estimates. Errors in the model predictions are thought to result from errors in the parameter estimates, and, for the Gash model, from the assumption that daily rainfall comes in one shower. It is suggested that a model combining the advantages of both might be suitable for routine application in the humid tropics. (Author's abstract)
W91-00158

ANALYSIS OF INSTANTANEOUS RAINFALL RATE DURING FLASH FLOODS IN BARCELONA.
Barcelona Univ. (Spain). Dept. of Atmospheric Physics, Astronomy and Astrophysics.
A. Redano, and J. Lorente.
Weather WTHRAL, Vol. 45, No. 6, p 215-222, June 1990. 7 fig, 6 ref.

Descriptors: *Barcelona, *Convective precipitation, *Flash floods, *Flood forecasting, *Rainfall rate, *Rainfall-runoff relationships, *Spain, *Weather data collections, Mediterranean Sea, Rain gages, Rainfall intensity, Storms.

Rainfall in the Mediterranean regions of the Iberian Peninsula is characterized by the predominance of convective precipitation. A method is needed to determine the damaging effects due to the instantaneous rainfall rate, based on the establishment of dense local scale and mesoscale rain gage networks. These dense networks of rain gages are therefore installed in zones which are very vulnerable to heavy precipitation such as urban areas, hydrographic basins, etc. From data obtained in this network, a number of storms have been studied. It was found that convective precipitation in the coastal Mediterranean fringe can occasionally be of a very heavy intensity. The statistical analysis of a 60-year rainfall rate data bank in Barcelona, Spain, gave storm durations (with rainfall > or = 60 mm/hr) of less than 2 hr in 88% of cases. The storms generally occur during autumn and summer in the early evening. Because of the strong spatial variation of rainfall rate, the data obtained with only one rain gage, and therefore the corresponding intensity-duration-frequency curves, are not sufficient to estimate the total rainfall in a zone. Statistical data, based on dense rain gage network measurements, seem indispensable. Normally the individual raincells are smaller than 10 km, so they belong to the local scale. In these cases, synoptic situations are almost irrelevant, since the influence of the Mediterranean Sea is the most influential factor of enhancement of precipitation in autumn, although in conjunction with other factors. Nowcasting, based on radar, satellite imagery and rain gage network data, is the best system for flood alert and prevention, because of its small spatial and temporal scale. (Fish-PTT)
W91-00189

CLIMATIC CHANGE IN SUNDERLAND.
Sunderland Polytechnic (England). Dept. of Geography.
D. A. Wheeler.
Weather WTHRAL, Vol. 45, No. 6, p 229-231, June 1990. 3 tab, 3 ref.

Descriptors: *Climatic changes, *Climatic data, *Climatology, *England, *Global warming, *Rainfall impact, *Weather patterns, Air temperature, Potential water supply, Rainfall, Water supply, Wind.

The weather of 1989 has sharpened both the public's and the scientist's concern about man-induced climatic change. Conditions were particularly unusual in Sunderland, in northeast England. Temperatures in 1989 were the warmest on record with a mean of 10.5 C. Despite the high mean conditions, no absolute maximum records were broken and the year was characterized by persistently high rather than extremely high temperatures. It was the sunniest year on record. Part of the character of 1989's weather can be accounted for by random variation. Nevertheless, such peculiar behavior should act as a warning signal. It is at this early stage difficult to predict the detailed regional patterns of rainfall change. However, the events of 1989 should draw attention to the apparent vulnerability of the northeast region to climatic variation. In particular, any increase in the frequency of westerlies may be critical. In this case western districts might expect higher rainfall but the increasingly sheltered eastern regions, especially those such as northeast England which are protected by the highest hills, should expect much drier conditions. Winds were unusually dry and concentrated in the southwest and westerly sectors in 1989. However, the winds to which the region is most exposed and which provide the majority of the rain, those from between north and southeast, were correspondingly less abundant. A geographical disequilibrium of water supply potential may be a more immediately serious threat to the British Isles than a slight warming. (Fish-PTT)
W91-00190

DYNAMIC MODEL FOR SHORT-SCALE RAINFALL DISAGGREGATION.
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
D. Koutsoyiannis, and T. Xanthopoulos.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 303-322, June 1990. 7 fig, 3 tab, 16 ref.

Descriptors: *Depth-area-duration analysis, *Rainfall simulation, *Statistical disaggregation, *Statistical models, *Stochastic hydrology, Probability distribution, Rainfall distribution, Rainfall intensity, Statistical analysis, Statistical significance.

A single site dynamic disaggregation model was developed. It is a generalized step-by-step approach to stochastic disaggregation problems. The low-level variables studied have Markovian structure and normal or gamma marginal distributions. Combined with a rainfall model, the disaggregation scheme serves as a rainfall generator, transforming monthly rainfall into events and hourly amounts. Application of the combined model with all parameters derived from historical records gives satisfactory results. Various statistics, as well as marginal distribution functions of the associated variables computed from synthetic samples derived by the model, exhibited agreement with the theoretical expectations; the relevant statistical tests of 5 percent or 10 percent significance levels were positive. (Fleishman-PTT)
W91-00409

EFFECTS OF THE DRY SEASON ON THE VEGETATION CANOPY OF SOME RIVER BASINS OF WEST AFRICA AS DEDUCED FROM NOAA-AVHRR DATA.
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 2I.
W91-00410

REMOTE SENSING AND LARGE-SCALE GLOBAL PROCESSES.
For primary bibliographic entry see Field 7B.
W91-00454

PHYSICAL CAUSES AND PREDICTABILITY OF VARIATIONS IN SEASONAL RAINFALL OVER SUB-SAHARAN AFRICA.
Meteorological Office, Bracknell (England).
C. K. Folland, J. A. Owen, and K. Maskell.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 87-95, 5 fig, 1 tab, 14 ref.

Descriptors: *Climatology, *Drought, *Meteorology, *Model studies, *North Africa, *Rainfall, *Sahel, *Water temperature, Tropical regions, Wind.

Possible causes of the decadal timescale decline in rainfall in sub-Saharan Africa observed since the 1950's have been much studied and several mechanisms have been suggested. A study which used an 11-level atmospheric general circulation model indicated that global scale sea surface temperature patterns may play a key role in modulating sub-Saharan rainfall. Using the model, the persistence of SST anomalies during the latter half of the rainfall season was sufficient to allow useful hindcasts of sub-Saharan rainfall for three months ahead in two wet and two very dry years. (See also W91-00454) (Author's abstract)
W91-00464

POTENTIAL APPLICATION OF SATELLITE DATA FOR RAINFALL ESTIMATION.
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 97-104, 2 fig, 2 tab, 19 ref.

Descriptors: *Florida, *Meteorology, *Rainfall, *Remote sensing, *Satellite technology, Estimating, GOES satellite, Infrared imagery, Rain gages, Rainfall distribution, Weather forecasting.

Geostationary Operational Environmental Satellite (GOES) visible and thermal infrared data, in conjunction with the Griffith-Woodley method, were used to estimate rainfall in Florida. Both the life history and streamline techniques of the Griffith-Woodley method were studied. The results showed that the satellite data were useful for estimating both the volume and areal distribution of rainfall, which are very difficult to assess using the conventional rain gage method. The rain gage rainfall (GR) was well correlated with satellite rainfall estimation (SR) for the life history technique, i.e., GR = -0.557 + 1.079 SR, in units of mm/day; whereas, for the streamline technique, GR = 2.007 + 1.525 SR. (See also W91-00454) (Author's abstract)
W91-00465

MONITORING OF WEATHER CONDITIONS ON MESOSCALE TO IMPROVE A PRECIPITATION WARNING SYSTEM FOR HYDROLOGIC PURPOSES.
Kozponti Elorejelzo Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 7B.
W91-00467

FREQUENCY DISTRIBUTIONS OF HEAVY RAINSTORMS IN ILLINOIS.
Illinois State Water Survey Div., Champaign.
F. H. Huff, and J. R. Angel.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-100215. Price codes: A03 in paper copy, A01 in microfiche. Report No. ISWS/CIR-172/89, 1989. 36p, 14 fig, 4 tab, 7 ref.

Descriptors: *Hydrologic data collections, *Illinois, *Maps, *Meteorology, *Precipitation, *Rainfall distribution, *Rainstorms, Climates, Data collections, Distribution analysis, Hydrologic data, Spatial distribution, Temporal distribution.

This publication represents a condensed version of an extensive report on the distributions of heavy rainstorms in Illinois, based on data from 61 precipitation stations operating during 1901-1983. Shown are annual frequency distributions of point rainfall for periods ranging from five minutes to ten days and for recurrence intervals varying from 2 months to 100 years. Results are presented in two forms: mean relations for ten regions of approximately homogeneous precipitation, climate, and statewide isohyetal maps based on the 61 station data. The statewide frequency relations provided in this document have been abstracted from a comprehensive report on the frequency distributions and hydroclimatic characteristics of heavy rainstorms in Illinois. The relations are those most commonly used by hydrologists, soil scientists, and others who need information on extreme rainfalls. This publication also addresses other aspects of Illinois extreme rain events, including climatic trends in heavy rainfall frequencies, urban effects on the distribution of heavy rainfall, sampling variability within regions of similar rainfall climate, the seasonable distribution of heavy rainfall events, and other pertinent spatial and temporal characteristics of heavy rainstorms. (Lantz-PTT)
W91-00553

MECA WORKSHOP ON ATMOSPHERIC H2O OBSERVATIONS OF EARTH AND MARS.
For primary bibliographic entry see Field 7B.
W91-00576

EFFECT OF GLOBAL-SCALE DIVERGENT CIRCULATION ON THE ATMOSPHERIC WATER VAPOR TRANSPORT AND MAINTENANCE.
Iowa State Univ., Ames. Dept. of Earth Sciences.
T. C. Chen.
IN: MECA Workshop on Atmospheric H2O Observations of Earth and Mars. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. p 22-28, 5 fig, 6 ref.
NSF Grant ATM-8611476.

Descriptors: *Atmospheric circulation, *Atmospheric water, *Climatology, *Meteorology, Atmospheric physics, Monsoons, Seasonal variation.

Many efforts have been made by meteorologists in the past three decades to examine the local maintenance of water vapor by moisture transport. It is difficult to explain the relationship between regions of high water vapor and content and total moisture. The precipitation caused by condensation is often associated with the vertical motion of atmospheric divergent circulation. Based upon this practice, the author shows how the high water vapor content over certain regions is attributed to the convergence by divergent circulations. Two aspects are presented: (1) how the high water vapor content in the tropics during winter and summer seasons is maintained; and (2) how the sudden intensification of tropical divergent circulations associated with monsoon onset enhances the water vapor content over monsoon regions. The data used in this study were generated by the FGGE III-b analyses of the European Center for Medium Range Weather Forecasts. Although water vapor is essentially transported by a rotational component, this study demonstrates that only the water vapor transported by the divergent component is linked to the source and sink, and therefore to the maintenance of atmospheric water vapor content. (See also W91-00576) (Lantz-PTT)
W91-00577

CUMULUS CONVECTION AND TERRESTRIAL WATER-VAPOR DISTRIBUTION.
National Center for Atmospheric Research, Boulder, CO.
L. J. Donner.
IN: MECA Workshop on Atmospheric H2O Observations of Earth and Mars. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. p 41-45, 2 fig, 5 ref.

Descriptors: *Atmospheric water, *Cloud physics, *Convection, *Meteorology, Atmospheric precipitation, Cloud liquid water, Condensation, Precipitation.

Cumulus convection plays a significant role in determining the structure of the terrestrial water vapor field. It also contributes substantially to the momentum and thermal fields. Cumulus convection acts directly on the moisture field by condensing and precipitating water vapor and by redistributing water vapor through cumulus-induced eddy circulations. Additionally, through its radiative and direct interactions with the thermal field, cumulus convection partially establishes the condensation threshold for water vapor. The purpose of this study is to outline the mechanisms by which cumulus convection influences the terrestrial water vapor distribution. This is a problem of enormous complexity, and several theories for its partial resolution exist. Cumulus convection is a dominant mechanism in the transport and removal of atmospheric water vapor in the terrestrial atmosphere. Cumulus parameterizations seek to link the effects of small-scale cumulus convection to the properties of large, synoptic-scale atmospheric flows. Several families of cumulus parameterization exist, differing fundamentally in their basic assumptions. The effects of cumulus convection are most evident in the tropics and baroclinic zones of the middle latitudes, and consist primarily of a mean drying. (See also W91-00576) (Lantz-PTT)
W91-00578

OBSERVATIONS OF ATMOSPHERIC WATER VAPOR WITH THE SAGE II INSTRUMENT.
SASC Technologies, Inc., Hampton, VA.
For primary bibliographic entry see Field 7B.
W91-00579

MEASUREMENTS OF H2O IN THE TERRESTRIAL MESOSPHERE AND IMPLICATIONS FOR EXTRA-TERRESTRIAL SOURCES.
Pennsylvania State Univ., University Park. Dept. of Meteorology.
J. J. Olivero.
IN: MECA Workshop on Atmospheric H2O Observations of Earth and Mars. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. p 71-74, 1 fig, 1 tab, 15 ref.

Descriptors: *Atmospheric water, *Data acquisition, *Meteorology, *Remote sensing, Atmospheric chemistry, Hydrogen, Microwaves, Radiometry.

Water vapor is an important minor constituent in the terrestrial mesosphere. Its photolysis products control ozone above the ozone mixing ration peak; it is radiatively active, especially in the infrared; water sublimes to cause polar mesospheric clouds and possibly other suggested aerosol phenomena; the molecules cluster to form massive ions which dominate the chemistry of the lower ionosphere; and, as the principle hydrogen compound below the mesosphere, it controls the global hydrogen budget and hydrogen escape rate. During the last decade several measurement techniques have been employed to observe H2O at these atmospheric levels. Five data sets were produced by ground-based microwave radiometry. A second group of data sets involves various aircraft and rocket techniques and were observed over a much wider range of latitudes. Ground-base measurements at mid-latitudes strongly support a very dry mesopause-lower thermosphere. Other measurements can be interpreted as being consistent with a high altitude or external source of H2O. The latter process was not seriously considered until very recently, however, these new hypotheses have profound implications for the upper atmosphere of all the planets. (See also W91-00576) (Lantz-PTT)
W91-00580

NIMBUS 7 LIMS WATER VAPOR MEASUREMENTS.
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
E. E. Remsberg, and J. M. Russell.
IN: MECA Workshop on Atmospheric H2O Observations of Earth and Mars. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. p 80-81, 7 ref.

Descriptors: *Atmospheric water, *Data acquisition, *Infrared radiation, *Remote sensing, *Satellite technology, *Water vapor, Measuring instruments, Vapor pressure.

The Limb Infrared Monitor of the Stratosphere (LIMS) experiment on NIMBUS 7 used the technique of thermal infrared limb scanning to sound the composition and thermal structure of the Earth's stratosphere. One of the LIMS channels was spectrically centered at 6.9 micrometers to measure the vertical profile of water vapor radiance from about 15 to 55 km. Data were obtained from late October 1978 until May 1979 over a latitudinal range of 64 S. to 84 N. providing nearly global coverage. The data showed that: (1) there is a pole-ward latitudinal gradient with mixing ratios that increase by a factor of 2 from the Equator to +/-60 degrees at 50 mb; (2) and that most of the time there is a fairly uniform mixing ratio of 5 ppmv at high latitudes, but more variation exists during winter; (3) a well developed hygropause or minimum in mixing ration exists several kilometers above the tropopause at low to mid latitudes; (4) a source region of water vapor exists in the upper stratosphere to lower mesosphere that is consistent with methane oxidation chemistry, at least within the uncertainties of the data; and (5) a zonal mean distribution exists in the lower stratosphere that is consistent with the idea of quasi-isentropic transport by eddies in the meridional direction. (See also W91-00576) (Lantz-PTT)
W91-00581

DETERMINISTIC SIGNALS IN PRECIPITATION IN THE NORTHWESTERN UNITED STATES.
State Univ. of New York at Stony Brook. Inst. for Atmospheric Sciences.
R. G. Currie, and D. P. O'Brien.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1649-1656, July 1990. 7 fig, 5 tab, 35 ref.

Descriptors: *Climatic changes, *Climatology, *Precipitation, *Rain gages, *Weather forecasting, Drought, Idaho, Lunisolar signal, Montana, Wyoming.

Evidence for the 18.6-year lunisolar M(N) signal was found in 91 of 102 rain gage records (89% detection ratio) in the states of Montana, Wyoming, and Idaho, while the 10 to 11-year solar cycle term was detected in 67 of these time series (66% detection ratio). Lunar nodal 19-year M(N) wave trains for these three states show complex patterns, with many experiencing a bistable 180 degree phase switch at epoch 1973.3 (epochs are dates of maximum in tidal forcing). At epoch 1954.7 +/-2.5 years, Wyoming, Montana, and eastern Idaho experienced drought conditions. By epoch 1973 +/-2.5 years, a wet cell of opposite polarity had invaded the eastern half of Montana and parts of eastern Wyoming; concomitantly, drought had expanded westward to include virtually all of Idaho. Bistable 180 degree phase switch-

es in climate parameters were first reported on Patagonian tree ring data and were later found for a flood index in India, a drought index for Beijing, in flooding of the Nile and St. Lawrence Rivers, in air temperature and air pressure records worldwide, and in rainfall for the northeastern United States and the corn belt. (Author's abstract)
W91-00609

OXIDATION OF S(IV) IN RAIN-WATER COLLECTED IN JAPAN.
Institute of Public Health, Tokyo (Japan).
For primary bibliographic entry see Field 5B.
W91-00668

ORIGIN OF SOLUBLE CHEMICAL SPECIES IN BULK PRECIPITATION COLLECTED IN TOKYO, JAPAN: STATISTICAL EVALUATION OF SOURCE MATERIALS.
Tokyo Inst. of Tech. (Japan). Dept. of Environmental Chemistry and Engineering.
For primary bibliographic entry see Field 5B.
W91-00670

MESOSCALE MODELING OF ACIDITY PRODUCTION IN OROGRAPHIC CLOUDS AND RAIN.
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. Associe de Meteorologie Physique.
For primary bibliographic entry see Field 5B.
W91-00671

WATERBIRDS DYNAMICS AT BOOL LAGOON, SOUTH AUSTRALIA, 1983-87.
Australian National Parks and Wildlife Service, Berri.
For primary bibliographic entry see Field 2H.
W91-00686

MAGPIE GOOSE, ANSERANUS SEMIPALMATA, NESTING ON THE MARY RIVER FLOODPLAIN, NORTHERN TERRITORY, AUSTRALIA: EXTENT AND FREQUENCY OF FLOODING LOSSES.
Conservation Commission of the Northern Territory, Darwin (Australia).
For primary bibliographic entry see Field 2H.
W91-00688

ATMOSPHERIC CHEMISTRY OF PEROXIDES: A REVIEW.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-00841

FIELD INVESTIGATIONS ON THE SNOW CHEMISTRY IN CENTRAL AND SOUTHERN CALIFORNIA-I. INORGANIC IONS AND HYDROGEN PEROXIDE.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-00842

COMPARISON OF TWO CLOUDWATER/FOGWATER COLLECTORS: THE ROTATING ARM COLLECTOR AND THE CALTECH ACTIVE STRAND CLOUDWATER COLLECTOR.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 7B.
W91-00844

WET AND DRY DEPOSITION FLUXES ABOVE THE NORTH SEA.
Vrije Univ., Brussels (Belgium). Dienst Analytische Scheikunde en Geochemie.
W. Baeyens, F. Dehairs, and H. Dedeurwaerder.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1693-1703, July 1990. 5 fig, 6 tab, 25 ref.
California Air Resources Board Contract AG-185-32.

Descriptors: *Air pollution, *Atmospheric chemistry, *Chemistry of precipitation, *Dry deposition, *Heavy metals, *North Sea, *Wet deposition, Cadmium, Chemical composition, Copper, Fluctuations, Iron, Lead, Manganese, Model studies, Precipitation, Rainfall, Sodium, Zinc.

Annual wet and dry metal fluxes to the Southern Bight of the North Sea have been estimated at the West-Hinder station about 50 kilometers off the coast of Belgium. The troposphere of the Southern Bight is surrounded by some of the most industrialized countries and subject to important meteorological variations. Between the dissolved metal concentrations in rain water and the precipitation volume a hyperbolic-like dilution profile was observed. The range of wet metal fluxes for the North Sea were determined to be Cu(1.05-2.8), Cd(0.15-0.42), Mn(0.47-1.6), and Na(745-2700). Pb(0.18-1.1), Zn(3.1-18.4), and Fe(3.54-19.5) showed a broader range. All values are expressed as micrograms/square centimeter/year. Dry deposition fluxes at sea were measured using vasilinated plexiplates, and calculated using dry deposition model and cascade impactor results. Despite the large uncertainties on the calculated dry deposition fluxes, results obtained by both methods agree within a factor of 2.3. Finally, for Na, Cu, Zn, and Cd, wet fall-out is probably the predominant deposition process. For Mn, Pb, and Fe, the wet and dry fall-out may be of the same magnitude. (Korn-PTT)
W91-00845

INTENSIVE STUDIES OF SIERRA NEVADA CLOUDWATER CHEMISTRY AND ITS RELATIONSHIP TO PRECURSOR AEROSOL AND GAS CONCENTRATIONS.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
J. L. Collett, B. D. Daube, D. Gunz, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1741-1757, July 1990. 13 fig, 5 tab, 48 ref.
California Air Resources Board Contract A6-185-32.

Descriptors: *Acid rain, *Aerosols, *Air pollution, *Ammonia, *Ammonium, *Cloud chemistry, *Organic acids, *Path of pollutants, *Precipitation scavenging, Aerosol-gas equilibrium, California, Chemical interactions, Chemistry of precipitation, Cloud liquid water, Hydrogen peroxide, Nitrates, Nitric acid, Sequoia National Park, Sierra Nevada, Sulfates, Sulfites.

Measurements of inorganic aerosol and gas phase species were conducted at fir three sites in central California during a 4 day period in April 1988. The measurement sites were located along an east-west transect at Visalia, Ash Mountain, and Lower Kaweah, with elevations of 90, 550, and 1900m, respectively. Aerosol compositions were nearly neutral at all locations, however, large concentrations of NH3 at Visalia contributed significant excess alkalinity to the air mass sampled there. Concentrations of all major species were observed to decrease with elevation during most of the sampling periods. Concentrations at the upper two sites exhibited diurnal fluctuations, with peaks in the late afternoon, consistent with the transport of pollutants from San Joaquin Valley sources by daytime upslope winds. Concentrations of most of the species reached a maximum at the elevated sites on 28 April, as a weak cold front approached, reducing the atmospheric stability over the valley floor. Concentrations at Visalia on this day were somewhat lower than those observed earlier in the week. Clouds intercepting the mountain slopes on 28 April were sampled at two locations. The cloud water pH at both sites was observed to fall throughout the event, dropping as low as 4.34. Precursor concentrations of aerosol NO3(-), SO4(2-), and NH4(+), and gas phase HNO3 and NH3, were sufficient to account for the observed cloudwater loadings of NO3(-), SO4(2-), and NH4(+). In-cloud measurements made near the cloud base indicated a considerable S(IV) oxidation potential in the form of H2O2, but only low S(IV) concentrations. Cloud water concentrations of formic acid were approximately three times acetic acid concentrations. Carbonyl concentrations were dominated by formaldehyde and glyoxal. (Author's abstract)
W91-00846

CHEMICAL CHARACTERIZATION OF ACID PRECIPITATION IN ALBANY, NEW YORK.
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
For primary bibliographic entry see Field 5A.
W91-00850

SOURCE-RECEPTOR RELATIONSHIPS FOR WET SO4(2-) AND NO3(-) PRODUCTION.
For primary bibliographic entry see Field 5B.
W91-00851

RADIOMETRIC STUDIES OF CLEAR AIR ATTENUATION AND ATMOSPHERIC WATER VAPOR AT 22.235 GHZ OVER CALCUTTA (LAT. 22 DEGREES 32 MINUTES N, LONG. 88 DEGREES 20 MINUTES E).
Calcutta Univ. (India). Inst. of Radiophysics and Electronics.
A. K. Sen, P. K. Karmakar, A. Mitra, A. K. Devgupta, and M. K. Dasgupta.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1909-1913, July 1990. 4 fig, 2 tab, 8 ref.

Descriptors: *Atmospheric water, *Data acquisition, *India, *Radiometry, *Water vapor, Calcutta, Microwaves, Monsoons, Seasonal variation, Water properties.

Water vapor, an important minor atmospheric constituent can impose serious limitations to the propagation of radio waves, especially microwave and millimeter wave band. Moreover, it can affect the thermodynamic balance, photochemistry of the atmosphere, sun-weather relationships, and the biosphere. Measurements of the vertical and horizontal distribution of water vapor as well as its temporal variations were conducted for the year 1985-1986 using a microwave radiometer tuned to the thermal emission line of water vapor at 22.235 GHz. Analyses of the data obtained reveals that the antenna temperature attains a maximum of about 160 K in the monsoon months (June-September) and minimum of about 80 K in the winter months (December-February). A similar trend is exhibited by the variation of attenuation data. It reveals that the attenuation values under clear weather conditions for different seasons vary between 1 and 4 dB for the entire year. The average attenuation is 2.41 dB for the pre-monsoon period and 1.18 dB for the post-monsoon period. An attempt is also made to determine the monthly variation of noise temperature, attenuation and water vapor content. It is noted that each of the variations closely resembles the variational pattern of water vapor content. This suggests that the 22.235 GHz emission noise temperature and attenuation may originate mainly from the water vapor present in the atmosphere. (Korn-PTT)
W91-00852

CHEMICAL COMPOSITION DIFFERENCES IN FOG AND CLOUD DROPLETS OF DIFFERENT SIZES.
California Inst. of Tech., Pasadena. Dept. of Chemical Engineering.
S. N. Pandis, J. H. Seinfeld, and C. Pilinis.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1957-1969, July 1990. 12 fig, 1 tab, 28 ref.
California Air Resources Board Agreement A732-043.

Descriptors: *Acid rain, *Air pollution, *Chemistry of precipitation, *Cloud liquid water, *Fog, *Sulfates, *Water chemistry, Cloud chemistry, Fluid drops, Mathematical studies, Particle size.

The distribution of acidity, and solute concentrations, among the various droplet sizes in a fog or cloud, and the effect of the evaporation-condensation cycle on the composition and size distribution of atmospheric aerosols is studied. Significant total solute concentration differences can occur in aqueous droplets inside a fog or cloud. In fog which

was simulated during a period of dense fog, the solute concentration in droplets > 10 micrometers in diameter increased with size. Droplets with diameters of 20 micrometers attain a solute concentration that is 3.6 times larger than in 10 micrometer droplets. Droplets on which most of the liquid water condenses have access to most of the reacting medium for in situ S(IV) oxidation and are therefore preferentially enriched with sulfate. Gas and aqueous phase chemical processes result in an increase of the total solute mass concentration nonuniform over the droplet spectrum for a mature fog. These chemical processes tend to decrease the total solute mass concentration differences while high cooling rates have the opposite effect. The mass/size distribution of the condensation nuclei influences quantitatively, but not qualitatively, these concentration differences. (Author's abstract)
W91-00854

RAINFALL DEFICITS: DISTRIBUTION OF MONTHLY RUNS.
Canterbury Regional Council, Christchurch (New Zealand).
G. A. Griffiths.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 219-229, July 1990. 2 fig, 2 tab, 27 ref.

Descriptors: *Drought, *Meteorology, *Model studies, *Probabilistic process, *Rainfall, *Simulation, Data analysis, Seasonal variation, Statistical analysis.

A probabilistic model is derived to describe temporal series of monthly rainfall deficits in terms of the number of runs, run length and rainfall depth per run. A rainfall deficit is defined as a submedial value in a set of rainfalls which have equal durations. With allowance for symmetry, the joint distribution is also applicable to surfeits or supramedial values. Classic run theory supplies exact, parameter-free, probability density functions for a number of runs and run lengths. Some simple assumptions on the generation of deficit rainfalls lead to a two-parameter gamma density for rainfall depth per run. The model was tested with 130 years of data from a rainfall station and its use in estimating an extreme value distribution of minima and in determining properties of the longest expected deficit run length in a stated period was demonstrated. The theoretically based model should provide a useful description of temporal rainfall patterns of varying durations particularly for the application of statistical decision theory to problems concerning hydrological drought. (Author's abstract)
W91-00886

EFFECT OF OBLIQUE RAIN ON INCLINED SURFACES: A NOMOGRAPH FOR THE RAINGAUGE CORRECTION FACTOR.
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
For primary bibliographic entry see Field 7B.
W91-00899

STUDY ON SHORT-TERM RAINFALL PREDICTION BY RADAR RAINGAUGE.
Public Works Research Inst., Tsukuba (Japan).
K. Ishizaki, F. Yoshino, K. Takeuchi, and A. Yoo.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 3-12. 6 fig, 3 tab, 14 ref.

Descriptors: *Advection, *Hydrologic models, *Meteorology, *Radar, *Rain gages, *Rainfall, *Rainfall forecasting, *Weather forecasting, Data acquisition, Echo-tracking method, Japan, Nagasaki, Storms.

A short-term rainfall prediction model using the echo-tracking method was applied to a number of rainfall cases to determine the accuracy of the model. The accuracy of one-hour prediction proved to be practical. The echo-tracking method and the advection model method were compared by applying them to the Nagasaki Storm of July 1982. The results confirmed that a storm rainfall can be predicted one hour before it occurs and that there is little difference in prediction accuracy between these methods. (See also W91-00961) (Author's abstract)
W91-00962

TOWARDS AN IMPROVED SYSTEM FOR WEATHER RADAR CALIBRATION AND RAINFALL FORECASTING USING RAINGAUGE DATA FROM A REGIONAL TELEMETRY SYSTEM.
Institute of Hydrology, Wallingford (England).
R. J. Moore, B. C. Watson, D. A. Jones, K. B. Black, and C. M. Hagget.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 13-21, 7 fig, 5 ref.

Descriptors: *Flood forecasting, *Flood warning systems, *Meteorological data collection, *Radar, *Rain gages, *Rainfall, *Rainfall forecasting, *Telemetry, *Weather forecasting, Computers, Data acquisition, England, Instrumentation, London, Rainfall distribution.

The UK weather radar network is approaching completion and attention is being focussed on its better use by the water industry for hydrological application. A feature of the national network design is that a small number of rain gages, typically five, is provided for calibration of each radar. However, regional water authorities can have as many as ten times this number of rain gages as part of a centrally controlled regional telemetry system. Current research, carried out as a collaborative venture between the Thames Water Authority and the Institute of Hydrology, addresses the problem of how to obtain more accurate and robust estimates of spatial rainfall through the combined use of weather radar and a regional network of telemetering rain gages. A way of fitting multiquadric surfaces to the ratios of gauge to coincident radar grid square rainfall is among the procedures being investigated. Recent progress in the development of a regional forecasting system for rainfall for small space-time resolutions and model lead times is outlined. Two procedures for identifying the speed and direction of storm movement from weather radar grid square data are based on local and regional correlation matching techniques respectively. New procedures developed as part of the research program will be incorporated in a computer-controlled flood forecasting system developed for flood warning in the London area. (See also W91-00961) (Author's abstract)
W91-00963

USE OF SATELLITE DERIVED RAINFALL ESTIMATES AS INPUTS TO FLOW PREDICTION IN THE RIVER SENEGAL.
Reading Univ. (England). Dept. of Meteorology.
S. Hardy, G. Dugdale, J. R. Milford, and J. V. Sutcliffe.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 23-30. 5 fig, 2 tab, 4 ref.

Descriptors: *Meteorological data collection, *Rainfall, *Remote sensing, *River flow, *River forecasting, *Satellite technology, *Streamflow forecasting, Africa, Catchment areas, Data acquisition, Meteosat, Model studies, Rain gages, Senegal.

The accuracy obtainable in river flow forecasts when rainfall estimates based on data from the geostation are satellite Meteosat are input to catchment models in place of rain gage data was investigated. Particularly where the rain gage network is sparse or communications are unreliable, the complete and regular coverage provided by satellite is a major advantage for real-time, operational flow forecasting. Preliminary results are presented from a research program in which catchment model outputs were compared on a daily basis with river flow observations. After selecting the most appropriate model, the study tested the effect on the calculated flow at two gaging stations of using the distributed rainfall estimated from Meteosat in place of rain gage data. The model results were compared with the measured flows of the subcatchments. The chosen rainfall-runoff model performed at least as well when satellite-based rainfall estimates are used as input in place of normal rain gage data. This has important implications as it makes available real-time flow forecasting and flood warning in the Senegal basin. If the methodology is found to provide substantial advantages it will also be applicable to other catchments in sensitive areas of Africa. (See also W91-00961) (Sand-PTT)
W91-00964

AREAL REDUCTION FACTORS FOR DESIGN STORM CONSTRUCTION: JOINT USE OF RAINGAUGE AND RADAR DATA.
Institute of Hydrology, Wallingford (England).
E. J. Stewart.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 31-40, 5 fig, 2 tab, 11 ref. UK Department of the Interior Contract PECD7/7/190.

Descriptors: *Design storms, *Flood forecasting, *Meteorological data collection, *Radar, *Rain gages, *Rainfall, *Remote sensing, Data acquisition, England.

The spatial variability of rainfall was analyzed in an upland region in North West England using both rain gage and weather radar data. Two differing methodologies are outlined for the re-evaluation of area reduction factors in the study area for a range of durations. Areal reduction factors for durations of 1, 2, 4, and 8 days are presented which are slightly lower than those currently accepted as applicable throughout the UK. Areal reduction factors decreased with return period, but vary little with location within the study area. Preliminary results of the analysis of the ratios of short duration rainfalls to 1-day rainfalls show that the ratios for the North West are generally greater than those derived from the Flood Studies Report (FSR). The rainfall totals in each duration were derived from the hourly radar data using a running sum method within the rainfall day itself. Since durations were not allowed to extend into the subsequent rainfall day, the ratios ascribed to the 2 to 12-hour durations can be taken to apply to slightly shorter actual durations. This has the effect of increasing the difference between the ratios for the North West and the FSR. (See also W91-00961) (Sand-PTT)
W91-00965

ACCURACY OF THE MAXIMUM RECORDED DEPTH IN EXTREME RAINSTORMS.
Iowa State Univ., Ames. Dept. of Civil Engineering.
E. Foufoula-Georgiou.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 41-49. 4 fig, 15 ref. NSF Grant CES-8708825.

Descriptors: *Rainstorms, *Statistical analysis, Error analysis, Rain gages, Rainfall distribution, Storms.

The actual maximum depth of a storm is seldom measured but is usually approximated by the maximum recorded depth. These depths can be quite different depending on the rain gage density and the spatial rainfall pattern. This paper presents a simplified error analysis of the actual maximum depth of a storm and provides an estimate of the first three moments of the normalized error e = (actual maximum depth-maximum recorded depth)/actual maximum depth as a function of the rain gage density. Such results may be useful in devising storm depth adjustment procedures when

storms of different spatial patterns and variable density recording networks are combined in storm regionalization or storm transposition studies. (See also W91-00961) (Sand-PTT)
W91-00966

INFLUENCE OF THE ANGLE OF INCIDENCE OF THE RAINFALL ON THE OVERLAND FLOW PROCESS.
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 2J.
W91-00969

FLOODS AND DROUGHTS IN LABE RIVER BASIN: THE HYDROGRAPH SHAPE.
Hydrometeorologicky Ustav, Prague (Czechoslovakia).
For primary bibliographic entry see Field 2E.
W91-00975

OPERATIONAL SNOW ACCUMULATION AND SNOWMELT MODELING.
National Board of Waters, Helsinki (Finland). Hydrological Office.
V. Vehvilainen.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 213-222. 6 fig, 2 tab, 7 ref.

Descriptors: *Hydrologic models, *Mathematical models, *Model studies, *Runoff forecasting, *Snow accumulation, *Snowmelt, Costs, Finland, Forecasting, Precipitation, Watersheds.

The modified HBV-3 watershed model has been in use since 1981 for operational springtime forecasting in Finland. This model is in use in 13 watersheds ranging from 500-30,000 sq km. In order to improve the results of the springtime forecast research has been conducted to develop more physical snowmelt models and to test the ability of snow models to estimate areal snow water equivalent over the accumulation period in winter. It is shown that this modeling can produce estimates of areal water with the same accuracy as methods based on snow course measurements. The problem in model estimation of areal water equivalent is to arrange the collection of precipitation data from all precipitation stations. The cost of estimation of areal water equivalent with the model will be moderate compared to other forecasting methods. (See also W91-00961) (Sand-PTT)
W91-00983

NEW PERSPECTIVES ON DEVELOPMENTS IN MODELING OF EFFECTIVE RAINFALL BY APPLYING THE FDTF METHOD (NOUVELLES PERSPECTIVES DE DEVELOPPEMENT DANS LA MODELISATION DES PLUIES EFFICASES PAR APPLICATION DE LA METHODE DPFT).
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 2E.
W91-00985

2C. Snow, Ice, and Frost

CLASSIFICATION OF UNIDIRECTIONAL THREE-LAYER FLOW OVER A HUMP.
Contra Costa Water District, Concord, CA.
For primary bibliographic entry see Field 8B.
W91-00041

VARIABLE LAPSE RATE SNOWLINE MODEL FOR THE REMARKABLES, CENTRAL OTAGO, NEW ZEALAND.
Department of Scientific and Industrial Research, Christchurch (New Zealand). Land and Soil Science Div.
J. R. F. Barringer.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 32-46, 1989. 5 fig, 3 tab, 29 ref.

Descriptors: *Mathematical models, *Model studies, *Snow, *Snowline, *Snowpack, Ablation, Alpine regions, Mountains, New Zealand, Snow accumulation.

Studies of snow accumulation and ablation have been conducted using snowmelt-stream runoff relationships or linear lapse rates to extrapolate low altitude temperature and rainfall. The relevance of these relationships to the problem of obtaining estimates of winter snowlines was examined. Temperature extrapolation using fixed linear lapse rates was identified as a major source of error in previous studies. Simulations based upon measured and interpolated temperature data from three high altitude meteorological stations on the Remarkables, Central Otago, show that the standard modeling routines used are essentially sound, allowing daily snowlines to be modeled with reasonable accuracy. A variable lapse rate technique provided more accurate prediction of high altitude temperatures. Actual snowlines were determined by aerial photography. Discriminant analysis based on high altitude temperatures and low altitude standard meteorological records can be successfully applied as an alternative method of temperature extrapolation, providing a marked improvement on previous extrapolation techniques. Using this technique, it should be possible to reconstruct snowline data when upper mountain temperature data are not available. (Author's abstract)
W91-00076

ESTIMATED RUNOFF FROM MAN-MADE SNOW.
Wright Water Engineers, Inc., Denver, CO.
L. M. Eisel, K. M. Bradley, and C. F. Leaf.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 519-526, June 1990. 3 fig, 4 tab, 3 ref.

Descriptors: *Artificial precipitation, *Colorado, *Consumptive use, *Snowmaking, *Water loss, Alpine regions, Recreation, Runoff, Snow skiing, Snowpack.

The consumptive loss from snowmaking at six Colorado ski areas was calculated. The focus of the investigation was on the consumptive loss that occurs to man-made snow particles during the period they reside on or in the snowpack until spring snowmelt (termed the watershed loss). Calculated watershed losses under a variety of precipitation and temperature conditions at six ski areas varied from 7% to 33%. These calculations were made using the calibrated Subalpine Water Balance Simulation Model. The watershed loss of 7% to 33% indicates the range of likely watershed losses that can be expected at Colorado ski areas. A previously published paper provided estimates of the mean consumptive loss during the snowmaking process (termed initial loss) for conditions existing at Colorado ski areas to be 6% of water applied. Therefore, based on the mean initial loss, the total consumptive loss from man-made snowmaking under conditions found at Colorado ski areas could be expected to range from 13% to 37%. These results demonstrate the range of total consumptive losses that could be expected in various years and for various watershed conditions. These total percentage losses cannot be extrapolated directly to other specific sites because the total consumptive loss is dependent on temperature during actual snowmaking, temperature and precipitation throughout the winter at the specific ski area, and watershed conditions at the ski area. (Author's abstract)
W91-00092

SPRING BREAK-UP IN NORTHERN CANADA PAST AND PRESENT.
Lakehead Univ., Thunder Bay (Ontario). Dept. of Geography.
D. D. Kemp.
Weather WTHRAL, Vol. 45, No. 5, p 183-186, May 1990. 2 fig, 4 ref.

Descriptors: *Canada, *History, *Ice breakup, Ice, Ice jams, Social aspects, Spring breakup, Springs.

In the Canadian north, the coming of spring is marked by the rapid melting of the winter's accumulation of snow and the break-up of ice on rivers and lakes. This period produces short-term disruption in the lives of remote northern communities. Excess surface moisture makes dirt roads impassable and gravel airstrips dangerous to use. Waterways become unsuitable for boat traffic and floatplants. All of this increases the isolation of many northern communities, but with proper planning and the use of modern technology, such as the helicopter, the consequences of spring break-up can be minimized. Historically, conditions on the rivers and lakes were of major concern to the traders, and from an early date, the clerks and officers of the Hudson's Bay and North West Companies included references to such conditions in their journals. Journal entries from Pond's Fort on the Athabasca River start on April 1, 1786. They reveal the typically changeable weather conditions of late winter and early spring. Spring break-up appears to have been almost two weeks early in 1786. With appropriate allowances for language and spelling the journal account might well have described the events associated with spring break-up at the present time. Missing from the journal entries is any sense of major concern, and there is every indication that life went on much as usual. (Mertz-PTT)
W91-00116

DIFFERENTIAL REFLECTIVITY RADAR HAIL MEASUREMENT TECHNIQUE: OBSERVATIONS DURING THE DENVER HAILSTORM OF 13 JUNE 1984.
Pennsylvania State Univ., University Park. Communications and Space Sciences Lab.
K. Aydin, Y. Zhao, and T. A. Seliga.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 7, No. 1, p 104-113, February 1990. 4 fig, 3 tab, 53 ref. Army Research Office, Geoscience Division Contracts DAAL03-87-K-0031 and DAAL03-89-K-0158.

Descriptors: *Colorado, *Data acquisition, *Hail, *Precipitation mapping, *Radar, *Remote sensing, Convective precipitation, Ice, Melting, Particle size, Storms.

Multiparameter-polarimetric radars are increasingly being used for studying the microphysics of convective storms. A differential reflectivity radar technique for observing hailstorms was utilized during the 13 June 1984 Denver hailstorm. The hail regions of the storm were identified with the differential reflectivity hail signal. Histograms of the effective reflectivity factor Z(H) and the differential reflectivity Z(DR) were generated for different heights in the hail regions and the relative variation of these parameters was determined. It was observed that due to melting, the mean values of Z(H) and Z(DR) increased with decreasing height below the 0 deg level (around 2.6 km above ground level). Furthermore, at the lower levels Z(DR) varies between -1 and +2 dB, and Z(H) is generally greater than 50 dBZ. The value of Z(H) peaked at around 60 dBZ or more when Z(DR) was in the range -0.5 to 0 dB and 1.5 to 2 dB at 1.5 km and 2 km below the 0 deg level. These and other features of Z(H) and Z(DR) were interpreted in terms of the size, shape and fall behavior of the hailstones using the dual wavelength ratio and the linear depolarization ratio radar measurements, together with results from scattering computations. The negative Z(DR) regions in the storm were inferred to be composed of melting hailstones with sizes predominantly in the 12 to 40 mm range; size falls when larger dimensions are aligned (on the average) vertically. Positive Z(DR) values greater than 1 dB were concluded to be due to melting hailstones with sizes less than 12 mm; size here falls when larger dimensions are aligned (on the average) horizontally. (Author's abstract)
W91-00140

EFFECTS OF SUBURBANIZATION UPON SNOWMELT RUNOFF.
Trent Univ., Peterborough (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2E.

W91-00408

HYDROLOGICAL REMOTE SENSING RESEARCH WITH LARGE-SCALE APPLICATIONS IN WESTERN EUROPE.
Zurich Univ. (Switzerland). Remote Sensing Labs.
For primary bibliographic entry see Field 7B.
W91-00455

USE OF SATELLITE MICROWAVE RADIOMETERS FOR LARGE-SCALE HYDROLOGY.
Innsbruck Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
For primary bibliographic entry see Field 7B.
W91-00457

EFFECTS OF CLIMATE CHANGE ON SNOWMELT RUNOFF PATTERNS.
Eidgenoessisches Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
J. Martinec, and A. Rango.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 31-38, 7 fig, 1 tab, 4 ref.

Descriptors: *Alpine regions, *Global warming, *Model studies, *Mountains, *Precipitation, *Runoff, *Snowmelt, Air temperature, Climates, Seasonal variation, Snow cover.

A doubling of atmospheric CO2 content in the next century as a result of the greenhouse effect could increase global temperatures by 3 degrees C and have a variable effect on precipitation. Effects such as these will have a direct influence on the hydrological regime. In mountainous areas, snowmelt patterns would be affected by changed temperatures so that the runoff from snowmelt would be increased and redistributed during the snowmelt season and possibly increased during the winter months. Three mountainous basins in Canada, USA, and Europe were selected to study the potential effects on snowmelt runoff using a snowmelt runoff simulation model. The runoff in a snowmelt season was simulated using measured temperature, precipitation, and remotely-sensed snow covered area. The simulation was repeated using the changed values of variables according to the predicted future climate. In the three basins studied in response to a 3 degree C temperature increase, snowmelt season runoff was increased on the average by about 10% and the runoff in April (+121%) and May (+65%) was increased the most with the months June-September experiencing decreases or no change. Changes in precipitation of -5%, +5%, and +10% during the snowmelt season seemed to have only minimal effects on the runoff. It is speculated that precipitation changes during the winter accumulation season will have more significant effects on runoff. Finally, the new climate would distinctly change the appearance of the mountain basins in May and June because the snow covered areas will be reduced much more rapidly. (See also W91-00454) (Author's abstract)
W91-00458

GLOBAL WATER BALANCE AND GLOBAL CLIMATE MODEL IN THE PLEISTOCENE.
Akademiya Nauk SSSR, Moscow. Inst. Geografii.
A. B. Kazanskiy.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 39-45, 1 fig, 10 ref.

Descriptors: *Climatology, *Glaciers, *Hydrologic budget, *Paleoclimatology, *Paleohydrology, Evaporation, Mathematical analysis, Sea level.

It has been widely suggested that the main ocean level change cycle in the pleistocene had an approximate period of 100,000 yr, which does not conform to paleotemperature measurements. These have a much longer period than the main period of ocean level change. This contradiction has been investigated by analyzing a previously published global water balance equation. This equation has been put into a form in which the ocean level variation and the amount of the average 'effective' evaporation per unit area from the world's ocean surface (evaporation minus rainfall) are unknown. With this equation it is possible to demonstrate the smallness of relative variation of 'effective' evaporation when continental ice sheets degrade, but its effect becomes perceptible when ice sheets are growing. This conclusion is confirmed by estimates of ocean level changes during the last 17,000 yr B.P. Further analysis based on this equation resulted in a model relating the main paleotemperature cycle with the main ocean level changes cycle. (See also W91-00454) (Author's abstract)
W91-00459

SATELLITE DETERMINATION OF COAST RANGE, ALASKAN GLACIER MASS BALANCE RELATED TO ATMOSPHERIC CIRCULATION.
Maine Univ. at Orono. Inst. for Quaternary Studies.
M. S. Pelto.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 127-137, 3 fig, 3 tab, 15 ref.

Descriptors: *Climatology, *Glaciers, *Remote sensing, *Satellite technology, *Snowline, Ablation, Air temperature, Alaska, Arctic zone, British Columbia, Coast Range, Global warming, Precipitation.

Annual balance is determined for 90 glaciers in the Coast Range of Alaska-British Columbia, using a technique based on satellite imagery identification of the snowline position at various times during the ablation season, and the equilibrium line position observed at the end of the ablation season. This method allows annual balance calculation with an accuracy of +/-0.25 m/yr. During the 1981 through 1984 hydrologic years the mean annual temperature in the Coast Range region was 1.4 C above normal and precipitation 15% below normal, and the mean annual balance of Coast Range glaciers was -0.6 m/yr. During the 1985 through 1987 hydrologic years, mean annual temperature was 1.8 C above normal, precipitation was 30% above normal, and mean annual balance was +0.7 m/yr. The average terminus fluctuation of the 90 Coast Range glaciers observed was -11 m/yr during the 1973-1987 period, the smallest retreat rate of this century. (See also W91-00454) (Author's abstract)
W91-00468

DETERMINATION OF SNOW WATER EQUIVALENTS BY USING NOAA-SATELLITE IMAGES, GAMMA RAY SPECTROMETRY AND FIELD MEASUREMENTS.
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).
R. Kuittinen.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 151-159, 2 fig, 2 tab, 20 ref.

Descriptors: *Finland, *Remote sensing, *Satellite technology, *Snowmelt, Cloud cover, Errors, Gamma radiation, Model studies, Snowpack, Spectrometry.

A method was developed to estimate areal snow water equivalents during snow melt in lowland areas of Finland by using NOAA/AVHRR images, airborne gamma ray spectrometry and field measurements. The errors were 20-50 mm for satellite images and 5-10% of the snow equivalent for gamma ray spectrometry. The results of field measurements can be combined with remotely sensed data. Because cloud cover prevents the use of satellite imagery, a snow melt equation is used to estimate snowmelt on cloudy days. Areal snow water equivalents were estimated with an error between 15 and 45 mm in the spring of 1986. (See also W91-00454) (Author's abstract)
W91-00470

MULTISPECTRAL SNOW AREA ALGORITHM FOR OPERATIONAL 7-DAY SNOW COVER MONITORING.
Bristol Univ. (England). Remote Sensing Unit.
R. M. Lucas, A. R. Harrison, and E. C. Barrett.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 161-166, 2 fig, 10 ref.

Descriptors: *England, *Remote sensing, *Satellite technology, *Snow cover, *Snowpack, Algorithms, Coniferous forests, Data interpretation, Forests, Infrared imagery, Mapping, Multispectral techniques, Snowmelt.

A potentially operational snow mapping scheme which is applicable to areas of temporary snow cover (e.g. United Kingdom) uses daily NOAA AVHRR imagery for the production of weekly composite snow area estimates. This technique is based upon an unsupervised multispectral classification of AVHRR channels allowing snow/cloud and snow type discriminations together with the accurate location of snowpack margins. Masking of the snowpack by conifer forest is less extensive in the UK than in other snow covered regions. Areas of obscured snow not detected by classifier can be identified by overlaying a digitized forest areas map onto each image and applying an appropriate interpolation procedure. Snow area maps derived on a daily basis using the multispectral technique are co-registered to produce snow duration maps for selected periods and images detailing the pattern of snowmelt over time. Areas where data are lacking can be compensated for by employing ground station and digital terrain data. Supporting sub-routines have been developed also for the correction of forest masking and shadowing of the snow by cloud. (See also W91-00454) (Author's abstract)
W91-00471

EFFECT OF TOSTON DAM ON UPSTREAM ICE CONDITIONS.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 6G.
W91-00574

ZERO-CURTAIN EFFECT: HEAT AND MASS TRANSFER ACROSS AN ISOTHERMAL REGION IN FREEZING SOIL.
Michigan Univ., Ann Arbor. Dept. of Geological Sciences.
S. I. Outcalt, F. E. Nelson, and K. M. Hinkel.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1509-1516, July 1990. 5 fig, 23 ref, append.
National Science Foundation Grants DPP-8117124 and SES-8722676.

Descriptors: *Freezing soil, *Frost, *Frozen ground, *Soil temperature, *Thermal properties, *Zero-curtain effect, Alaska, Arctic zone, Heat transfer, Mass transfer, Michigan, Permafrost, Thawing, Vapor transport.

The term zero curtain refers to the effect of latent heat in maintaining temperatures near 0 C over extended periods in freezing or thawing soils. Analysis of thermal data from an arctic site (Toolik Lake, Alaska) and a mid-latitude location (Ann Arbor, Michigan) suggests that the phenomenon may be a universal characteristic of wet, medium-textured mineral and organic soils during freezing. Nonconductive processes play an important role in formation and maintenance of the zero-curtain effect. Water advection, condensation, and evaporation events are recognizable in mappings of thermal and ion concentration records on time-depth meshes. The zero curtain appears to be produced and maintained by vapor transport and internal distillation mechanisms, driven by osmotic potential variations induced by freeze-thaw events at the soil surface. The term zero curtain is applicable to locations outside permafrost regions, but units of measurements should not be assigned to it. (Author's abstract)
W91-00597

SALTATION OF SNOW.
National Hydrology Research Inst., Saskatoon (Saskatchewan).
J. W. Pomeroy, and D. M. Gray.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1583-1594, July 1990. 8 fig, 1 tab, 40 ref.
Natural Sciences and Engineering Research Council of Canada Grant A4363.

Descriptors: *Drifting snow, *Saltation, *Snow cover, Mathematical models, Snow sampling, Transport rate, Wind, Wind velocity.

Redistribution of surface snow by wind transport significantly affects the winter microclimate, snow cover accumulation, and hence snowmelt runoff patterns in cold, windswept regions. Saltation of snow, the transport of snow in periodic contact with and directly above the snow surface, is governed by atmospheric shear forces applied to the erodible snow surface, the nonerodible surface, and the moving snow particles. Empirical data measured over a snow-covered plain suggests functions for parameters important to the apportionment of atmospheric shear forces; the aerodynamic roughness height during saltation, the mean horizontal velocity of saltating particles, and the efficiency of the saltation process. The resulting mass transport expression shows an approximately linear increase in snow saltation transport rate with friction velocity, in agreement with the measurements presented. The expression is sensitive to the cohesion of the snow surface, as indexed by the threshold wind speed, that wind speed at which transport ceases; for wind speeds well above the threshold condition, higher threshold wind speeds correspond to higher transport rates. An adaptation of the expression allows calculation of the mass concentration of saltating snow from measured data and the transport rate of saltating snow from the mean wind speed at 10 m height. Application of the transport rate expression using measured wind speeds, directions, and weather observations demonstrates that the directional component of annual saltating snow transport does not always correspond with wind direction frequency. (Author's abstract)
W91-00603

PHYSICAL CHEMICAL PROPERTIES OF UNCHARGED WATER CLUSTERS AND ONE-DIMENSIONAL ICE BASED ON QUANTAL CALCULATIONS.
Missouri Univ.-Rolla. Dept. of Physics.
D. E. Hagen, C. K. Lutrus, and S. H. S. Salk.
Atmospheric Environment ATENBP, Vol. 24A, No. 6, p 1391-1396, June 1990. 5 fig, 1 tab, 45 ref.
NSF Grant ATM-8716918.

Descriptors: *Freezing, *Ice, *Ice formation, *Physical properties, *Thermodynamics, *Water chemistry, Crystallization, Entropy, Model studies, Statistical methods, Temperature effects.

A systematic study on the physical and chemical properties of finite water clusters as a function of size and on an infinite-sized cluster, i.e. ice, was performed by modeling a one-dimensional crystal. A modified version of a semi-empirical quantum chemical technique particularly well suited for hydrogen bonding was used. Calculations showed that hydrogen bonding leads to increased cluster stability with increasing size n at 0 K. Statistical mechanical methods were used to study cluster stability at finite temperatures as embodied in the free energy of formation. In contrast to the behavior of the 0 K binding energy, the free energy of formation is found to increase continually with cluster size. The 1-D clusters are therefore unstable and will not be found in nature. The quantum mechanical and statistical mechanical methods gave consistent results between the finite and infinite 1-D ice chains. (Geiger-PTT)
W91-00667

FIELD INVESTIGATIONS ON THE SNOW CHEMISTRY IN CENTRAL AND SOUTHERN CALIFORNIA-I. INORGANIC IONS AND HYDROGEN PEROXIDE.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-00842

FIELD INVESTIGATIONS ON THE SNOW CHEMISTRY IN CENTRAL AND SOUTHERN CALIFORNIA-II. CARBONYLS AND CARBOXYLIC ACIDS.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-00843

RELEASE OF HEAVY METALS FROM SNOWPACKS ON THE JAPAN SEA SIDE OF JAPAN.
Kanazawa Univ. (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W91-00858

MODELING SNOWFALL-TO-SNOWMELT DELAY.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
V. Yevjevich, and R. Sivapathasundram.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 203-211. 6 fig, 1 tab, 2 ref.

Descriptors: *Hydrologic models, *Mathematical models, *Model studies, *Runoff forecasting, *Snow accumulation, *Snowmelt, Catchment areas, Runoff volume, Stochastic process, Watersheds.

Precipitation is rarely divided into rainfall and snowfall. Snowfall delay until it becomes snowmelt, normally not modeled, needs modeling in order to accurately compute runoff from precipitation. From measured or computed snowfall and surveyed water content of snow on the ground the snowmelt as input to runoff can be determined both in the amount and time occurrence. For the total accumulated snowfall equal to the total accumulated snowmelt the difference of times of their occurrences gives the delayed snowfall-snowmelt time. Both delay and times of occurrences can then be statistically modeled. This modeling was undertaken on the W-3 watershed (3.25 sq mi) of the U.S. Agricultural Research Service Sleepers River watershed, near Danville, Vermont. The model is useful in its potential to determine the times when snowfall would be turned into snowmelt as an input to the runoff process. In the case where precipitation is simulated by the Monte Carlo method, then separated into rainfall and snowfall by the appropriate stochastic modeling, the models of snowfall delays would be a final step in transferring the precipitation input time series for runoff. (See also W91-00961) (Sand-PTT)
W91-00982

OPERATIONAL SNOW ACCUMULATION AND SNOWMELT MODELING.
National Board of Waters, Helsinki (Finland). Hydrological Office.
For primary bibliographic entry see Field 2B.
W91-00983

EXSRM, AN EXPERT SYSTEM FOR SNOWMELT RUNOFF MODEL (SRM).
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2E.
W91-01002

2D. Evaporation and Transpiration

EVALUATION OF THREE EVAPOTRANSPIRATION MODELS IN TERMS OF THEIR APPLICABILITY FOR AN ARID REGION.
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
R. Lemeur, and L. Zhang.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 395-411, May 1990. 11 fig, 4 tab, 19 ref.

Descriptors: *Arid-zone hydrology, *China, *Evapotranspiration, *Hydrologic models, *Model studies, Canopy, Electromagnetic waves, Hydrologic budget, River basins.

Evapotranspiration has a major controlling influence on all hydrological processes. Unfortunately, reliable estimates are extremely difficult to obtain, especially in arid regions. Three evapotranspiration models were evaluated: the Advection-Aridity, the Complementary Relationship Areal Evapotranspiration (CRAE), and the Penman-Monteith models. By applying these models to an arid river basin in Xinjiang, China, the consistency and reliability of the models were examined. It was found that the Penman-Monteith model is particularly sensitive to the canopy resistance, but is not sensitive to the surface albedo. In arid regions canopy resistance may range from 400 to 1000 s/m for crops and grassland and a 10% error in canopy resistance results in a 10% error in the estimated evapotranspiration. The use of the surface roughness length and surface albedo have significant effects on the estimates of evapotranspiration in the Advection-Aridity model. To estimate regional evapotranspiration, a weighted average method was proposed. By using this method, regional evapotranspiration is obtained from point estimates (Advection-Aridity and Penman-Monteith models) which are weighted according to their relative surface areas. The actual evapotranspiration for the river basin obtained by this method is very close to water balance estimates. It was concluded that the Advection-Aridity, the CRAE, and the Penman-Monteith models are applicable to arid regions, and that the Penman-Monteith model yields the best results. (Author's abstract)
W91-00165

ESTIMATES OF EVAPOTRANSPIRATION IN ALKALINE SCRUB AND MEADOW COMMUNITIES OF OWENS VALLEY, CALIFORNIA, USING THE BOWEN-RATIO, EDDY-CORRELATION, AND PENMAN-COMBINATION METHODS.
Geological Survey, Washington, DC.
L. F. W. Duell.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Supply Paper 2370-E, 1990. (Hydrology and Soil-Water-Plant Relations in Owens Valley, California; ch. E). 39p, 26 fig, 7 tab, 56 ref, append.

Descriptors: *Alkaline soils, *California, *Estimating equations, *Evapotranspiration, *Owens Valley, Bowen ratio, Eddy correlation, Meadows, Penman equation, Shrubs.

In Owens Valley, evapotranspiration (ET) is one of the largest components of outflow in the hydrologic budget and the least understood. ET estimates for December 1983 through October 1985 were made for seven representative locations selected on the basis of geohydrology and the characteristics of phreatophytic alkaline scrub and meadow communities. The Bowen-ratio, eddy-correlation, and Penman-combination methods were used to estimate ET. The results of the analyses appear satisfactory when compared with other estimates of ET. Results by the eddy-correlation method are for a direct and a residual latent-heat flux that is based on sensible-heat flux and energy-budget measurements. Penman-combination potential-ET estimates were determined to be unusable because they overestimated actual ET. Modification of the psychrometer constant of this method to account for differences between heat-diffusion resistance and vapor-diffusion resistance permitted actual ET to be estimated. The methods described in this report may be used for studies in similar semiarid and arid rangeland areas in the Western United States. Meteorological data for three field sites are included in the appendix of this report. Simple linear regression analysis indicates that ET estimates are correlated to air temperature, vapor-density deficit, and net radiation. Estimates of annual ET range from 301 millimeters at a low-

density scrub site to 1,137 millimeters at a high-density meadow site. The monthly percentage of annual ET was determined to be similar for all sites studied. (Author's abstract)
W91-00333

HAPEX-MOBILHY: RESULTS FROM A LARGE-SCALE FIELD EXPERIMENT.
Centre National de Recherches Meteorologiques, Toulouse (France).
For primary bibliographic entry see Field 7B.
W91-00456

FIRST ISLSCP FIELD EXPERIMENT: EXPERIMENT EXECUTION AND PRELIMINARY ANALYSES.
Maryland Univ., College Park.
For primary bibliographic entry see Field 7B.
W91-00460

RELATING NIMBUS-7 GHZ DATA TO LAND SURFACE EVAPORATION.
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
For primary bibliographic entry see Field 7B.
W91-00461

FIFE: THE VARIATION IN ENERGY PARTITION AT SURFACE FLUX SITES.
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
W. J. Shuttleworth.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 67-74, 9 fig, 4 ref.

Descriptors: *Evaporation, *Evapotranspiration, Climatology, Meteorology.

The proportion of surface energy used for evaporation was compared for 20 micrometeorological sites distributed over the First ISLSCP Field Experiment (FIFE) study area on four so-called 'Golden Days'. This proportion changed only slowly during daylight hours and the midday value represented the daylight average well. There were significant differences between sites, which are systematic but can change from day to day. Intersite differences on individual days showed no significant correlation with leaf area index or soil moisture, though there is evidence of a limited relation to the fraction of green vegetation. Site to site variation showed no obvious dependence on topography, but this result is confused by a possible relationship to experimental systems and method. Assuming the measurements are an unbiased, quasi-random sample, the spatial average evaporative fraction during daylight hours is satisfactorily defined within a standard error of around 2% to 3%. (See also W91-00454) (Author's abstract)
W91-00462

RELATIONSHIPS BETWEEN THE HYDROLOGIC BALANCE OF A SMALL WATERSHED AND REMOTELY SENSED SOIL MOISTURE.
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2A.
W91-00463

MONITORING SPATIAL VARIABILITY OF FOREST INTERCEPTION.
Montreal Univ. (Quebec). Dept. of Geography.
M. G. Durocher.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 215-229, July/September 1990. 7 fig, 2 tab, 43 ref.

Descriptors: *Data acquisition, *Forest hydrology, *Forest watersheds, *Hydrologic budget, *Instrumentation, *Interception, *Monitoring, *Rainfall-runoff relationships, *Spatial variation, *Statistical analysis, England, Groundwater movement, Model studies, Network design, Precipitation, Rainfall, Stemflow.

Most of the recent developments on forest interception are mainly concerned with only one of the two rainfall components affected by the interception: that lost by evaporation from the system. Little attention has been paid to the proportion of rainfall which actually reaches the ground. Many observations have helped to illustrate that the forest canopy is acting like a filter composed of a structure which can significantly modify the spatial distribution of the incident rainfall reaching the soil surface. Field instrumentation was designed and installed to quantify the influence of forest interception on the spatial and temporal distribution of water flux onto and into the forest soil at the plot scale. The field site is located near Bristol, England in a plantation of about 40-year-old red oak. An application is presented which demonstrates that the instrumentation has the required resolution to monitor the spatial variability and dynamics of the flux processes. The observations show that spatial variability of interception may play an important role, not only in small scale soil moisture heterogeneity, but also in the hydrological response of a forested catchment at the hillslope scale. Results also highlight the need for gathering more field information on the effects of vegetation on the spatial variability of soil surface water input. (Korn-PTT)
W91-00861

TRANSPIRATION OF PLANTATION PINUS RADIATA ESTIMATED BY THE HEAT PULSE METHOD AND THE BOWEN RATIO.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
T. J. Hatton, and R. A. Vertessy.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 289-298, July/September 1990. 5 fig, 1 tab, 40 ref.

Descriptors: *Bowen ratio, *Data acquisition, *Model studies, *Pine trees, *Transpiration, Australia, Catchment areas, Evaporation, Forest hydrology, Forest watersheds, Heat pulse method.

The direct measurement of water use by trees (transpiration) permits the partitioning of this component of total stand evaporation from soil evaporation and the loss of intercepted or condensed water from the canopy. Such estimates are necessary for modeling the biological, as distinct from the physical, control of transpiration with respect to evaporative demand, soil water levels, and canopy wetness. Water use by individual trees may be estimated by a number of plant physiological methods, including those based on sapflow tracer techniques such as the heat pulse method. The heat pulse technique can potentially provide accurate estimates of transpiration by individual plants. The heat pulse method was used to estimate stand transpiration from a radiata pine (Pinus radiata) plantation in southeastern Australia over a period of four days. The diurnal pattern of sapflow was related to net radiation with a time lag of about 1.5 hours. Despite high soil moisture levels, sapflow did not keep up with evaporative demand in the afternoon. Sapflow estimates of transpiration exceeded estimates for evaporation based on the micrometeorological measures of the Bowen ratio energy balance approach for all four days of the study. (Korn-PTT)
W91-00867

INTERCEPTION LOSS AND RAINFALL REDISTRIBUTION BY THREE SEMI-ARID GROWING SHRUBS IN NORTHEASTERN MEXICO.
Toronto Univ. (Ontario). Faculty of Forestry.
For primary bibliographic entry see Field 2I.
W91-00878

EVAPORATION FROM DAMPLAND VEGETATION ON A GROUNDWATER MOUND.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
P. Farrington, G. D. Watson, G. A. Bartle, and E. A. N. Greenwood.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 60-75, July 1990. 6 fig, 1 tab, 17 ref.

Descriptors: *Australia, *Evaporation, *Groundwater budget, *Groundwater depletion, *Vegetation effects, *Wetlands, Diurnal variation, Forest ecosystems, Mathematical analysis, Water measurement.

Evaporation by perennial vegetation growing above the unconfined aquifers represents the greatest discharge of the unconfined groundwater underlying Perth, Western Australia. Annual evaporation from an area of wetland vegetation in a dampland on a groundwater mound near Perth, Western Australia, was estimated from measurements of daily evaporation using ventilated chambers on thirteen occasions between March 1987 and March 1988. Evaporation over this period was estimated to be 814 mm, which exceeded the annual rainfall (747 mm) by 67 mm of water. Groundwater loss during summer was 266 mm of water (equivalent to 35% of annual rainfall). During summer, estimates of daily evaporation using diurnal water-table fluctuations gave values which were highly correlated ($r = 0.90$) with the ventilated chamber method. Provided that estimation was restricted to periods when vegetation is drawing mainly on groundwater, the diurnal fluctuation method offers a practical, cheap alternative method of estimating evaporation from wetlands. (Author's abstract)
W91-00879

DIURNAL FLUCTUATION IN STREAM FLOW AND IN SPECIFIC ELECTRIC CONDUCTANCE DURING DROUGHT PERIODS.
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
For primary bibliographic entry see Field 2E.
W91-00881

CHEMICAL STUDIES OF CHLORIDE AND STABLE OXYGEN ISOTOPES IN TWO CONIFER AFFORESTED AND MOORLAND SITES IN THE BRITISH UPLANDS.
Institute of Hydrology, Wallingford (England).
C. Neal, and P. T. W. Rosier.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 269-283, July 1990. 5 fig, 2 tab, 28 ref.

Descriptors: *Chlorides, *Coniferous forests, *Forest hydrology, *Forest watersheds, *Oxygen isotopes, *Rainfall-runoff relationships, *Scotland, *Tracers, *Water chemistry, Chemical properties, Network design, Rainfall, Seasonal variation, Stream discharge, Surface water data, Wales, Water sampling.

Chloride concentration variations for three streams in the Crinan Canal region of southwest Scotland, draining heather (Calluna vulgaris) and immature and mature sitka spruce conifer forest (Picea sitchensis (Bong.) Carr) are compared with incident rainfall values. Results show the importance, and correspondence, of in-catchment processes for attenuating atmospheric inputs of chloride before its entry to the stream. All three streams exhibit a damped chloride concentration variation compared with rainfall. The chloride chemistries for the three streams are intercorrelated. The weekly data show a net accumulation of chloride into the catchment over the 1 year sampling period. This is associated with an inappropriate stream sampling frequency and/or large yearly fluctuations, in the rainfall input; 80% of the rainfall chloride contribution was introduced during four of the 52 weeks of sampling. The yearly flux of chloride leaving the catchment as stream flow is remarkably similar for all three catchments. The study highlights the need for long and detailed data records from which information can be obtained on chemical budgets and the deficiencies in the measurement of atmospheric inputs of chloride. Although mature conifers are known to capture significant inputs of chemicals to a catchment, not measured by a standard rainfall collector in uplands areas, analogous results are not inferred in the lowland Crinal Canal case. Far more detailed studies are required if a definitive statement is to be made. The chloride results from the Crinan Canal Study are compared with analogous data for streams draining the Hafren Forest at Plynlimon in mid-Wales. Similar degrees of damping are observed and seasonal oscillations occur which do not have the same

phase or amplitude. In addition, oxygen isotopic data are presented for the Plynlimon case to highlight a higher degree of damping than for chloride. (Author's abstract)
W91-00890

EVAPORATION FROM SOIL SURFACE IN PRESENCE OF SHALLOW WATER TABLES.
Mosul Univ. (Iraq). Dept. of Irrigation and Drainage.
H. R. Rasheed, H. Al-Anaz, and K. A. Abid.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 353-361. 4 fig, 3 tab, 8 ref.

Descriptors: *Evaporation, *Soil water, *Water table, Capillarity, Field tests, Soil surfaces.

Field experiments were carried out to study the effect of the presence of shallow water table depth on the evaporation process from soil surfaces. Four different soils were obtained from known agricultural sites near Mosul, Iraq, for investigations with the water table at six different depths from 175 to 50 cm. There are two main factors affecting the evaporation process: the external meteorological conditions and/or the soil characteristics. These factors affect the soil surface evaporation individually or collectively depending on water table location and capillary rise height of the soil. Based on the experimental work, equations for estimating the soil surface evaporation were determined for relatively deep and shallow water table depths. (See also W91-00961) (Author's abstract)
W91-00996

2E. Streamflow and Runoff

POPULATIONS, GROWTH, BIOMASS AND PRODUCTION OF FISH IN A SMALL STREAM IN NORTH-WEST POLAND.
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
For primary bibliographic entry see Field 2H.
W91-00007

STREAM CANOPY AND ITS RELATIONSHIP TO SALMONID BIOMASS IN THE INTERMOUNTAIN WEST.
Forest Service, Ogden, UT. Intermountain Research Station.
For primary bibliographic entry see Field 8I.
W91-00013

TESTING OF HABITAT ASSESSMENT MODELS FOR SMALL TROUT STREAMS IN THE MEDICINE BOW NATIONAL FOREST, WYOMING.
Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie.
For primary bibliographic entry see Field 8I.
W91-00014

ALGORITHM FOR ROUTING UNSTEADY FLOWS IN URBAN DRAINAGE NETWORKS.
Gutteridge, Haskins and Davey Pty Ltd., Sydney (Australia).
For primary bibliographic entry see Field 4C.
W91-00031

DEPTH-INTEGRATED MODEL FOR SUSPENDED SEDIMENT TRANSPORT.
Technische Hogeschool Delft (Netherlands).
For primary bibliographic entry see Field 2J.
W91-00033

HYDRAULIC JUMPS AT POSITIVE AND NEGATIVE STEPS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
For primary bibliographic entry see Field 8B.
W91-00034

VELOCITY DISTRIBUTION IN ALLUVIAL CHANNEL FLOW.
Karnataka Regional Engineering Coll., Suratkal (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00036

FLOW RESISTANCE IN COMPOUND CHANNELS.
Ulster Univ. at Jordanstown, Newtownabbey (Northern Ireland). Dept. of Civil Engineering and Transport.
W. R. Myers, and E. K. Brennan.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 141-155, 1990. 11 fig, 30 ref.

Descriptors: *Channel morphology, *Discharge capacity, *Flood channels, *Flow discharge, *Flow resistance, Channel flow, Flood plains, Hydraulic models, Hydraulics, Momentum transfer.

Preliminary results from the Flood Channel Facility sponsored by the British Science and Engineering Research Council and Hydraulics Research Ltd. are presented. The Facility takes the form of a large compound channel and the first series of experiments have been analyzed to assess flow resistance characteristics of simple and compound channels having smooth boundaries. The effects of momentum transfer from main channel to flood plains on the capacity of the compound and main channel sections have been demonstrated. Flow resistance relationships for the compound section, main channel and flood plains have been presented in terms of Manning's and Darcy-Weisbach resistance coefficients, and compared with simple channel shapes. This has emphasised the complexity of compound channel flow resistance, while also pointing out the likely errors involved in applying simple channel methods of analysis and design to rivers and channels of compound geometry. (Author's abstract)
W91-00037

IMPROVED METHOD OF CALCULATION FOR STEADY UNIFORM FLOW IN PRISMATIC MAIN CHANNEL/FLOOD PLAIN SECTIONS.
Queen Mary Coll., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00038

TURBULENCE MEASUREMENTS IN A SHEAR LAYER REGION OF A COMPOUND CHANNEL.
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00039

SERC FLOOD CHANNEL FACILITY: SKEWED FLOW EXPERIMENTS.
Bristol Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00040

WAVE TYPE FLOW AT ABRUPT DROPS.
Hirosaki Univ. (Japan). Faculty of Agriculture.
N. Kawagoshi, and W. H. Hager.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 235-252, 1990. 14 fig, 7 ref, append.

Descriptors: *Flow characteristics, *Hydraulic geometry, *Hydraulic jump, *Hydraulics, *Standing waves, Cavitation, Channel flow, Fluid mechanics, Froude number, Tailwater, Wave crest.

The wave-type flow over abrupt drops was investigated experimentally. Based on a large number of observations collected in a 50-cm-wide channel with two different drop heights, and on the analysis of this and other data, the following conclusions may be drawn: (1) The ratio of sequent depths for wave-type flow may explicitly be expressed as the sum of the sequent depths ratio for a classical jump and the sequent depth ratio excess. The sequent depth ratio excess is proportional to the inflow Froude number. (2) For relative drops of less than the limiting height the tailwater surface becomes undular. (3) Quantities of interest, such as the coordinates of the wave crest, the plunge point, the lengths of the standing wave and jump, or the length of bottom separation may be given by two scaling parameters. These are the drop Froude number and the modified approaching velocity head. (4) A dimensionless plot allows direct reading of all flow-geometry parameters of interest in wave-type flow. (5) The data compare reasonably well with other experiments, but they include a much wider range of inflow parameters. This range of parameters accounts for all cases encountered in real applications. (Stoehr-PTT)
W91-00042

GEOMORPHOLOGICAL EFFECTS OF CATASTROPHIC FLOODING ON A SMALL SUBTROPICAL ESTUARY.
Council for Scientific and Industrial Research, Congella (South Africa). Estuaries and Coastal Processes Programme.
For primary bibliographic entry see Field 2J.
W91-00049

EXPERIMENTAL STUDY OF COMPLEX RESPONSE IN RIVER CHANNEL ADJUSTMENT DOWNSTREAM FROM A RESERVOIR.
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2J.
W91-00050

BED FORM RESISTANCES IN OPEN CHANNEL FLOWS.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00063

PREDICTION OF FLOW CHARACTERISTICS IN MAIN CHANNEL/FLOOD PLAIN FLOWS.
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00073

ESTIMATING STATISTICAL PARAMETERS FOR AN N-SEGMENT DISCRETE HYDROLOGIC DATA SERIES.
Clark Univ., Worcester, MA. Dept. of Geography.
W. Du.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 3-16, 1989. 1 fig, 1 tab, 32 ref.

Descriptors: *Flood data, *Flood discharge, *Flood forecasting, *Flood frequency, *Floods, *Statistical methods, China, Parametric hydrology, Probability distribution, Probable maximum flood.

Extreme or rare floods, with probabilities in the range of 1 in 100 to 1 in 10 million chance of occurrence per year, are of interest to the hydrologic and engineering communities for project design and planning. However, streamflow records of greater than 100 yr are meager, and most records are considerably shorter. In the United States and other countries, the Pearson Type III and the Log-Pearson Type III probability distributions are recommended by governmental water resources agencies for flood frequency analysis. The accuracy of such analysis directly depends on the accuracy of estimating parameters of those distributions. A new algorithm to estimate statistical parameters for an N-segment discrete hydrological data series and related conditional flood frequency analysis has been developed. The new algorithm differs from traditional methods in two ways: (1) the method concerns an N-segment discrete hydrologic data series, and its mathematical treatment of extreme floods more closely approximates real hydrological situations than traditional methods, and (2) the method deals with conditional frequencies and considers the real position of historical floods. Application of the algorithm to a

dataset from a river basin in China provided a good fit. (Tappert-PTT)
W91-00074

WATER BALANCE OF LAKE ROTOITI, NORTH ISLAND: FLOODS AND SHORT-CIRCUITING OF INFLOWS FROM LAKE ROTORUA.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W91-00077

RECONSTRUCTION OF THE RECENT FLOW HISTORY OF A BRAIDED GRAVEL RIVER.
Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
T. B. Hoey.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 76-97, 1989. 10 fig, 3 tab, 44 ref.

Descriptors: *Bed load, *Braided streams, *Channel morphology, *Mannings equation, *Mathematical models, *Sediment transport, *Streamflow, Channel flow, New Zealand, Paleohydrology, River beds, Sedimentation.

Coarse gravel deposits have commonly been used in paleohydrologic reconstruction, and are divided into the hydraulic approach and the geomorphic approach. The hydraulic approach was used to reconstruct recent flows in the Kowai River, a braided gravel-bed river near Springfield, New Zealand. Critical tractive stress, the method used, is sensitive to selection of the dimensionless shear stress at which entrainment is presumed to occur, and to variation in the measured parameters of slope and particle size. The importance of cluster bedforms in the Kowai leads to the choice of 0.06 for the critical dimensionless shear stress. Five cross-sections were used for paleodischarge analysis. Flood magnitudes that correspond well with the two year flood of the river were obtained using a technique of reconstructing the river bed at the time of deposition of the various bar units. Combination of discharge estimates with geomorphic evidence permitted interpretation of current river bed morphology in terms of three recent flow events. Sources of uncertainty include measurement error in slope, particle size and cross-section surveys, reliability of roughness determination, estimation of suspended sediment concentration, accuracy of estimates of the effect of bar roughness, applicability of shear stress equations to turbulent conditions, and accuracy of bed surface reconstructions. (Tappert-PTT)
W91-00079

HYDROLOGIC AND HYDRAULIC RESEARCH IN MOUNTAIN RIVERS.
Geological Survey, Denver, CO.
R. D. Jarrett.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 419-429, June 1990. 6 fig, 1 tab, 29 ref.

Descriptors: *Alpine regions, *Flood flow, *Hydraulics, *Mountain streams, *Paleohydrology, *Rainfall-runoff relationships, Colorado, Data acquisition, Data interpretation, Elevation, Error analysis, Flood peak, Rocky Mountains, Storms.

Although current (1990) knowledge of hydrologic and hydraulic processes is based on many years of study, there are river environments where these processes are complex and poorly understood. One of these environments is in mountainous areas, which cover about 25% of the United States. Use of conventional hydrologic and hydraulic techniques in mountain-river environments may produce erroneous results and interpretations in a wide spectrum of water resources investigations. An ongoing U.S. Geological Survey research project is being conducted to improve the understanding of hydrologic and hydraulic processes of mountainous areas and to improve paleohydrologic techniques used in mountain rivers. Much of this research has been conducted in Colorado but rivers in other Rocky Mountain states are also being studied. To understand runoff from mountainous areas, the causative hydrologic processes, particularly precipitation, need to be understood. Floods of interest are produced by short-duration and high-duration intensity rainstorms. An elevation limit (2,450 m) has been observed for significant rainfall which supports the elevation limit of significant flood runoff from studies of streamflow data and paleoflood investigations. Knowledge of data errors, problems with application of measurement techniques, and overestimated peak discharge is essential because the values of the largest floods commonly are the most erroneous. (Peters-PTT)
W91-00083

HYDROCLIMATIC APPLICATION STRATEGY FOR THE POISSON PARTIAL DURATION MODEL.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
J. F. Cruise, and K. Arora.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 431-442, June 1990. 1 fig, 7 tab, 42 ref. Louisiana Water Resources Research Institute Project No. 127-90-5141.

Descriptors: *Duration analysis, *Flood forecasting, *Louisiana, *Model studies, *Poisson ratio, *Statistical analysis, Climatic data, Drainage area, Humid climates, Streamflow data, Subtropic zone.

A strategy for formulating and testing the Poisson partial duration extreme value model was developed. The procedure was demonstrated using recorded streamflow series from a humid subtropical region of the southern United States. The observed data series were partitioned by climatic causes and tested for both the Poisson assumption and the validity of the exponential as marginal distributions. Several statistical tests were utilized in making these determinations. It was found that a majority of streamflow series (15 of 19 watersheds in Louisiana) could be represented by the model and that significant differences do exist between the arrival structures of floods resulting from different climatic mechanisms. However, these differences generally do not exist in the distribution of the flood magnitudes. In addition, it is possible that model validity is restricted by drainage basin size. The largest drainage areas were consistently found to be not well represented by the Poisson approach. It is possible that the storage effects and nonuniformity of large watersheds may damp out the Poisson characteristics of the flood series. (Author's abstract)
W91-00084

ERRORS IN ESTIMATED STREAMFLOW PARAMETERS AND STORAGES FOR UNGAUGED CATCHMENTS.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
K. C. Gan, T. A. McMahon, and I. C. O'Neill.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 443-450, June 1990. 2 fig, 7 tab, 11 ref.

Descriptors: *Error analysis, *Model studies, *Rainfall-runoff relationships, Reservoi, *Storage requirements, *Streamflow, *Streamflow forecasting, *Ungaged catchments, Australia, Flood control, Regression analysis, Reservoir storage, Statistical analysis.

For a set of 81 catchments in southeast Victoria, Australia, predictive equations were developed by least squares regression of the mean and coefficient of variation of annual streamflow against a variety of rainfall and physiographic parameters. The data were also divided into subsets according to catchment size, subregion, or record length if the relationships differed significantly between subsets. Only the catchment area and some rainfall statistical parameters were found to be significant. Streamflow parameters predicted by the regression equations were used to estimate storage requirements in ungaged catchments. The errors in estimating streamflow parameters by regression for a particular ungaged catchment are unknown, but may be estimated on an average statistical basis. The likely upper boundary to the storage error may be estimated and due allowance made in the design of reservoirs for ungaged catchments. (Peters-PTT)
W91-00085

STORMFLOW AND SEDIMENT LOSS FROM INTENSIVELY MANAGED FOREST WATERSHEDS IN EAST TEXAS.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 4C.
W91-00087

TEMPORAL LAG EFFECT IN BED LOAD SEDIMENT TRANSPORT.
Willing and Partners, Canberra (Australia).
For primary bibliographic entry see Field 2J.
W91-00093

INFLUENCE OF SAND OR GRAVEL ON THE EROSION OF COHESIVE SEDIMENT.
Queen's Univ., Kingston (Ontario).
For primary bibliographic entry see Field 2J.
W91-00095

WEAKLY DEPOSITING TURBIDITY CURRENT ON A SMALL SLOPE.
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
For primary bibliographic entry see Field 2J.
W91-00096

MEASURES OF FLOW VARIABILITY FOR GREAT LAKES TRIBUTARIES.
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
R. P. Richards.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 361-377, November 1989. 6 fig, 2 tab, 8 ref.

Descriptors: *Flow profiles, *Monitoring, *Statistical analysis, *Stream discharge, *Stream pollution, *Streamflow data, *Water quality, Great Lakes, Mathematical analysis, Nonpoint pollution sources, Pollution load.

Design of monitoring programs for load estimation is often hampered by the lack of existing chemical data from which to determine patterns of flux variance, which determine the sampling program requirements when loads are to be calculated using flux-dependent models like the Beale Ratio Estimator. In contrast, detailed flow data are generally available for the important tributaries. For pollutants from nonpoint sources there is often a correlation between flow and pollutant flux. Thus, measures of flow variability might be calibrated to flux variability for well-known watersheds, after which flow variability could be used as a proxy for flux variability when estimating sampling needs for tributaries for which adequate chemical observations are lacking. Three types of measures of flow variability were investigated, including ratio measures, spread measures, and the coefficient of variation of the logs of flows. In the latter, flows are log transformed because flow distributions are often approximately log-normal. The ratio measures and the spread measures are scale independent, and thus are measures only of the shape of the distribution. The coefficient of variation is also scale independent but in log space. Values of these measures of flow variability for 120 Great Lakes tributaries are highly intercorrelated, although the relationship is often non-linear. The coefficient of variation of the log of the flows is also well correlated with the coefficient of variation of fluxes of suspended solids, total phosphorus, and chloride, for a smaller set of rivers where the existence of abundant chemical data allows comparison. Tributaries with abnormal distributions often show up as outliers when one measure of flow variability is plotted against another. (Author's abstract)
W91-00136

MENU OF COUPLED VELOCITY AND SEDIMENT-DISCHARGE RELATIONS FOR RIVERS.
Pima County Dept. of Transportation and Flood Control, Tucson, AZ.

For primary bibliographic entry see Field 2J.
W91-00149

STABILITY LIMITS FOR PREISSMANN'S SCHEME.
Hydraulics Research Ltd., Wallingford (England).
P. G Samuels, and C. P. Skeels.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 8, p 997-1012, August 1990. 4 fig, 25 ref, 2 append.

Descriptors: *Channel morphology, *Flow models, *Model studies, *Open-channel flow, *River flow, Flow discharge, Flow equations, Flow velocity, Fourier analysis, Hydraulic engineering, Numerical analysis, Stability analysis, Water level.

Computational models of river flow are a well-established tool in engineering practice. Models based on the St. Venant equations of open-channel flow can provide quantitative information on discharge, velocity, and level for a variety of purposes. The St. Venant equations form the basis of many one-dimensional river models. The Preissmann box scheme is often used to generate approximate solutions, chiefly because the modeler has considerable flexibility in the choice of space and time steps. A comprehensive Fourier stability analysis of the Preissmann scheme was applied to the St. Venant equations, including the general form of the friction term. Previous analyses have either neglected or simplified the form of the flow resistance. No such approximations are made in this application. It shows analytically that the linearized, numerical equations are stable when weighted towards the new time level and when the magnitude of the Vedernikov number is less than one. This second condition is the limit of hydrodynamic stability at which roll waves form and the numerical scheme mirrors this physical stability limit. Difficulties that occur in practical applications of this computational method must have their origin in factors omitted from the Fourier analysis, such as the treatment of boundary conditions and the nonlinear terms in the flow equations. (Author's abstract)
W91-00150

EXPLICIT METHODS FOR 2-D TRANSIENT FREE-SURFACE FLOWS.
Florida International Univ., Miami. Dept. of Civil and Environmental Engineering.
R. J. Fennema, and M. H. Chaudhry.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 8, p 1013-1034, August 1990. 14 fig, 21 ref.

Descriptors: *Finite difference methods, *Flow models, *Hydraulic engineering, *Model studies, *Numerical analysis, *Open-channel flow, *Streamflow, Boundary conditions, Critical flow, Flood waves, Unsteady flow, Viscosity.

The computation of unsteady free-surface flows is required for the analysis of tidal oscillations, flows produced by the operation of control structures, and flood waves generated by storms or failure of structures. For such analyses, numerical models may be used as a management tool if the water level and wave speed can be accurately predicted over a wide range of conditions. In many situations these flows are described by two-dimensional models, which require solver routines and the inclusion of proper boundary conditions. Two second-order accurate finite-difference explicit schemes were applied to integrate the shallow-water (St. Venant) equations describing two-dimensional, unsteady gradually varied flows. Both schemes are second-order accurate in space and time, allow sharp discontinuous initial conditions, and do not require isolation of the bores. Both subcritical and supercritical flows may be present simultaneously in different parts of the channel or in a sequence in time. These schemes were applied to analyze two typical hydraulic flow problems: partial dam breach and passage of a flood wave through a channel contraction. It was found that some numerical oscillations occur near the sharp-fronted waves; these can be controlled by the selective addition of artificial viscosity. Boundary conditions are readily incorporated in both schemes, but the finite-difference formulation of sharp corners needs additional investigation. Explicit tracking of the bore is not necessary in these schemes, since the shock is spread only over a few mesh points. Although many schemes are available for computational analysis, these schemes are relatively easy to program and give good results. (Fish-PTT)
W91-00151

NONPARAMETRIC FLOOD-FREQUENCY ANALYSIS WITH HISTORICAL INFORMATION.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
K. Adamowski, and W. Feluch.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 8, p 1035-1047, August 1990. 6 fig, 15 ref. National Science and Engineering Research Council of Canada.

Descriptors: *Flood data, *Flood forecasting, *Flood frequency, *Historic floods, *Simulation analysis, Parameter estimation, Parametric hydrology, Probability distribution.

Inclusion of historical information in flood-frequency analysis increases the accuracy of flood estimates; however, some of the major factors affecting this accuracy are the a-priori specification of a particular probability distribution function and the method of estimating its parameters. A new nonparametric procedure is proposed that altogether eliminates the specification of a distribution and greatly simplifies parameter-estimation problems. The nonparametric method, however, is not particularly efficient in extrapolating distribution function beyond an available record length. Thus, to overcome such a problem, a new kernel is introduced in the form of an extreme-value distribution. Also, the smoothing parameter is estimated by a cross-validation procedure, and a new mixture-distribution model is proposed for inclusion of historical data into analysis. A simulation study employing a two-parameter log-normal distribution shows that the accuracy of flood estimates does not greatly increase with the addition of data length beyond 10 years. It was found that inclusion of historical information into nonparametric analysis improves extrapolation. (Author's abstract)
W91-00152

MODEL OF FLOW IN REGULATED OPEN-CHANNEL NETWORKS.
Miami Univ., Coral Gables, FL. Coll. of Engineering.
E. D. Swain, and D. A. Chin.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 537-556, July/August 1990. 10 fig, 13 ref.

Descriptors: *Drainage engineering, *Hydraulic engineering, *Model studies, *Numerical analysis, *Open-channel flow, *Unsteady flow, Drainage patterns, Flow profiles, Hydraulic structures, Leakage, Mathematical equations, Mathematical models, Mathematical studies, Open channels, Open-channel drainage, Simulation analysis.

The use of computers to model unsteady flow in open channels is an essential part of water resources engineering. A numerical model was developed to simulate unsteady flow in open-channel networks. The model is an improvement over currently available network models in that the effects of hydraulic structures and leakage through the riverbed are incorporated. In addition, a matrix solution method was developed that takes advantage of the banded nature of network problems and, in some cases, reduces the solution time drastically. A method of reducing the bandwidth of the coefficient matrix is incorporated. Verification by comparison to other solution methods shows close agreement. The computation time using the banded matrix solution routine was compared to a commonly used method for reducing solution time to determine the conditions under which the banded matrix solution is faster. The model presented is useful in simulating gate operating rules, analyzing effective flood control measures, and comparing water delivery schemes over large distances where there is significant loss to leakage. (Author's abstract)
W91-00172

STREAMFLOW SIMULATION USING DETERMINISTIC MODEL.
Dames and Moore, Park Ridge, IL.
A. Prakash, and G. Dearth.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 566-580, July/August 1990. 2 fig, 8 tab, 15 ref.

Descriptors: *Model studies, *Streamflow forecasting, *Wastewater disposal, *Water pollution control, California, Computer models, Correlation analysis, Data interpretation, Distribution patterns, Evapotranspiration, Hydrologic data, Meteorological data collection, Regression analysis, Streamflow data, Time series analysis.

To protect human health and the natural environment, most regulatory agencies require dischargers to identify the hydrologic characteristics of the receiving stream and establish a relationship between streamflow and quality and quantity of effluents to be discharged. To develop this information for ungaged streams, the hydrologist has to be able to simulate sequential daily, monthly, and seasonal streamflows for different climatic conditions. The National Weather Service River Forecast System model was used to generate 30 years of sequential streamflows for Laguna de Santa Rosa in northern California. The model was calibrated by simulating 11 years of daily streamflows for a 12.5 sq mi subwatershed in the upper portion of the watershed. Daily streamflow data for this subwatershed were retrieved from a USGS gaging station. Daily precipitation values were obtained as weighted averages of data from two stations in the vicinity. These were converted into a six-hourly time series using average distribution patterns for six-hourly precipitation. Daily lake evaporation values were estimated using regression analyses with monthly pan evaporation data for nearby stations, daily average distribution patterns, and applicable pan coefficients. These values were converted into evapotranspiration demand by the model using specified evapotranspiration adjustment factors. In spite of these approximations and adjustments, the calibration was satisfactory. However, extreme caution must be exercised to generate representative input data for these models using appropriate regression, correlation, and data generation techniques. (Fish-PTT)
W91-00174

RAINFALL-REAERATION EFFECTS.
Florida Inst. of Tech., Melbourne. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W91-00175

REGIONAL FLOW-DURATION CURVES FOR UNGAUGED SITES IN MASSACHUSETTS.
Massachusetts Div. of Water Supply, Boston.
N. Fennessey, and R. M. Vogel.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 530-549, July/August 1990. 4 fig, 2 tab, 33 ref, append.

Descriptors: *Flow duration, *Flow models, *Hydrologic models, *Massachusetts, *Model studies, *Streamflow forecasting, *Watershed management, Algorithms, Basins, Distribution graphs, Probability distribution, Regression analysis.

A flow-duration curve is the cumulative distribution function of daily streamflows at a site. A regional hydrologic model was developed for estimating flow-duration curves at ungaged and unregulated basins in Massachusetts. Flow-duration curves often exhibit complex shapes, requiring probability density functions with three or more parameters. The lower half of daily flow-duration curves were approximated using a two-parameter lognormal probability density function. A conjugate gradient algorithm was employed to fit log-normal density functions to the lower half of ob-

served flow-duration curves at 23 basins. Regional regression equations were developed to describe the lognormal model parameters in terms of easily measured basin characteristics. The resulting regional flow-duration model only requires estimates of the watershed area, and a basin relief parameter, both of which are easily obtained from U.S. Geological Survey 7.5-min quadrangle maps. In addition, confidence intervals were derived for flow-duration curves estimated at ungaged sites. A validation experiment revealed that the resulting regional hydrologic model can provide remarkably precise estimates of a flow-duration curve at an ungaged site, considering the simplicity of the model and its ease of application. (Author's abstract)
W91-00185

ANALYSIS OF INSTANTANEOUS RAINFALL RATE DURING FLASH FLOODS IN BARCELONA.
Barcelona Univ. (Spain). Dept. of Atmospheric Physics, Astronomy and Astrophysics.
For primary bibliographic entry see Field 2B.
W91-00189

COST EFFECTIVENESS OF THE STREAMFLOW-GAGING PROGRAM IN WEST VIRGINIA.
Geological Survey, Charleston, WV.
G. S. Runner, R. L. Bragg, and J. T. Atkins.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 87-4089, 1989. 57p, 12 fig, 17 tab, 20 ref.

Descriptors: *Cost analysis, *Data acquisition, *Flow measurement, *Hydrologic data, *Stream gages, *Streamflow, *Water resources data, *West Virginia, Budgeting, Estimating, Funding, Gaging stations, Streamflow data.

This report documents the results of a cost-effectiveness study of streamflow-gaging activities in West Virginia. Data uses and sources of funding were identified for 74 streamflow-gaging stations currently operated in West Virginia. One streamflow-gaging was identified as producing data no longer sufficiently needed to warrant continuing its operation; this station was discontinued. Data collected at three other streamflow-gaging stations were identified as having uses specific only to short-term studies; it was recommended that these stations be discontinued at the end of the data-collection phases of the studies. The current policy for operation of the 74 streamflow gaging stations required a budget of $390,000 per year. The average standard error of estimation of streamflow records is 24.6% and the range of error at individual stations is from 6.6 to 79.2%. It was shown that this overall standard error could be reduced to 22.0% if field activities were altered with no change in budget. A minimum budget of $375,000 is required to operate the 74 stations; a smaller budget would not permit proper service and maintenance of the stations and recorders. At the minimum budget, the average standard error is 22.5%. The maximum budget analyzed was $430,000, which resulted in an average standard error of 21.1%. Large areas in West Virginia lack sufficient streamflow data to provide valid estimates of streamflow characteristics. The paucity of data in these areas will be remedied as funds become available. (Author's abstract)
W91-00331

GUIDE FOR SELECTING MANNING'S ROUGHNESS COEFFICIENTS FOR NATURAL CHANNELS AND FLOOD PLAINS.
Geological Survey, Denver, CO.
G. J. Arcement, and V. R. Schneider.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Supply Paper 2339, 1989. 38p, 22 fig, 4 tab, 23 ref.

Descriptors: *Channel flow, *Channel morphology, *Flood plains, *Hydraulic roughness, *Mannings equation, *Roughness coefficient, *Vegetation effects, Photography, Riparian vegetation, Shrubs, Trees.

Although much research has been done on Manning's roughness coefficient, n, for stream channels, very little has been done concerning the roughness values for densely vegetated flood plains. The n value is determined from the values of the factors that affect the roughness of channels and flood plains. In densely vegetated flood plains, the major roughness is caused by trees, vines, and brush. The n value for this type of flood plain can be determined by measuring the vegetation density of the flood plain. Photographs of flood-plain segments where n values have been verified can be used as a comparison standard to aid in assigning n values to similar flood plains. (Author's abstract)
W91-00335

COMPARISON OF TRACER-DILUTION AND CURRENT-METER DISCHARGE MEASUREMENTS IN A SMALL GRAVEL-BED STREAM, LITTLE LOST MAN CREEK, CALIFORNIA.
Geological Survey, Menlo Park, CA. Water Resources Div.
G. W. Zellweger, R. J. Avanzino, and K. E. Bencala.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4150, 1989. 20p, 7 fig, 13 ref.

Descriptors: *California, *Current meters, *Discharge measurement, *Dye releases, *Streamflow, *Tracers, Gravel, Stream discharge, Streambeds, Underflow.

Discharge was determined in a small gravel-bed stream, Little Lost Man Creek, California, using both a current meter and two tracer dilution measurements: one with a mixing length of 25 meters and the other with a mixing length of 300 meters. Comparison of discharge values obtained indicated that as much as 25% of the channel discharge may have been flowing as underflow through gravel zones in the channel. Current-meter discharge measurements were used to obtain point discharge; tracer-dilution discharge measurements were used to obtain discharge measurements which incorporated mixing of surface water and underflow over 25 and 300 meters of stream reach. Within the study reach, the confined channel contained gravel and cobble to a depth of at least one meter. During summer low flow of 5 to 20 L/s, the surface stream appeared to be 1 to 2 meters wide, about 20% of the channel width. Determining discharge in small pool-and-riffle streams using conventional current-meter techniques is hampered by shallow depths, rough bottoms, and flow through the gravel bed under and parallel to the stream. Furthermore, discharge can vary both diurnally and longitudinally over relatively short reaches. Discharge measurement by continuous tracer dilution can accommodate these factors to some extent. Chloride was injected for eight days during which the stream water was sampled along a 300-meter reach below the injection point. On the seventh day, a second injection of sodium, chloride, and rhodamine WT dye was made for 24 hours, 305 meters below the first injection, and was sampled 25 meters downstream. Current-meter discharge measurements were made along the study reach three times during the experimental period. The average discharge of 17.4 L/s calculated from the tracer that traveled 300 meters was greater than the average of 15.9 L/s calculated for the tracer that traveled 25 meters. Both of these tracer-dilution measurements were greater than the average current-meter discharge measurement of 13.0 L/s. The comparison supports the hypothesis that a significant part of total stream discharge is moving as underflow through gravel zones within the stream channel. (Author's abstract)
W91-00337

STORM RUNOFF AND ITS EFFECTS ON THE WATER QUALITY AND BOTTOM-MATERIAL QUALITY OF CEDAR CREEK, WEST-CENTRAL ILLINOIS, 1985-6.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-00339

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1987 - NOVEMBER 30, 1988.
Geological Survey, Reston, VA.
S. P. Sauer, W. E. Harkness, B. E. Krejmas, and K. E. White.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-585, 1989. 84p, 7 fig, 1 plate, 20 tab.

Descriptors: *Annual reports, *Delaware River, *Diversion, *Interbasin transfers, *Reservoir releases, New Jersey, New York City, Precipitation, Reservoir storage, Runoff.

A Decree of the Supreme Court of the United States in 1954 established the position of Delaware River Master. The Decree authorizes diversions of water from the Delaware River basin but requires compensating releases from certain New-York-City-owned reservoirs to be made under the supervision and direction of the River Master. Reports to the Court, not less frequently than annually, were stipulated. During the 1988 report year, December 1, 1987, to November 30, 1988, precipitation and runoff ranged from above average to below average in the Delaware River basin. For the year as a whole, precipitation was 6.41 inches below average. Reservoir storage in the basin remained in the normal zone of the operation curves for the reservoirs throughout the year and operations were conducted as prescribed by the Decree for the entire report year. On December 1, 1987, combined storage in New York City Delaware River Basin reservoirs was 86 percent of capacity. During the winter and spring, storage increased to capacity by the beginning of the water operations year, June 1, 1988. Diversions from the Delaware River basin by New York City and New Jersey did not exceed those authorized by the terms of the Amended Decree. Releases were made as directed by the River Master at rates designed to meet the Montague flow objective on 127 days during the year. Releases were made at augmented conservation rates or at rates designed to relieve thermal stress in the streams downstream from the reservoirs at other times. The excess release quantity as defined by the Decree was expended on October 28, 1988 and the Montague design rate was reduced from 1,860 cu ft/s to 1,750 cu ft/s. New York City complied fully with the terms of the Decree and with the directives of the River Master during the year. (Author's abstract)
W91-00344

STREAMFLOW AND WATER-QUALITY DATA FOR LITTLE SCRUBGRASS CREEK BASIN, VENANGO AND BUTLER COUNTIES, PENNSYLVANIA, DECEMBER 1987 - NOVEMBER 1988.
Geological Survey, Harrisburg, PA.
K. M. Kostelnik, and R. R. Durlin.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Rpt. 89-577, 1989. 26p, 4 fig, 14 tab, 14 ref. Prepared in cooperation with the US Dept. of the Interior, Office of Surface Mining Reclamation and Enforcement and the PA. Dept. of Environmental Resources, Bureau of Mining and Reclamation

Descriptors: *Pennsylvania, *Streamflow data, *Surface water, *Water quality, Ions, Little Scrubgrass Creek Basin, Metals, Nutrients, Suspended sediments.

Streamflow and water-quality data were collected throughout the Little Scrubgrass Creek basin, Venango and Butler Counties, Pennsylvania, from December 1987 to November 1988, to determine the prevailing quality of surface water throughout the basin. This data will assist the Pennsylvania Department of Environmental Resources during its review of coal mine permit applications. A water-quality station on Little Scrubgrass Creek

near Lisbon, provided continuous-record of stream stage, pH, specific conductance, and water temperature. Monthly water-quality samples collected at this station were analyzed for total and dissolved metals, nutrients, major cations and anions, and suspended sediment concentrations. Fourteen partial-record sites, located throughout the basin, were similarly sampled four times during the period of study. Streamflow and water-quality data obtained at these sites during various base flow periods are also presented. (Author's abstract)
W91-00357

ANNUAL YIELD AND SELECTED HYDROLOGIC DATA FOR THE ARKANSAS RIVER BASIN COMPACT ARKANSAS--OKLAHOMA 1989 WATER YEAR.
Geological Survey, Little Rock, AR. Water Resources Div.
M. A. Moore, T. E. Lamb, and L. D. Hauth.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 90-131, 1990. 35p, 1 fig, 3 tab, 3 ref. Prepared in cooperation with the Arkansas-Oklahoma Arkansas River Compact Commission.

Descriptors: *Arkansas, *Arkansas River Basin, *Arkansas River Basin Compact, *Hydrologic data, *Interstate compacts, *Oklahoma, *Water management, *Water yield, Hydrologic data collections, Water quality.

The computed annual yield and deficiency of the subbasins as defined in the Arkansas River Compact, Arkansas-Oklahoma, are given in tables. Actual runoff from the subbasins and depletion caused by major reservoirs in the compact area are also given in tabular form. Monthly maximum, minimum, and mean discharges are shown for the 14 streamflow stations used in computing annual yield. Water-quality data are shown for the Arkansas River at James W. Trimble Lock and Dam, near Van Buren, Arkansas, and Neosho River below Fort Gibson Lake near Fort Gibson, Oklahoma. (Author's abstract)
W91-00360

CATASTROPHE MODEL FOR THE FORCED HYDRAULIC JUMP.
Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria.
For primary bibliographic entry see Field 8B.
W91-00373

SIMULATION OF ONE-DIMENSIONAL DAM-BREAK FLOWS.
Florida International Univ., Miami. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 8A.
W91-00399

EFFECTS OF SUBURBANIZATION UPON SNOWMELT RUNOFF.
Trent Univ., Peterborough (Ontario). Dept. of Geography.
J. M. Buttle.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 285-302, June 1990. 4 fig, 6 tab, 30 ref.

Descriptors: *Rainfall-runoff relationships, *Snowmelt, *Suburban areas, *Urban hydrology, *Urban runoff, *Urbanization, Drainage area, Flood peak, Ontario, Runoff, Small watersheds.

The influence of suburbanization upon runoff response to snowmelt and rain-on-snow inputs was examined for a small drainage basin in south-central Ontario. Modification of more than 50 percent of the basin area over a 14 year period led to a six-fold increase in the spring quickflow response ratio and an increase in the number of snowmelt events that generate appreciable quickflow. Anticipated changes in mean peak discharge, time of rise and quickflow response ratio did not emerge, and the influence of development upon these streamflow characteristics may have been overshadowed by annual changes in basin antecedent conditions. The distinction between hydrograph properties associated with snowmelt and rain-on-snow events has become more pronounced with suburbanization. Rain-on-snow generated higher maximum peak flows and lower average peak discharge per unit input compared with snowmelt, and these differences were accentuated by development of the basin. Rain-on-snow also produced more variable time of rise values, while the reduction in hydrograph recession coefficients that accompanied suburban development was most apparent for snowmelt events. The results suggest that suburbanization can have a subtle, yet real influence upon basin runoff regime during spring snowmelt. (Author's abstract)
W91-00408

DISTRIBUTION OF MICRO-ARTHROPODS IN SOME SOUTHERN ENGLISH STREAMS: THE INFLUENCE OF PHYSICOCHEMISTRY.
Queen Mary Coll., London (England). School of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-00419

SIMPLIFIED METHODS OF ESTIMATING DAILY MEAN STREAM WATER TEMPERATURE.
Freshwater Biological Association, Ambleside (England).
D. T. Crisp.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 457-462, June 1990. 2 fig, 3 tab, 4 ref. Department of the Environment Contract PECD 7/7/159.

Descriptors: *Estimating, *Freshwater, *Statistical analysis, *Streams, *Water temperature, England, Mathematical methods.

For a small stream in upper Teesdale, northern England, estimates of the daily mean water temperature were obtained from: (a) the mean of temperature readings taken at regular but less frequent intervals than hourly (twelve, six and three times per day); (b) the daily mid-point (= 0.5(maximum + minimum)); (c) spot temperatures at two times in the day when the daily temperature trace usually crosses the mean value. These estimates were then compared with the 'true' daily mean (assuming that the average of twenty-four hourly temperature readings is the 'true' mean). The accuracy of the estimate of daily mean decreased with reduced frequency of reading but, even at only three readings per day, was always within plus or minus 0.5 C of the true value. Consolidation of the daily estimates gave estimates of monthly and annual means within plus or minus 0.1 C of the true value. Nearly 96% of estimates of the daily mean based on the 'first mean crossing' were within plus or minus 0.5 C of the true value and no bias could be shown. Estimation of the daily means from temperature at the time of the 'second mean crossing' was relatively complicated and gave less satisfactory results than did the first mean crossing. The daily mid-point and the temperature at the time of the first mean crossing gave a good general indication of daily mean temperatures. When consolidated to monthly or annual means the estimates were within plus or minus 0.25 C and 0.10 C respectively, of the true values. (Author's abstract)
W91-00421

INTERACTIONS AMONG NUTRIENTS, ALGAE AND INVERTEBRATES IN A NEW ZEALAND MOUNTAIN STREAM.
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
M. J. Winterbourn.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 463-474, June 1990. 6 fig, 3 tab, 39 ref.

Descriptors: *Algae, *Freshwater, *Invertebrates, *Mountain streams, *New Zealand, *Nutrients, *Streams, Aquatic life, Colonization, Forest watersheds, Insecticides, Larvae, Malathion, Midges, Nets, Periphyton, Pesticides, Pigments, Plankton, Scanning electron microscopy, Species diversity, Springs.

Colonization of nutrient-diffusing substrata by periphyton and invertebrates was investigated at forested and open sites in a small, mountain stream and a spring in the South Island of New Zealand. Substrata had colonization surfaces made from 100 micrometer mesh plankton netting that enabled algal assemblages to be removed intact for scanning electron microscopy. They also allowed small volumes of solvent to be used for the extraction of photosynthetic pigments. At all sites, periphyton assemblages were dominated by species of Achnanthes, Cocconeis and Gomphonema, and except in the forest in winter, periphyton biomass was always greater on enriched (N+P added) than control substrata. Invertebrates colonizing diffusion substrata were principally larval Chironomidae (Orthocladiinae). No larvae were present in winter, but in three spring and summer trials mean larval densities were higher on nutrient-enriched than control substrata at all sites. The inclusion of an insecticide Malathion in diffusion substrata, reduced insect colonization at open and forested sites. After 28 days, no concurrent increases in algal pigment concentration were observed on nutrient-enriched or control substrata at the forested site. However, pigment concentrations were higher on substrata incorporating Malathion at the open site, suggesting that algal standing crop was depressed by the activities of grazers. (Author's abstract)
W91-00422

WATER TEMPERATURE IN A STREAM GRAVEL BED AND IMPLICATIONS FOR SALMONID INCUBATION.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
For primary bibliographic entry see Field 8I.
W91-00427

STREAMFLOW AND WATER-QUALITY DATA FOR MEADOW RUN BASIN, FAYETTE COUNTY, PENNSYLVANIA, DECEMBER 1987 - NOVEMBER 1988.
Geological Survey, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W91-00431

HYDROLOGIC AND WATER-QUALITY DATA FOR STREAMS AND IMPOUNDMENTS IN THE COTEAU DES PRAIRIES--UPPER MINNESOTA RIVER BASIN, 1979-84.
Geological Survey, St. Paul, MN.
C. J. Smith, G. A. Payne, and L. H. Tornes.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 88-84, 1990. 46p, 12 fig, 13 tab, 15 ref. Prepared in cooperation with the U.S. Army Corps of Engineers; U.S. Soil Conservation Service.

Descriptors: *Hydrologic data, *Minnesota River Basin, *Reservoirs, *Soil erosion, *Streams, *Water pollution sources, *Water quality, Coteau des Prairies, Sediment transport, Solute transport, Streamflow data, Water properties, Water sampling.

Water-quality and streamflow data were collected in the Coteau des Prairies region of southwestern Minnesota and eastern South Dakota from 1979-84. Data were collected to: (1) document the water quality characteristics of streams and impoundments in the Coteau area; (2) predict the impact of proposed impoundments; (3) define the amount of dissolved and suspended material transported; and (4) determine the differences in water quality between the impoundment inflows and outflows. Streamflow and water quality data were collected at 12 stream and four impoundment sites. Continuous record gages, set to collected data at 15-minute intervals, and readings taken by local observers wee used to complete discharge records at 10 stream sites and stage records at three impoundment sites. Automatic samplers and local observers collected storm runoff, sediment, and nutrient samples at 10 stream sites. Water quality samples were collected at various time and stage intervals during high flow and periodically during low flow. Primary emphasis in the stream-sampling program

was on analysis of samples for nutrients in 1980-82, and on analysis of suspended sediment and nutrients in 1983-84. Field measurements were made of pH, water temperature, dissolved oxygen, specific conductance, alkalinity, and bacteria. Secondary emphasis was on analysis of major dissolved substances. Primary emphasis in the impoundments was on analysis of samples for phosphorus and chlorophyll and on the measurement of transparency. Temperature and dissolved-oxygen concentrations were measured to determine the degree of stratification. All data collected during the study are given in this report. The tables list mean-daily stream discharge, results of water quality analyses, and bed material particle-size analyses at stream sites. The tables also list information on pool stage, water temperature, and transparency, on dissolved-oxygen, chlorophyll a, phytoplankton, and nutrient concentrations, and on chemical and particle-size analyses of bed material at impoundment sites. (Author's abstract)
W91-00434

RADAR DATA PROCESSING FOR HYDROLOGY IN THE CEVENNES REGION.
Laboratoire Central des Ponts et Chaussees, Bouguenais (France).
For primary bibliographic entry see Field 7B.
W91-00466

FLOOD MONITORING FROM SPACE IN CHINA.
Ministry of Water Resources, Beijing (China). Remote Sensing Application Center.
For primary bibliographic entry see Field 7B.
W91-00474

EFFECT OF TOSTON DAM ON UPSTREAM ICE CONDITIONS.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 6G.
W91-00574

RAINFALL-RUNOFF RELATIONS DERIVED FROM THE PROBABILITY THEORY OF STORAGE.
IBM Research Lab., Yorktown Heights, NY.
J. R. M. Hosking, and R. T. Clarke.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1455-1463, July 1990. 3 fig, 8 ref, append.

Descriptors: *Mathematical models, *Model studies, *Probability distribution, *Rainfall-runoff relationships, *Runoff forecasting, *Stream discharge, Evapotranspiration, Probabilistic process, Soil moisture deficiency, Soil moisture retention, Storage capacity.

The relationship between river discharge and the rainfall which causes it is one of the central problems of hydrology. Using a simplified representation of how a river basin stores precipitation, generates runoff, and loses water through evapotranspiration, probabalistic relationships between precipitation, soil moisture deficit, and generated runoff were derived. The 'distribution function model' was used to describe the soil moisture storage capacity of the basin: storage capacity, per unit of basin surface area, is regarded as a spatially variable quantity described by a density function. By routing the generated runoff through what is essentially a linear reservoir with stochastic inputs and outputs, it was shown how the median discharge can be calculated which corresponds to a rainfall input of some specified return period T time intervals. The return period for basin discharge can, with certain assumptions, also be calculated, thereby yielding probability statements relating the T-period rainfall to its resultant discharge. (Author's abstract)
W91-00592

EVALUATION OF AUTOMATED TECHNIQUES FOR BASE FLOW AND RECESSION ANALYSES.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
R. J. Nathan, and T. A. McMahon.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1465-1473, July 1990. 9 fig, 1 tab, 34 ref.

Descriptors: *Base flow, *Catchment areas, *Mathematical analysis, *Recession, *Streamflow forecasting, Analytical techniques, Australia, Comparison studies, Low flow, Mathematical models, Stream discharge.

Several automated techniques concerned with base flow separation and recession analyses were evaluated with the overall objective being the development of a regional model for use on ungauged catchments. Two base flow techniques were considered, one based on a digital filter and the other on simple smoothing and separation rules. A comparison between two commonly used techniques of recession analyses, the correlation method and the matching strip method, was also undertaken. The relative performances of the techniques were evaluated using the results obtained from the daily streamflow records of 186 catchments in southeastern Australia. It was found that the matching strip method yields more discriminating and accurate information about recession behavior than does the correlation method; indeed, the uncertainties inherent in the correlation method make it unsuited to the analysis of slow recession rates. Use of a simple digital filter with a parameter set to 0.925 was found to be a fast and objective method of continuous base flow separation. The results obtained using this technique were found to yield similar answers to those obtained using a traditional graphical technique for a range of stream variabilities and catchment sizes. (MacKeen-PTT)
W91-00593

ASSESSMENT OF A CONCEPTUAL RAINFALL-RUNOFF MODEL'S ABILITY TO REPRESENT THE DYNAMICS OF SMALL HYPOTHETICAL CATCHMENTS: 1. MODELS, MODEL PROPERTIES, AND EXPERIMENTAL DESIGN.
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W91-00604

ASSESSMENT OF A CONCEPTUAL RAINFALL-RUNOFF MODEL'S ABILITY TO REPRESENT THE DYNAMICS OF SMALL HYPOTHETICAL CATCHMENTS: 2. HYDROLOGIC RESPONSES FOR NORMAL AND EXTREME RAINFALL.
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W91-00605

LOGGING EFFECTS ON STREAMFLOW: STORM RUNOFF AT CASPAR CREEK IN NORTHWESTERN CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
For primary bibliographic entry see Field 4C.
W91-00610

RESOURCE LIMITATION IN A STREAM COMMUNITY: PHOSPHORUS ENRICHMENT EFFECTS ON PERIPHYTON AND GRAZERS.
Academy of Natural Sciences of Philadelphia, PA.
For primary bibliographic entry see Field 2H.
W91-00618

DAILY FLOW FORECASTING WITH REGRESSION ANALYSIS.
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, B. K. Huong, and P. D. Loi.
Water SA WASADV, Vol. 16, No. 3, p 179-184, July 1990. 5 tab, 9 ref.

Descriptors: *Flow pattern, *Mekong River Basin, *Regression analysis, *River flow, *River forecasting, *Streamflow forecasting, Comparison studies, Diurnal variation, Laos, Least squares method, Thailand.

Regression analysis methods have been used quite extensively in river flow forecasting. In this study, five commonly used regression methods, namely ordinary least squares, ridge, principal components, stepwise, and least absolute value regressions, were considered in the context of daily flow forecasting. For this comparative study, relevant data at two stations were used, from Nam Ngum Dam Site in Laos and from Ban Chot of the Chi River Basin in Thailand. From applications to these two catchments located in the Lower Mekong Basin, it was found that: (1) ordinary least squares, stepwise, and least absolute value regressions have very good and comparable forecasting capability which is better than that of the remaining two methods and; (2) stepwise regression is the least time-consuming method, while absolute value regression requires the most time. Having a very good performance, requiring the least computing time, and resulting in simpler equations, stepwise regression is the best among the methods considered. (Author's abstract)
W91-00634

PALAEOFLOOD HYDROLOGY: A TOOL FOR SOUTH AFRICA--AN EXAMPLE FROM THE CROCODILE RIVER NEAR BRITS, TRANSVAAL, SOUTH AFRICA.
Geological Survey, Pretoria (South Africa). Regional Geology Div.
A. M. Smith, and P. K. Zawada.
Water SA WASADV, Vol. 16, No. 3, p 195-200, July 1990. 4 fig, 3 tab, 21 ref.

Descriptors: *Flood data, *Historic floods, *Indirect flood measurement, *Paleohydrology, *South Africa, Crocodile River, Data acquisition, Geological terraces, Hydrologic data collections, Maximum probable floods, Probable maximum flood.

At present, in South Africa the estimation and prediction of high magnitude flows are based solely on conventional flood frequency analysis using a short gauged record (national average of 30 years). The problem is further compounded in areas of the country where no, or inadequate, gauging stations exist. This inadequate record can be augmented by the application of paleoflood hydrological (PFH) techniques. In this study, PFH techniques were applied to a reach of the Crocodile River. These techniques utilized hydrological calculations based on terrace levels and particle size analysis which were then compared to the gauged record. PFH analysis yielded discharges similar to the 1918 and 1978 extreme flood events documented from the gauged record. In addition, PFH analysis identified four prehistoric floods with discharges of 4500, 6000, 7000 and 9500 cu m/sec. The first three discharges are believed to have occurred under the present climatic and fluvial regime. The latter figure may have occurred under a different climatic regime and therefore may represent a relict feature. If the 9500 cu m/sec event is excluded, then 7000 is the maximum calculated discharge. This figure approximated the regional maximum flood (RMF) value of 6415 cu m/sec as calculated using the Francou-Rodier equation. PFH therefore represents an independent method of testing the validity of the RMF. In view of the short gauging record in South Africa and the increasing development adjacent to river courses, PFH represents a valuable tool for identifying extreme flood events. Such data will be of considerable assistance to flood plain management. (Author's abstract)
W91-00636

BENTHIC TURFS VS FLOATING MATS OF ALGAE IN RIVER FOOD WEBS.
California Univ., Berkeley. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00708

RESISTANCE OF LOTIC ECOSYSTEMS TO A LIGHT ELIMINATION DISTURBANCE: A LABORATORY STREAM STUDY.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2H.

W91-00709

EFFECTIVE MODELLING OF A MAJOR INLAND OIL SPILL ON THE OHIO RIVER.
Ohio State Univ., Columbus. School of Natural Resources.
For primary bibliographic entry see Field 5B.
W91-00714

STEADY UNIFORM FLOW IN PRISMATIC CHANNELS WITH FLOOD PLAINS.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Civil Engineering.
T. Dracos, and P. Hardegger.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 2, p 169-185, 1987. 7 fig, 4 tab, 18 ref.

Descriptors: *Channel flow, *Flood plains, *Flow models, *Model studies, *Open-channel flow, *Stage-discharge relations, Computers, Flood channels, Mathematical models, Prismatic channels, Roughness coefficient, Uniform flow, Unsteady flow.

Most of the methods used for the computation of uniform flow in channels with flood plains are based on a separate determination of the flow in the main channel and the flood plains. A single method is proposed which allows the direct determination for the stage-discharge relation in a channel with a flood plain. The empirical method presented for the computation of the depth-discharge relation in compound channels is based on experimental results published by other investigators. Within the limitations posed by the restricted number of tests, especially with roughness of the flood plains different from the roughness of the main channel, it was possible to develop empirically a set of relations which allow one to determine the apparent roughness coefficient of a compound channel. With the help of this coefficient the stage-discharge relation in channels with flood plains can be computed by the single channel method. For channels with roughness of the flood plains different from roughness of the main channel the effective roughness coefficient must first be computed by using the Einstein-Horton formula. The procedure described for the determination of the apparent roughness coefficient can also be used to determine the apparent roughness coefficient needed for the computation of gradually varied as well as unsteady flow in channels with flood plains, provided the flow conditions are such that a one-dimensional treatment is permissible. Furthermore, the relations developed for that purpose are suitable for computer applications and can easily be incorporated in existing computer programs. The approach gives satisfactory results. (Agostine-PTT)
W91-00761

PERTURBATION SOLUTION OF THE FLOOD-ROUTING PROBLEM.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W91-00763

SEDIMENT YIELD AND DISCHARGE IN MOUNTAINOUS SMALL RIVER BASINS: ACTUAL CONDITION OF SEDIMENT DISCHARGE AFTER DAMAGE CAUSED BY SAND AND STONE AVALANCHES (IN JAPANESE).
For primary bibliographic entry see Field 2J.
W91-00766

CLASSIFICATION OF THE MACROINVERTEBRATE FAUNA OF TWO RIVER SYSTEMS IN SOUTHWESTERN AUSTRALIA IN RELATION TO PHYSICAL AND CHEMICAL PARAMETERS.
Western Australia Univ., Nedlands. Aquatic Research Lab.
For primary bibliographic entry see Field 2H.
W91-00774

VARIABILITY OF RESULTS FROM THE USE OF PHABSIM IN ESTIMATING HABITAT AREA.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W91-00775

EFFECTS OF SEDIMENT AND FLOW REGIME ON THE AQUATIC INSECTS OF A HIGH MOUNTAIN STREAM.
Wyoming Univ., Laramie. Dept. of Plant Science.
For primary bibliographic entry see Field 2H.
W91-00776

EFFECT OF REGULATION ON 0+ FISH RECRUITMENT IN THE GREAT OUSE, A LOWLAND RIVER.
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 6G.
W91-00777

ENHANCEMENT OF BENTHIC MACROINVERTEBRATES BY MINIMUM FLOW FROM A HYDROELECTRIC DAM.
Versar, Inc., Columbia, MD.
For primary bibliographic entry see Field 6G.
W91-00778

ASSESSING OPTIONS FOR STREAM REGULATION USING HYDROLOGIC SIMULATIONS AND CUMULATIVE IMPACT ANALYSIS: FLATHEAD RIVER BASIN, USA.
Montana Power Co., Butte.
J. H. Jourdonnais, J. A. Stanford, F. R. Hauer, and C. A. S. Hall.
Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 279-293, June/July 1990. 6 fig, 5 tab, 49 ref.

Descriptors: *Hydraulic models, *Montana, *Regulations, *River systems, *Stream regulation, *Water resource management, Environmental impact, Flathead River, Multiobjective planning, River regulations, Tradeoff analysis, Wildlife conservation.

A study was conducted to resolve regulation problems upstream and downstream of Flathead Lake and on the lake proper. Members of a technical working group, representing eight water and wildlife management agencies, contributed 75 regulation scenarios they deemed necessary to conserve or enhance ecological (fish and wildlife) and societal (hydropower production, flood control, and recreation) resources for which they had management authority. The hydrology model simulated the effect of each scenario on system water balance; scenarios that were within the physical and legal constraints of the system were accepted for determination of cumulative impacts on resources. A multiattribute tradeoff analysis was used to assess cumulative impacts to key resources as a consequence of each regulation scenario (simulation) accepted for evaluation. Impacts were subjectively and independently quantified by each member of the working group following a point and importance weighing system agreed to a priori. Valuation of impacts was done on the basis of 36 technical studies of the effects of regulation on system resources. Impact valuations were summed to yield a variable referred to as weighted cumulative impact (WCI), where the highest, positive WCI indicated least cumulative impact on resources. Scenarios were then ranked in terms of WCI. When ecological resources only were evaluated, the preregulation Flathead Lake scenario generated the highest WCI. However, when all resources were considered, scenarios ranked very differently but a preferred alternative was identified by virtue of its highest WCI. This interactive process of hydrology simulation and computation of cumulative impacts mediated resource conflicts and served as an important tool in deriving water management recommendations in the Flathead River Basin. (Author's abstract)
W91-00779

SEASONAL VARIATION OF SIRODOTIA DELICATULA SKUJA (RHODOPHYTA, BATRACHOSPERMACEAE) IN A SMALL STREAM FROM SAO PAULO STATE, SOUTHEASTERN BRAZIL.
Universidade Estadual Paulista, Sao Jose do Rio Preto (Brazil). Inst. de Biociencias.
For primary bibliographic entry see Field 2H.
W91-00782

WATER CHEMISTRY OF THE SOLIMOES/AMAZON RIVER (A HIDROQUIMICA DO RIO SOLIMOES/AMAZONAS).
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
For primary bibliographic entry see Field 2K.
W91-00820

NUTRIENT DYNAMICS OF DECOMPOSING LEAVES FROM AMAZONIAN FLOODPLAIN FOREST SPECIES IN WATER.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W91-00824

SPATIAL AND TEMPORAL VARIATION IN FISHES OF RIFFLE HABITATS: A COMPARISON OF ANALYTICAL APPROACHES FOR THE ROANOKE RIVER.
Oklahoma Univ., Kingston. Biological Station.
For primary bibliographic entry see Field 8I.
W91-00868

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM I. OCCURRENCE AND DISTRIBUTION WITH PARTICULAR REFERENCE TO THE DIATOMS.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
For primary bibliographic entry see Field 2H.
W91-00869

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM II. ALGAL STANDING CROP (MEASURED BY CHLOROPHYLL-A) ON SOFT AND HARD SUBSTRATA.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
For primary bibliographic entry see Field 2H.
W91-00870

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM III. INTERACTION BETWEEN DISCHARGE, SEDIMENT COMPOSITION AND DIATOM FLORA.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
For primary bibliographic entry see Field 2H.
W91-00871

DIURNAL FLUCTUATION IN STREAM FLOW AND IN SPECIFIC ELECTRIC CONDUCTANCE DURING DROUGHT PERIODS.
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
D. Kobayashi, K. Suzuki, and M. Nomura.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 105-114, July 1990. 9 fig, 1 tab, 3 ref.

Descriptors: *Drought effects, *Evapotranspiration, *Forest hydrology, *Japan, *Soil-water-plant relationships, *Streamflow, *Surface-groundwater relations, *Vegetation effects, Diurnal variation, Groundwater movement, Headwaters, Hydrograph analysis, Hydrologic data, Ion transport, Seasonal variation.

Many hydrologists have been interested in the diurnal fluctuation in stream flow during a summer drought, but there are few reports on this subject. In a headwater basin covered with boreal forest in northern Japan, drought flow was observed in winter and in summer. In summer drought it was found that remarkable diurnal fluctuation of stream

flow and of electric conductance is caused by daytime evapotranspiration. It was found that the daily reduction in stream flow was accompanied by a reduction in the total ion concentration. The drought hydrograph was separated into two components assuming the drought flow to be a mixture of ionically dense throughflow and of ionically dilute groundwater flow entering the stream in its lower reaches. It was judged that the diurnal fluctuation of streamflow was the result not of direct evaporation from the stream channel, but of daily evapotranspiration from the forest along the stream channel, for the following reasons: (1) reduction of streamflow in the daytime accompanied reduction of total ion concentration. When direct evaporation from the stream occurs, the ions in the flow will be concententrated; and (2) The dewpoint measured is near or higher than the stream temperature, and therefore the evaporation from the stream is small or negative. Therefore the streamflow would diminish with the reduction of inflow by evapotranspiration. Discrepancy of the trends of daily fluctuation of ion concentration for SO3(2-) and Mg(2+) suggests selective absorption of ions by tree roots. (Hoskin-PTT)
W91-00881

TOPOGRAPHIC EFFECTS ON FLOW PATH AND SURFACE WATER CHEMISTRY OF THE LLYN BRIANNE CATCHMENTS IN WALES.
Geological Survey, Trenton, NJ.
D. M. Wolock, G. M. Hornberger, and T. J. Musgrove.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 243-259, July 1990. 7 fig, 6 tab, 37 ref.

Descriptors: *Acid rain, *Flow models, *Flow profiles, *Geomorphology, *Model studies, *Surface flow, *Topography, *Wales, *Watersheds, Catchment areas, Hydrogen ion concentration, Mathematical analysis, Slopes, Surface runoff.

Topographic shape is a watershed attribute thought to influence the flow path followed by water as it traverses a catchment. Flow path, in turn, may affect the chemical composition of surface waters. Topography is quantified in the hydrological model TOPMODEL as the relative frequency distribution of the index ln(a/tanB) where a is the upslope area per unit contour that drains past a point and tanB is the local surface slope. Spatial distributions of ln(a/tanB) were calculated for eight catchments in Wales on a 25 m x 25 m grid. Among the catchments, mean observed stream hydrogen ion concentration during high flow periods was highly correlated with the mean of the ln(a/tanB) distribution. The steady-state gain of a transfer function (time series) model relating hydrogen ion concentration to discharge was positively correlated with the mean of the ln(a/tanB) distribution. These results suggest that during high flow periods, both the average stream acidity and the magnitude of fluctuations in hydrogen ion concentration are conditioned by the topographic shape of the catchment. By performing a sensitivity analysis on TOPMODEL, it was also shown that as the mean of the ln(a/tanB) distribution for a catchment increases, so does its theoretical likelihood to produce significant quantities of surface and near-surface runoff. The observed results in the Llyn Brianne catchments are consistent with this theoretical expectation in that surface or near-surface runoff is often higher in acidity than are deeper sources of hillslope runoff. (Author's abstract)
W91-00888

CHEMICAL STUDIES OF CHLORIDE AND STABLE OXYGEN ISOTOPES IN TWO CONIFER AFFORESTED AND MOORLAND SITES IN THE BRITISH UPLANDS.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W91-00890

USING RN222 TO EXAMINE GROUNDWATER/SURFACE DISCHARGE INTERACTION IN THE RIO GRANDE DE MANATI, PUERTO RICO.
Florida Univ., Gainesville. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00893

NEW DIRECTIONS FOR SURFACE WATER MODELING.
For primary bibliographic entry see Field 7C.
W91-00961

TOWARDS AN IMPROVED SYSTEM FOR WEATHER RADAR CALIBRATION AND RAINFALL FORECASTING USING RAINGAUGE DATA FROM A REGIONAL TELEMETRY SYSTEM.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2B.
W91-00963

USE OF SATELLITE DERIVED RAINFALL ESTIMATES AS INPUTS TO FLOW PREDICTION IN THE RIVER SENEGAL.
Reading Univ. (England). Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W91-00964

EVALUATION AND PREDICTION OF POSSIBLE MAN-INDUCED CHANGES IN THE HYDROLOGICAL CYCLE.
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 4C.
W91-00967

PHYSICS-BASED APPROACH TO STOCHASTIC HYDROLOGY OF FIRST-ORDER DRAINAGE BASINS.
California Univ., Davis. Dept. of Civil Engineering.
M. L. Kavvas, R. S. Govindaraju, and M. N. Saquib.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 63-71. 2 fig, 9 ref.
NSF Grant CEE-8411896.

Descriptors: *Catchment areas, *Hydrological models, *Mathematical models, *Model studies, *Rainfall-runoff relationships, *Stochastic models, Differential equations, Flow models, Overland flow, Streamflow, Subsurface flow.

The methodology for a physics-based solution to the stochastic hydrology of first-order drainage basins is discussed. A first-order drainage basin is defined as one which is drained by a single Hortonian first-order stream. It is considered as the basic basin unit which acts as the building block for higher order, complex basins. It is made up of overland flow, subsurface flow and streamflow zones. The flow processes in these three zones interact with each other through the zone boundaries. The partial differential equations, describing the flow processes in each of the zones, together with the boundary conditions and the initial conditions form the nonlinear physics-based mathematical model of the first-order basin hydrology. Within the framework of this mathematical model the uncertainties in the various components of the first-order basin hydrology are identified and the solution methodology for the resulting nonlinear stochastic partial differential equations of the first-order basin hydrology is outlined. (See also W91-00961) (Author's abstract)
W91-00968

MODULAR MODEL FOR SIMULATING CONTINUOUS OR EVENT RUNOFF.
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
D. Stephenson.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 83-91. 4 fig, 8 ref.

Descriptors: *Aquifers, *Computer models, *Groundwater, *Hydrologic models, *Model studies, *Physical models, *Rainfall-runoff relationships, *Storm runoff, *Storm water, *Surface runoff, Computer programs, Simulation.

Stormwater model arrangements are reviewed on the basis of the ease of initial access or re-access and the ease of learning its principles and limitations. Computer programs able to assemble loosely-connected elements are simplest to use and understand. Arrangements of elements and assembly in parallel or series enables all possible types of models to be accommodated. Hydraulic elements are used for surface runoff visualization and groundwater aquifers are simulated in parallel for continuous or long-term simulations. The following modules can be built in to computer programs: catchments, circular conduits (pipes), trapezoidal channels, compound channels, storage basins, and aquifers. (See also W91-00961) (Author's abstract)
W91-00970

USE OF KINEMATIC WAVE METHOD TO ASSESS EFFECTS OF URBAN DEVELOPMENT ON FLOOD PEAK CHANGES.
Nanyang Technological Inst., Singapore. School of Civil and Structural Engineering.
For primary bibliographic entry see Field 4C.
W91-00971

ENTROPY BASED METHOD FOR FLOOD FORECASTING.
Louisiana Geological Survey, Baton Rouge.
P. F. Krstanovic, and V. P. Singh.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. 105-113. 3 fig, 1 tab, 10 ref.

Descriptors: *Flood forecasting, *Hydrologic models, *Mathematical models, *Model studies, *Rainfall-runoff relationships, *River flow, *Stochastic models, *Streamflow forecasting, Entropy.

The entropy theory was used to develop a univariate model for forecasting of long-term streamflow. The model modifies the original Burg equations from the maximum entropy spectral analysis (MESA), and uses autocovariance matrix of streamflow record. The model was verified on five rivers from different regions of the world (Rio Orinoco and Rio Caroni in Venezuela, Krishna River and Godavari River in India, and Spring Creek in Louisiana). The streamflow model predicted periodicity and trend reasonably well. The streamflow model and the ARIMA model were comparable in forecasting in the case of not very irregular streamflows. For such cases, theoretical equivalency existed between the two models. The streamflow and ARIMA models, despite a long record, gave completely different forecasts for very irregular streamflows. The streamflow periodicity in the ARIMA model was accounted for by either AR(12) or MA(12) parameters. The streamflow model accounted for this seasonality by including the seasonal Lagrange multipliers. The model can be applied to any other univariate stationary hydrologic process, where stochasticity is not of high order (i.e., minute rainfall). (See also W91-00961) (Author's abstract)
W91-00972

ASSESSMENT OF NETWORK MODELS IN FLOOD FORECASTING.
Bureau of Meteorology, Hobart (Australia).
T. A. Malone, and I. Cordery.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 115-124. 3 fig, 3 tab, 7 ref.

Descriptors: *Flood basins, *Flood forecasting, *Flood hydrographs, *Hydrologic models, *Model studies, *Network models, *Rainfall-runoff rela-

tionships, Australia, New South Wales, Streamflow forecasting.

Two similar, non-linear, network models were applied to three basins in coastal New South Wales to examine their potential for use in operational flood forecasting. Network models have the potential to make direct allowance for non-uniform spatial distribution of rainfall, as well as to provide for non-linear basin response to the input rainfall. The two models were applied under operational flood forecasting conditions to data for 7 or 8 observed floods on each basin and their ability to reproduce the observed hydrographs was examined. These results were compared with those obtained from the unit hydrograph approach which is currently used for flood forecasting on these basins. The results indicate that the determination of excess rainfall is probably more critical than the type of model used to calculate the direct runoff hydrograph. There appears to be little difference between the abilities of the unit hydrograph and the network models to reproduce the observed hydrographs on these three basins which ranged in size from 630 to 10,000 sq km. However overall, the network models appear to offer a number of advantages over the unit hydrograph for flood forecasting, especially in larger basins, including: (1) the ability to model the spatial variation in rainfall; (2) the potential to model the variation in loss parameters: and (3) the ability to alter predetermined calibration parameters to suit observations as a flood progresses. (See also W91-00961) (Author's abstract)
W91-00973

FLOODS AND DROUGHTS IN LABE RIVER BASIN: THE HYDROGRAPH SHAPE.
Hydrometeorologicky Ustav, Prague (Czechoslovakia).
J. Buchtele.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 133-142. 9 fig, 4 tab, 5 ref.

Descriptors: *Drought, *Flood basins, *Flood hydrographs, *Flood waves, *Floods, *Hydrograph analysis, *Hydrologic models, *Rainfall-runoff relationships, *River basins, Air pressure, Air temperature, Czechoslovakia, Europe, Labe River Basin, Simulation.

Rainfall and runoff daily data for the 60-year period 1895-1954 were used for evaluation of flood waves in the Labe River basin in Czechoslovakia with an area of more than 50,000 sq km. The tendency of rainfall cells maxima to appear at the same place in the span of several days or weeks is illustrated. Small discharge waves then occur before large floods. Regional rainfall usually begins in the afternoon and rarely lasts more than 48 hours. The characteristics of spatial non-uniformity of rainfalls were used as parameters for Instantaneous Unit Hydrograph variability in the Sacramento model. For drought periods, the influence of air pressure and fall of air temperature below the freezing point on hydrograph recession curves are demonstrated. (See also W91-00961) (Author's abstract)
W91-00975

REVIEW OF THE SEARCH FOR A QUANTITATIVE LINK BETWEEN HYDROLOGIC RESPONSE AND FLUVIAL GEOMORPHOLOGY.
Massachusetts Inst. of Tech., Cambridge.
R. L. Bras, and I. Rodriguez-Iturbe.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 149-163. 6 fig, 31 ref. NSF Grant ECE-8513556.

Descriptors: *Channel morphology, *Geomorphology, *Hydrographs, *Hydrological models, *Mathematical models, *Model studies, *River basins, Reviews, Unit hydrographs.

Channels in a river basin generally develop in a tree-like structure with the outlet stream as the main truck and upstream reaches a bifurcating pattern of smaller and smaller branches. These networks exhibit tremendous regularity and organization, expressed not only in the geometry but in the size and relationship between the parts. Many results exist describing, at least in two planar dimensions, the structure of the channel network. Some essential descriptors of channel networks are reviewed in order to present the most recent results linking hydrology and fluvial geomorphology. Areas of research are highlighted in the context of available results on the geomorphologic unit hydrograph. (See also W91-00961) (Author's abstract)
W91-00977

GEOMORPHOCLIMATIC DERIVATION OF FLOOD FREQUENCY (PEAK AND VOLUME) AT THE BASIN AND REGIONAL SCALE.
Politecnico di Milano (Italy). Inst. of Hydraulics.
B. Bacchi, R. Rosso, D. Adom, and A. Brath.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 165-176. 4 fig, 36 ref.

Descriptors: *Flood basins, *Flood frequency, *Flood peak, *Geomorphology, *Rainfall-runoff relationships, *Runoff volume, Hydrological models, Sensitivity analysis, Storms.

A theoretical analysis is presented which permits the determination of the second order properties of peak discharge and runoff volume, based only on the knowledge of the rainfall statistics at a point, without recourse to any assumption about the underlying distribution. The analysis accounted for the effects due to spatial integration of precipitation over the basin area, absorption and rainfall-runoff transformation. Three dimensionless geomorphoclimatic parameters were used to describe the interaction of the rainfall field with basin area, absorption, and network response. A sensitivity analysis of the derived second order properties revealed the strong influence exerted by the scale and geomorphoclimatic characteristics of the basin. The results suggest the use of some caution in regionalization procedures for flood frequency analysis, especially with regard to the identification of homogeneous regions, based on the delineation of zones with nearly constant values of the dispersive characteristics of recorded flood data. (See also W91-00961) (Author's abstract)
W91-00978

REGIONALIZATION OF MODEL PARAMETERS FOR A LARGE WATERSHED.
Seoul National Univ. (Republic of Korea). Dept. of Civil Engineering.
J. Sonu.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 177-185. 5 fig, 1 tab, 4 ref.

Descriptors: *Flood forecasting, *Flood stages, *Hydrological models, *Model studies, *Rainfall-runoff relationships, *River basins, *Watersheds, Computer models, Flood routing, Han River basin, Korea, Reservoir operation.

The forecasting of the flood stage at major points along a river requires a simple but accurate forecasting model. The method known as the storage function method was used for the prediction of the flood stage which basically employs the continuity equation and equation of motion. The equation of motion expresses the non-linear relation of storage and discharge. The parameters associated with the model were determined by finding the relation between parameter and basin characteristics. The computed and observed hydrographs in the case of the Han River basin in Korea were compared and the parameters readjusted for better forecasting. The model has the advantage of using basically the same equations for the watershed channel and reservoir routing which makes programming simpler and computer time shorter. (See also W91-00961) (Author's abstract)
W91-00979

ANALYTICAL RELATIONSHIPS BETWEEN RAINFALL AND RUNOFF FOR A PROBABILITY-DISTRIBUTED MODEL OF BASIN RESPONSE.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
R. T. Clarke.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 187-193. 1 fig, 8 ref.

Descriptors: *Mathematical models, *Model studies, *Rainfall-runoff relationships, *River basins, *Runoff, *Soil water, Evapotranspiration, Probability distribution.

Using a probability-distributed model of basin response, the frequency characteristics of runoff generation are shown to be related analytically to the frequency characteristics of precipitation and of potential evapotranspiration. A relationship was derived for the cumulative probability distribution of runoff depth generated during a time interval in terms of (1) the transition probabilities in a two-state (wet-dry) Markov chain that is used to describe transitions from wet to dry periods and conversely; (2) the probability distribution of rainfall depths occurring in time intervals within wet periods; (3) a function H, the cumulative probability distribution for soil moisture deficit, where H is conditional on s, the soil moisture capacity (regarded as spatially variable); and (4) a density function p(s)ds giving the proportion of basin area with soil moisture capacity in the range (s, s+ds). (See also W91-00961) (Author's abstract)
W91-00980

CONCEPTUAL MODEL SIMULATING THE HYDROLOGICAL PROCESSES ON A DRAINAGE BASIN IN A PLAIN AREA.
Hohai Univ., Nanjing (China). Dept. of Hydrology.
X. R. Liu.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 195-202. 4 fig, 1 tab, 7 ref.

Descriptors: *Catchment areas, *Groundwater, *Hydrological models, *Model studies, *Rainfall-runoff relationships, *River basins, *Surface-groundwater relations, *Water table, Aquifers, Discharge hydrographs, Evaporation, Groundwater movement, Groundwater storage, Infiltration, Soil water, Water table fluctuations.

A conceptual model was developed to simulate the hydrological processes on a drainage basin in a plain area where the vertical fluxes predominate and where the groundwater table is very close to the surface and, therefore, the interaction between surface water and groundwater should be taken into account. The hydrological components of the system are described in the model by means of four storages and their governing rules which are drawn from experience as well as theoretical knowledge. The model predicts the discharge at the outlet of the basin based on the input data of rainfall and pan evaporation. It is also capable of predicting groundwater table depth at each rainfall station. This model, a compromise between the excessively physical and the excessively empirical, has the following advantages: (1) It uses common hydrological and meteorological data; (2) It can be applied to different sizes of drainage basins; (3) It produces groundwater table fluctuations as well as discharge hydrographs; and (4) Consideration of the fluctuation of the groundwater table forces the simulation of infiltration, evaporation, and ground-

water flow to be more explicit, and places a constraint on the model structure, which makes it more reliable. (See also W91-00961) (Sand-PTT)
W91-00981

EFFECTS OF RECHARGE SYSTEMS ON HYDROLOGICAL INFORMATION TRANSFER ALONG RIVERS.
9 Eylul Univ., Izmir (Turkey). Dept. of Civil Engineering.
N. Harmancioglu, and T. Baran.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 223-233. 7 fig, 3 ref.

Descriptors: *Data interpretation, *Hydrologic models, *Information transfer, *Karst hydrology, *Rainfall-runoff relationships, *River basins, *Runoff, *Surface-groundwater relations, Regression analysis, Seasonal variation, Snow, Turkey.

Concepts of 'transferrable' and 'transferred' information are used for the analysis of information transfer between runoff-runoff and precipitation-runoff processes in basins with different recharge systems. Two basins were studied: (1) the Skizdere Basin in northeastern Turkey along the Black Sea Coast; and (2) the Aras Basin in eastern Turkey which receives much of its precipitation as snow. The results show within-the-year variation of transferred and transferable information to reflect how each basin responds to seasonally varying inputs. In basins with precipitation as the basic input to produce runoff, information transfer between selected points along a river is determined significantly by the similarity between their climatic factors. In karstic basins, however, neither runoff-runoff nor precipitation-runoff regressions are sufficient to transfer information especially during the non-rainy seasons, as sub-basins with different degrees of karstification respond diversely to input precipitation. (See also W91-00961) (Author's abstract)
W91-00984

NEW PERSPECTIVES ON DEVELOPMENTS IN MODELING OF EFFECTIVE RAINFALL BY APPLYING THE FDTF METHOD (NOUVELLES PERSPECTIVES DE DEVELOPPEMENT DANS LA MODELISATION DES PLUIES EFFICASES PAR APPLICATION DE LA METHODE DPFT).
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
J. Y. Rodriguez, D. Sempere, and C. Obled.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 235-244. 10 fig, 1 tab, 14 ref. English summary.

Descriptors: *Hydrological models, *Model studies, *Rainfall, *Rainfall-runoff relationships, *Watersheds, France, Unit hydrographs.

The FDTF approach identifies, on a multievent set, both the response function on the watershed and the series of excess rainfall associated with each event. The algorithm is alternate and iterative, and some improvements have been included in the deconvolution phase. Compared to the classical unit hydrograph approach, the major breakthrough consists of identifying an a priori consistent excess rainfall series that allows an objective calibration of any runoff function or infiltration model. A case study is provided, based on a small experimental watershed (554 sq km) in Cevennes southern France. (See also W91-00961) (Author's abstract)
W91-00985

REGIONAL METHODS FOR ESTIMATION OF DESIGN FLOODS FOR SMALL TO MEDIUM SIZED DRAINAGE BASINS IN AUSTRALIA.
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. H. Pilgrim.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 247-260, 3 fig, 1 tab, 20 ref.

Descriptors: *Design floods, *Flood forecasting, *Flood frequency, *Rainfall-runoff relationships, *Regional analysis, *Regional floods, Australia, Basins, Catchment areas, Estimating, Hydrological models, Statistical analysis.

In terms of overall economic value, design for small to medium sized rural basins is the most important aspect of flood estimation. Methods for these basins need to be based on observed flood data in the region, and should be simple to apply and familiar to designers, unambiguous in application, and of a probabalistic nature. As design sites are normally ungaged, regionalized procedures are required, but these methods must also recognize major differences in flood producing characteristics between different regions. Design methods to fulfill these requirements have been derived for most of Australia for inclusion in a revised edition of Australian Rainfall and Runoff, the guide to flood estimation published by the Institution of Engineers Australia. The regional methods derived from observed data are of two general types, the probabilistic Rational Method and regional flood frequency procedures. Values of design parameters show much less variation with basin characteristics than for previously used methods based on judgement or plot experiments. The flood estimates are also of much greater accuracy. (See also W91-00961) (Author's abstract)
W91-00986

DETERMINATION OF DESIGN FLOOD HYDROGRAPHS BASED ON REGIONAL HYDROLOGICAL DATA.
Graz Univ. (Austria). Inst. for Hydromechanics, Hydraulics and Hydrology.
H. Bergman, and B. Sackl.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 261-269. 4 fig, 7 ref.

Descriptors: *Design floods, *Flood forecasting, *Flood frequency, *Flood hydrographs, *Model studies, *Rainfall-runoff relationships, *Regional analysis, *Regional floods, Flood peak, Frequency analysis, Hydrological models, Probabilistic process, Statistical analysis, Stochastic models.

Knowledge of the probability of flood hydrographs is necessary for many problems in water management. The determination becomes difficult as a result of missing data in ungaged catchments and by the mathematical definition and evaluation of multivariate probability of the entire flood hydrograph. A stochastic-deterministic model was developed in an attempt to provide a better probabilistic description of the multivariate flood-process. The estimation of flood characteristics, such as peak runoff, volume and time course is based on basin properties and regional flood analysis. The determination of flood hydrograph probability is founded upon a bivariate statistical analysis of peaks Q-D and volumes V-D of the direct runoff. (See also W91-00961) (Sand-PTT)
W91-00987

REGIONAL ANALYSIS OF THE MEAN ANNUAL FLOOD AND OF FLOOD FREQUENCY CHARACTERISTICS.
National Technical Univ., Athens (Greece). Div. of Water Resources.
M. Mimikou, and J. Gordios.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 271-281. 1 fig, 3 tab, 11 ref.

Descriptors: *Flood forecasting, *Flood frequency, *Greece, *Hydrological models, *Model studies, *Rainfall-runoff relationships, *Regional analysis, Climates, Frequency analysis, Geomorphology, Rainfall intensity, Soil types, Statistical analysis.

An attempt was made to predict the mean annual flood of daily and of instantaneous extremes and flood quantiles for basins in a hydrologically homogeneous region. The variation of the mean annual flood and of the parameters of the Extreme Value type I distribution for basins in northwestern and western Greece are explained in terms of geomorphoclimatic characteristics of the basins. These characteristics are: drainage area, mean annual areal precipitation, stream frequency, main stream slope and length, intensity of the 1-day, 5-year return period rainfall and a soil type index. The developed regional models predict with satisfactory accuracy the mean annual floods and flood quantiles needed in hydrologic design, for ungaged basins of the region studied. (See also W91-00961) (Author's abstract)
W91-00988

ASSESSMENT OF THE US CONSERVATION SERVICE METHOD FOR ESTIMATING DESIGN FLOODS.
Brawijaya Univ., Malang (Indonesia). Fakultas Teknik.
A. A. Hoesein, D. H. Pilgrim, G. W. Titmarsh, and I. Cordery.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 283-291. 2 fig, 4 tab, 18 ref.

Descriptors: *Design floods, *Flood forecasting, *Flood frequency, *Hydrological models, *Rainfall-runoff relationships, Australia, Frequency analysis, Statistical analysis.

The U.S. Soil Conservation Service (SCS) method was tested as a design flood procedure in two regions in southeastern Australia. Runoff curve numbers were derived from observed data on a probabilistic rather than an event basis, fitting the design case. Derived values depended on the method for determining time of concentration and the average recurrence interval of the design flood, and to a minor extent on basin characteristics. Values derived by the normal SCS handbook procedure were shown to give very poor estimates of flood frequency values. Mapping of derived values provides a satisfactory basis for flood design. (See also W91-00961) (Author's abstract)
W91-00989

REGIONAL FLOOD FREQUENCY ANALYSIS USING RIDGE REGRESSION.
Hydro-Quebec, Montreal.
R. Roy, B. Bobee, F. Ashkar, and F. Roberge.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 293-300. 3 tab, 10 ref.

Descriptors: *Flood forecasting, *Flood frequency, *Frequency analysis, *Regional analysis, Canada, Comparison studies, Quebec, Regression analysis, Ridge regression, Statistical analysis.

Regional analysis has been proposed for estimating flow quantiles using ordinary multiple regression with basin physiographic and climatic characteristics as independent variables. The high pairwise correlation existing among the predictors suggests that ridge regression, which is more capable of overcoming the problems of multicollinearity, would give better results. The efficiency of both multiple regression and ridge regression in estimating quantiles was evaluated using physiographic characteristics of small drainage basins in Quebec, Canada. Using a jackknife type technique, it is shown that for the Canadian rivers studied and under certain conditions, ridge regression models

improve the multiple regression solutions. (See also W91-00961) (Sand-PTT)
W91-00990

HYDROLOGY AND MANAGEMENT OF DROUGHT IN THE UNITED STATES.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
N. S. Grigg.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 303-312. 1 tab, 16 ref.

Descriptors: *Drought, *Planning, *Water management, *Water supply, Decision making, Risk assessment, Water resources management, Water shortage.

Awareness of drought problems in the U.S. has risen in recent years, but effective water system planning and operations for drought conditions are impeded by differing expectations, definitional problems, hydrologic complexity and institutional fragmentation. Results of surveys about management of the 1986 U.S. Southeast drought and about the use of risk analysis by water purveyors are reported. In spite of meteorological and hydrologic advances, use of information technologies and risk-based decision making lags among water management practitioners. Improved support and use of data and models is needed to manage future droughts in the U.S. (See also W91-00961) (Author's abstract)
W91-00991

DROUGHTS AND FLOODS: THEIR DEFINITION AND MODELING.
Politechnika Warszawska (Poland). Inst. of Environmental Engineering.
M. Ozga-Zielinska.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 313-322. 4 fig, 14 ref.

Descriptors: *Drought, *Drought forecasting, *Flood flow, *Flood forecasting, *Floods, *Hydrological models, *Model studies, *River flow, *Statistical models, Differential equations, Flow equations, Surface-groundwater relations, Water table.

The notions of drought and flood were used to interpret the situation in the river concerning its flow rate. They do not have any precise definition based on the physics of the flow phenomena. The conventional definitions of drought and flood, their characteristics and statistical methods of their computing and forecasting are discussed, along with some physical based approaches to modeling river flow. A catchment is described as a dynamic system with two sub-systems, i.e. surface and groundwater sub-systems. Each of them is separately described by the input-output relationship in the form of an ordinary linear differential equation. (See also W91-00961) (Author's abstract)
W91-00992

REGIONALIZATION OF LOW FLOW CHARACTERISTICS USING LOGISTIC AND GLS REGRESSION.
Geological Survey, Reston, VA.
G. D. Tasker.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 323-331. 1 tab, 11 ref.

Descriptors: *Flow models, *Low flow, *Model studies, *River flow, *Streamflow, Hydrologic models, Regional analysis, Regression analysis, River basins.

Two new methods are described for dealing with practical problems encountered in implementing regional regression models to predict low flow characteristics. First, to determine the probability of encountering a flow of zero at a site as a function of the basin characteristics at the site, a logistic regression was used to relate the probability of zero flow to basin characteristics. A second practical problem in regional regression arises because estimates of low flow characteristics, such as mean annual minimum flow, at stream gages are based upon records of different length or at some sites estimates may be may be based upon a relatively small number of low flow measurements rather than a complete record of flows. In addition, low flows at a site autocorrelated, resulting in an effectively shorter record. Ordinary least squares regression is not appropriate in such cases. Instead an estimated generalized least squares estimator for the regional regression model is used. This model takes into account differences in accuracy of at-site estimates of low flow characteristics, the sample cross correlation between estimates, and the sample autocorrelation of annual minimum flows. (See also W91-00961) (Author's abstract)
W91-00993

CHARACTERISTICS OF STREAMFLOW DROUGHT.
Ohio Univ., Athens. Dept. of Civil Engineering.
T. J. Chang.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 333-341. 6 fig, 2 tab, 11 ref.

Descriptors: *Drought, *Flow models, *Model studies, *Statistics, *Streamflow, Flow equations, Hydrologic models, Ohio River basin, River basins.

Assuming the nonhomogeneous Poissonian behavior of droughts, the intensity function was developed to investigate the characteristics of drought occurrences that can be used for the purpose of simulation. Based on the daily streamflows from the Ohio River Basin, it was found that drought intensities were varied depending highly on time and truncation level. The correlation coefficients between drought durations and their corresponding deficits were significantly large for all the streamflow stations studied in the basin. Such findings suggest that regional water resources management using drought series should consider modifications. (See also W91-00961) (Author's abstract)
W91-00994

DEVELOPMENT AND APPLICATION OF SIMPLE WATER BALANCE MODELS TO UNDERSTAND THE RELATIONSHIP BETWEEN CLIMATE AND WATER RESOURCES.
National Oceanic and Atmospheric Administration, Washington, DC.
For primary bibliographic entry see Field 2A.
W91-00995

DERIVING STREAM PARAMETERS FOR HYDROLOGIC MODELING FROM DIGITAL ELEVATION DATA.
Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.
K. F. Connors, T. W. Gardner, and R. L. Day.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 397-406. 4 fig, 1 tab, 13 ref.

Descriptors: *Geographic information systems, *Hydrologic models, *Model studies, *Stream profiles, *Streamflow, Digital elevation model, Errors, Maps, Stream discharge, Surface water.

The utility of a digital elevation model (DEM) to derive stream channel parameters for input to a hydrologic model, SPUR (Simulation of Production and Utilization of Rangelands) was investigated. The relationships between stream parameters (stream length and slope) and the Shreve stream order and the relationship between these stream networks and associated parameters and the prediction of surface water discharge from SPUR were examined. DEM-derived networks with different Shreve orders produced significantly different stream lengths and stream slopes but were only different from similar networks derived manually from 1:24,000 topographic maps. The most complex network produced the lowest errors in monthly runoff volume predictions. This results from the effects of increasing stream length, increasing average stream slope, and increasing number of contributing areas as stream order is decreased. The simplest stream network produced results that best matched the observed peak flow rates for low probability events. (See also W91-00961) (Author's abstract)
W91-01000

EXSRM, AN EXPERT SYSTEM FOR SNOWMELT RUNOFF MODEL (SRM).
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
E. T. Engman, A. Rango, and J. Martinec.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 417-426, 5 fig, 10 ref.

Descriptors: *Expert systems, *Hydrologic models, *Model studies, *Runoff forecasting, *Snowmelt, Computer programs, Simulation.

An expert system is being developed to assist unfamiliar users to set up and operate a complex model for simulating snowmelt runoff. The expert system encodes the procedures that experienced hydrologists use to set up input data, select parameters, and adjust these vales when initial simulations do not match measured data. The expert system is built around an existing FORTRAN model which is not changed and does not need to be reprogrammed into a different computer language. Parts of the expert system can be implemented as they are completed without affecting the model operation. Since the FORTRAN code itself is not changed, historic inputs and parameter estimations can be mixed with the inputs and parameters developed by the expert system. (See also W91-00961) (Sand-PTT)
W91-01002

USING GIS TO ASSESS SPATIAL VARIABILITY OF SCS CURVE NUMBER AT THE BASIN SCALE.
Politecnico di Milano (Italy). Inst. of Hydraulics.
M. Mancini, and R. Rosso.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 435-444, 8 fig, 5 tab, 9 ref.

Descriptors: *Geographic information systems, *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *River basins, *Storm runoff, Italy, Soil moisture retention, Soil types, Variation coefficient.

Calibration of Soil Conservation Service Curve Number (CN) is performed within a distributed framework. This is based on the detailed information from the Geographic Information System (GIS) available for Petrace basin, southern Italy. The spatial variability of CN was analyzed in terms of random field, and the effects due to aggregation of tributary areas were investigated for increasing area used for averaging. Due to the large fluctuations of CN estimates, storm runoff production was found to be highly variable within the basin. The combined effect of aggregation area and rainfall depth was analyzed. It was found that increasing rainfall depth strongly decreases surface runoff variability. On the contrary, surface runoff variability is much less sensitive to increasing aggrega-

tion area. However, the values of coefficient of variation of surface runoff production are much larger than the corresponding ones found for soil potential maximum retention and curve number, independently of rainfall depth. (See also W91-00961) (Sand-PTT)
W91-01004

2F. Groundwater

WATER SUPPLY FOR MEXICO CITY.
Universidad Autonoma Metropolitana, Mexico City. Unidad Iztapalapa.
For primary bibliographic entry see Field 3D.
W91-00020

CASCADING WATER: A THREAT TO GROUND WATER QUALITY.
For primary bibliographic entry see Field 5B.
W91-00053

THREE-DIMENSIONAL SCALE MODEL OF GROUND-WATER SOLUTE TRANSPORT.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Div. of Engineering Fundamentals.
For primary bibliographic entry see Field 5B.
W91-00064

GROUNDWATER MODELLING AS A TOOL FOR WATER MANAGEMENT: WAIMEA PLAINS, NELSON.
Nelson Catchment Board (New Zealand).
A. D. Fenemor.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 17-31, 1989. 9 fig, 11 ref.

Descriptors: *Alluvial aquifers, *Computer models, *Groundwater, *Groundwater management, *Model studies, Coastal aquifers, Finite difference methods, Flow models, New Zealand, Pumping tests, Safe yield, Saline water intrusion.

The Waimea Plains is a 7500 ha area of intensive horticulture and cropping near Nelson, New Zealand, underlain by three major alluvial aquifers. Summer drawdowns exceed 10 m near the town of Richmond, and seawater intrusion is considered possible because coastal heads are frequently drawn below sea level. A quasi three-dimensional computer model of the groundwater system of the Waimea alluvial basin was developed and calibrated. A modified version of the Trescott finite difference model, developed by the U.S. Geological Survey, was used. The aquifers were represented by three layers of 20 x 46 nodes with a uniform grid spacing of 487 m. Model parameters were derived from pumping test data, water balance accounting, and pumpage records. Both steady-state and transient calibrations were performed. Model simulations evaluated the optimal yield of the aquifers given the constraints of preventing seawater intrusion or excessive water level declines, and maintaining minimum river flows. Other simulations showed the seasonal fluctuations in head when no pumpage is occurring, and the impacts of various irrigation scheme proposals. Results of this modeling assisted the Nelson Catchment Board in formulating management policies for the water resources of the Waimea Plains restricting summer water usage. (Tappert-PTT)
W91-00075

PCG SOLUTIONS OF FLOW PROBLEMS IN RANDOM POROUS MEDIA USING MIXED FINITE ELEMENTS.
California Univ., Irvine. Dept. of Civil Engineering.
D. E. Dougherty.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 2-11, March 1990. 6 fig, 4 tab, 32 ref.

Descriptors: *Finite element method, *Groundwater movement, *Mathematical models, *Mathematical studies, *Model studies, *Numerical analysis, *Porous media, Computer models, Data interpretation, Hydraulic conductivity, Mathematical equations, Solute transport.

The preconditioned conjugate gradient (PCG) method has found wide acceptance for the solution of symmetric systems of equations, such as those that arise in groundwater flow simulations. Several heuristic preconditioners for the PCG method are examined using random hydraulic conductivity fields, because such distributions of conductivity are of practical interest in studies of solute transport and can be very difficult to solve due to the high condition number they engender. The flow problems are discretized with the mixed finite element method, the resulting matrix is reduced in size by block Gauss elimination, and PCG is applied to the resulting problem. As a result of the matrix reduction and the need to store the resultant matrix implicitly because of storage limitations for large problems, the selection of a preconditioner is not obvious. Four heuristic preconditioners, selected because of the simplicity with which they can be constructed from the implicit matrix representations and because of their potential for high performance computers, are tested: diagonal, tridiagonal, scaled diagonal, and scaled tridiagonal. Tests were performed on fields with random hydraulic conductivity, both isotropic and anisotropic correlation functions, and a large range of standard deviations. The scaled tridiagonal and diagonal preconditioners prove very effective and efficient for a broad range of problems, even for conductivity variations of 25 orders of magnitude. (Author's abstract)
W91-00117

THEORY OF SUBSURFACE WATER-BORNE SOLUTE TRANSPORT.
Australian Nuclear Science and Technology Organisation, Sutherland. Environmental Science Div.
For primary bibliographic entry see Field 5B.
W91-00119

NUMERICAL MODEL FOR AREAL MIGRATION OF WATER AND LIGHT HYDROCARBON IN UNCONFINED AQUIFERS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5B.
W91-00120

SIMULATION OF DISPERSION IN LAYERED COASTAL AQUIFER SYSTEMS.
Geological Survey, Reston, VA. Water Resources Div.
T. E. Reilly.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 211-228, May 1990. 9 fig, 10 ref.

Descriptors: *Coastal aquifers, *Dispersion, *Groundwater movement, *Mathematical models, *Saline water intrusion, *Saline-freshwater interfaces, *Simulation analysis, Confining units, Density stratification, Fluid mechanics, Hydrodynamics, Seawater, Solute transport, Transition zone, Water circulation.

Freshwater-saltwater transition zones in coastal aquifers in equilibrium are subject to constant circulation of seawater because of hydrodynamic dispersion. This movement of seawater may be subtle, but it is observed in field studies and is important in describing the saltwater-freshwater transition zone. To simulate the dispersed nature of the saltwater-freshwater interface and the associated saltwater circulation zones, it is necessary to consider the problem as a density-dependent miscible-solute-transport problem. The transport mechanism of hydrodynamic dispersion attempts to account for fluid movement due to velocity variations that cannot be measured or simulated. In layered coastal systems, the scale of horizontal movement is usually very different from the scale of movement through confining units. This requires that dispersivities used to describe the system under investigation reflect the difference in scale. This formulation was used to examine groundwater flow in layered coastal aquifers. The numerical experiments indicate that although the transition zone may be thought of as an impermeable 'sharp' interface with freshwater flow parallel to the transition zone in homogeneous aquifers, this is not the case for layered systems. Freshwater can discharge through the transition zone in the confining units. Further, for the best simulation of layered coastal aquifer systems, either a flow-direction-dependent dispersion formulation is required, or the dispersivities must change spatially to reflect the tight thin confining unit. (Fish-PTT)
W91-00155

EVALUATION OF HYDROGEOCHEMICAL PARAMETERS WITH SPONTANEOUS POTENTIAL LOGS.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 7B.
W91-00157

SOME FUNDAMENTAL WEAK SPOTS OF KRIGING TECHNIQUE AND THEIR CONSEQUENCES.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Soil and Groundwater.
For primary bibliographic entry see Field 7C.
W91-00159

ESTIMATING GROUNDWATER RECHARGE USING A SURFACE WATERSHED MODELLING APPROACH.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
F. H. S. Chiew, and T. A. McMahon.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 285-304, May 1990. 10 fig, 6 tab, 15 ref.

Descriptors: *Groundwater management, *Groundwater recharge, *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Surface-groundwater relations, Australia, Evapotranspiration, Irrigation, Streamflow data, Watersheds.

Groundwater level predictions are required to evaluate management options for groundwater control, particularly in salt-affected lands. To provide realistic long-term predictions, good estimates of recharge based upon physical processes are necessary. A surface watershed modeling approach, the daily version of the rainfall-runoff model HYDROLOG, was used as the surface model with potential evapotranspiration estimated from Morton's representation of wet environment evapotranspiration. The surface model was calibrated and tested by comparing the streamflow simulated by the model and the recorded streamflow. Groundwater recharge is an output from the model. Modeling was carried out in both the irrigated and non-irrigated areas of the northern half of the Campaspe River Basin in northern Victoria, Australia. It was concluded that this approach is promising as the model was able to simulate fluctuations in the recharge rates. The model predicted higher recharge in the spring-winter months compared with the summer-autumn months. This is expected as rainfall is higher in the spring-winter months. The model predicted higher recharge in the southern parts of the catchment. This is also expected as rainfall is much higher in the south and the soils there are more sandy. The model was also able to detect recharge caused by irrigation. However, modeling of the irrigated areas in a similar way to the non-irrigated areas may not be appropriate. As a result, the recharge estimates in the irrigated areas should be used with caution. (See also W91-00161) (Fish-PTT)
W91-00160

SPATIALLY CONTINUOUS DETERMINATION OF GROUNDWATER FLOW TO SURFACE WATER BODIES: APPLICATION TO THE CONNECTING CHANNELS BETWEEN LAKES HURON AND ERIE.
Wisconsin Univ.-Milwaukee. Dept. of Geosciences.
For primary bibliographic entry see Field 2A.
W91-00163

HYDROCHEMICAL CHARACTERIZATION OF GROUNDWATER MIXING IN SEDIMENTARY AND METAMORPHIC RESERVOIRS WITH COMBINED USE OF PIPER'S PRINCIPLE AND FACTOR ANALYSIS.
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 2K.
W91-00164

USING ISOTOPE FRACTIONATION OF NITRATE-NITROGEN AND NITRATE-OXYGEN FOR EVALUATION OF MICROBIAL DENITRIFICATION IN A SANDY AQUIFER.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-00166

REMOTE-SENSING APPLICATION TO WELL MONITORING.
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih, and J. D. Jordan.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 497-507, July/August 1990. 5 fig, 2 tab, 14 ref.

Descriptors: *Flowing wells, *Infrared imagery, *Monitoring wells, *Remote sensing, *Saline water intrusion, Aerial photography, Artesian wells, Data acquisition, Data interpretation, Reflectance techniques, Spectral analysis, Spectrophotometry, Vegetation.

The artesian wells flowing uncontrolled in many parts of Florida have caused a serious saline-contamination problem. Locating these wells by ground search is made difficult by the urbanized or reforested condition of formerly agricultural land. Both ground-based color infrared (GCIR) and aerial color infrared (ACIR) photographs were taken for analysis of the spectral reflectance of land-surface features that can provide information for detection of flowing wells. Both GCIR and ACIR showed similar patterns of spectral reflectance for the same component class of land-surface features. Well-site soil had higher spectral reflectance than soil not associated with a well. Well water had higher spectral reflectance than natural pond and ditch water. The spectral reflectance patterns of vegetation types studied all have two peak-intensity values. The vegetation types had differences in spectral reflectance magnitude except for leather fern and cattail (similar to each other) and St. Augustine grass and cucumber (also similar to each other). The combination of green and red channels of spectral reflectance videodigitized from ACIR photography appears to be useful for classifying landcover types and distinguishing flowing wells. (Author's abstract)
W91-00169

UNSTEADY DRAWDOWN OF WATER TABLE.
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
M. E. Savci.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 508-526, July/August 1990. 19 fig, 1 tab, 13 ref.

Descriptors: *Drawdown, *Groundwater level, *Groundwater movement, *Mathematical models, *Model studies, *Water table fluctuations, *Water table gradient, Drainage ditches, Drainage engineering, Numerical analysis, Reservoirs, Unsteady flow, Water table profiles.

Unsteady water table drawdown problems have either theoretically or experimentally been studied for many years. Equations have been developed to predict water table geometry for flow toward a drainage ditch or reservoir whose water surface level is subject to a sudden specified drop. A closed function representing the water table geometry is obtained for the classical potential formulation of the problem under initial and boundary conditions related by means of a perturbation method. The first order term of this closed function is identical to the previously published solutions. The inclusion of the second and third order terms improved the accuracy considerably. The water table profile found as a function of only one variable is predicted for various power series parameter values, ranging between -1 and 0. Temporal and spatial variations of the water table were obtained for various power series parameter values. The comparison of the present results with those of previous works shows good agreement. (Fish-PTT)
W91-00170

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES. VOLUME I.
For primary bibliographic entry see Field 4B.
W91-00215

PUMPING TEST IN A LOW PERMEABILITY CLAYSTONE AQUIFER EXECUTED WITH HIGH-RESOLUTION ELECTRONIC WATER LEVEL RECORDERS AND EVALUATED WITH THE VERSATILE COMPUTER PROGRAM HYDROPAR.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
K. Trippler.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 3-14, 3 fig, 2 tab, 4 ref.

Descriptors: *Aquifer testing, *Aquifers, *Computer programs, *Data interpretation, *Groundwater movement, *Permeability, *Pumping tests, Clays, Data acquisition, Hydraulic conductivity, Observation wells, Water supply, West Germany.

A long duration pumping test was carried out in October 1983 west of Hannover, West Germany, in a low permeability, highly fractured claystone aquifer system. Groundwater was pumped continuously for 120 hours (0.96 cu m/hr) from one well. The drawdown was automatically measured in 13 observation wells with high-resolution ultrasonic transducers which functioned as both a transmitter and receiver. The data are stored on magnetic tape and the data can be processed directly by computer using the versatile program HYDROPAR. Results from this pump test showed that the aquifer is semiconfined (S=0.001) and has a low transmissivity (T=0.21 sq m/hr). The results confirm that the test was carried out in a semiconfined aquifer system of low to medium hydraulic conductivity. In arid and semi-arid areas such an aquifer can be used for domestic water supply. (See also W91-00215) (Lantz-PTT)
W91-00216

ANALYSIS OF PUMPING TEST DATA FROM BOREWELLS IN FRACTURED ROCKS OF KARNATAKA.
Roorkee Univ. (India). Dept. of Earth Sciences.
S. K. Mishra, B. B. Singhal, and D. C. Singhal.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 15-25, 2 fig, 3 tab, 15 ref.

Descriptors: *Aquifer testing, *Boreholes, *Data interpretation, *Geologic fractures, *Groundwater movement, *Mathematical analysis, *Pumping tests, Flow pattern, Geohydrology, Mathematical equations, Mathematical studies, Porosity.

Aquifer characteristics and well characteristics were computed from data of pumping tests conducted in the Northern parts of Karnataka. An attempt was made to compute aquifer characteristics using a double porosity model. The time-drawdown curves match to a greater extent with the type curves for a double porosity model and results computed are consistent with the field observations. It is concluded that the flow in fractured formations is complex. The use of Rorabaugh's method for well characteristics in fractured formations discriminates between the laminar, turbulent, and transitional nature of flows. The specific drawdown versus discharge plots help to better understand the flow patterns in fractured formations. (See also W91-00215) (Lantz-PTT)
W91-00217

ANALYSIS OF TEST PUMPING DATA FROM UNCONFINED AQUIFERS BY SIMULATION.
Roorkee Univ. (India). School of Hydrology.
D. Kashyap, P. K. Sarkar, and A. M. Khaled.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 27-35, 2 fig, 3 tab, 7 ref.

Descriptors: *Aquifers, *Data interpretation, *Groundwater movement, *Mathematical analysis, *Pumping tests, *Simulation analysis, Case studies, Drawdown, Groundwater budget, Groundwater mining, India, Mathematical studies, Observation wells, Specific yield, Transmissivity, Vertical flow.

The application of Neuman's theory coupled with the principle of superposition is suggested for analyzing test pumping data from unconfined aquifers. The procedure involves repeated intelligent guesses of the parameters until a close enough match between the observed and the computed time-drawdown curves is obtained. Such an analysis can account for the partial penetration of wells and extra intermittent pumpings from the aquifer. The estimated parameters include: storage coefficient, specific yield, transmissivity and vertical anisotropy. A case study includes a pumping test of 5760 minutes duration conducted on unconfined aquifer at Khajuri-Akbarpur, India. The discharge from the pumping well was 4620 cu m/day and drawdowns were monitored in two observation wells. The pumping well was fully penetrating and the observation wells were partially penetrating. The time drawdown data reveal that the drawdowns displayed declining trends between 500-900 minutes and 2400 and 4000 minutes. The phenomenon occurred in both the observation wells causing sudden kinks in the time drawdown curves. Results of the case study suggest that a procedure for test pumping analysis may account for time variant test pumping discharge, uncontrolled pumpings, and partial penetration of wells provided that adequate data are recorded during the test. (See also W91-00215) (Lantz-PTT)
W91-00218

CRITICAL EVALUATION OF PUMPING TEST DATA FROM FRACTURED CRYSTALLINE FORMATION.
Madras Univ. (India). Dept. of Applied Geology.
P. N. Ballukraya, R. Sakthvadivel, and B. R. Reddi.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 37-45, 7 fig, 1 tab, 8 ref.

Descriptors: *Aquifers, *Crystalline rocks, *Data interpretation, *Geologic fractures, *Groundwater movement, *Pumping tests, Boreholes, Drawdown, Groundwater budget, Hydraulic conductivity, Transmissivity.

Conventional methods for the estimation of aquifer parameters often pose difficulties when applied to pumping test data from borewells in crystalline rock aquifers. The time-drawdown curves obtained from pumping and observation wells reflect the variation in hydraulic conductivity both in space and direction. Formation of segments in the time-drawdown need not necessarily be due to barrier boundaries as has been observed in alluvial aquifers, but may be the effect of varying hydraulic conditions in the aquifer itself with respect to pumping time. A multiple pumping test carried out in a crystalline formation was analyzed leading to the conclusion that the data from the pumping well

itself is a better indicator of transmissivity characteristics than observation wells, and that they can be estimated more accurately using a numerical method than by conventional methods. (See also W91-00215) (Author's abstract)
W91-00219

COMPUTATION OF TRANSMISSIVITY FROM STEP-DRAWDOWN TESTS.
Action for Food Production (AFPRO), Geohydrological Investigation Team, Hyderabad-500 007.
M. Srinivas.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 47-58, 4 fig, 4 tab, 4 ref, append.

Descriptors: *Aquifer testing, *Drawdown, *Groundwater management, *Pumping tests, *Transmissivity, Computer programs, Data interpretation, Groundwater budget, Mathematical equations.

The main drawback in transmissivity computations from step-drawdown test data is a significant well-loss component. A method is suggested for estimating the transmissivity from pumped data of step-drawdown tests. Employing Jacob's method of analysis, well losses are computed and corrected for in the drawdown values for each step. The corrected drawdowns are used in Logan's formula after being modified. Logan's formula uses maximum drawdown values and the resulting transmissivity values were erroneous up to 50% or more. They compared very well with each other as with the transmissivity values computed from long-duration test data. A computer program in FORTRAN is also given for complete analysis and results from inputting just the field data. This method is considered cost effective and time saving. (See also W91-00215) (Lantz-PTT)
W91-00220

RURAL WATER SUPPLY INVESTIGATIONS IN SCARCITY VILLAGES IN BHANDARA DISTRICT, MAHARASHTRA.
Central Ground Water Board, Nagpur (India). Central Region.
For primary bibliographic entry see Field 7B.
W91-00222

APPLICATION OF RADIOACTIVE TRACER TECHNIQUES FOR DETERMINING GROUNDWATER VELOCITY AND DIRECTION.
Bhabha Atomic Research Centre, Bombay (India).
For primary bibliographic entry see Field 7B.
W91-00223

ENVIRONMENTAL ISOTOPE-AIDED STUDIES ON WATER RESOURCES IN THE REGION OF CHEJU ISLAND.
Korea Advanced Energy Research Inst., Daeduk (Republic of Korea).
J. S. Ahn, J. W. Kim, J. H. Kim, Z. K. U, and C. C. Chong.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 89-98, 5 fig, 8 tab, 18 ref.

Descriptors: *Cheju Island, *Groundwater quality, *Groundwater resources, *Radioactive tracers, *Saline water intrusion, *Tracers, Acids, Bases, Deuterium, Groundwater budget, Tritium, Well yield.

The groundwaters yielded from existing deep wells situated within 2 km from the coast-line in the U-do and Songsan areas of Korea and classified as category 7, that is primarily saline dominated by alkalies and strong acids, such as saline water. The chlorine content of the groundwater ranges from about 200 ppm to 600 ppm. Tritium, deuterium, and oxygen-18 contents of seawater are 5.74 +/-0.2 ppt in maximum, and 8.67 +/-0.45 TU, -24 +/-0.18 ppt, -3.6 + 0.12 ppt in case of rainwater, and 15.11 +/-0.61 TU, -43.4 +/-1.12 ppt, -7.2 +/-0.5 ppt in case of pure and non-affected groundwater by saltwater encroachment. Groundwater bodies that are highly effected by saltwater intrusion are characterized by a content of tritium that is similar to that of non-affected groundwater. (See also W91-00215) (Lantz-PTT)
W91-00224

GROUNDWATER RECHARGE ESTIMATION BY TRITIUM TRACER TECHNIQUE IN SATHUPALLY AREA, ANDHRA PRADESH, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
C. Sudarsana Raju, C. S. Murti, and M. A. Haleem.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 99-108, 2 fig, 1 tab, 6 ref.

Descriptors: *Groundwater recharge, *India, *Radioactive tracers, *Sathupally, *Tracers, *Tritium, Geohydrology, Gneiss, Groundwater budget, Sandstones.

Geohydrological studies were carried out in the Sathupally area of Godavari Valley, A.P., India. The geological formations present in the area include Archean gneisses and Kamti sandstone. Recently there has been an influx in the use of groundwater resources in the region. During the 1985-86 hydrological cycle, groundwater recharge was measured in the 517 sq km Tammileru River basin in Sathupally. Twenty-five sites were injected with 4 ml of 200 microCi-tritiated water at a depth of 80 cm below ground level. This injection took place in the first week of 1985 prior to the onset of the southwest monsoon. Observations indicated that the depth of recharge varied (using the piston flow model) from -9 cm to +24 cm among the 25 sites. The values were found to be positive in the recharge area and negative in the discharge portion of the basin. Average recharge depth was found to be 6.4 cm. During the 1985-86 monsoon, total groundwater recharge into the basin reservoir was estimated to be 33 cu mm. (See also W91-00215) (Lantz-PTT)
W91-00225

ENVIRONMENTAL CHLORIDE METHOD FOR GROUNDWATER RECHARGE STUDIES: POTENTIALITIES AND LIMITATIONS.
National Geophysical Research Inst., Hyderabad (India).
B. S. Sukhija, P. Nagabhushanam, and D. V. Reddy.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 109-118, 2 fig, 6 ref.

Descriptors: *Chlorides, *Geochemistry, *Groundwater budget, *Groundwater movement, *Groundwater recharge, *Tracers, Hydrologic budget, Rainfall-runoff relationships, Soil water.

A study of groundwater recharge is a basic requirement in any water balance study. The application of environmental and other isotope tracer techniques for such purpose has been demonstrated by many workers in different hydrologic regimes. Chloride has only been recently used as a simple geochemical tracer. The potential use and limitation of environmental chloride for estimating groundwater discharge is addressed. Currently, there are two methodologies used for evaluation: (1) using the chloride concentration of groundwater and soil water, and (2) comparing the input with actual chloride content. Another method that is used compares soil profiles where the total deposition of chloride is studied. Average chloride concentration can be related to long-term recharge and chloride concentration in rainfall based on the chloride balance. Recent chloride studies have shown the mechanism of recharge and the environmental hazards that are a result of deforestation. Environmental chloride is a simple geochemical tracer with great potential for use in environmental studies. (See also W91-00215) (Lantz-PTT)
W91-00226

SPECIFIC YIELD ESTIMATIONS BY RADIOACTIVE TRACER IN INDO-GANGETIC PLAIN.
Uttar Pradesh Irrigation Research Inst. Roorkee (India).
R. K. Raja, S. N. Rawat, and S. S. Chhabra.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 119-130, 5 fig, 5 tab, 5 ref.

Descriptors: *Groundwater resources, *India, *Radioactive tracers, *Specific yield, *Tracers, *Well yield, Aquifers, Developing countries, Geohydrology, Groundwater budget, Pumping tests.

Specific yield is an important geohydrological parameter of an aquifer when determining changes in groundwater storage. Due to the variability of alluvial material, the evaluation of specific yield has long been recognized to be subject to large inaccuracies, and is usually determined by laboratory or field measurements. Both types of measurements have distinct limitations and practical difficulties. Tracer techniques provide a comparatively better alternative, provide a more reliable results of specific yield and assessment of aquifers. A field study was carried out to estimate the specific yield at Devla (District Saharanpur), Rampur (District Bijnor), Biralsi (District Muzaffarnagar), Badaut (District Meerut), and Chharra (District Aligarh) lying in the Indo-Gangetic plain of Western Uttar Pradesh, India, using tritium as a radioactive tracer. Pump test and grain size analysis methods have also been carried out to compare the results obtained by tracer techniques at the same test sites. The study indicates that the specific yield values obtained by the tracer method vary from 8.18% to 23.48%; it varies from 7.40% to 23.23% by pump test for the shallow unconfined aquifer in five districts of the Indo-Gangetic Plain. The tracer technique gives a fairly acceptable value for specific yield, and the results are in close agreement with those obtained by the pump test method. They differ, however, with the results obtained through grain size analysis. (See also W91-00215) (Lantz-PTT)
W91-00227

JOINT SYSTEM ANALYSIS FOR THE EVALUATION OF FLOW IN FRACTURED AQUIFER.
Central Ground Water Board, Bhubaneswar (India).
For primary bibliographic entry see Field 7C.
W91-00228

USE OF SINGLE WELL DILUTION TECHNIQUE FOR SEEPAGE MEASUREMENTS FROM CANALS USING RADIO-ACTIVE TRACER.
Uttar Pradesh Irrigation Research Inst. Roorkee (India).
A. N. Bhargava, P. R. Singh, and S. S. Chhabra.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 155-166, 5 fig, 3 tab, 5 ref.

Descriptors: *Canals, *Groundwater recharge, *Radioactive tracers, *Seepage, *Surface-groundwater relations, *Tracers, Deoband Canal, Flow velocity, Groundwater movement, India, Mathematical studies, Permeability, Upper Ganga Canal.

The height of a water column in a borehole at different distances from a canal bank plays an important role in determining the subsurface flow of water from canals. In the past investigators did not consider this factor when evaluating the seepage velocity by the single well dilution technique. A field study has been carried out by from various sections along several earthen canals of Uttar Pradesh using a radioactive tracer. The variation of the tracer dilution velocity with parameters related to the canal and borehole were studied. Once the seepage velocity was known, the seepage loss from the canals, using the single well dilution technique, was estimated through a mathematical process. The results of the seepage loss at the test sites in the Upper Ganga Canal were 1.83 and 2.16 cu m/sec/million cu m of wetted surface for the Deoband Canal. (See also W91-00215) (Lantz-PTT)
W91-00230

APPROACH IN DETERMINATION OF AQUIFER GEOMETRY AND ESTIMATION OF AQUIFER PARAMETERS OF AN AREALLY EXTENSIVE UPPER KAMTHI SANDSTONE AQUIFER IN PARTS OF GODAVARI VALLEY, ANDHRA PRADESH.
M. Veeranna, and K. V. J. R. Krupanidhi.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 167-169.

Descriptors: *Aquifers, *Artesian aquifers, *Geohydrology, *Geologic units, *Groundwater movement, Geologic fractures, Hydraulic properties, Wells.

The Godwana basin of the Godavari Valley in Andhra Padesh, India, is comprised of sandstone, clay, and siltstone striking a NW-SE direction with a dip toward the NE. The formations are traversed by numerous faults. This has become a problem with regard to deciphering the depth, thickness and extent of aquifers in view of the sloping and disturbed strata. The lithological and electrical logs of Yedlapalli and Koyyuru boreholes have indicated occurrence and extension of the potential confined Upper Kamthi Aquifer. The observation at Yedlapalli have shown the presence of hydraulic continuity in this artesian aquifer, although it is associated with structural disturbances. It has also helped in deciphering the location of negative boundaries beyond the Koyyuru well field but not in between the Koyyuru and Yedlapalli well fields. In such situations a planned construction of small diameter observation wells at distances of 4 to 5 km would help in understanding the aquifer geometry and estimating the aquifer parameters in the region. This would save construction and testing costs for conventional well fields. (See also W91-00215) (Lantz-PTT)
W91-00231

SUBMERSIBLE PUMP TESTS CONDUCTED ON BORES DRILLED BY D.T.H. COMPRESSOR RIGS AND THE COMPARISON OF TWO DISCHARGES.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
A. J. Merh, and K. H. Chatrola.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 171-173.

Descriptors: *Geohydrology, *Groundwater movement, *Pumping tests, Boreholes, Case studies, Pumps, Wells.

The shortage of drinking water from 1986-1988 in Gujarat State, India posed a challenge to geohydrologists in locating a suitable site for a borehole in basaltic terrain. Drilling was done by D.T.H. compressor rigs making 150mm diameter boreholes. Discharges were measured by 90 degree V notch methods. A goal of a minimum of 1 L/s discharge was considered suitable for a submersible pump. A comparison between two discharges shows that out of 21 cases 13 had an increase in discharge when the boreholes were pumped. In four of the cases there was no change and in four other cases there was a decrease in discharge. The decrease may be due to the time gap between drilling and test pumping. Six cases prompted the use of submersible pumps; five deep well pumps were recommended and six hand pumps were suggested. In four of the cases the discharge obtained was not significant. (See also W91-00215) (Lantz-PTT)
W91-00232

AQUIFER PARAMETER ESTIMATION AND GROUNDWATER POTENTIALITY IN GRANITE-BASALT TERRAIN NEAR HYDERABAD, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
C. Sudarsana, and M. Muralidhar.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 175-178, 4 fig, 1 tab, 5 ref.

Descriptors: *Aquifers, *Geohydrology, *Groundwater budget, *Groundwater resources, *India, Developing countries, Hyderabad, Mathematical equations, Water resources development.

The area under investigation is 200 sq km to the southwest of Sadasivpet at the contact between the Peninsular granite and Deccan basalts near Hyderabad, India. The region is well drained and most of the agricultural and domestic water demands are met by groundwater. There is still room for further groundwater development, determined from field and aquifer studies that indicate that the area has vast untapped groundwater potential. Considering the local geohydrological factors, exploitation of groundwater reserves should be attempted. Specific Capacity (C) of the wells is determined by Slitcher's formula. The C values range from 19 to 102 L/min/m and in one case is 207 and in another 639. Formation-wise, there is no distinct difference in the C values, but to have uniformity the unit area specific capacities of the wells are calculated. They vary from 0.5 L/min/sq m to 2.39 L/m/sq m. (See also W91-00215) (Lantz-PTT)
W91-00233

INSTRUMENTATION AND TECHNIQUE OF GROUNDWATER EXPLORATION (WITH NATURE OF AQUIFER) IN UNCONSOLIDATED SEDIMENTS (GANGETIC PLAINS) OF UTTAR PRADESH, NORTHERN INDIA.
Lucknow Univ. (India). Dept. of Geology.
A. C. Nautiyal.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 183-193, 5 fig, 14 ref.

Descriptors: *Data acquisition, *Drilling, *Groundwater resources, *Uttar Pradesh, *Water resources development, Aquifers, Drills, Groundwater budget, Hydraulic machinery, India, Pumps, Sand.

In the Gangetic Plains of Uttar Pradesh, India, the rotary rigs (RR) are used for drilling underground water wells. Subsequently, the drilled hole is lined with a steel pipe to a depth of 45.60 m. From this depth, the well is screened to a depth of 130 m. A filter pack is poured into the annular space between the aquifer and the screen. The filter retains the aquifer particles outside its outer boundary and the screen slot size is chosen to prevent the filter pack itself from passing through the slots. An electric-submersible pump (with five impellers) is placed inside a steel pipe, surrounded by a housing pipe, at a depth of about 33.44 m, being submerged within the shallowest first aquifer zone (between 24.32 m and 33. 44 m depth). A good number of shallow wells drilled in the Gangetic alluvial plains commonly revealed sandy aquifers of high potentiality of yielding groundwater. Two such wells drilled in southeastern Lucknow's alluvial plains revealed distinct inter-layering of soft clay (grayish yellow), sand (light gray to light olive gray), clay and kankar (yellowish gray), clay with kankar and sandy fragments (very light gray with yellowish tinge), and four sandy unconfined aquifers (each 9 m thick) horizons (sands being yellowish gray to very light gray, fine grained, winnowed) were located, with these sediments collectively called Bhangar in the Ganges valley of northern India. (See also W91-00215) (Lantz-PTT)
W91-00235

PARAMETER ESTIMATION FOR A QUASI-THREE-DIMENSIONAL FLOW MODEL.
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 7C.
W91-00236

INVESTIGATIONS OF GROUNDWATER RESOURCES AT SELECTED LEVELS IN DROUGHTPRONE AREA OF PAHARI BLOCK, DISTRICT MIRZAPUR, U.P., INDIA.
Banaras Hindu Univ., Varanasi (India). Dept. of Geophysics.
G. S. Yadav, and T. Lal.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 209-219, 4 fig, 7 ref.

Descriptors: *Data interpretation, *Electrical studies, *Geohydrology, *Geophysical surveys, *Groundwater resources, *India, *Resistivity, *Vertical electric sounding, Aquifers, Data acquisition, Groundwater budget, Pahari, Water resources development.

Vertical Electrical Sounding was carried out at 28 locations using the Schlumberger configuration for the investigation of groundwater resources in drought prone areas in Pahari Block, District Mirzapur, U.P. The data were interpreted by partial curve matching and Automatic Iterative Methods of Resistivity Sounding Interpretation (AIMRESI). Based on the results of the investigation, three vertical geoelectrical cross-sections representing the base of the alluvial cover, i.e. Vindhyan sandstone exposed in the central parts of the area, and the distribution of groundwater resources along the respective profiles are presented. Its depthwise areal distribution throughout the region under study is presented in four horizontal geoelectrical cross-sections at selected levels. Apart from these sections, a depth contour map is also presented showing the variations of thickness of alluvial cover and fractured sandstones on the top of the resistant substratum. Geohydrological conditions present a complex picture, especially with lithological variations of the alluvial cover derived mainly from Vindhyan sediments. The study indicates that the exploitable groundwater is mainly confined to the sandy layers and the sandy clayey layers in the northern parts of the area under investigation, while in the south-central region the groundwater is confined only to the fractured rocks of Vindhyan sandstone. (See also W91-00215) (Author's abstract)
W91-00237

MORE ACCURATE DETERMINATION OF AQUIFER PARAMETERS USING THE IP SOUNDING METHOD.
University of Science, Penang (Malaysia).
For primary bibliographic entry see Field 7B.
W91-00238

INTEGRATED GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS FOR DELINEATING KARSTIC ZONES IN CARBONATE FORMATIONS OF ANANTAPUR DISTRICT, A.P., INDIA.
National Geophysical Research Inst., Hyderabad (India).
T. Shibasaki, T. Venkataswara Rao, B.

Venkatanarayana, C. P. Gupta, and S. Sankaran.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 229-237, 4 fig, 7 ref.

Descriptors: *Geohydrology, *Geology, *Geophysical surveys, *Geophysics, *India, *Karst, *Karst hydrology, Anantapur, Carbonate rocks, Groundwater budget.

Detailed geological and geoelectrical investigations were carried out to understand the process of karstification in lower Cuddapah carbonate rocks of proterozoic age at Chillavaripalle, Anantapur district, Andhra Pradesh, India. The term karst indicates a specific morphological feature developed in carbonate rocks and is synonymous with cavernous conditions in limestone formations. The geological studies revealed the presence of a few shear and fault zones. Geomorphological observations helped identify a few horizontal cavernous zones occurring at different levels above the present river bed. Regional and detailed geoelectrical sounding and profiling indicated the presence of cavernous zones at shallow depths with a good groundwater potential. A borewell drilled at one of the identified subsurface cavernous zones showed a high groundwater yield of 50,000 L/min. The eustatic which occurred during the Quaternary period in several parts of the world might have played a significant role in the karstification of these carbonate rocks. (See also W91-00215) (Lantz-PTT)
W91-00239

HYDROGEOLOGICAL STUDY OF LATERITE AT A REPRESENTATIVE DAM SITE IN MALVAN VALLEY OF KONKAN REGION (MAHARASHTRA-INDIA) USING SEISMIC REFRACTION METHOD.
Central Water and Power Research Station, Poona (India).
A. Ansari, and B. S. Shrotri.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 239-248, 3 fig, 1 tab, 4 ref.

Descriptors: *Geohydrology, *India, *Seepage control, *Seismic properties, *Seismic surveys, *Water storage, *Water supply development, Laterites, Malvan Valley, Porosity.

The Konkan region in Maharashtra State comprises a 400 km long by 50 to 100 km wide belt along the west coast of India, south of Bombay. This region is largely covered by laterite, which is known for its high permeability. Due to this high permeability, most of the rainfall (approximately 200 cm/yr) drains into the Arabian Sea. Hence, there is a need to design appropriate water storage schemes. The peculiar cellular structure of the laterite cap is considered favorable for increasing the effective porosity of the formation. The cap acts as a conduit for vertical and/or horizontal movement of seepage water. From a seismic refraction survey conducted at Poip Dam, it is concluded that providing a positive cut-off would be an impractical proposition (Bedrock being 14-18 m deep). Therefore, clay blanketing is suggested in the reservoir area to prevent and/or reduce the entry of water through the laterite. (See also W91-00215) (Lantz-PTT)
W91-00240

BOREHOLE GEOPHYSICAL LOGGING TECHNIQUES FOR DELINEATING FRACTURED ZONES AND CAVITIES IN HARD ROCK AREAS FOR HYDROFRACTURING: A CASE STUDY.
H. N. Parikh, V. V. Ayachit, N. C. V. N. Chakravarthy, and R. K. Garg.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 249-262, 6 fig, 2 tab, 3 ref.

Descriptors: *Borehole geophysics, *Boreholes, *Case studies, *Geologic fractures, *Geophysics, *Groundwater resources, *Hydrofracturing, *Well development, Logging(Recording), Resistivity, Water resources development.

During severe scarcity conditions in the Saurashtra region of Gujarat State, deep drilling was taken up to explore the deeper aquifers in the Deccan trap formation. In some bores the yields were small and it was decided to attempt hydrofracturing in the weak fractured and jointed zones and cavities by delineating them using borehole geophysical logging techniques. Based on a study in the Deccan trap formation the following conclusions were made: (1) Correlation of lithological data with resistivity logs has indicated predominantly low resistive layers amid the high resistivity layers, which are likely to be promising for exploitation through hydrofracturing; (2) Caliper logs of these bores, which normally indicate the well diameter, clearly demarcated weak zones in the bore for further exploitation; and (3) Resistivity and caliper logs have shown a lot of coherence in delineating layers suitable for exploitation by hydrofracturing for better yields. (See also W91-00215) (Lantz-PTT)
W91-00241

HYDROGEOPHYSICAL STUDIES FOR CHARACTERIZING THE CRYSTALLINE AQUIFERS OF TAMBRAPARNI BASIN, TAMIL NADU, INDIA.
V.O.C. Coll., Tuticorin (India). Dept. of Geology.
A. Balasubramanian, K. K. Sharma, and J. C. V. Sastri.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 263-268, 3 fig, 1 tab, 12 ref.

Descriptors: *Aquifers, *Geohydrology, *Geophysical surveys, *Geophysics, *Groundwater resources, *India, *Resistivity, *Vertical electric sounding, Conductivity, Crystalline rocks, Electrical properties, Groundwater budget, Hydraulic conductivity, Porosity.

A geohydrophysical approach for deriving the empirical relationships between electrical resistivity measurements and aquifer parameters can also provide a means for solving many groundwater problems in hard rock terrain. The usefulness of vertical electrical sounding (VES) is evaluated for determining the hydrologic characteristics of crystalline aquifers in southern Tamilandu. VES are widely used in groundwater investigations and sometimes can replace test drilling. The measurements of aquifer resistivity are intuitively attractive for estimating aquifer hydraulic conductivity because of the fundamental relationship between hydraulic and electrical conductivity through their dependance on tortuosity and porosity. Most of the applications of resistivity sounding are on a qualitative basis. Quantitative work has been limited to the application of these measurements for determining the empirical relationships between aquifer resistivity, formation factors, and hydraulic conductivity in a specific aquifer. A combination of field geophysical measurements, drilled hole details, aquifer tests and water quality studies can provide the most valuable solutions for predicting aquifer properties on a regional scale. (See also W91-00215) (Lantz-PTT)
W91-00242

DECIPHERING GROUNDWATER USING REMOTE SENSING TECHNIQUES.
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W91-00243

PROSPECTING GROUNDWATER IN PUSHKAR LAKE REGION THROUGH REMOTE SENSING - A CASE STUDY.
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W91-00244

KRIGED ESTIMATES OF WATER-LEVELS FROM THE SPARSE MEASUREMENTS IN A HARD ROCK AQUIFER.
National Geophysical Research Inst., Hyderabad (India).
M. Thangarajan, and S. Ahmed.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 287-302, 8 fig, 11 ref.

Descriptors: *Aquifers, *Data interpretation, *Groundwater level, *Groundwater resources, *Kriging, *Mathematical analysis, Geohydrology, Groundwater recharge, Mathematical equations, Model studies.

Groundwater levels in the Vaippar basin (a hard rock aquifer in southern India) have been estimated at each node of the aquifer model from a limited number of observations. Universal Kriging was used to estimate the water levels and to calculate the estimation variance. A few more hypothetical locations were selected to reduce the estimation variance near the boundaries. A bivariate interpolation technique using a polynomial of a higher degree was also applied to compare the results. Finally, estimations were made using the theory of Intrinsic Random Function of first order (IRF-k). A single generalized covariance for all pre and post monsoon periods was developed. This study shows two important aspects viz., use of the theory of IRF-k to estimate the water levels at the nodes of an aquifer model and that a single generalized covariance model can be used to estimate the water levels for different time periods. This also helps in estimating water levels in the future without computing a generalized covariance. It was shown that the values of estimation error is more when a model taken for post-monsoon is used. This is due to the fact that the generalized covariance calculated for the water levels in post-monsoon period has a higher nugget effect. The higher value of nugget effect is the result of the large fluctuations in phreatic water levels due to the rainfall recharge. (See also W91-00215) (Lantz-PTT)
W91-00245

RADIAL VERTICAL ELECTRICAL SOUNDINGS: A CASE STUDY IN GROUNDWATER EXPLORATION.
Karnatak Univ., Dharwad (India). Dept. of Studies in Geology.
V. R. Hegde, K. Gowdreddy, and S. B. Chetti.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 303-305, 2 fig.

Descriptors: *Case studies, *Electrical properties, *Geohydrology, *Geophysical surveys, *Groundwater resources, *Sounding, *Vertical electric sounding, Geologic fractures, Groundwater level, India, Resistivity.

Groundwater occurrence in hard rock is mainly confined to the weathered and fractured zone. Crystalline rocks are generally inhomogeneous and anisotropic to the flow of electric current due to the presence of fractures/joints and minor fissures. Radial soundings have been conducted at 11 evenly distributed localities in the northeastern part of the Sasive Halla Basin of Ron Taluk, Dharwad district, India. The sounding curves at differing points within the localities indicate that the top layer of soil has a resistivity varying from 3.6 ohm/m to 88 ohm/m. The depth to the hard and compact basement indicated by the asymptotic nature of vertical electrical sounding curves, varies from very near the surface to 60 m. Borewells drilled at Lakkalakatti and Itgi have yielded 9.72 L/sec (approximately 7000 gal/min. The results of

radial vertical electrical soundings have indicated the presence of fracture patterns and also the intensity and degree of fracturing at different depths. (See also W91-00215) (Lantz-PTT)
W91-00246

DEEP GEOELECTRICAL SOUNDINGS AND SHAPES OF CURVES USED FOR RECOMMENDATIONS OF BORE SITES IN BASALTIC TERRAIN.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
For primary bibliographic entry see Field 7B.
W91-00247

DESCRIPTION OF LINEAMENTS FOUND IN KALAVAD TALUKA OF JAMNAGAR DISTRICT AND DRILLING DRILLED FOR WATER SUPPLY.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
A. J. Merh, S. A. Laghate, and R. K. Patel.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 311-314, 2 fig.

Descriptors: *Geophysical surveys, *Groundwater resources, *India, *Kalavad Taluka, *Remote sensing, *Water supply development, Boreholes, Groundwater movement, Lineaments, Pumping tests, Site selection, Well drilling.

Kalavad Taluka, India, was investigated for water supply under the technology mission for drinking water and scarcity program of 1987-88. Villages were surveyed using remote sensing, geohydrological investigations, and geophysical soundings. The purpose of this groundwater investigation was to locate suitable sites for drilling or digging a bore well in order to establish a dependable water supply. The following observations were made: (1) Most of the successful sites were at the intersection of lineaments with the drainage courses; (2) East-west trending lineaments are more productive;(3) Bores drilled on a lineament crossing a reservoir, dam or talav are more productive; (4) Weathered and fractured dykes are more productive; (5) Pump tests are recommended on boreholes near lineaments which have produced less discharge during drilling; (6) Water bore sites should be established near a village; and (7) If site selection is considered accurate and the bore well is non-productive, it is advisable to conduct a pump test after the monsoon. (See also W91-00215) (Lantz-PTT)
W91-00248

BRISK GROUND WATER INVESTIGATION FOR LOCATING BORE HOLE SITE IS BASALTIC TERRAIN.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
A. J. Merh, and S. A. Laghate.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 315-317.

Descriptors: *Basalts, *Boreholes, *Geophysical surveys, *Groundwater resources, *India, *Resistivity surveys, *Water resources development, Aquifers, Developing countries, Electrical properties, Geohydrology, Groundwater budget, Porosity.

The drought years of 1984-87 created an acute shortage of drinking and irrigation water in Saurashtra, the western portion of Gujarat State, India. The area villages are underlain by deccan trap basalts. Geohydrologically basalt rocks are poor aquifers; they do not possess primary porosity or permeability. Generally, the water levels in open wells in basaltic terrain decline with the approach of summer. In 1987 there was an acute decline in well-water level and groundwater availability in open wells was reduced 80-90% from the normal seasonal yield. Water resources were assessed using remote sensing with the use of imagery and areal photographs. Important features were marked by manual transfer. First-hand information on existing conditions was gathered at each village. The exact yield of water from the point of drilling could not be predicted. Geophysical soundings indicated subsurface variation in resistivities. Neither true resistivity values nor shape of the resistivity curve can assure a solution to the problem. Experience during these surveys showed that five average size villages could be surveyed within eight days of work. A maximum of four geoelectrical soundings can be done in one day. (See also W91-00215) (Lantz-PTT)
W91-00249

FRACTURE PATTERN MODELLING FOR GROUNDWATER TARGETTING IN HARD ROCK TERRAIN: A STUDY AIDED BY REMOTE SENSING TECHNIQUE.
Indian Inst. of Tech., Madras.
For primary bibliographic entry see Field 7C.
W91-00250

ELECTRICAL RESISTIVITY SURVEY FOR GROUND WATER IN VARAHA RIVER BASIN, A.P., INDIA.
Andhra Univ., Waltair (India). Dept. of Geology.
T. V. S. R. Kshira Sagar, and B. Nagamalleswara Rao.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 329-332, 2 fig, 1 tab, 2 ref.

Descriptors: *Data acquisition, *Geophysical surveys, *Groundwater budget, *Groundwater resources, *India, *Resistivity surveys, *Varaha River Basin, Electrical properties, Geohydrology, Groundwater level, Saline water intrusion.

An electrical resistivity survey has revealed the presence of a multilayered system characterized by alternating clay and sand zones along the Varaha River Basin, India. In addition, there are weathered products of country rocks of the Khondalite group. The wide variation observed in the resistivity data reflects the nature of intermixing sand and clay in the zones. The resistivity survey has brought to light the existence of saline zones with calcarious shells south of Lingarajupalem and Karivanipalem areas at shallow depths of 16-20 m below ground level. The low resistivity (2.5 ohm/m) observed in this area is indicative of a marine environment, possibly resulting from the paleo-sea level changes. The yields of tube wells vary from 165-1,665 gallons/day depending on the geohydrological conditions of the area. In the Varaha River basin the depth to static water varies from 5 to 10 m. (See also W91-00215) (Lantz-PTT)
W91-00251

DIGITAL ENHANCEMENT OF SURFACE GEOLOGIC FEATURES IN A PART OF BANAS RIVER CATCHMENT FOR GROUND WATER POTENTIAL CHARACTERIZATION.
Central Ground Water Board, Jaipur (India).
For primary bibliographic entry see Field 7C.
W91-00252

ROLE OF HYDROGEOLOGICAL SET UP IN THE YIELD OF WELLS IN GRANITE TERRAIN: CASE HISTORIES OF NIZAMABAD, WARANGAL AND HINDUPUR AREAS.
Regional Engineering Coll., Warangal (India).
M. P. Ranga Rae, and S. K. Radhakrishnam Raju.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 337-340.

Descriptors: *Geohydrology, *Groundwater yield, *Hindupur, *India, *Nizamabad, *Warangal, *Well yield, Case studies, Drawdown, Drought, Geology, Gneiss, Granites, Groundwater management, Groundwater resources, Remote sensing.

The need for exploration and evaluation of groundwater resources is of considerable importance, especially when considering the severe water shortages in the area of Andhra Pradesh, India, as a result of varying monsoons. Intensive groundwater surveys were conducted in the districts of Nizamabad, Warangal, and Anantapur. These areas were chosen in order to study the occurrence of groundwater in granites and gneisses belonging to unclassified crystallines of the Archean age. A number of sites were located for tube wells, open wells, dug cum borewells and infiltration galleries based on integrated surveys involving geological, geohydrological and geophysical investigations. Remote sensing techniques were utilized to evaluate the structural features of the terrain. All areas that were investigated from 1968-88 were of hard rock terrain. The yields of the tube wells drilled at Nizamabad varied from 400 L/min to 2000 L/min. As many as 20% of the tube wells have registered high yields with reasonable drawdown. All of these tube wells are 15 cm in diameter drilled to a depth of 40-55 meters. In the Warangal area the tube wells produced 8 to 80 L/min. This is considered a low yield. The Hindupur area is notorious for its history of drought. Tube wells delivered 40-240 L/min in this area. (See also W91-00215) (Lantz-PTT)
W91-00253

REMOTE SENSING BASED APPROPRIATE METHODOLOGY FOR THE GROUNDWATER EXPLORATION: A CASE STUDY FROM PRECAMBRIANS OF SOUTH INDIA.
Anna Univ., Madras (India). Inst. of Remote Sensing.
For primary bibliographic entry see Field 7C.
W91-00254

ENVIRONMENTAL ISOTOPE-AIDED STUDY ON RIVER WATER AND GROUNDWATER INTERACTION IN THE REGION OF SEOUL AND TAEGU.
Korea Advanced Energy Research Inst., Daeduk (Republic of Korea).
For primary bibliographic entry see Field 2A.
W91-00257

ESTIMATION OF RECHARGE AND POLLUTANT TRANSFER TO GROUNDWATER BY MODELLING OF UNSATURATED ZONE.
Roorkee Univ. (India). School of Hydrology.
D. Kashyap, K. M. Mohan Rao, and S. Gupta.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 395-403, 2 tab, 15 ref.

Descriptors: *Groundwater recharge, *Mathematical models, *Model studies, *Path of pollutants, *Soil water, *Solute transport, *Unsaturated flow, Data interpretation, Evapotranspiration, Geohydrology, Groundwater movement, Infiltration, Root zone.

The geological formation extending from ground to water table is generally known as the unsaturated zone since only a part of the pore space in this zone is filled with water. The unsaturated zone acts as a conduit for the vertical transfer of water and pollutants to the water table. It also accommodates the root zone of agricultural crops. Thus, the processes of infiltration, evapotranspiration, recharge, pollutant transfer to water table from ground or below, are essentially governed by the unsaturated zone. However, most of the research efforts in groundwater hydrology and hydraulics have been traditionally directed toward the saturated zone. An attempt is made to present basic equations governing the flow and mass transport through the unsaturated zone, and various possible strategies for their solution. A case study is included. Further, the data requirements (such as diffusi-

vity and specific moisture capacity) are highlighted. (See also W90-00215) (Lantz-PTT)
W91-00259

COMPUTER SIMULATION OF AN INJECTED TRACER MOVEMENT.
Central Water and Power Research Station, Poona (India).
N. M. Mahajan.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 423-439, 4 fig, 3 tab, 6 ref.

Descriptors: *Computer programs, *Data interpretation, *Groundwater movement, *Path of pollutants, *Seepage, *Simulation analysis, *Tracers, Aquifers, Flow velocity, Geohydrology, Graphical analysis, Permeability, Porosity.

Problems of seepage hydraulics may be solved using mathematical models written in a finite difference form, and with digital computer programs. These models provide solutions for the two dimensional flow through porous media which gives distribution of groundwater potential at each nodal point. An attempt is made to use the model in a modified form in order to follow the path of an injected tracer, by computing true velocities (porous velocities), from the knowledge of groundwater head distribution, permeabilities, and Darcy velocities. The streamlines are computed by approximating a polygonal succession of straight lines. In each square or rectangular element, velocity vector of streamlines is assumed parallel to the resultant of the porous velocities. The transit time through each segment is computed and totaled to obtain the travel time of the tracer particle from an injection borehole to the observation borehole. Two cases have been studied. In the first case, movement of the tracer is observed in an isotropic aquifer. In the second case tracer movement is observed in a stratified aquifer. The studies indicate that the rate of travel of a tracer is proportional to the permeability of the aquifer. In the case of the stratified aquifer, the inputs of the tracer at the observation points are in proportion to the receptive permeabilities of the strata through which the tracer travels. These studies are useful in predicting contaminant movement. (See also W91-00215) (Lantz-PTT)
W91-00262

INTERACTIVE GROUNDWATER DATABASE SYSTEM.
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W91-00263

BOREHOLE RESISTIVITY LOGGING IN PVC SCREENED WELL.
National Geophysical Research Inst., Hyderabad (India).
S. V. V. Prasada Rao, G. Varadarajan, P. Prabhakara Prasad, K. Subrahmanyam, and T. Seshunarayana.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 457-460, 2 fig, 1 ref.

Descriptors: *Borehole geophysics, *Boreholes, *Data acquisition, *Logging (Recording), *Polyvinyl chloride pipe, *Resistivity surveys, *Screened wells, Porosity, Salinity, Water quality, Wells.

Normal resistivity logs run in a PVC screened well in unconsolidated formations, and exhibit almost the same curve characteristics as that of an open mud-filled hole. The log normal curve is almost identical in both the screened and uncased well. The short normal curve shows a slight increase in resistivity of the screened well when compared to the open well. This method is particularly useful for logging in collapsing formations such as coastal sediments. Periodic logging in PVC screened wells will enable the measurement of changes in porosity and water salinity during the life span of a well. (See also W91-00215) (Lantz-PTT)
W91-00264

TECHNIQUES OF AQUIFER PARAMETER EVALUATION USING POCKET COMPUTERS.
V.O.C. Coll., Tuticorin (India). Dept. of Geology.
A. Balasubramanian, and J. C. V. Sastri.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 461-469, 2 fig, 2 tab, 11 ref, append.

Descriptors: *Aquifers, *Computers, *Data interpretation, *Groundwater movement, *Pumping tests, Computer programs, Mathematical equations, Performance evaluation.

Pocket computer techniques of aquifer parameter evaluation involves both simple and iterative computations. Simple methods enable approximating properties such as transmissivity and storage coefficients, using a least squares approach. Parameter estimation with limited data can also be attempted through iterative techniques. Results obtained with a pocket computer: (1) require less computing time; (2) have simple computational steps; and (3) use less memory constants. Programmable pocket computers cost twenty times less than personal computers, but have the limitations of: (1) using BASIC language; (2) having less memory cells; and (3) have difficulty displaying results. (See also W90-00215) (Lantz-PTT)
W91-00265

ACQUISITION OF HYDROGEOLOGIC DATA FOR THE MAPPING OF SHALLOW UNCONFINED DECCAN BASALTIC AQUIFERS FROM MAHARASHTRA, INDIA.
Poona Univ. (India). Dept. of Geology.
H. Kulkarni, and S. B. Deolankar.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 471-482, 4 fig, 7 ref.

Descriptors: *Aquifers, *Geohydrology, *Hydrologic data collections, *Hydrologic maps, *India, *Maharashtra, Geologic fractures, Groundwater resources, Lithology, Maps, Wells.

The low-permeability Deccan basalts of Maharashtra, India form shallow unconfined aquifers tapped by large-diameter dugwells. The heterogeneity of these aquifers necessitates their detailed geohydrological mapping (on the scale of 1:5000). The basic geohydrological map projects information relevant to the geologic framework of the area, such as: the lithological contacts, the delineation of fracture zones, dykes and the location of dugwells which form the fundamental and in-depth data acquisition unit. The data acquired through the unit, such as subsurface lithological sections, seasonal water levels, and distribution of the areas through which water enters each well, can be used to prepare groundwater maps. Geohydrological maps and the groundwater maps can be effectively used as a base for detailed geohydrological investigations of an area. (See also W90-00215) (Author's abstract)
W91-00266

AQUIFERS OF THE WESTERN MOUNTAIN AREA.
Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland 1988. 229p.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater, *Regional Aquifer-Systems Analysis, Geochemistry, Geology, Groundwater development, Groundwater movement, Groundwater potential, Groundwater resources, Hydraulics, Hydrology, Regional analysis, Western Mountain Region.

Understanding an entire aquifer system is essential for water managers to adequately evaluate the impacts of large groundwater developments. Study of groundwater systems must be done on a regional basis that cuts across the political boundaries. The U.S. Geological Survey instituted the Regional Aquifer-System Analysis (RASA) Program in 1978 to provide the information needed by scientists and managers for proper groundwater development in the U.S. The objectives of each RASA study are to define the regional hydrology and to establish the framework (geologic, hydraulic, and geochemical) for detailed local investigations. This monograph contains papers presented at the special RASA session on Aquifers of the Western Mountain Area held 1-6 November 1987 at Salt Lake City, Utah during the 23rd Annual Conference and Symposium of the American Water Resources Association. Five RASA projects are represented: Northern Great Plains Regional Aquifer (1 paper), Snake River Plain (1 paper), Great Basin (1 paper), Upper Colorado River Basin (8 papers), and San Juan Basin (2 papers). In addition, a list of publications of the RASA studies discussed in the monograph is presented. (See W91-00305 thru W91-00317) (MacKeen-PTT)
W91-00304

REGIONAL BEDROCK AQUIFERS OF THE NORTHERN GREAT PLAINS, NORTH-CENTRAL UNITED STATES.
Geological Survey, Lakewood, CO. Water Resources Div.
J. S. Downey.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 5-13, 3 fig, 23 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater movement, *Regional Aquifer-Systems Analysis, Bedrock aquifers, Great Plains, Hydrodynamics, Petroleum.

At least five major aquifers underlie the northern Great Plains of the United States. These aquifers form a hydrologic system that extends for more than 600 miles from the recharge areas in the Rocky Mountains to discharge areas in eastern North Dakota and the Canadian Provinces of Manitoba and Saskatchewan. The regional groundwater flow system in the aquifers has affected the water composition within the Williston basin. Hydrodynamic forces involved with the flow system may contribute to the accumulation of petroleum within the basin. (See also W91-00304) (Author's abstract)
W91-00305

SNAKE RIVER PLAIN REGIONAL AQUIFER SYSTEM STUDY.
Geological Survey, Boise, ID. Water Resources Div.
G. F. Lindholm.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 15-36, 15 fig, 17 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater, *Groundwater movement, *Regional Aquifer-Systems Analysis, Agricultural water, Basalts, Flow models, Groundwater discharge, Groundwater management, Groundwater recharge, Hy-

draulic conductivity, Hydrologic budget, Irrigation, Model studies, Simulation analysis, Snake River Plain, Springs, Transmissivity, Water use.

Two-thirds of the 15,600 sq mile Snake River Plain and most of the 10,800 square mile eastern part of the plain are underlain by Quaternary basalt of the Snake River Group. Electrical resistivity soundings indicate that, in places, the basalt may be as much as 5,000 ft thick. Water moves horizontally through vesicular, extensively broken flow tops and vertically through fractures. Hydraulic conductivity decreases with depth and most water moves through the upper 200 to 500 ft of the aquifer, where an estimated 200 million to 300 million acre-ft are stored. Model analyses indicate that transmissivity of the upper 200 ft of the basalt aquifer generally exceeds 100,000 sq ft/day and, in places, 1 million sq ft/day. Simulation indicates that transmissivity of the entire aquifer may be as much as 4 million sq ft/day. Water in the aquifer generally flows southwestward. Most discharge is spring flow to the entrenched Snake River between Milner and King Hill. Piezometers verify vertical flow components in recharge and discharge areas. Use of surface water for irrigation since the 1880's increased groundwater recharge, storage, and discharge until the 1950's when trends were reversed. In 1880, about two-thirds of the 3.2 million acre-ft of recharge in the eastern part of the plain was from drainage basins tributary to the plain; all discharge was to the Snake River. In 1980, nearly two-thirds of the 6.7 million acre-feet of recharge was from surface water irrigation and 20% of the discharge was pumpage for irrigation. About 3.1 million acres, or one-third of the plain, were irrigated in 1980; 2 million acres were supplied by surface water, 1 million by groundwater pumped from 5,300 wells, and 0.1 million by combined surface water and groundwater. (See also W91-00304) (Author's abstract)
W91-00306

GROUND-WATER FLOW SYSTEMS OF WESTERN UTAH.
Geological Survey, Salt Lake City, UT. Water Resources Div.
J. S. Gates, and M. S. Bedinger.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 37-55, 9 fig, 19 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater, *Groundwater movement, *Regional Aquifer-Systems Analysis, *Well water, Dissolved solids, Drinking water, Flow system, Great Salt Lake, Groundwater discharge, Groundwater recharge, Selective withdrawal, Sevier Lake, Utah, Water quality.

Groundwater is an important source of supply in western Utah. About 85% of the water withdrawn from wells in Utah is from this area. Most water has been developed from aquifers in basin-fill deposits, although substantial quantities of water also occur locally in carbonate rocks. An estimated 70 million acre-ft of water is stored in the uppermost 100 ft of saturated basin fill. Three regional groundwater flow systems occur in western Utah: Great Salt Lake, Great Salt Lake Desert, and Sevier Lake systems. These flow systems are recharged by water from the mountains and plateaus at the eastern edge of the Basin and Range province and from mountains within the province; movement and discharge of water are along paths to three lowest discharge, or sink areas: Great Salt Lake, Great Salt Lake Desert, and Sevier Desert/Sevier Lake area. Groundwater in the major areas of withdrawal is generally of suitable quality for public supply, commonly containing less than 1,000 mg/L of dissolved solids. Areas with the best quality groundwater, containing less than 500 mg/L of dissolved solids, are in the mid-elevation to upper-elevation parts of local flow systems. Groundwater in the lower parts of the local flow systems contains concentrations of dissolved solids generally exceeding 1,000 mg/L, at least partly because natural discharge has concentrated salts in the water. (See also W91-00304) (Author's abstract)
W91-00307

UPPER COLORADO RIVER BASIN REGIONAL AQUIFER-SYSTEMS ANALYSIS: MESOZOIC ROCKS IN COLORADO, UTAH, AND WYOMING, ARIZONA, AND NEW MEXICO.
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. W. Freethey.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 57-70, 7 fig, 1 tab, 6 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater, *Groundwater movement, *Groundwater resources, *Regional Aquifer-Systems Analysis, Arizona, Calcium bicarbonate, Colorado, Flow system, Groundwater discharge, Groundwater management, Groundwater recharge, Mesozoic rocks, New Mexico, Saline water, Transmissivity, Upper Colorado River Basin, Utah, Water supply, Wyoming.

The Upper Colorado RIver Basin Regional Aquifer-Systems Analysis (RASA) began in 1981 and was the 14th such study conducted by the U.S. Geological Survey. Mesozoic rocks underlie about 85,000 sq mi in the Upper Colorado River Basin, excluding the Upper San Juan River Basin in New Mexico. In places, within the deep structural basins of southwestern Wyoming, northwestern Colorado, and northeastern Utah, the thickness of these sedimentary rocks exceeds 15,000 ft. To facilitate more detailed analysis, the Mesozoic rocks were divided into five aquifers and five confining units. The five aquifers contain about 10 billion acre-ft of water, but much of it is deep below the land surface and saline. Only about 5% of the water is considered recoverable and suitable for most uses. Recharge to and discharge from the regional groundwater system in Mesozoic rocks is estimated to be about 1 million acre-ft/year. The aquifers in the southern one-half of the basin contain most of the usable groundwater in sandstone. The sandstone may be fractured locally. Transmissivity exceeds 2,000 sq ft/day in small parts of the areas where saturated thickness is several thousand feet and locally where aquifers are extremely fractured. The fresh water generally is a calcium bicarbonate type and the briny water is a sodium chloride type. Region-wide development of the groundwater resources in rocks of Mesozoic age has been negligible, but development has affected some aquifers locally. (See also W91-00304) (Author's abstract)
W91-00308

SOURCES OF HYDROLOGIC DATA ON MESOZOIC FORMATIONS IN THE UPPER COLORADO RIVER BASIN AND COMPARISON OF DATA ANALYSIS METHODS.
Geological Survey, Albany, NY. Water Resources Div.
J. F. Weigel.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 71-80, 4 fig, 11 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Data acquisition, *Data interpretation, *Geohydrology, *Groundwater resources, *Hydrologic data, *Regional Aquifer-Systems Analysis, Analytical methods, Data collections, Groundwater management, Hydraulic conductivity, Mesozoic rocks, Upper Colorado River Basin, Water level, Water supply, Wells.

Hydrologic data were collected and compiled from publications and from public and private sources for an aquifer systems analysis of the Upper Colorado River Basin. Hydrologic and lithologic data representing 104 Mesozoic formations were obtained; these provide coverage throughout the study area but not for the entire extent of any one formation. The data (representing 1,208 sites) were obtained through five methods of collection and analysis, but the resulting values for hydrologic properties are not directly comparable because the methods of data collection present differing volumes of aquifer. The methods include aquifer tests (73), which represent the largest aquifer volume; specific-capacity tests (380) and drill-stem tests (630), which represent a somewhat smaller aquifer volume; slug-injection tests (8), which represent a still smaller aquifer volume; and analyses of cores (from 262 sites), which represent the smallest aquifer volume. Two or more methods were used at some sites. Hydraulic conductivity (K), in millidarcies per centipoise, can be closely estimated from a sample's permeability to air (k) in millidarcies. Water level data from 1,125 water wells and 1,871 petroleum test holes were obtained; those measured in water wells are more accurate than those calculated from formation fluid pressures in petroleum test holes. (See also W91-00304) (Author's abstract)
W91-00309

LITHOLOGIC AND HYDROLOGIC PROPERTIES OF MESOZOIC ROCKS IN THE UPPER COLORADO RIVER BASIN.
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. W. Freethey.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 81-99, 12 fig, 1 tab, 13 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Geohydrology, *Groundwater resources, *Hydrologic properties, *Lithology, *Regional Aquifer-Systems Analysis, Geohydrologic units, Groundwater management, Groundwater storage, Hydraulic conductivity, Mesozoic rocks, Porosity, Sandstones, Stratigraphy, Upper Colorado River Basin.

Lithologic and hydrologic properties of 5 aquifers and 5 confining units of Mesozoic rocks were determined for the Upper Colorado River Basin Regional Aquifer Systems Analysis (RASA) by laboratory tests, drill-stem tests, specific capacity tests, and miscellaneous field tests using pumping and flowing wells. Most Mesozoic sandstones are very fine to fine grained and contain differing amounts of silica or carbonate cement. For Mesozoic sandstones, the relationship between grain size statistical parameters, such as mean size, sorting, skewness and kurtosis, and hydraulic conductivity, is indefinite probably because of the differing degree of cementation. Effective porosity ranges from less than 10 to 30% in aquifers, and generally decreases with depth. Geohydrologic units designated as aquifers and those designated as confining units are distinguishable on the basis of relative differences in permeability to air. Aquifers generally are from 3 to 70 times more permeable than overlying or underlying confining units. Hydraulic conductivity is largest in the Morrison, Navajo-Nugget, and Entrada-Preuss aquifers and smallest in the Dakota and Mesaverde aquifers. Hydraulic conductivity decreases with increasing depth and decreasing dissolved solids concentration. Despite differences in effective porosity, permeability, and hydraulic conductivity among aquifers, groundwater storage capacity probably is largest in the thickest units: the Mesaverde and Navajo-Nugget aquifers. Hydraulic conductivity values derived from various methods differ somewhat, but only the values from drill-stem tests were significantly different. Values derived from drill-stem tests are smaller because tested intervals are deeper and the rocks probably are more cemented than in inter-

vals analyzed by other methods. (See also W91-00304) (Author's abstract)
W91-00310

HYDROLOGY OF THE NAVAJO SANDSTONE IN SOUTHEASTERN AND SOUTHERN UTAH.
Geological Survey, Albuquerque, NM. Water Resources Div.
P. J. Blanchard.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 101-119, 12 fig, 1 tab, 17 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater, *Groundwater resources, *Hydrologic properties, *Navajo Sandstone, *Regional Aquifer-Systems Analysis, Groundwater discharge, Groundwater management, Groundwater recharge, Hydraulic conductivity, Lithology, Porosity, Sandstones, Transmissivity, Utah.

The hydrology of the Navajo Sandstone has been investigated in about 27,000 square miles of southeastern and southern Utah. The Navajo Sandstone is mostly a fine-grained, well sorted, crossbedded, eolian sandstone of Triassic and Jurassic age. The lithology of the Navajo Sandstone is nearly uniform throughout both its areal and vertical extent. The Navajo Sandstone thickens westward from being locally absent near the Colorado State line to about 2,000 ft in southwestern Utah. No readily apparent geographical trend exists in median grain size, sorting coefficient, or porosity. A general northeast to southwest increase in horizontal hydraulic conductivity occurs, ranging from less than 1 ft/day in the northeast to about 2 or more ft/day in the southwest. A general northeast to southwest increase in transmissivity also occurs, ranging from about 2,000 feet squared per day in the northeast to about 5,000 sq ft/day in the southwest. This increase is due to the increase in thickness and hydraulic conductivity of the Navajo Sandstone in the same direction. Recharge to the Navajo Sandstone occurs mostly from winter precipitation. The quantity of recharge is larger where the formation is extensively fractured or where the formation is overlain by thick, sandy, unconsolidated deposits. Natural discharge from the Navajo typically occurs as seeps and small springs that have rates of discharge of less than 5 gal/min, but that have been reported to be as large as 390 gal/min. Rates of discharge from wells range from less than 1 to more than 3,000 gal/min, and generally increase from northeast to southwest. The larger rates of discharge typically occur near structural features where the formation is extensively fractured. (See also W91-00304) (Author's abstract)
W91-00311

GEOCHEMISTRY OF WATER ASSOCIATED WITH THE NAVAJO SANDSTONE AQUIFER, SAN RAFAEL SWELL AREA, UTAH.
Geological Survey, Denver, CO. Water Resources Div.
B. A. Kimball.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 121-133, 7 fig, 2 tab, 22 ref.

Descriptors: *Aquifer characteristics, *Aquifers, *Geochemistry, *Geohydrology, *Groundwater dating, *Navajo Aquifer, *Navajo Sandstone, *Regional Aquifer-Systems Analysis, *Stable isotopes, *Water chemistry, Carmel formation, Dissolved solids, Groundwater recharge, Minerals, Saline water, Utah.

Water samples collected from the Navajo aquifer in south-central Utah indicate that there are areas that have dissolved solids concentrations larger than normal for the region. These larger concentrations result solely from chemical reactions between aquifer minerals and the groundwater. Stable isotope ratios of water samples collected from the aquifer indicate that, in some areas, water in the Navajo Aquifer may have acquired solutes from dissolving minerals in the Carmel Formation. Those groundwater samples with the greatest salinity have stable isotope ratios characteristic of water in the Carmel Formation. After accounting for the sources of bicarbonate in these waters, the ages determined by C-14 activity were corrected. The resulting ages ranged from 8,100 to 15,600 years in samples distant from recharge areas. This range corresponds to the high stand of late Pleistocene lakes, and may indicate that recharge occurred during wetter climatic conditions. (See also W91-00304) (Author's abstract)
W91-00312

HYDROSTRATIGRAPHIC CHARACTERIZATION OF PALEOZOIC FORMATIONS IN THE UPPER COLORADO RIVER BASIN, ARIZONA, COLORADO, NEW MEXICO, UTAH, AND WYOMING.
Geological Survey, Denver, CO. Water Resources Div.
A. L. Geldon.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 135-159, 12 fig, 3 tab, 41 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater movement, *Hydrologic properties, *Regional Aquifer-Systems Analysis, Arizona, Colorado, Flow system, Groundwater recharge, Hydrostratigraphy, New Mexico, Paleozoic rocks, Stratigraphy, Upper Colorado River Basin, Utah, Wyoming.

The stratigraphy, hydrologic properties, and hydrodynamics of Paleozoic sedimentary rocks in the Upper Colorado River Basin were investigated as part of the Regional Aquifer Systems Analysis program of the U.S. Geological Survey. The study area includes parts of the Middle Rocky Mountains, Southern Rocky Mountains, Wyoming Basin, and Colorado Plateaus physiographic provinces. Paleozoic formations from all systems except the Silurian are present. Their combined thickness ranges from 0 to 18,000 ft. Depths of burial range from 0 to 27,000 ft. The Paleozoic rocks comprise 11 hydrostratigraphic units: two regional aquifers, four local aquifers, and five confining layers. The largest values of porosity, permeability, hydraulic conductivity, transmissivity, and artesian well and spring yield are consistently exhibited by the two regional aquifers: the Devonian and Mississippian carbonate rocks hydrostratigraphic unit and the Pennsylvanian and Permian sandstone hydrostratigraphic unit. The smallest values of these properties are consistently exhibited by the confining layers. Transmissivity within individual hydrostratigraphic units ranges from 0.001 to 47,000 sq ft/day; yields range from less than 1 to 10,000 gal/min. Recharged mostly by precipitation and leakage from streams, groundwater moves from peripheral and internal divides to structural basins and stream valleys, where springs, seepage to stream alluvium, production from wells, evapotranspiration, upward movement to Mesozoic and Tertiary rocks, and outflow to Pennsylvanian shale and carbonate rocks hydrostratigraphic unit and the Mississippian and Pennsylvanian carbonate rocks and evaporites hydrostratigraphic unit separate the Paleozoic rocks into two flow systems. Vertical exchange of water between these flow systems occurs locally. (See also W91-00304) (Author's abstract)
W91-00313

GEOPHYSICALLY DETERMINED POROSITY OF PALEOZOIC ROCKS IN THE UPPER COLORADO RIVER BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
G. A. Wetherbee, and W. P. Van Liew.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 161-169, 6 fig, 2 tab, 8 ref.

Descriptors: *Aquifer characteristics, *Borehole geophysics, *Geohydrology, *Geophysical surveys, *Groundwater resources, *Paleozoic rocks, *Porosity, *Regional Aquifer-Systems Analysis, Aquifers, Data interpretation, Dolomite, Geologic formations, Limestone, Sandstones, Upper Colorado River Basin.

As part of the Regional Aquifer System Analysis of the Upper Colorado River Basin, porosity of mostly clean Paleozoic sandstone, limestone, and dolomite formations was estimated from borehole geophysical logs of oil and gas exploration wells. Assumptions concerning physical properties of formations, such as lithology, formation and interstitial fluid densities, and sonic pulse transmit times, enabled porosity to be calculated from sonic, bulk-density, and neutron-porosity logs. Geophysical porosity values determined from these logs were compared with porosity determined in the laboratory from borehole core samples. Average porosity values were 1.0-16.2% for Permian and Pennsylvanian sandstone, 0.4-10.5% for Mississippian and Devonian carbonate rocks, 5.0% for Ordovician rocks from one well in Bighorn Dolomite, and 11.7% for Cambrian rocks from one well in Sawatch Quartzite. (See also W91-00304) (MacKeen-PTT)
W91-00314

POROSITY AND PERMEABILITY OF THE PALEOZOIC ROCKS IN THE UPPER COLORADO RIVER BASIN, ARIZONA, COLORADO, NEW MEXICO, UTAH, AND WYOMING.
Geological Survey, Denver, CO. Water Resources Div.
A. L. Geldon.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 171-190, 13 fig, 2 tab, 23 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Geohydrology, *Paleozoic rocks, *Permeability, *Porosity, *Regional Aquifer-Systems Analysis, Anhydrite, Aquifers, Dolomite, Halite, Hydrologic properties, Limestone, Lithology, Sandstones, Sedimentary rocks, Shales, Stratigraphy, Upper Colorado River Basin.

The porosity and permeability of Paleozoic sedimentary rocks in the Upper Colorado River Basin were studied as part of the Regional Aquifer Systems Analysis program of the U.S. Geological Survey. Among common rock types, sandstone was found to have the highest porosity and intergranular permeability, followed by dolomite, limestone, shale, anhydrite, and halite. The porosity and intergranular permeability of sandstone increase with increasing grain size and decreasing amounts of interstitial minerals and cement. The porosity and intergranular permeability of carbonate rocks are smallest in fine-grained, crystalline, laminar, and brecciated varieties and largest in grainy, vuggy, and nodular varieties. Intergranular permeability in sandstone appears to be related to porosity in most hydrostratigraphic units, whereas carbonate rocks in many hydrostratigraphic units display little or no correlation between the two hydrologic properties. There is virtually no relation between either porosity or intergranular permeability and depth in Paleozoic carbonate rocks and only a vague relation between these hydrologic properties and depth in Paleozoic sandstone. The permeability of all hydrostratigraphic units increases from structural basins to uplifted areas as

the rocks comprising them become more fractured and less cemented. On the average, sandstone is more porous but less permeable in aquifers than in confining layers; dolomite is more porous but less permeable; limestone is less porous and permeable; and shale is more porous but equally permeable. In-situ permeability generally is larger than intergranular permeability because of fractures and solution channels. Median ratios of orthogonally measured intergranular permeability range from 1:1 to 3:1. (See also W91-00304) (Author's abstract)
W91-00315

USING A GEOGRAPHIC INFORMATION SYSTEM TO DEVELOP A GROUND-WATER FLOW MODEL.
Geological Survey, Albuquerque, NM. Water Resources Div.
J. M. Kernodle, and R. D. Philip.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 191-202, 5 fig, 7 ref.

Descriptors: *Computer models, *Flow models, *Geographic information systems, *Geohydrology, *Groundwater movement, *Model studies, *Regional Aquifer-Systems Analysis, Aquifers, Arizona, Colorado, Flow system, Groundwater recharge, Morrison Formation, New Mexico, San Juan Basin, Traveltime, Utah.

A geographic information system was used to manipulate spatial data and formulate those data as input for a preliminary, three-dimensional, finite-difference, groundwater flow model of the flow system in the Morrison Formation and the Dakota and Gallup Sandstones in the San Juan structural basin of New Mexico, Colorado, Arizona, and Utah. The primary purpose of the model was to aid in the selection of sampling sites for the age dating of groundwater by developing preliminary numerical estimates of predevelopment hydraulic heads, flow paths, and travel times of water from recharge areas to potential sample sites in the Morrison Formation. During the compilation of model input, a set of semi-automated procedures using a geographic information system to process spatial data was tested and refined. When the procedures were refined, the model grid was redimensioned and the redefined model was operational in 2 days. These procedures provide the potential to: (1) easily test large-scale, finite-difference models for their sensitivity to grid dimension and orientation; and (2) allow the hydrologist to concentrate on accurate spatial analysis of hydrologic properties rather than on subjective cell by cell parameter assignments, which are tedious and difficult to change. The techniques that were refined during the preparation of the preliminary model will be used to prepare a much more encompassing and detailed groundwater flow model that will be used to simulate a minimum of 14 aquifers and confining units. (See also W91-00304) (Author's abstract)
W91-00316

METHODS AND PRELIMINARY RESULTS OF GEOCHEMICAL SAMPLING, SAN JUAN BASIN, NEW MEXICO, COLORADO, ARIZONA, AND UTAH.
Geological Survey, Albuquerque, NM. Water Resources Div.
W. L. Dam.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 203-217, 7 fig, 25 ref.

Descriptors: *Aquifer characteristics, *Aquifers, *Chemical analysis, *Data acquisition, *Geochemistry, *Geohydrology, *Groundwater movement, *Regional Aquifer-Systems Analysis, *Sampling, *Water analysis, Flowing wells, Groundwater dating, Meteoric water, Morrison Formation, New Mexico, Radioisotopes, San Juan Basin, Stable isotopes, Water sampling.

Geochemical data were collected by the U.S. Geological Survey from aquifers in Jurassic and Cretaceous rocks in the New Mexico part of the San Juan Basin to evaluate regional trends in groundwater flow and geochemistry. Standard methods including on-site precipitation of C-14 were used to collect samples for dissolving constituents, stable isotopes, and radioactive isotopes. Sixteen flowing wells completed primarily in the Jurassic Morrison Formation in the northwest part of the basin were sampled in 1986. The following general trends in concentrations were present down-gradient from recharge areas: major cations, chloride, sulfate, bromide, fluoride, iodide, iron, and strontium increased; pH, bicarbonate, and carbonate decreased; organic carbon, silica, and most trace elements did not change significantly. Stable isotopes of oxygen and hydrogen in 11 samples near the basin margin indicate a meteoric water origin; 3 samples from the central part of the basin were relatively depleted in deuterium. The median values for delta S-34 (sulfate) and delta C-13 were 10.1 and -10.4 permil. Only in one of four samples analyzed did C-14 exceed the detection limit; it had an activity of 3.1 +/-0.2 percent modern carbon. On the basis of 1986 results, samples were collected in 1987 for delta S-34 in on-site precipitated sulfide and for Cl-36. (See also W91-00304) (Author's abstract)
W91-00317

HYDROGEOLOGY OF THE DINARIC KARST.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
B. F. Mijatovic.
International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. 254p.

Descriptors: *Aquifer systems, *Dinaric Karst, *Geohydrology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Geologic formations, Geology, Groundwater development, Groundwater movement, Regional analysis, Water resources, Water table.

This monograph on the hydrogeology of the Dinaric Karst in Yugoslavia was prepared on the occasion of the Field Trip to the Dinaric Karst of 15-28 May 1983, which was organized by the International Association of Hydrogeologists (Yugoslav National Committee). The original concept of the study of karst as an exceptional natural phenomenon is being supplanted more and more by approaches oriented towards rational and complete utilization of water resources, paying due consideration to technical, economic and social aspects. The volume includes 13 papers prepared by Yugoslav authors dealing with karst hydrology and methods of investigation. It is intended as a broad insight into the hydrogeologic problems of the Dinaric Karst, and thus a contribution to a wider and more comprehensive exchange on problems of hydrogeological systems in karst areas worldwide. (See W91-00319 thru W91-00330) (MacKeen-PTT)
W91-00318

GEOLOGY OF KARST TERRAINS AND THEORY IN THE WORKS OF JOVAN CVIJIC.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 8E.
W91-00319

HYDROGEOLOGIC REGIONAL CLASSIFICATION OF KARST IN YUGOSLAVIA.
Institute of Geology, Zagreb (Yugoslavia).
A. Sarin.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 42-54, 1 fig, 18 ref.

Descriptors: *Aquifer systems, *Aquifers, *Geohydrology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Geohydrologic boundaries, Groundwater, Regional analysis.

A hydrogeologic regional classification scheme of karst in Yugoslavia is presented, beginning with a review of previous classifications introduced from 1909 to 1977. The present scheme was shaped by actual hydrogeologic conditions as well as their practical consequences, and by integrity in geographic distribution. The four regional classes of karst in Yugoslavia were designated: Adriatic Karst Belt, High Karst Belt, Fluviokarst Belt, and Isolated Karst. The first three belts represent subregions of the Karst Hydrogeologic Region, while the Isolated Karst are isolated karst regions within two remaining hydrogeologic regions of Yugoslavia, the Inner Region in the central and eastern parts, and the Pannonian Region in the north-central and north-eastern parts of the country. The Karst Hydrogeologic Region comprises an integral, long and wide belt in the southwest part of Yugoslavia. Its southwest border is the southwestern coastline of the extreme Adriatic Islands and its northeastern border is the boundary of the Inner Hydrogeologic Region. All of the islands are included. The region is about 650 km long and 60-150 km wide for the continental region, or 159-200 km wide when the islands are included. The area amounts to about 69,650 sq km. The Isolated Karst is widely dispersed over the remaining two hydrogeologic regions in a total area of approximately 18,300 sq km. All the four subregions give a total area of karst terrains near 88,000 sq km, which is 34% of the Yugoslavian territory. (See also W91-00318) (MacKeen-PTT)
W91-00320

HYDROGEOLOGIC FEATURES OF THE DINARIC KARST.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
M. Komatina.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 55-73, 5 fig, 9 ref.

Descriptors: *Aquifer systems, *Aquifers, *Dinaric Karst, *Geohydrology, *Groundwater movement, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Adriatic Sea, Black Sea, Catchment areas, Flow velocity, Geohydrologic boundaries, Geohydrologic units, Groundwater, Groundwater discharge, Groundwater recharge, Limestone.

A review of the hydrogeologic features of the Dinaric Karst Region in Yugoslavia is presented. The region is composed mainly of limestone with a porosity generally ranging from 0.5 to 1.5%. The Dinaric Region is characterized by extremely high precipitation, typically 2000 mm/yr for the majority of mountainous areas. The distribution and movement of groundwater in the region has been extensively studied. In particular, the position of the Adriatic/Black Sea watershed has been described. Water from more than two-thirds of the Dinaric Karst Region flows to the Adriatic Sea. Direction of flow was studied using sodium fluorescein and other tracers, revealing the following general conditions: (1) concentration of flow directions from a series of ponors towards a single water body, and (2) radial dispersion of a beam of directions from a single ponor towards a larger number of underground water bodies. The average water flow velocity for the region was 3.6 cm/s. Considering only stronger water discharge (greater than 0.5 cu.m./s), there are 105 drainage points, 60% of which are waters of the Adriatic catchment area and the rest are springs from the Black Sea catchment area. A review of the more important hydrogeologic units of the Adriatic and the Black Sea catchment areas is also presented. (See also W91-00318) (MacKeen-PTT)
W91-00321

SPELEOLOGICAL PHENOMENA OF DINARIC KARST.
Institute for Karst Research, Postojna (Yugoslav-

ia).
P. Habic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 74-86, 1 fig, 35 ref.

Descriptors: *Aquifer systems, *Aquifers, *Caves, *Dinaric Karst, *Geohydrology, *Geomorphology, *Karst, *Regional Aquifer-Systems Analysis, *Yugoslavia, Cavern flow, Groundwater, Groundwater movement, History, Limestone.

A review of the speleological properties of the Dinaric Karst showed that the main factors influencing these properties are complicated geological setting, differentiated relief, high humidity, and varied geologic history. The history of speleological investigations in the region can be divided into two important periods: the period from the mid-16th century to the end of the 19th century, characterized by individual expeditions, and the period since 1883, when the first speleological society was founded. Dinaric karst can be divided by general orographic morphological properties into three longitudinal zones: Low Littoral Karst, High Dinaric Karst, and Inner Dinaric Karst. Speleological properties differentiate after particular hydrogeological units, with direction of underground runoff playing an important role. Karst caverns in pure limestone of deep karst can be divided by form and origin into two basic types: (1) mostly corrosional vertical potholes, and (2) erosional caves. Simple, deep potholes, composed potholes, snow potholes, horizontal karst caverns, dry karst caverns, and active water caves are all speleological features found in the Dinaric Karst. (See also W91-00318) (MacKeen-PTT)
W91-00322

KARST POLJES IN DINARIDES.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
B. F. Mijatovic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 87-109, 5 fig, 3 tab, 15 ref.

Descriptors: *Aquifer systems, *Dinaric Karst, *Geohydrology, *Geologic formations, *Geology, *Geomorphology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Carbonate rocks, Groundwater, Groundwater movement, Poljes, River sediments, Sediments.

The genesis, evolution and geohydrological functioning of karst poljes in the Dinarides is reviewed. Karst poljes, which are typically closed depressions, are the largest form of carbonate rock megarelief. The two most important factors in the formation of karst poljes in the Dianarides mountainous territories were geological and paleoclimatic. Common features of karst poljes in the Dinarides include elongated shape, direction from northwest to southeast, variable size (1-433 cu km), steplike position, tectonic predisposition, and flat bottom covered by stream sediment deposits. Surface water of karst poljes drain through underground routes, and poljes are periodically flooded. Present karst poljes forms are not a result of river erosion, but originated from accumulation of loose sediments deposited by water currents in the lowest parts of former karst relief. The hydrodynamic regime in karst poljes depends on three basic factors: (1) lithologic composition of the rocks forming the karst polje base; (2) hypsometric position of the polje in regard to the lower groundwater draining steps; and (3) presence or absence of hydrogeologic barriers in the polje. (See also W91-00318) (MacKeen-PTT)
W91-00323

REVIEW OF SOME SIGNIFICANT PONORS IN SINJSKO AND DUVANJSKO POLJES.
Institute of Geology, Zagreb (Yugoslavia).
S. Bozicevic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 110-114, 3 fig.

Descriptors: *Aquifer systems, *Geohydrology, *Geologic formations, *Geology, *Geomorphology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Sinkholes, *Yugoslavia, Canals, Dinaric Karst, Groundwater level, Groundwater movement, Limestone, Underground streams.

The geological features of selected ponors in Sinjsko and Duvanjsko Poljes are reviewed. The Sinjski Ponor Zone is located on the western margin of former Busko blato and consists of a natural channel and a number of additionally drilled sections. The complex morphology of the Sinjski Ponor and detection of water flow at the lowest drilled holes indicate an abrupt lowering of the groundwater level at the margin of the polje. The Stara Mlinica Ponor is the best known ponor of the Busko blato. It is closely connected with the fractured limestone zone and serves to discharge high waters. The Kovaci Ponor is in the Duvanjsko Polje. The entrance to the ponor has two holes, over 20 m wide and high. This structure contains horizontal canals which at a distance from the entrance continue in the form of syphon basins. The total length of all underground canals investigated in this ponor to date is 180 m. (See also W91-00318) (MacKeen-PTT)
W91-00324

PROBLEMS OF SEA WATER INTRUSION INTO AQUIFERS OF THE COASTAL DINARIC KARST.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
B. F. Mijatovic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 115-142, 15 fig, 1 tab, 7 ref.

Descriptors: *Aquifer systems, *Coastal aquifers, *Geohydrology, *Groundwater management, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Saline water barriers, *Saline water intrusion, *Water quality, Aquifers, Boreholes, Dinaric Karst, Groundwater barriers, Groundwater level, Pumping, Water resources, Water supply, Yugoslavia.

The problems of sea water intrusion into aquifers of the coastal Dinaric karst are discussed. Littoral karst aquifers subject to sea water intrusion can be divided into two groups: aquifers opened to the sea and aquifers with incomplete barriers to the sea. In aquifers opened to the sea, exploitation of the fresh water zone always causes the intrusion of brackish water into the fresh water zone. In general, the intensity of this disturbance is less for greater distance between the captage and the sea. Captages consisting of horizontal drainage galleries provided the maximum water yields and the fewest salt water effects by regulation of pumping rate or by construction of an artificial barrier perpendicular to the direction of water circulation. In littoral karst aquifers with incomplete barriers to the sea, sea water intrusion is localized to that part of the aquifer between sea level and the contact surface of the aquifer with the impermeable barrier. To avoid penetration of salt water into captage, it is necessary to stop pumping at any sudden disturbance of water level, or to increase the piezometric level of fresh water over the minimum critical water level. To protect against saline water intrusion, it is necessary to install a network of observation boreholes for measuring the brackish zone, both in its vertical and horizontal profiles. Examples of fresh water captation works in the Dinaric Karst Region include the coastal karst region from Split to Sibenik, the Patan Spring area, and the Gustirna Uvala. (See also W91-00318) (MacKeen-PTT)
W91-00325

APPLICATION OF GEOPHYSICAL METHODS TO HYDROGEOLOGICAL PROBLEMS IN DINARIC KARST OF YUGOSLAVIA.
Geophysical Institute, Belgrade, Yugoslavia.
For primary bibliographic entry see Field 7B.
W91-00326

SOME METHODS OF HYDROGEOLOGIC EXPLORATION AND WATER REGULATION IN THE DINARIC KARST WITH SPECIAL REFERENCE TO THEIR APPLICATION IN EASTERN HERZEGOVINA.
Karst Water Research Inst., Trebinje (Yugoslavia).
P. Milanovic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 160-200, 16 fig, 7 ref.

Descriptors: *Aquifer systems, *Data acquisition, *Geohydrology, *Geophysical surveys, *Groundwater management, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Water resources management, *Yugoslavia, Dinaric Karst, Geologic formations, Geology, Groundwater development, Groundwater level, Groundwater movement, Herzegovina, Hydroelectric plants, Instrumentation, Poljes, Underground streams, Water resources.

Methods of hydrogeologic exploration and water regulation in the Dinaric Karst and applications in eastern Herzegovina are reviewed. Exploration methods have included preparation of geologic maps, speleology, exploration boreholes, automatic recording instruments, radioactive tracers, geobomb, remote detection, and seismologic monitoring. The evolution process of karst collectors can be divided into two global stages, pre-Savian and neotectonic, with two periods, the Pliocene-Pleistocene period, and the end of the Pleistocene period (the recent period). Basic geohydrologic parameters of the karst areas of Montenegro, eastern Herzegovina and coastal Dubrovnik are: (1) high outflow coefficient (0.7-0.8); (2) porosity of karstified rock of 0.79% to as high as 6-10%; (3) depth of karstification of surface to 15 m for most of the mass, with a base at 250 m; (4) large fluctuations in water levels; (5) underground water flow rates of 0.002-55.2 cm/s (average 0.5-0.9 cm/s); and (6) infiltration and discharge zones. The Fatnicko and Dabarsko Poljes, the Bregava River, the Popovo Polje, and the Buna River Spring described. Exploration and water regulation projects undertaken in the area include the closing of the Obod Estavella by concrete plug, the submersion of the Trebisnjica River sources, and the study of the 'Hutovo' accumulation. The construction of the first phase of the Trebisnjica Hydro-System has greatly changed the regime of surface and underground waters in the eastern Herzegovina region and in the Dubrovnik littoral belt and Neretva River Valley. (See also W91-00318) (MacKeen-PTT)
W91-00327

HYDROGEOLOGIC FEATURES OF TYPICAL KARST TERRAINS IN MONTENEGRO.
Institute of Geological Research, Titograd, Yugoslavia.
V. Radulovic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 201-227, 18 fig.

Descriptors: *Aquifer systems, *Dinaric Karst, *Geohydrology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Springs, *Yugoslavia, Flooding, Geologic formations, Geology, Groundwater development, Groundwater movement, Groundwater pollution, Montenegro, Poljes, Potable water, Surface-groundwater relations, Underground streams, Water resources, Water table.

The major part of the territory of Montenegro belongs to the high karst zone, which is very complex. Hydrogeologic features of the terrain include Niksicko Polje region, representing a system of large and small tectonic folds, the Gornja Zeta catchment area, comprising rocks of

the Paleozoic Mesozoic and Cenozoic age, extended areas of Quaternary sediments, surface springs and ponors. There is 80% inflow in autumn and spring, periodic flooding and large oscillations in the water table. The location of karst springs in the region is detailed. Concentration of population in the Niksicko Polje and industrial development have resulted in pollution of the soil and groundwater in the area. While there is lack of potable water during dry seasons of the year all along the periphery of the Boka Kotorska Bay, during the rainy seasons, abrupt discharge of groundwater from dispersed karst water bodies produces severe damages. (See also W91-00318) (MacKeen-PTT)
W91-00328

HYDROGEOLOGICAL FEATURES OF SOME NORTHERN DALMATIA LITTORAL KARST PARTS, LIKA AND CROATIAN LITTORAL.
Institute of Geology, Zagreb (Yugoslavia).
F. Fritz, S. Bahun, B. Biondic, A. Polsak, and Z. Vulic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 228-239, 2 fig.

Descriptors: *Aquifer systems, *Dinaric Karst, *Geohydrology, *Groundwater movement, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Dalmatia, Geologic formations, Geology, Groundwater development, Groundwater management, Hydroelectric plants, Littoral zone, Sinkholes, Springs, Water resources.

A description of the geohydrologic features of northern Dalmatia karst terrain is presented. The terrain of this low coastal region of Ravni Kotari is composed of a series of parallel northwest to southeast folds. Groundwater circulates through permeable deposits of Cretaceous carbonate and Eocene formaminifere limestone. The Middle Eocene flysh as a whole is water impermeable. Sea level fluctuation in the past 25,000 years is an important factor in karst features development and sea water intrusion. Important geohydrologic features of the region include: (1) Velebit Mountain, characterized by specific karst morphology and now a protected region,; (2) Lake Vranjsko, 30 sq m in area and 4-5 m deep, it is partitioned from the sea by a mountain ridge of Cretaceous and Eocene limestone; (3) the Obrovac Power Plant, a reversible type of plant under construction; (4) the Tucic Ponor, which absorbs flood waters from the Ricica watershed during the rainy season; (5) the Plitvicka Jezera Lakes, a National Park since 1949; (6) the Kruscica Accumulation Basin, which contains 140 million cu m of water and utilizes the Lika and Gacka Rivers for hydropower and agriculture; (7) Horvatova and Poljakova Pecina Caves, both extensively karstified; (8) Perinka Ponor, one in a series of 20 ponors on the northern slopes of Velebit Mountain; (9) submarine and coastal springs at Jurjevo, at the foot of the northern slope of Velebit; (10) the Bay of Baka, 280 l/s underground water was captured; and (11) Zwir II Water Catchment, designed for catchment of water from the springs on the right bank of the Rjecina River. (See also W91-00318) (MacKeen-PTT)
W91-00329

HYDROGEOLOGIC FEATURES OF SOME KARST PARTS OF SLOVENIA.
Institute for Karst Research, Postojna (Yugoslavia).
R. Gospodaric.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 240-254, 6 fig.

Descriptors: *Aquifer systems, *Dinaric Karst, *Geohydrology, *Groundwater resources, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, Caves, Geohydrologic units, Geologic formations, Geology, Groundwater development, Groundwater movement, Slovenia, Springs, Surface-groundwater relations, Water resources, Yugoslavia.

Geohydrologic features of Slovenia, in northwestern Yugoslavia, were examined. In this region, the geologic structure and hydrogeologic units of Dinaric Karst become more narrow, and in the northwest they disappear under alluvium of Furlania, while on the other side the alpine karst of the Julian Alps begins. The caves in through-flow karst developed mostly on the level of karst rivers, as assessed by direct water tracing methods. Indirect methods were used to delineate the zones of shallow and deep karst. Important geohydrologic features of the region include: (1) the Novokracine Blind Valley, developed in the passage of Eocene flysh to Paleocene and Cretaceous limestones; (2) the Pivka Basin of Ilirska Bistrica, characterized by periodic lakes and karst springs and shallow, through-flow karst; (3) Postojna Cave System, where the Pivka River sinks underground; (4) Skocjanske Jame and Divaca Karst, caves typical of deep, contact karst; (5) Lipica, classical karst area with important natural and tourist functions; (6) karst groundwater near Brestovica, pumped from heterogeneous karst aquifers without significantly lowering the groundwater level; (7) Mrzlek Karst Springs, exploited for water supply; (8) Karst Spring Boka in Soca River Valley; and (9) Bled, a tourist town with glacial relief forms, moraines and terraces of glacial and fluvioglacial sediments. (See also W91-00318) (MacKeen-PTT)
W91-00330

GEOHYDROLOGY AND REGIONAL GROUND-WATER FLOW OF THE COASTAL LOWLANDS AQUIFER SYSTEM IN PARTS OF LOUISIANA, MISSISSIPPI, ALABAMA, AND FLORIDA--A PRELIMINARY ANALYSIS.
Geological Survey, Baton Rouge, LA.
A. Martin, and C. D. Whiteman.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 88-4100, 1989. 88p, 63 fig, 2 tab, 67 ref, 2 plates in pocket.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Coastal aquifers, *Geohydrology, *Groundwater movement, *Regional Aquifer-Systems Analysis, Alabama, Florida, Louisiana, Mississippi, Regional analysis.

The Coastal Lowlands aquifer system of Louisiana, Mississippi, Alabama, and Florida consists of alternating, discontinuous beds of sand, gravel, silt, and clay of Miocene age and younger. The sediments thicken and dip toward the Gulf of Mexico and are highly heterogeneous. The Coastal Lowlands aquifer system has been subdivided into five regional aquifers defined on the basis of water level and pumpage data largely from heavily pumped areas. These aquifers from youngest to oldest are: The upper Pleistocene aquifer, the lower Pleistocene-upper Pliocene aquifer, the lower Pliocene-upper Miocene aquifer, the middle Miocene aquifer, and the lower Miocene aquifer. Electric logs of 279 wells were analyzed to construct maps of aquifer thickness, sand and clay content, and dissolved-solids concentrations of interstitial water. Analysis of the hydraulic characteristics of the regional aquifers indicates that the upper Pleistocene aquifer has the highest lateral hydraulic conductivity and the lower Miocene aquifer has the lowest. A six-layer finite-difference groundwater flow model was used to investigate and quantify the regional groundwater flow of the Coastal Lowlands aquifer system. The model was calibrated to match 1980 steady state conditions. Results indicate that pumpage from the Coastal Lowlands aquifer system exerts a major effect on the system under 1980 conditions; about 66% of the water that entered the flow system was discharged by pumpage. Regional groundwater flow under predevelopment conditions was primarily from recharge areas in central and southeastern Louisiana and southwestern Mississippi toward discharge areas along the gulf coast and in the major river valleys. Pumping for industry, public supply, and irrigation has produced cones of depression that distort or reverse the predevelopment flow pattern. (Author's abstract)
W91-00332

HYDROGEOLOGY AND GROUND-WATER-QUALITY CONDITIONS AT THE GEARY COUNTY LANDFILL, NORTHEAST KANSAS, 1988.
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-00338

HYDROGEOLOGY AND SIMULATION OF GROUND-WATER FLOW AT SUPERFUND-SITE WELLS G AND H, WOBURN, MASSACHUSETTS.
Geological Survey, Boston, MA. Water Resources Div.
V. de Lima, and J. C. Olimpio.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4059, 1989.

Descriptors: *Geohydrology, *Groundwater movement, *Hydrologic models, *Landfills, *Massachusetts, *Path of pollutants, *Superfund sites, *Wells, Aquifer characteristics, Aquifer testing, Model testing, Sensitivity analysis, Transmissivity.

The area around wells G and H, two former public supply wells for Woburn, MA, and currently designated as an Environmental Protection Agency 'Superfund' site, was the focus of intensive hydrogeologic investigations. Wells G and H and two nearby industrial supply wells were constructed in a stratified drift aquifer ranging in width from 0.5 to 1 mile and as much as 90 ft thick. The transmissivity of the aquifer in the vicinity of wells G and H ranges from 11,500 to 14,000 sq ft/day, and the aquifer can sustain well yields of as much as 700 gallons per minute. Recharge to the aquifer is from precipitation. Under normal conditions, with only the industrial supply wells pumping, groundwater discharges to the stream in most of the study area, and the river is a gaining stream throughout the year. When wells G and H are also pumped simultaneously, infiltration of surface water significantly decreases streamflow in the area. A three-dimensional groundwater flow model of the aquifer in the vicinity of wells G and H was designed and calibrated. The model represents an 0.8-sq-mile area and consists of nearly 5,000 active nodes in three model layers. Throughout all model layers in the center of the model area, simulated hydraulic heads matched observed and estimated hydraulic heads to within 1 ft. Throughout the remainder of the model area, hydraulic heads matched within 5 ft except in some corners and sides near till-bedrock boundaries. Under steady-state conditions, the simulated gain in streamflow was 0.27 cu ft/s, which is within the range of gains (0.1 to 0.62 cu ft/s) measured during low-flow conditions. Under transient conditions, simulated streamflow losses were 1.25 cu ft/s at the end of a 30-day aquifer test during which withdrawals averaged 3.05 cu ft/s. Sensitivity tests of the calibrated model were conducted to determine if the differences between simulated and observed/estimated data values could be attributed to the range of uncertainty in the values of input data and boundary conditions. Test results indicate that the model is least sensitive to variations in model boundary conditions, river stage, and recharge, and most sensitive to variations in storage coefficients, and order-of-magnitude changes in transmissivity and streambed conductance. (Author's abstract)
W91-00340

AVAILABILITY AND HISTORICAL DEVELOPMENT OF GROUND-WATER RESOURCES OF LONG ISLAND, NEW YORK--AN INTRODUCTION.
Geological Survey, Syosset, NY. Water Resources Div.
B. Nemickas, G. E. Mallard, and T. E. Reilly.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 88-4113, 1989. 43p, 14 fig, 4 tab, 26 ref.

Descriptors: *Groundwater availability, *Groundwater data, *Groundwater quality, *Long Island, *New York, *Water resources data, *Water resources development, Aquifer characteristics, Groundwater pollution, Leachates, Saline water intrusion, Water pollution treatment.

Groundwater is one of Long Island's most valuable natural resources. Without it, the extensive growth of population and industry that have occurred on the island since the 1940's would not have been possible. The present population, with its industry and agriculture, will continue to require a supply of high-quality water in the future. Several past human activities have adversely affected this resource; for example, excessive pumping in some areas has caused saltwater intrusion, plumes of leachate from solid-waste landfills have caused local contamination of the aquifers, cesspool discharges have caused nitrate contamination of groundwater, and application of pesticides has caused groundwater contamination in eastern Suffolk County. Some of the problems can be or have been corrected or avoided through proper management. Proper management requires an understanding of the basic laws of physics and chemistry that govern the occurrence and movement of groundwater and associated chemical constituents; it also requires information on the geometry, hydraulics, and natural chemical quality of the Long Island system. Techniques for studying this hidden resource include collection of groundwater samples and water-level data at wells to define the hydraulics and chemistry of the system, and then interpretation and refinement of this information through techniques such as computer simulation. Four case studies of human-induced contamination of the groundwater system show how knowledge of the problem and of the hydrologic system can lead to appropriate responses. For these cases, the responses were: (1) importation of water to reduce or stop saltwater intrusion in Kings and Queens counties; (2) installation of sanitary sewers to avoid groundwater contamination by domestic waste-disposal systems; (3) improved design, management, and operation of landfills to prevent the formation and entry of leachate into the underlying groundwater; and (4) bans on the use of a certain pesticide and temporary treatment of the pumped water until pesticide concentrations were lowered through dilution (flushing) and degradation. All four responses were different, yet appropriate. (Shidler-PTT)
W91-00345

GEOHYDROLOGIC ASPECTS FOR SITING AND DESIGN OF LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL.
For primary bibliographic entry see Field 5E.
W91-00347

GEOHYDROLOGY AND SIMULATED EFFECTS OF PUMPAGE ON THE NEW ORLEANS AQUIFER SYSTEM AT NEW ORLEANS, LOUISIANA.
Geological Survey, Baton Rouge, LA.
D. C. Dial, and D. M. Sumner.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water Resources Technical Report No. 46, 1989. 54p, 1 plate, 32 fig, 4 tab, 36 ref. Prepared in cooperation with Louisiana Department of Transportation and Development.

Descriptors: *Aquifer systems, *Geohydrology, *Louisiana, *Model studies, *New Orleans Aquifer System, *Pumpage, *Simulation analysis, Mathematical models, Saline water intrusion, Subsidence, Water supply.

The New Orleans Aquifer System was evaluated as an alternative public-supply source for New Orleans. It is the only aquifer system that contains a large volume of freshwater beneath the city. It consists of a series of alternating beds of sand and clay that deepen southward toward the Gulf of Mexico. The aquifer system includes the Gramercy, Norco, Gonzales-New Orleans, and '1,200-foot' aquifers, and the intervening clay beds. Hydraulic conductivities of the aquifers range from 100 to 130 feet per day and storage coefficients average about 0.0005, based on aquifer-test results. Aquifer-test data are unavailable for the '1,200-foot' aquifer. Confining-unit hydraulic conductivities were based on their depth of burial. A three-dimensional finite-difference groundwater flow model was used to evaluate the New Orleans Aquifer System. The model was calibrated by comparing observed and computed water levels for the period 1900 to 1981. Differences of 20 feet or less were observed for most of the modeled area. The model was used to predict the effects of pumping on water levels and saltwater encroachment. Flow within the aquifer system was simulated for the period 1987-2006 at the 1986 pumping rate of 40 Mgal/d (million gallons per day) and with an increase of 130 Mgal/d over the 1986 rate. The first simulation showed a gradual recovery over the 20-year period. The lowest water level at the end of 20 years was 90 feet below sea level near Michoud. The second simulation showed a maximum decline of 410 feet below sea level near the lakefront at Lake Pontchartrain. Dewatering of the aquifer could possibly occur as a result of increased pumping, but its effect is of little significance. The increased pumpage required to supply New Orleans (130 Mgal/d superimposed on the present pumpage of 40 Mgal/d) would cause saltwater to move more rapidly toward the areas of pumping. The rate of encroachment in the Industrial Canal area would be about 500 feet per year and in the Michoud area about 250 feet per year. The Gonzales-New Orleans aquifer has the capability to supply the needs of New Orleans but certain problems need to be addressed such as the effect of water-level decline on subsidence and the control of saltwater encroachment. (Author's abstract)
W91-00348

GROUND-WATER HYDROLOGY OF THE CENTRAL RATON BASIN, COLORADO AND NEW MEXICO.
Geological Survey, Arvada, CO.
A. L. Geldon.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Supply Paper 2288. 81p, 62 fig, 15 tab, 68 ref. Prepared in cooperation with the U.S. Bureau of Land Management.

Descriptors: *Colorado, *Geohydrology, *Groundwater basins, *Groundwater potential, *New Mexico, *Raton Basin, Aquifer characteristics, Coal mines, Groundwater chemistry, Groundwater quality.

The watersheds of the Purgatoire and Apishapa Rivers contain most of the public coal lands in the Raton Basin. From 1978 to 1982, 231 wells, 38 springs, and 6 mines were inventoried, and groundwater samples were collected from 71 sites. The Raton Basin is an asymmetrical trough, containing 10,000 to 25,000 feet of sedimentary rocks that range in age from Pennsylvanian to Eocene. These rocks are intruded by Miocene igneous rocks, covered with Pleistocene and Holocene alluvium, and underlain by Precambrian crystalline rocks. Bituminous coal occurs in the Vermejo and Raton Formations of Cretaceous and Paleocene age. Virtually all of the sedimentary rocks transmit water. Stream alluvium is the most productive aquifer. Bedrock aquifers have smaller yields but greater distribution. The principal bedrock aquifers are the Cuchara-Poison Canyon and the Raton-Vermejo-Trinidad. Other formations are nearly impermeable or too deep to be utilized economically. Water in alluvium typically is less mineralized than in bedrock but more susceptible to contamination. Sodium and calcium bicarbonate waters predominate in the area, but sodium chloride water commonly occurs in the Cuchara-Poison Canyon aquifer and may occur in the Pierre Shale. Plumes of sulfate-enriched water extend from coal mines into bedrock and alluvial aquifers. Dissolved-solids concentrations range from less than 500 milligrams per liter in calcium bicarbonate water to more than 1,500 milligrams per liter in sulfate and chloride waters. Much of the groundwater is hard. Nitrogen is enriched in shallow groundwate , and fluoride is enriched in deeper groundwater. Levels of iron, manganese, zinc, and selenium locally exceed standards for domestic consumption. The Purgatoire River and its tributaries are predominantly gaining streams, but losing reaches occur. Water quality in streams is affected by tributary inflows, mine discharge, contact with and seepage from tailings, groundwater seepage, diversion ditches, and changes in stage. Groundwater flows regionally from west to east and locally from stream divides to valleys. Depths to water vary from 500 feet beneath divides to less than 100 feet in valleys. Groundwater supplies probably are insufficient for expanded settlement and coal mining. (Author's abstract)
W91-00349

STATISTICAL PROCESSOR FOR ANALYZING SIMULATIONS MADE USING THE MODULAR FINITE-DIFFERENCE GROUND-WATER FLOW MODEL.
Geological Survey, Oklahoma City, OK.
For primary bibliographic entry see Field 7C.
W91-00353

ANALYSIS OF GEOPHYSICAL WELL LOGS AND FLOWMETER MEASUREMENTS IN BOREHOLES PENETRATING SUBHORIZONTAL FRACTURE ZONES, LAC DU BONNET BATHOLITH, MANITOBA, CANADA.
Geological Survey, Lakewood, CO.
F. L. Paillet.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4211, 1989. 30p, 13 fig, 30 ref.

Descriptors: *Borehole geophysics, *Flow measurement, *Geohydrology, *Geologic fractures, *Groundwater movement, *Manitoba, *Well logs, Canada, Flowmeters, Fracture permeability, Geologic formations, Pumping tests.

Sensitive thermal-pulse flowmeter measurements and various geophysical well logs were obtained in boreholes penetrating regional fracture zones in a granitic batholith at a location on the southwestern margin of the Canadian shield. Flowmeter measurements were made in a pair of boreholes 130 meters apart, shown by geophysical logs to intersect an isolated fracture zone about 270 meters in depth. Flow measurements made before start of the pumping test indicated no flow in one borehole; periodic flow in the other borehole was related to irregular drawdowns near the bottom of casing, causing inflow adjacent to the deep fracture zone, and outflow at a point less than 30 meters in depth. Pumping tests were made on each of the boreholes produced from a single set of fractures within or splaying off the major fracture zone at 270 meters in depth. However, flow occurred between the boreholes along intersecting fractures a few meters beneath the major fracture zone during cross-hole pumping tests made by maintaining a constant hydraulic-head difference of about 80 meters. Additional flowmeter measurements were made without pumping in a third borehole located approximately 5 kilometers east of the two boreholes used for the pumping tests. Flowmeter measurements indicated flow along the borehole between two individual sets of fractures within a major fracture zone located along the contact of the batholith with surrounding gneiss. In two instances, acoustic tube-wave amplitude attenuation indicated substantial fracture permeability even though other geophysical well logs and core inspection confirmed the presence of an unfractured layer of contrasting acoustic properties. Borehole-wall breakouts indicative of substantial stress anisotropy were identified on the geophysical well logs for two of the boreholes used in this study and corresponded almost exactly with the distribution of core disking in one of these boreholes. This could indicate that local stress concentration in the vicinity of fracture zones caused opening or reopening of some of the most favorably oriented fractures. (Author's abstract)
W91-00354

GROUND-WATER RESOURCES OF THE ARKANSAS RIVER BASIN IN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
J. M. Kilpatrick, and A. H. Ludwig.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 88-725, 1990. 45p, 12 fig, 13 tab, 34 ref. Prepared in cooperation with the U.S. Army Corps of Engineers.

Descriptors: *Aquifer characteristics, *Arkansas, *Groundwater potential, *Groundwater resources, *River basins, *Water resources data, Arkansas River Basin, Geologic formations, Geomorphology, Groundwater pollution, Groundwater quality.

The Arkansas River basin in Arkansas lies almost entirely within the Interior Highlands physiographic division. The Interior Highlands consist of hilly to mountainous terrain underlain by sandstone, shale, limestone, and dolomite. Significant water-yielding units within the Arkansas River basin in Arkansas include subsurface Paleozoic rocks such as the Eminence and Potosi Dolomites, the Gasconade Dolomite and the Van Buren Formation, and Roubidoux Formation as well as outcrops of Paleozoic rocks, the Sparta Sand, and Quaternary deposits. Groundwater withdrawals in the 15-county area approximating the study area totaled 257 million gallons per day in 1985. More than 70 percent of this total was withdrawn from the Sparta Sand and the Quaternary deposits in the Coastal Plain. Less than 10 percent was withdrawn from the Paleozoic units that underlie the Interior Highlands. The quality of groundwater withdrawn from the various aquifers in the study area generally is suitable for most uses. With the exception of the Sparta Sand, the major aquifers yield water that is commonly very hard and highly mineralized. Yields from the different water-bearing units are highly variable. Several of the subsurface Paleozoic formations yield as much as 450 gallons per minute, whereas outcrops of Paleozoic rocks rarely yield more than 10 gallons per minute. In the Coastal Plain, the Sparta Sand and the Quaternary deposits yield as much as 2,000 and 2,500 gallons per minute, respectively. In the northern part of the study area, the extensive fracturing of formation outcrops makes them more susceptible to contamination from the surface. Several studies have identified localized bacterial contamination of water from both wells and springs in this part of the study area. Nitrate concentrations exceeding U S Environmental Protection Agency primary drinking water standards have occurred in some areas. No areas within the study area met the critical-use criteria established by the Arkansas Soil and Water Conservation Commission. Potential groundwater problems include potential contamination from one Resource Conservation and Recovery Act site, two Comprehensive Environmental Response, Compensation, and Liability Act sites, and numerous landfills and surface impoundments. (Author's abstract)
W91-00355

GROUND-WATER DATA FOR MICHIGAN 1988.
Geological Survey, Lansing, MI.
G. C. Huffman, and C. R. Whited.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-597, 1989. 54p, 4 fig, 4 tab, 119 ref. Prepared in cooperation with the Michigan Department of Natural Resources Geological Survey Division.

Descriptors: *Groundwater, *Groundwater resources, *Hydrologic data, *Michigan, *Water resources data, Aquifers, Observation wells, Water level, Water use.

Water levels, locations, depths, and aquifers tapped are given for 112 observation wells. Tabulated data include a listing of groundwater reports in Michigan, extremes of water levels for calendar year 1988 and for the period of record, pumpage of most major groundwater users in the State, and water-quality data from selected wells. The two largest municipal users of groundwater, were the cities of Lansing and Kalamazoo. In 1988, Lansing pumped 7.8 billion gallons from the Saginaw Formation and glacial deposits and Kalamazoo pumped 7.4 billion gallons from glacial deposits only. (Author's abstract)
W91-00358

GRAPHICAL KERNEL SYSTEM (GKS) VERSION OF COMPUTER PROGRAM MODPATH-PLOT FOR DISPLAYING PATH LINES GENERATED FROM THE U.S. GEOLOGICAL SURVEY THREE-DIMENSIONAL GROUND-WATER FLOW MODEL.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W91-00361

WHAT IS A LEACHER.
Biospherics, Inc., Beltsville, MD. Ground Water and Environmental Programs.
For primary bibliographic entry see Field 5B.
W91-00362

HIGH WATER LEVEL INSTALLATION OF MONITORING WELLS FOR UNDERGROUND STORAGE TANKS.
For primary bibliographic entry see Field 5G.
W91-00364

SUBSURFACE TRANSPORT OF INORGANIC AND ORGANIC SOLUTES FROM EXPERIMENTAL ROAD SPREADING OF OIL-FIELD BRINE.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 5B.
W91-00365

PROPOSAL TO USE CHLORINE-36 FOR MONITORING THE MOVEMENT OF RADIONUCLIDES FROM NUCLEAR EXPLOSIONS.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 5A.
W91-00366

MODELING THE POTENTIAL EFFECT OF ADDITIVES ON ENHANCING THE SOLUBILITY OF AROMATIC SOLUTES CONTAINED IN GASOLINE.
Michigan Technological Univ., Houghton. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W91-00369

REMOTE DATA COLLECTION AND CONTROL FOR HYDROGEOLOGIC MONITORING.
CH2M Hill Engineering, Waterloo (Ontario).
For primary bibliographic entry see Field 7B.
W91-00370

WATER WATER EVERYWHERE . . . HAVE YOU LOOKED.
BCI Geonetics, Inc., Laconia, NH.
A. W. Stone.
Water Well Journal WWJOA9, Vol. 44, No. 6, p 48-49, June 1990.

Descriptors: *Groundwater availability, *Groundwater management, *Groundwater potential, *Groundwater resources, *Water management, *Water supply development, Decision making, Surface water, Water demand, Water supply.

In looking for ways to satisfy the ever increasing demands on the drinking water supply, there may be supply options available about which resource managers are unaware, or have underestimated. One option that appears to be frequently overlooked and underestimated is groundwater resources. Despite the fact that enormous opportunity for groundwater resource development exists and that many of the sophisticated surface water options are at the limit of engineering ingenuity and hydrological potential, groundwater resource development remains hindered by a surface water mind-set and inaccurate perceptions about the groundwater supply perpetuated by the results of myopic investigations undertaken many years ago. However, these attitudes and perceptions must be challenged if a resource manager is to provide the best chance of creating solutions to perceived or real water deficits. This can only be accomplished by supplying a thorough knowledge of all supply options. In many areas and in many parts of the world, a quantification of the real ground water potential is the missing link in a total integrated management strategy. Therefore, it is imperative that a full assessment of groundwater potential be at the top of the decision-making checklist. (Fleishman-PTT)
W91-00412

RESEARCH ON AGRICHEMICALS IN WATER RESOURCES.
Geological Survey, Iowa City, IA.
For primary bibliographic entry see Field 5B.
W91-00417

GROUND-WATER CONDITIONS IN LAS VEGAS VALLEY, CLARK COUNTY, NEVADA. PART 1: HYDROGEOLOGIC FRAMEWORK.
Geological Survey, Carson City, NV.
R. W. Plume.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Water-Supply Paper 2320-A, 1989. 15p, 5 pl, 2 fig, 1 tab, 36 ref. Prepared in cooperation with the Clark County Department of Comprehensive Planning.

Descriptors: *Aquifer characteristics, *Geohydrology, *Groundwater basins, *Groundwater resources, *Las Vegas Valley, *Nevada, Geologic formations, Geologic history, Geological surveys, Lithology, Sedimentary basins.

Las Vegas Valley, Nevada, is a structural basin formed by bedrock that ranges in age from Precambrian through Miocene. Gravity data indicate that the deeper parts of the basin are filled with 3,000-5,000 ft of clastic sedimentary deposits that range in age from Miocene through Holocene. These deposits constitute the valley-fill aquifer and yield most of the water pumped in the valley. The upper 1,000 ft of this valley fill consist of coarse-grained deposits (sand and gravel), fine-grained deposits (silt and clay), and heterogeneous deposits that comprise either thinly interbedded coarse-grained and fine-grained deposits or mixtures of the two. Coarse-grained deposits, in places more than 1,000 ft thick, underlie the south and west sides of the valley and interfinger with fine-grained and heterogeneous deposits toward the center of the valley. Intervals of fairly thin heterogeneous deposits underlie parts of the valley, but they are not laterally persistent. The bedrock basin that underlies Las Vegas Valley consists of a deeply-buried part that underlies most of the valley and a shallow bedrock surface on the west side of the valley. The deep part of the basin is bounded on the east by normal faults at the base of Frenchman Mountain, on the west by a possible normal fault that coincides with a zone of fault scarps, on the north by vertical or strike-slip displacement along the Las Vegas shear zone, and on the northwest by a bedrock high that underlies the area between Tule Springs and Corn Creek Springs. The shallow bedrock surface (as much as 1,000 ft deep) underlies the west side of the valley from La Madre Mountain to the McCullough Range. Some of the fault scarps in the valley fill coincide with possible bedrock faults, which suggests a tectonic origin for some of the faulting of valley-fill deposits; however, the area of fault scarps on the west side of the valley also coincides with a rapid lateral change from incompressible bedrock to more compressible valley-fill deposits. Thus, both differential compaction and tectonic movement may be responsible for faulting of valley-fill deposits. (Author's abstract)
W91-00429

GEOCHEMISTRY OF IRON IN A SAND DUNE AQUIFER, NEAR COOS BAY AND NORTH BEND, OREGON.
Geological Survey, Portland, OR.
For primary bibliographic entry see Field 2K.
W91-00430

GROUND-WATER DATA FOR GEORGIA, 1988.
Geological Survey, Doraville, GA.
C. N. Joiner, M. F. Peck, M. S. Reynolds, and W. L. Stayton.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-408, 1989. 176p, 84 fig, 62 ref. Prepared in cooperation with the Georgia Department of Natural Resources, Environmental Protection Division, Georgia Geologic Survey.

Descriptors: *Georgia, *Groundwater data, *Groundwater level, *Groundwater quality, *Hydrologic data, *Subsurface mapping, *Water resources data, Aquifer characteristics, Drought effects, Hydrographs, Water sampling, Wells.

Continuous water-levels records from 144 wells and water-level measurements from an additional 617 wells in Georgia during 1988 provide the basic data for this report. Daily mean water-level hydrographs for selected wells illustrate the effects that changes in recharge and discharge have had on the groundwater reservoirs in the State during 1988. Monthly mean water levels are shown for the 10-year period 1979-88. Maps showing the potentiometric surface of the Upper Floridan aquifer for May 1988 and the Claiborne and Clayton aquifers for October 1988 also are presented. Annual mean water levels in Georgia generally were below those measured in 1987; water levels ranged from 6.9 ft higher to 7.3 ft lower. Record-low water levels were measured during the last half of 1988 in 18 wells tapping the crystalline rock aquifer, the Cretaceous rock aquifer system, the Midville aquifer system, and the Clayton, Upper Floridan, and upper Brunswick aquifers. These record lows were from 0.1 to 1.4 ft lower than the previous record lows. A prolonged drought resulted in decreased recharge to the aquifers and increased groundwater pumping, which caused water levels to decline. Water quality samples collected periodically throughout Georgia are analyzed as part of areal and regional groundwater studies. Maps showing chloride concentrations in the Upper Floridan aquifer in October 1988 in coastal Georgia and in the Savannah and Brunswick areas are presented. Periodic monitoring of water quality in the Savannah and Brunswick areas indicates that chloride concentrations in the Upper Floridan generally have remained stable. (Author's abstract)
W91-00432

HYDROGEOLOGY AND WATER QUALITY OF SIGNIFICANT SAND AND GRAVEL AQUIFERS IN PARTS OF AROOSTOOK COUNTY, MAINE: SIGNIFICANT SAND AND GRAVEL AQUIFER MAPS 75, 76, 77, 78, 84, AND 85.
Maine Dept. of Environmental Protection, Augusta.
D. B. Locke, J. I. Steiger, T. K. Weddle, and C. D. Neil.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-1a, 1989. 88p, 13 plates, 7 fig, 14 tab, 81 ref.

Descriptors: *Geohydrology, *Glacial aquifers, *Groundwater resources, *Hydrologic data, *Maine, *Subsurface mapping, *Water quality, *Water resources data, Alluvial deposits, Geological surveys, Sand aquifers, Well yield.

A reconnaissance-level hydrogeologic study was made of 2139 sq mi in Aroostook County, Maine. Maps 75, 76, 77, 78, 84, and 85 of the Significant Sand and Gravel Aquifer Map Series published by the Maine Geological Survey cover the study area. The significant sand and gravel aquifers consist of glacial ice-contact, ice-stagnation, outwash, and alluvial deposits found primarily in the valleys of the major river systems and their tributaries and near other surface-water bodies. By definition, significant aquifers are capable of yielding more than 10 gal/min to a properly constructed well. Significant aquifers comprise approximately 111 sq mi (5%) of the study area; yields estimated to exceed 50 gal/min are believed to be available from only 1.5 sq mi (less than 1%) of the area. Typically, the water table is within 15 ft of land surface. On the basis of well records, the greatest known depth to bedrock exceeds 214 ft. The greatest known well yield is approximately 1,710 gal/min from a gravel-packed well owned by a food processing company. The regional groundwater quality ranges from acidic to slightly basic; calcium, sodium, and magnesium are the most abundant cations; bicarbonate is the most abundant anion; and the water generally is hard. In some locations, concentrations of iron and manganese are large enough to limit the suitability of untreated water for some uses. (Author's abstract)
W91-00435

HYDROGEOLOGIC AND WATER-QUALITY DATA FROM WELL CLUSTERS NEAR THE WASTEWATER-TREATMENT PLANT, U.S. MARINE CORPS AIR STATION, CHERRY POINT, NORTH CAROLINA.
Geological Survey, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W91-00438

HYDROLOGIC AND CHEMICAL DATA FROM SELECTED WELLS AND SPRINGS IN SOUTHERN ELMORE COUNTY, INCLUDING MOUNTAIN HOME AIR FORCE BASE, SOUTHWESTERN IDAHO, FALL 1989.
Geological Survey, Boise, ID.
For primary bibliographic entry see Field 5B.
W91-00440

WATER LEVELS IN PERIODICALLY MEASURED WELLS IN THE YUCCA MOUNTAIN AREA, NEVADA, 1988.
Geological Survey, Denver, CO.
J. M. Gemmell.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 90-113, 1990. 47p, 2 fig, 2 tab, 14 ref. Prepared in cooperation with the Nevada Operations Office. DOE Interagency Agreement DE-A108-78ET44802.

Descriptors: *Groundwater data, *Groundwater level, *Nevada, *Radioactive waste disposal, *Wells, Hazardous waste disposal, Hydrographs, Saturation zone, Underground waste disposal, Yucca Mountain.

This report presents water level data for 10 wells that were periodically measured in 1988 in the Yucca Mountain area, Nevada. Water levels measured during 1987 are included in the report for reference. The report includes discussions of the methods used and corrections applied to obtain water level depths and altitudes from onsite measurements. Water levels for each well are presented in tabular and graphical (hydrographs) form. The altitude of the water level in the upper part of the saturated zone is about 775 meters above sea level to the west of and along part of the crest of Yucca Mountain; along the eastern edge and southern end of Yucca Mountain, the water level is 728 to 730 meters above sea level. The water level data were obtained to help evaluate the suitability of the area for storing high-level nuclear waste. (Author's abstract)
W91-00441

FATE AND TRANSPORT OF PETROLEUM RELEASED FROM UNDERGROUND STORAGE TANKS.
University of Southern California, Los Angeles.
For primary bibliographic entry see Field 5B.
W91-00452

CASE-CONTROL STUDY OF COLON CANCER AND VOLATILE ORGANICS IN WISCONSIN MUNICIPAL GROUNDWATER SUPPLIES.
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5C.
W91-00506

CORRELATIONS BETWEEN MEASUREMENTS OF ORGANIC HALIDE AND SPECIFIC HALOGENATED VOLATILE ORGANIC COMPOUNDS IN CONTAMINATED GROUNDWATER.
Arizona Univ., Tucson. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00528

ROLE OF STANDARDS IN IOWA'S GROUNDWATER PROTECTION PROGRAM: A REPORT TO THE IOWA GENERAL ASSEMBLY.
Iowa Dept. of Environmental Quality, Des Moines.
For primary bibliographic entry see Field 5G.
W91-00566

ROLE OF STANDARDS IN IOWA'S GROUNDWATER PROTECTION PROGRAM: A REPORT TO THE IOWA GENERAL ASSEMBLY, APPENDIX 2 - WRITTEN COMMENTS.
Iowa Dept. of Environmental Quality, Des Moines.
For primary bibliographic entry see Field 5G.
W91-00567

PESTICIDES IN GROUND WATER DATA BASE: 1988 INTERIM REPORT.
Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.
For primary bibliographic entry see Field 5B.
W91-00569

USERS MANUAL FOR THE SLUDGEMAN MODEL FOR THE GROUNDWATER PATHWAY IN THE MONOFILLING OF SEWAGE SLUDGE.
ICF Technology, Inc., Fairfax, VA.
For primary bibliographic entry see Field 5E.
W91-00575

EXACT SOLUTION FOR FLOW OF SLIGHTLY COMPRESSIBLE FLUIDS THROUGH MULTIPLE-POROSITY, MULTIPLE-PERMEABILITY MEDIA.
Scientific Research Inst. of Petroleum Exploration and Development, Beijing (China).
M. X. Liu, and Z. X. Chen.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1393-1400, July 1990. 1 fig, 15 ref.

Descriptors: *Aquifer systems, *Flow models, *Fluid flow, *Groundwater movement, *Mathematical models, *Model studies, *Porous media, Compressible flow, Permeability, Porosity, Reservoirs.

To describe the flow of fluids through a multiple aquifer system, a model was developed which describes the flow of a slightly compressible fluid through a multiple-porosity, multiple-permeability medium. The model considers flow within each porous system and the cross flow between any two different porous systems using a matrix of cross-flow coefficients. An exact solution for a bounded, closed cylindrical reservoir producing at a constant rate is obtained rigorously. The solution is expressed in terms of Bessel functions, so there are no particular difficulties in computing the solution numerically. The key to the method of solution is an orthogenal matrix transformation that makes the n-coupled governing equations uncoupled. A variety of problems of fluid flow through layered reservoirs may be obtained using the general solution and method presented by specifying the elements of the matrix of cross-flow coefficients and appropriate boundary conditions. (Author's abstract)
W91-00588

MULTILAYERED SHARP INTERFACE MODEL OF COUPLED FRESHWATER AND SALTWATER FLOW IN COASTAL SYSTEMS: MODEL DEVELOPMENT AND APPLICATION.
Geological Survey, Menlo Park, CA.
H. I. Essaid.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1431-1454, July 1990. 35 fig, 8 tab, 86 ref. U.S. Geological Survey and Universidad Politecnica de Valencia Grant CCA8309117.

Descriptors: *Coastal aquifers, *Flow models, *Saline water intrusion, *Saline-freshwater interfaces, California, Flow equations, Freshwater, Model studies, Regional analysis, Saline water, Sea level, Soquel-Aptos Basin.

Coastal aquifers are an important water resource in areas bordering seas. A quasi three-dimensional, finite difference model, that simulates freshwater and salt water flow separated by a sharp interface, has been developed to study layered coastal aquifer systems. The model allows for regional simulation of coastal groundwater conditions, including effects of salt water dynamics on the freshwater system. Vertically integrated freshwater and salt water flow equations incorporating the interface boundary condition are solved within each aquifer. Leakage through confining layers is calculated by Darcy's law, accounting for density differences across the layer. The locations of the interface tip and toe, within grid blocks, are tracked by linearly extrapolating the position of the interface. The model has been verified using available analytical solutions and experimental results. Application of the model to the Soquel-Aptos basin, Santa Cruz County, California, illustrates the use of the quasi three-dimensional, sharp interface approach for the examination of freshwater-salt water dynamics in regional systems. Simulation suggests that the interface today is still responding to long-term Pleistocene sea level fluctuations and has not achieved equilibrium with present day sea level conditions. (Author's abstract)
W91-00591

MATHEMATICAL MODELING OF TRACER BEHAVIOR IN SHORT-TERM EXPERIMENTS IN FISSURED ROCKS.
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-00598

EFFICIENT DETERMINISTIC-PROBABILISTIC APPROACH TO MODELING REGIONAL GROUNDWATER FLOW: 1. THEORY.
California Univ., Irvine. Dept. of Civil Engineering.
C. C. Yen, and G. L. Guymon.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1559-1567, July 1990. 5 fig, 4 tab, 25 ref.

Descriptors: *Flow models, *Geohydrology, *Groundwater movement, *Mathematical models, *Model studies, Groundwater management, Regional analysis, Unconfined aquifers, Variation coefficient, Water table fluctuations.

An efficient probabilistic model was developed and cascaded with a deterministic model for predicting water table elevations in regional aquifers. The objective was to quantify model uncertainty where precise estimates of water table elevations may be required. The probabilistic model is based on the two-point probability method which only requires prior knowledge of uncertain variables mean and coefficient of variation. The two-point estimate method was theoretically developed and compared with the Monte Carlo simulation method. The results of comparisons using hypothetical deterministic problems indicate that the two-point estimate is only generally valid for linear problems where the coefficients of variation of uncertain parameters (for example, storage coefficient and hydraulic conductivity) are small. The two-point estimate may be applied to slightly nonlinear problems with good results, provided coefficients of variation are small. In such cases, the two-point estimate method is much more efficient than the Monte Carlo method provided the number of uncertain variables is less than eight. (See also W91-00602) (Author's abstract)
W91-00601

EFFICIENT DETERMINISTIC-PROBABILISTIC APPROACH TO MODELING REGIONAL GROUNDWATER FLOW: 2. APPLICATION TO OWENS VALLEY, CALIFORNIA.
California Univ., Irvine. Dept. of Civil Engineering.
G. L. Guymon, and C. C. Yen.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1569-1581, July 1990. 12 fig, 3 tab, 12 ref.

Descriptors: *Flow models, *Geohydrology, *Groundwater movement, *Model studies, California, Mathematical models, Owens Valley, Regional analysis, Unconfined aquifers, Variation coefficient, Water table fluctuations.

The applicability of a deterministic-probabilistic model for predicting water tables in southern Owens Valley, California, was evaluated. The model is based on a two-layer deterministic model that is cascaded with a two-point probability model. To reduce the potentially large number of uncertain variables in the deterministic model, lumping of uncertain variables was evaluated by sensitivity analysis to reduce the total number of uncertain variables to three variables: hydraulic conductivity, storage coefficient or specific yield, and source-sink function. Results demonstrate that lumping of uncertain parameters reduces computational effort while providing sufficient precision for the case studied. Simulated spatial coefficients of variation for water table temporal position in most of the basin is small, which suggests that deterministic models can predict water tables in these areas with good precision. However, in several important areas where pumping occurs or the geology is complex, the simulated spatial coefficients of variation are overestimated by the two-point probability method. (See also W91-00601) (Author's abstract)
W91-00602

SPECIFIC STORAGE AS A POROELASTIC COEFFICIENT.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
D. H. Green, and H. F. Wang.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1631-1637, July 1990. 23 ref. Petroleum Research Fund Grant 19139-AC2, Department of Energy Grant DE FG02-84ER13184.

Descriptors: *Aquifer characteristics, *Aquifers, *Compressibility, *Elasticity, *Mathematical analysis, *Specific storage, *Storage coefficient, *Theoretical analysis, Groundwater storage, Hydraulic conductivity.

A definition derived for the specific storage coefficient is unambiguous for general isotropic three-dimensional aquifer elasticity. In every representative elementary volume, the specific storage coefficient is the fluid volume released from storage per unit decline in hydraulic head, per unit bulk volume, under conditions such that there is no strain in two orthogonal directions, and the total normal stress in the third orthogonal direction is constant. The specific storage coefficient is a point property of the aquifer and is defined independently of problem domain stress and head boundary conditions. The expression for specific storage coefficient in terms of aquifer and fluid compressibilities is identical to the familiar forms obtained assuming zero horizontal strain and constant overburden in an aquifer, although it is not restricted to these conditions. As a point property of the fluid-saturated material, the specific storage coefficient is one of four constants in the general constitutive poroelastic equations relating three-dimensional aquifer stress and strain to fluid pressure and dilatation. Written in terms of specific storage coefficient, the equations showed that pore fluid mass diffusion is governed by a diffusivity equal to the ratio of hydraulic conductivity to specific storage under arbitrary boundary conditions. It is shown that specific storage coefficient controls slow compressional body wave velocity in the low frequency limit and that the uniaxial aquifer compressibility is not necessarily related to the vertical direction. (Author's abstract)
W91-00607

FLUORESCENT POLYCYCLIC AROMATIC HYDROCARBONS AS PROBES FOR STUDYING THE IMPACT OF COLLOIDS ON POLLUTANT TRANSPORT IN GROUNDWATER.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5B.
W91-00623

SOME CHARACTERISTICS OF SPRINGS IN HIGH ELEVATION ALTERITIC MATERIAL: THEIR CONTRIBUTION TO THE UNDERSTANDING OF THE INTRICACY OF THE TWO-LAYERED 'SAND-BASEMENT' AQUIFER (MADAGASCAR HIGH PLATEAUX) (CARACTERISTIQUES D'EMERGENCES EN MILIEU ALTERITIQUE D'ALTITUDE: LEUR APPORT A LA COMPREHENSION DE L'AQUIFERE BICOUCHE ARENES-SOCLE (HAUTS PLATEAUX DE MADAGASCAR)).
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
J. C. Grillot.
Comptes Rendus de l'Academie des Sciences (Serie 2) CRASEV, Vol. 311, No. 1, p 227-232, July 5, 1990. 2 fig, 7 ref. English summary.

Descriptors: *Alpine regions, *Aquifer characteristics, *Conductivity, *Drainage, *Geohydrology, *Groundwater movement, *Springs, Alluvium, Aquifers, Bogs, Discharge measurement, Groundwater recharge, High Plateau, Infiltration, Isotope studies, Madagascar, Peat, Sand, Sediments, Water temperature.

Highly heterogeneous materials lie on the high plateau of Madagascar: sandy-silty alterites, micaceous arenites and sands, peat, boggy-silt, and alluvium. Many lowland flat bottomed areas are flooded for about 9 months of the year during which the alteritic morphology is affected. The flooding of the lowlads planted with rice is due to a line of springs generated within the alterites (free aquifer). Two such springs (S1 and S9) were monitored (water discharge, electrical conductivity, temperature, and isotopic determination of 18-O and 2-H) during a full hydrologic period. The two springs have different regimes; time-dependent variations are large for S1 and small for S9. The water electrical conductivity is low (10 microS/cm on average) and fluctuates similarly for the two springs which demonstrates the absence of interaction of the water flow with surrounding minerals. Temperatures are very similar though. During the warm and humid season (from December to May) they apparently vary as does the atmospheric temperature. This behavior can be explained by the thickness of the alterites (< 20 m) and by the amplitude of the piezometric fluctuations which put the aquifer within the heterothermal underground layer. However, the winter temperature rises during the austral winter (June to August). In the mean time, electrical conductivity values stabilize. On the S1 and S9 springs the temperature rise occurs also approximately 3 months after the end of the main rain period (March). One therefore can claim that this temperature rise is due to the upward drainage of warmer water originating from the basement. (Korn-PTT)
W91-00856

MATHEMATICAL MODELLING OF SEA WATER INTRUSION, NAURU ISLAND.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
For primary bibliographic entry see Field 2L.
W91-00865

EFFECTS OF FAULTS ON FLUID FLOW AND CHLORIDE CONTAMINATION IN A CARBONATE AQUIFER SYSTEM.

Geological Survey, Doraville, GA. Water Resources Div.
M. L. Maslia, and D. C. Prowell.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 1-49, July 1990. 15 fig, 4 tab, 45 ref.

Descriptors: *Aquifer characteristics, *Chlorides, *Geohydrology, *Georgia, *Groundwater chemistry, *Groundwater movement, *Groundwater pollution, *Model studies, *Saline water intrusion, Data analysis, Floridan Aquifer, Flow models, Geologic fractures, Groundwater availability, Groundwater management, Groundwater quality, Mathematical models, Potentiometric surface, Pumpage.

Water resources managers have been assigned the responsibility of understanding and predicting the effect of large withdrawals of groundwater on the aquifer systems. A unified, multidiscipline hypothesis is proposed to explain the anomalous pattern by which chloride has been found in water of the Upper Floridan aquifer in Brunswick, Glynn County, Georgia. Analyses of geophysical, hydraulic, water chemistry, and aquifer test data using the equivalent porous medium approach are used to support the hypothesis and to improve further the understanding of the fracture-flow system in this area. The data presented show that: (1) four major northeast-southwest trending faults, capable of affecting the flow system of the Upper Floridan aquifer, can be inferred from structural analysis of geophysical data and from regional fault patterns; (2) the proposed faults account for the anomalous northeastward elongation of the potentiometric surface of the Upper Floridan aquifer; (3) the faults breach the nearly impermeable units that confine the Upper Floridan aquifer from below, allowing substantial quantities of water to leak vertically upward; as a result, aquifer transmissivity need not be excessively large (as previously reported) to sustain the heavy, long-term pumpage at Brunswick without developing a steep cone of depression in the potentiometric surface; (4) increased fracturing at the intersection of the faults enhances the development of conduits that allow the upward migration of high-chloride water in response to pumping from the Upper Floridan aquifer; and (5) the anomalous movement of the chloride plume is almost entirely controlled by the faults. (Author's abstract)
W91-00877

EVAPORATION FROM DAMPLAND VEGETATION ON A GROUNDWATER MOUND.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2D.
W91-00879

WATER BANKING THROUGH ARTIFICIAL RECHARGE, LAS VEGAS VALLEY, CLARK COUNTY, NEVADA.
Las Vegas Valley Water District, NV.
For primary bibliographic entry see Field 4B.
W91-00880

MOVEMENT AND FATE OF ATRAZINE AND BROMIDE IN CENTRAL KANSAS CROPLANDS.
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5B.
W91-00882

THEORY AND APPLICATION OF AN APPROXIMATE MODEL OF SALTWATER UPCONING IN AQUIFERS.
Kansas State Geological Survey, Lawrence.
C. McElwee, and M. Kemblowski.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 139-163, July 1990. 8 fig, 25 ref. U. S. Geologic Survey Grant No. 14-08-0001-G1066.

Descriptors: *Aquifers, *Geohydrology, *Groundwater chemistry, *Groundwater movement, *Saline water intrusion, *Upconing, Boundary layers, Data analysis, Flow models, Groundwater management, Groundwater pollution, Groundwater quality, Kansas, Mathematical models, Saline water, Smoky Hill River.

Motion and mixing of salt water and fresh water are vitally important for water-resource development throughout the world. An approximate model of saltwater upconing in aquifers is developed, which results in three non-linear coupled equations for the freshwater zone, the saltwater zone, and the transition zone. The description of the transition zone uses the concept of a boundary layer. This model invokes some assumptions to give a reasonably tractable model, considerably better than the sharp interface approximation but considerably simpler than a fully three-dimensional model with variable density. The validity of the Dupuit-Forchheimer approximation of horizontal flow in each layer is assumed. Vertical hydrodynamic dispersion into the base of the transition zone is assumed; the concentration of the saltwater zone is assumed constant. Solute in the transition zone is assumed to be moved by advection only. Velocity and concentration are allowed to vary vertically in the transition zone by using shape functions. Several numerical techniques can be used to solve the model equations, and simple analytical solutions can be useful in validating the numerical solution procedures. The approximate model is applied to the Smoky Hill River valley in central Kansas. This model can reproduce earlier sharp interface results as well as evaluate the importance of hydrodynamic dispersion for feeding salt water to the river. Using a wide range of dispersivity values showed that unstable upconing always occurs. Therefore, in this case, hydrodynamic dispersion is not the only mechanism feeding salt water to the river. Calculations imply that unstable upconing and hydrodynamic dispersion could be equally important in transporting salt water. The current model could be useful in situations involving dense saltwater layers. (Author's abstract)
W91-00883

MOTION OF COASTAL GROUNDWATER IN RESPONSE TO THE TIDE.
Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
K. Inouchi, Y. Kishi, and T. Kakinuma.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 165-191, July 1990. 19 fig, 1 tab, 31 ref, append.

Descriptors: *Aquifers, *Coastal aquifers, *Groundwater movement, *Japan, *Saline water intrusion, *Tidal effects, Data analysis, Flow models, Geohydrology, Groundwater quality, Mathematical models, Transition zone.

Problems of seawater intrusion into confined coastal aquifers under the influence of the tide were analyzed using two different models; the freshwater-saltwater interface model and the dispersion model. The freshwater-saltwater interface model, which describes the motion of the groundwater level and the freshwater-saltwater interface in response to the tide, was applied to the confined coastal aquifers in the estuary of the Naka River and Yura district of Gogo Island in Japan. The position of the outlet of the confined groundwater into the sea and also the degree of spreading of the aquifer's thickness, which is assumed to vary exponentially with horizontal distance, were estimated. From the non-dimensional analysis based on the dispersion model, it was found that salt water intrudes furthest inland at the time at which the sea level reaches the mean sea level in the ebb tide stage, consistent with the result obtained by the freshwater-saltwater interface model, and the transition zone from fresh water to salt water becomes widest at that time. (Author's abstract)
W91-00884

RELATIVE PERFORMANCE OF A SOIL MOISTURE ACCOUNTING MODEL IN ESTIMATING RETURN FLOW.
Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 2G.
W91-00887

HYDROLOGY OF THE KARST AQUIFER AT THE EXPERIMENTAL SITE OF GUILIN IN SOUTHERN CHINA.
Institute of Karst Geology, Guilin (China).
Y. Daoxian, C. Drogue, D. Aide, L. Wenke, and C. Wutian.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 285-296, July 1990. 8 fig, 2 tab, 17 ref.

Descriptors: *China, *Geohydrology, *Karst hydrology, Boreholes, Geological surveys, Groundwater budget, Groundwater movement, Intermittent springs, Oxygen isotopes, Perennial springs, Storm seepage, Structural geology.

The experimental site of Guilin is located near the village of Yaji at the border of the Lijang Plain (Province of Guangxi, southern China). Within upper Devonian limestones and dolomitic limestones, a karst has developed in accordance with intense fracturing resulting from Mesozoic and Tertiary tectonic episodes. Its morphology is characterized by two major types of karst: a cone karst (peak cluster area) bounded by the Lijang Plain which comprises a tower or mogote karst (peak forest area). Groundwater discharges from a perennial spring (discharge up to 7 cubic meters/s) and three intermittent springs (discharge less than 5 cubic meters/s). Some observation boreholes have been drilled on the peak cluster area dolines and on the Lijang Plain in front of the spring. Tracing experiments in the dolines showed that the dolines are connected with the springs. The apparent flow velocity ranges between 4 and 180 m/h. Analyses of storm responses of the perennial spring and the variability in time of O18 concentration, pointed out the important role played by the flows occurring in the subcutaneous zone of the peak cluster area. (Author's abstract)
W91-00891

GROUNDWATER RESPONSE TO REFORESTATION IN THE DARLING RANGE OF WESTERN AUSTRALIA.
Water Authority of Western Australia, Perth.
R. W. Bell, N. J. Schofield, I. C. Loh, and M. A. Bari.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 297-317, July 1990. 9 fig, 2 tab, 26 ref.

Descriptors: *Australia, *Forest watersheds, *Groundwater level, *Groundwater management, *Reforestation, *Soil-water-plant relationships, *Surface-groundwater relations, *Vegetation effects, *Water table fluctuations, Forest hydrology, Rainfall, Salinity, Stream degradation, Water table rise.

Replacement of deep-rooted perennial vegetation with annual crops and pastures has led to rising groundwater tables and transport of previously stored salts to streams in south-west Western Australia. Trials to determine the potential of various reforestation strategies to reverse this process by lowering the groundwater table were commenced in 1976. Results were obtained from six experimental sites for the period 1979-1986. Despite the mean annual rainfall of the experimental period being 10% below the 1926-1986 mean, groundwater levels under pasture rose by up to 1.2 m. The change in groundwater levels beneath reforestation ranged from a 0.6 m increase to a 3 m decrease relative to the ground surface. Groundwater levels under reforestation in all cases decreased relative to groundwater levels under pasture. The magnitude of this reduction was shown to increase with the proportion of cleared area reforested and with the crown cover of the reforestation. The salinity of the water table decreased by 12% under reforestation and by 32% under pasture over the period 1979-1986. (Author's abstract)
W91-00892

USING RN222 TO EXAMINE GROUNDWATER/SURFACE DISCHARGE INTERACTION IN THE RIO GRANDE DE MANATI, PUERTO RICO.
Florida Univ., Gainesville. Dept. of Geology.
K. K. Ellins, A. Roman-Mas, and R. Lee.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/

4, p 319-341, July 1990. 10 fig, 6 tab, 37 ref.

Descriptors: *Environmental tracers, *Groundwater movement, *Karst, *Karst hydrology, *Puerto Rico, *Radon radioisotopes, *Surface-groundwater relations, *Tracers, Data acquisition, Geohydrology, Geophysical surveys, Groundwater budget, Streamflow.

Rn222 was used in the karst drainage basin of the Rio Grande de Manati in Puerto Rico to study groundwater/surface flow relationships. Locations of groundwater influx along two sections of the Rio Grande de Manati were identified. The Rn222 measurements were used together with stream discharge data in a mass balance equation to quantify the groundwater inputs. The investigation established that both of the sections of the Rio Manati surveyed not only gained groundwater, but lost surface flow. It was calculated that the river gained about 1.2 cubic meters/s and lost 0.5 cubic meters/s to the aquifer between Ciales and United States Geological Survey gauging station 5. Between United States Geological Survey gauging stations 6 and 7, groundwater influx and stream flow loss occurred simultaneously with groundwater inputs equalling surface discharge losses of 4 cubic meters/s. The study successfully demonstrated the innovative application of Rn222 as a geochemical tracer in examining groundwater/surface flow relationships in a karst system. (Author's abstract)
W91-00893

GEOSTATISTICAL METHODS FOR DETECTION OF OUTLIERS IN GROUNDWATER QUALITY SPATIAL FIELDS.
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
A. Bardossy, and Z. W. Kundzewicz.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 343-359, July 1990. 2 fig, 8 tab, 17 ref.

Descriptors: *Groundwater chemistry, *Groundwater quality, *Statistical analysis, Chlorides, Data analysis, Geohydrology, Groundwater data, Groundwater pollution, Hardness.

Detection of discordant groundwater quality observations is of primary importance. Because of the large amount of data to be analyzed, methods of plausibility analysis need to be simple and not too time-consuming. Two geostatistical methods were studied, which allow the identification of outlying data points based on the pattern present in the remaining data. The two methods used, point kriging and the intrinsic random functions of order k method (IRF-k), differ in severity of assumptions. The advantage of point kriging is its simplicity, and the disadvantage is the severity of the assumptions. The method is based on assumptions of either stationarity or intrinsic (weaker) stationarity. Both assumptions are restrictive in comparison the IRF-k method, which can accomodate polynomial trend (drifts) of the order k. However, in contrast to point kriging, the IRF-k method offers the welcome possibility of fully automated detection of outliers, which is particularly attractive in operational detection of outliers. Both approaches were tested on concentration of chloride and on total hardness in groundwater and performed satisfactorily. They lend themselves well also to operational applications. The use of the simple point kriging procedure is recommended for outlier detection (also for operational use) in the case of no significant drift, and the use of the IRF-k method otherwise. (Hoskin-PTT)
W91-00894

CLASSIFICATION OF SHALLOW GROUNDWATER TYPES IN A DUTCH COVERSAND LANDSCAPE.
Amsterdam Univ. (Netherlands). Landscape and Environmental Research Group.
For primary bibliographic entry see Field 2K.
W91-00895

SIMULATION OF NITRATE NITROGEN BREAKTHROUGH CURVES STEMMING FROM LEACHING OF AMMONIUM NITRATE THROUGH SOIL.
Orissa Univ. of Agriculture and Technology, Bhubaneswar (India).
For primary bibliographic entry see Field 5B.
W91-00896

MODULAR MODEL FOR SIMULATING CONTINUOUS OR EVENT RUNOFF.
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
For primary bibliographic entry see Field 2E.
W91-00970

CONCEPTUAL MODEL SIMULATING THE HYDROLOGICAL PROCESSES ON A DRAINAGE BASIN IN A PLAIN AREA.
Hohai Univ., Nanjing (China). Dept. of Hydrology.
For primary bibliographic entry see Field 2E.
W91-00981

EFFECTS OF RECHARGE SYSTEMS ON HYDROLOGICAL INFORMATION TRANSFER ALONG RIVERS.
9 Eylul Univ., Izmir (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00984

2G. Water In Soils

MODELING INFILTRATION IN HYSTERETIC SOILS.
Kentucky Univ., Lexington. Dept. of Civil Engineering.
S. E. Serrano.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 12-23, March 1990. 12 fig, 43 ref.

Descriptors: *Hysteresis, *Infiltration, *Mathematical models, *Model studies, *Rainfall infiltration, *Stochastic models, *Surface-groundwater relations, *Unsaturated flow, Data interpretation, Differential equations, Diffusivity, Groundwater movement, Mathematical studies, Percolation, Soil water.

Existing vertical infiltration models either assume a constant infiltration rate at the soil surface and a unique set of soil-water functional relationships (hysteresis is neglected), or use empirical expressions which disregard physical laws. A method for analyzing vertical infiltration in hysteretic soils subject to the random variations of point rainfall in watersheds, and a procedure for solving the resulting stochastic partial differential equation, is presented. The effect of the time random variability of point rainfall produces a water content process in the upper soil layer which can be modeled as a shot noise process. The hysteretic loops resulting from the natural wetting and drying cycles generate a correlated random soil-water diffusivity process. The modeling problem reduces to the solution of the infiltration equation subject to a shot noise boundary condition and a colored noise soil-water diffusivity. A new semi-group solution of this evolution equation is obtained and expressions for sample functions, the mean and the variance of the water content in space and time, are derived. A computational procedure for each of the components of the stochastic solution is presented, and suggestions for the reduction of the predicted variance are given. It is hoped that the present methodology will provide the modeler with a better tool to model infiltration in natural soils subject to the uncertainties associated with the rainfall regime and the hysteresis in the soil, and to encourage the use of physically based models for infiltration rather than empirical equations. (Author's abstract)
W91-00118

MOISTURE VARIATION STUDY BY NEUTRON-NEUTRON LOGGING.
Central Ground Water Board, Ahmedabad (India).
For primary bibliographic entry see Field 7C.
W91-00255

STUDY OF SOIL MOISTURE MOVEMENT IN THE VADOSE ZONE USING NEUTRON PROBE.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 7B.
W91-00256

SOIL MOISTURE STUDIES IN SOILS OF DELHI TERRITORY USING THE RESISTIVITY METER.
Indian Agricultural Research Inst., New Delhi. Nuclear Research Lab.
H. Chandrasekharan, B. R. Yadav, S. K. Tyagi, and P. B. S. Sarma.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 385-393, 4 fig, 2 tab, 10 ref.

Descriptors: *Data acquisition, *Delhi, *Geophysical surveys, *India, *Resistivity surveys, *Soil water, Conductivity, Electrical properties, Measuring instruments, Soil properties, Soil types.

The utility of a resistivity meter for the study of soil moisture in 21 villages of the Nangoli and Najafgarh blocks, and the Indian Agricultural Research Institute farm of the Delhi region, are presented in light of other soil water properties. Investigations reveal that for a given soil type, and for a given range of electrical conductivity of a soil saturation extract, the bulk soil electrical conductivities and the soil moisture contents have a linear relationship. An investigation of differing soil types may yield a better understanding of the potential of resistivity meters in determining soil moisture content. A correlation can be drawn between bulk soil electrical conductivity (determined by a resistivity meter), and the soil moisture content (Vol.vol%). (See also W91-00215) (Lantz-PTT)
W91-00258

FUNCTIONAL RELATION FOR CAPILLARY SUCTION VS. MOISTURE CONTENT.
Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 7C.
W91-00260

INVESTIGATING SEPTIC DISPOSAL SITES USING A VELOCITY PERMEAMETER.
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W91-00394

USE OF SATELLITE MICROWAVE RADIOMETERS FOR LARGE-SCALE HYDROLOGY.
Innsbruck Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
For primary bibliographic entry see Field 7B.
W91-00457

GENERAL MASS-CONSERVATIVE NUMERICAL SOLUTION FOR THE UNSATURATED FLOW EQUATION.
Princeton Univ., NJ. Water Resources Program.
M. A. Celia, E. T. Bouloutas, and R. L. Zarba.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1483-1496, July 1990. 7 fig, 20 ref. Nuclear Regulatory Commission Contract NRC-04-88-074, National Science Foundation Grant 8657419-CES, U.S. Environmental Protection Agency Agreement CR-814946.

Descriptors: *Flow equations, *Flow models, *Fluid flow, *Mathematical models, *Model studies, *Soil water, *Unsaturated flow, Aeration zone, Differential equations, Flow prediction, Infiltration, Mass balance, Mathematical analysis, Numerical analysis.

Prediction of fluid movement in unsaturated soils is an important problem in many branches of science and engineering, including soil science, agricultural

engineering, environmental engineering, and groundwater hydrology. In virtually all studies of the unsaturated zone, the fluid motion is assumed to obey the classical Richards equation. Numerical approximations based on different forms of the governing partial differential equation can lead to significantly different results for unsaturated flow problems. Numerical solution based on the standard h-based form of Richards equation generally yield poor results, characterized by large mass balance errors and erroneous estimates of infiltration depth. Conversely, numerical solutions based on the mixed form of Richards equation can be shown to possess the conservative property, so that mass is perfectly conserved. This leads to significant improvement in numerical solution performance, while requiring no additional computational effort. However, use of the mass-conservative method does not guarantee good solutions. Accurate solution of the unsaturated flow equation also requires use of a diagonal time (or mass) matrix. Only when diagonal time matrices are used can the solution be shown to obey a maximum principle, which guarantees smooth, nonoscillatory infiltration profiles. This highlights the fact that proper treatment of the time derivative is critical in the numerical solution of unsaturated flow. (MacKeen-PTT)
W91-00595

ZERO-CURTAIN EFFECT: HEAT AND MASS TRANSFER ACROSS AN ISOTHERMAL REGION IN FREEZING SOIL.
Michigan Univ., Ann Arbor. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2C.
W91-00597

NITROUS OXIDE DISSOLVED IN SOIL SOLUTION: AN INSIGNIFICANT PATHWAY OF NITROGEN LOSS FROM A SOUTHEASTERN HARDWOOD FOREST.
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
E. A. Davidson, and W. T. Swank.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1687-1690, July 1990. 2 tab, 15 ref. NSF Grants BSR-83-06181 and BSR-8514328.

Descriptors: *Denitrification, *Forest soils, *Nitrogen cycle, *Nitrous oxide, *Soil solution, Forest ecosystems, Forest watersheds, Nitrogen removal, North Carolina, Riparian zone, Seasonal variation, Solubility.

Understanding the processes of nitrous oxide production and diffusion in soil is complicated by the solubility of nitrous oxide in soil solution. Nitrous oxide is soluble and can accumulate in soil solution when gaseous diffusion is restricted. The importance of N losses via degassing of nitrous oxide from groundwater entering surface streams is unknown. Measurements of nitrous oxide in soil solution at an 8.9 ha watershed at the USDA Forest Service Coweeta Hydrologic Laboratory, North Carolina, revealed patterns of seasonal and spatial variation that were consistent with ecosystem regulation of denitrification. The highest concentrations were observed in the riparian zone in May, when soil nitrate, temperature, and moisture were conducive for denitrification. At each of the other sample dates and sites, at least one of these factors appeared to prevent significant nitrous oxide accumulation in soil solution. Extrapolation of the highest observed nitrous oxide concentrations to an annual basis corresponded to a loss of only 56 g N/ha/yr. Denitrification in the riparian zone may be an important fate of N in this hardwood forest, but nitrous oxide in soil solution does not appear to be a significant pathway of N loss. This site might be expected to produce nitrous oxide at higher rates than most hardwood forests, but extrapolation of the highest calculated losses from soil solution over the global area occupied by hardwood forest indicates that this source of nitrous oxide is insignificant for global atmospheric budgets. (Author's abstract)
W91-00613

PRESERVATION OF PLANT POLYMERS IN PEAT AND LIBERATION OF THEIR MONOMERS DUE TO ARTIFICIAL DRAINAGE.
Oulu Univ. (Finland). Dept. of Biochemistry.
For primary bibliographic entry see Field 2H.
W91-00643

PERIODIC MOISTURE FLUCTUATION AS A FACTOR AFFECTING MIRE VEGETATION.
Oulu Univ. (Finland). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-00644

TRANSFORMATION AND TRANSPORT OF AMMONIUM NITROGEN IN A FLOODED ORGANIC SOIL.
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
For primary bibliographic entry see Field 5B.
W91-00716

SPECTROSCOPIC INVESTIGATIONS OF PEAT-WATER INTERACTIONS: AN ESR, FT-IR, AND NMR STUDY.
Umea Univ. (Sweden). Dept. of Physical Chemistry.
For primary bibliographic entry see Field 2H.
W91-00789

INFILTRATION UNDER PONDED CONDITIONS: 3. A PREDICTIVE EQUATION BASED ON PHYSICAL PARAMETERS.
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
R. Havercamp, J. Y. Parlange, J. L. Starr, G. Schmitz, and C. Fuentes.
Soil Science SOSCAK, Vol. 149, No. 5, p 292-300, May 1990. 6 fig, 23 ref.

Descriptors: *Infiltration, *Infiltration capacity, *Mathematical models, *Ponding, *Soil water, Clays, Diffusivity, Sand, Soil types.

A new filtration equation was derived that takes into account the possibility of an infinite diffusivity near saturation. Using the example of two soils (clay and coarse sand), the new filtration equation has a sound physical basis. In particular, all parameters used are true soil properties that are constant with time and independent of the water depth imposed as a boundary condition. Different assumptions used for the development of the infiltration equation had to be verified: (1) the validity of the shape identity hypothesis, and (2) the validity of considering the soil moisture pressure value as a soil parameter constant in time and independent of surface boundary conditions. This permits the use of the infiltration model for prediction purposes. Compared with analytical, numerical, and experimental results, the equation shows a great precision (sigma squared $<$ .00510 square cm) at all times. The present law introduces a significant improvement over the law obtained previously dealing with ponded infiltration by introducing the physical effect of an infinite diffusivity at saturation. (Author's abstract)
W91-00790

WATER QUALITY AND PAM INTERACTIONS IN REDUCING SURFACE SEALING.
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
For primary bibliographic entry see Field 4D.
W91-00791

DEPLETION AND RECHARGE OF SOIL WATER IN TWO STANDS OF NORWAY SPRUCE (PICEA ABIES (L.) KARST).
Sveriges Lantbruksuniversitet, Umea. Dept. of Forest Site Research.
L. G. Norden.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 197-213, July/September 1990. 8 fig, 5 tab, 37 ref.

Descriptors: *Correlation analysis, *Forest hydrology, *Forest soils, *Recharge, *Soil water, *Spruce trees, *Statistical methods, *Water depletion, Drought, Gypsum, Spearman rank correlation, Soil water table, Statistical analysis, Sweden.

Depletion and recharge dynamics of soil water were studied at two forest sites in Northern and Southern Sweden during three growing seasons. At each site having a stand of Norway spruce (Picea abies (L.) Karst), soil water potential was measured with 90 gypsum blocks in 30 profiles at depths of 6, 20, and 50 cm from the soil surface. The size of the rectangular plots was 250 square cm. The large variation in soil water potential during desiccation periods extended throughout the measuring range of the gypsum blocks. The soil water potentials, at different times and depths, were log-normally distributed during only parts of the desiccation periods. Due to the large variation and skewed distribution of soil water potentials the nonparametric Spearman rank correlation statistic was used to analyze the pattern of desiccation. In the beginning of a dry period, the topsoil was more efficiently desiccated than the subsoil at both sites. This difference lasted throughout all droughts at the southern site and was explained by a higher root density in the topsoil. At the northern site, however, there was no difference in the degree of desiccation at different soil depths during an extended desiccation period. There was a vertical relationship in soil water desiccation in which an accentuated water depletion at the 6 cm soil depth was followed by a similar strong depletion 14 cm lower in the same observation profile. Strongly desiccated observation profiles were not necessarily situated close to each other but seemed randomly spread over the site. There was no relationship between extracted water at any of the three soil depths in the different observation profiles and proximity to trees or tree size. (Author's abstract)
W91-00860

SEASONAL SOIL WATER DYNAMICS IN THE JARRAH FOREST, WESTERN AUSTRALIA. I: RESULTS FROM HILLSLOPE TRANSECT WITH COARSE-TEXTURED SOIL PROFILES.
Water Authority of Western Australia, Perth.
J. K. Ruprecht, and N. J. Schofield.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 241-258, July/September 1990. 10 fig, 2 tab, 28 ref.

Descriptors: *Australia, *Eucalyptus trees, *Geohydrology, *Infiltration, *Slopes, *Soil water, *Soil water potential, *Surface-groundwater relations, Matric potential, Moisture meters, Recharge, Seasonal variation, Soil profiles, Tensiometers.

Seasonal soil water dynamics were measured on a hillslope transect in the jarrah forest of southwest Western Australia over the period 1984-86 using mercury manometer tensiometers, gypsum blocks, and a neutron moisture meter. The soil water potential gradients indicated downward vertical drainage flux through winter and spring. There was generally a change to an upward flux in early summer which was sustained through to autumn. A shallower ephemeral saturation zone was identified in and above a duricrust layer, lasting up to three days after heavy, late winter rainfall. The annual maximum to minimum unsaturated soil water storage on the hillslope was approximately 400 mm to 6 m depth and 480 mm to 15 m depth. This did not change significantly in years of substantially different winter rainfall. The magnitude of seasonal soil water storage was similar to other forested areas with deep soil profiles. The depth of observable infiltration was dependent on annual rainfall. This was consistent with the observation that groundwater levels responded to rainfall over the whole hillslope in wet years but only responded on the lower slopes in dry years. The average summer drying rate of the soil profile to 6 m of 3.5 mm/day was within the range of values reported for forests elsewhere. In late summer, following an extended drought period, the drying rate decreased downslope but increased midslope. (See also W91-00864) (Author's abstract)
W91-00863

SEASONAL SOIL WATER DYNAMICS IN THE JARRAH FOREST, WESTERN AUSTRALIA. II:

RESULTS FROM A SITE WITH FINE-TEXTURED SOIL PROFILES.
Water Authority of Western Australia, Perth.
J. K. Ruprecht, and N. J. Schofield.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 259-267, July/September 1990. 7 fig, 9 ref.

Descriptors: *Australia, *Eucalyptus trees, *Geohydrology, *Infiltration, *Slopes, *Soil water, *Soil water potential, *Surface-groundwater relations, Matric potential, Moisture meters, Recharge, Seasonal variation, Soil profiles, Tensiometers.

Seasonal soil water dynamics were measured at a fine-textured, upslope site within the jarrah forest of southwest Western Australia and compared to the results from a coarse-textured hillslope transect. Gravity drainage dominated during winter and early spring. This reversed in early summer and an upward potential was observed to 7 m depth. A shallow ephemeral saturation zone was observed above a clay pan at 1.5 m depth. This saturation zone persisted through late winter and early spring, contrasting with the short-lived saturation in the duricrust on the hillslope transect. The annual maximum to minimum unsaturated soil water storage was about 530 mm, 50 mm greater than the hillslope transect and higher than most values reported elsewhere in Australia. Significant soil water content changes following winter rain were generally restricted to 6 m but at one site occurred to 9 m. These depths were significantly less than the coarser-textured hillslope transect. Soil water drying rates averaged 5 mm/day during extended dry periods compared to 3.5 mm/day on the hillslope transect. The drying rate occurred uniformly through the profile until late summer when a significant decrease in the upper 3 m was observed. (See also W91-00863) (Author's abstract)
W91-00864

MOVEMENT AND FATE OF ATRAZINE AND BROMIDE IN CENTRAL KANSAS CROPLANDS.
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5B.
W91-00882

RELATIVE PERFORMANCE OF A SOIL MOISTURE ACCOUNTING MODEL IN ESTIMATING RETURN FLOW.
Roorkee Univ. (India). School of Hydrology.
K. M. M. Mohan Rao, D. Kashyai, and S. Chandra.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 231-241, July 1990. 3 fig, 3 tab, 13 ref.

Descriptors: *Flow models, *Groundwater movement, *Groundwater recharge, *Irrigation water, *Model studies, *Return flow, *Soil moisture, Natural recharge, Soil moisture retention, Soil types.

The current practice of estimating return flow (also know as groundwater recharge) from irrigation and rainfall is mostly based on soil moisture accounting (SMA) models and involves many restrictive assumptions. Prominent among them is the existence of a threshold moisture content termed 'field capacity', which must be quantified as a flow parameter to be compatible with its hydraulic implication in the SMA models. This study developed: (1) a method for quantifying field capacity as a flow parameter; and, (2) an assessment of a proposed SMA model for estimation of return flow, in comparison with an earlier distributed model based on a finite difference solution of the Richards' equation, for studying the possibility of replacement of the more elaborate distributed model by the easy to adopt SMA model. Distributed models (based on solution of the Richards' equation) are free from many of the restrictive assumptions associated with the SMA models, particularly that of field capacity. Thus, comparison of the return flow estimates of both these models, would show the impact of the restrictive assumptions in the SMA models. Use of an identical database showed reasonable agreement between the seasonal totals of return flow as predicted by both models. However, the daily rates differ considerably. These observations show the effects of not accounting for the time lag on occurrence, underestimation and overestimation of the return flow by the SMA model. Further, in general, the performance of the SMA model is more acceptable (in view of the objectives of the work) in the case of the loam soil (coarse soil), perhaps because the quantification of field capacity as a flow parameter by the proposed method is more suitable for coarse soils. (Hoskin-PTT)
W91-00887

NOTE ON THE ANALYSIS OF MOISTURE-DEPTH CURVES OBTAINED BY THE HOT-AIR METHOD FOR THE DETERMINATION OF SOIL MOISTURE DIFFUSIVITY.
Botswana Univ., Gaborone. Dept. of Geology.
A. Gieske, and J. J. De Vries.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 261-268, July 1990. 4 fig, 2 tab, 10 ref.

Descriptors: *Diffusivity, *Laboratory methods, *Soil moisture retention, *Soil water, Data analysis, Hot air method.

Diffusivities of undisturbed soil samples can be determined with the so-called hot-air method. Undisturbed soil cores collected in the field with hydraulic equipment are carefully equilibrated in the laboratory at suction levels between 1 and 10 kPa (pF1 and pF2 respectively). Hot air is then blown against one end of the core for a short period of time, causing the sample to dry out quickly from that end. By cutting the core into thin slices and determining the moisture content of each slice, a moisture distribution curve can be established from which the diffusivity as a function of moisture can be calculated. Several graphical and numerical methods exist for the analysis of the moisture vs. depth curves obtained with this method. Moreover, an implicit finite difference approach to the problem suggests that near the drying surface of the soil sample, diffusivity values are higher than under natural circumstances as a result of the treatment with hot air. The parameters of the diffusivity model depend sensitively on the data and therefore the numerical processing of the moisture vs. depth curves must be handled with caution, bearing in mind the various possible disturbances. (Hoskin-PTT)
W91-00889

SIMULATION OF NITRATE NITROGEN BREAKTHROUGH CURVES STEMMING FROM LEACHING OF AMMONIUM NITRATE THROUGH SOIL.
Orissa Univ. of Agriculture and Technology, Bhubaneswar (India).
For primary bibliographic entry see Field 5B.
W91-00896

METHOD TO EXTRACT SOIL WATER FOR STABLE ISOTOPE ANALYSIS.
Geological Survey, Reston, VA.
K. Revesz, and P. H. Woods.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 397-406, July 1990. 3 fig, 5 tab, 20 ref.

Descriptors: *Deuterium, *Laboratory methods, *Oxygen isotopes, *Sampling, *Soil water, *Water analysis, Chemical analysis, Distillation, Mass spectrometry, Temperature effects, Toluene.

A method has been developed to extract soil water for determination of deuterium (D) and O18 content. The principle of this method is based on the observation that water and toluene form an azeotropic mixture at 84.1 degrees C but are completely immiscible at ambient temperature. In a specially designed distillation apparatus, the soil water is distilled at 84.1 degrees with toluene and is separated quantitatively in the collecting funnel at ambient temperature. Traces of toluene are removed and the sample can be analyzed by mass spectrometry. Kerosene may be substituted for toluene. The accuracy of this technique is +/-2 and +/-0.2%, respectively, for delta D and delta O18. Reduced accuracy is obtained at low water contents. (Author's abstract)
W91-00898

EVAPORATION FROM SOIL SURFACE IN PRESENCE OF SHALLOW WATER TABLES.
Mosul Univ. (Iraq). Dept. of Irrigation and Drainage.
For primary bibliographic entry see Field 2D.
W91-00996

USING GIS TO ASSESS SPATIAL VARIABILITY OF SCS CURVE NUMBER AT THE BASIN SCALE.
Politecnico di Milano (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 2E.
W91-01004

2H. Lakes

EMPIRICAL MODELS FOR PREDICTING WATER QUALITY, AS APPLIED TO DATA ON LAKES OF POLAND.
Polish Academy of Sciences, Warsaw. Zaklad Paleobiologii.
J. Uchmanski, and W. Szeligiewicz.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 285-316, 1989. 7 fig, 7 tab, 33 ref, 3 append.

Descriptors: *Chlorophyll a, *Limnology, *Mathematical models, *Phosphorus, *Secchi disks, *Seston, *Water quality, Hypolimnion, Lakes, Oxygen, Poland.

Data were collected on the concentration of total P, visibility of Secchi disks, concentration of chlorophyll-a, and concentration of seston in several lakes in northern Poland. These data were used to develope a predictive model of P concentrations in lakes. After testing several versions, the model with a variable retention coefficient was selected. Regression equations were found describing relationships between the visibility of Secchi disk and the P concentration, the dry chlorophyll-a concentration and the P concentrations, and the dry seston concentration and the visibility of Secchi disk. Predictive equations were also developed for oxygen concentrations in the hypolimnion. (Author's abstract)
W91-00001

NUMERICAL MODEL OF PHOSPHORUS EXCHANGE BETWEEN THE SEDIMENTS AND THE NEAR-BOTTOM WATER IN A LAKE.
Warsaw Univ. (Poland). Lab. of Medical Physics.
P. Mitraszewski, and J. Uchmanski.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 317-346, 1988. 19 fig, 5 tab, 17 ref.

Descriptors: *Bottom sediments, *Cycling nutrients, *Limnology, *Phosphorus, *Poland, Bottom water, Lake Glebokie, Lake Inulec, Lakes, Mathematical models, Mathematical studies, Midges, Oligochaetes.

A model is presented which describes P exchange between the sediments and the near-bottom water in a lake. The effect of bottom animals (Chironomidae and Tubificidae) on this process, through their respiratory activity, was considered. Two versions of the model were considered, for anaerobic and for aerobic conditions, when a highly oxygenated sediment layer at the interface with the near-bottom water prevents the diffusion of phosphorus. The model was fitted with results from experiments with bottom-sediment cores taken from Lake Glebokie and Lake Inulec, Poland. The model was found to be more sensitive to changes of all the parameters under anaerobic than under aerobic conditions. Variation in temperature and oxygen concentration causes greater changes than is naturally characterized by small temperature oscillations, and a low oxygen concentration near the bottom. If benthic organisms are eliminated from the model, phosphorus concentration in the near-bottom water drops by about 30% in the case of Chironomidae, and by about 10% in the case of Tubificidae. Results from sensitivity analysis of the model indicate that the role of Chironomidae in phosphorus concentration is more important than that of Tubificidae. (Sand-PTT)
W91-00002

SIMULATION MODEL OF PHOSPHORUS CYCLING IN THE EPILIMNION OF A EUTROPHIC LAKE.
Polish Academy of Sciences, Warsaw. Zaklad Paleobiologii.
J. Uchmanski.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 347-386, 1988. 29 fig, 5 tab, 20 ref.

Descriptors: *Cycling nutrients, *Epilimnion, *Limnology, *Model studies, *Phosphorus, *Poland, *Simulation analysis, Aquatic bacteria, Detritus, Lake Glebokie, Microbiological studies, Phytoplankton, Water temperature, Zooplankton.

Time-related changes in the epilimnion of Lake Glebokie, Poland are described in a model using six variables: concentration of dissolved orthophosphate phosphorus, phytoplankton, bacteria, detritus, non-predatory zooplankton, and predatory zooplankton in the epilimnion of Lake Glebokie. The stability of the model was analyzed, and it was found that the variables showed damped oscillations around equilibrium points. Results of numerical experiments are presented, simulating a cessation of fish farming in the lake, changes in the water level, timing of P inflow to the epilimnion from deeper layers of the lake, and changes in temperature and light conditions. Results show that the inflow of P from deeper layers largely influences the values of the model variables. (Author's abstract)
W91-00003

METHODS FOR IMPROVING THE EFFICIENCY OF CALIBRATION OF A MODEL OF PHOSPHORUS CYCLING IN A LAKE ECOSYSTEM.
Politechnika Warszawska (Poland). Inst. of Environmental Engineering.
M. Loga.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 387-406, 1988. 8 fig, 4 tab, 12 ref.

Descriptors: *Cycling nutrients, *Limnology, *Mathematical models, *Model studies, *Phosphorus, *Phytoplankton, *Poland, Aquatic bacteria, Detritus, Lake Glebokie, Mathematical studies, Microbiological studies, Sensitivity analysis, Simulation analysis, Zooplankton.

As has been indicated by practice, the traditional trial and error method is not an efficient tool for estimating the parameters of ecological models. The degree of complication of a typical ecological model also makes it impossible to use currently available formal algorithms. Two techniques are presented which can increase the chance to obtain parameter values approximate to the correct ones through a better control of the process of estimation: the step by step merging subsequent method (SMSSE) and sensitivity analysis-aided estimation. The former method reduces the number of parameters estimated simultaneously, by eliminating some of the state equations. If necessary, evaluations of these equations are replaced in other equations with their approximations (e.g., Fourier series) obtained from measurement data. Though mentioned in the literature, the use of sensitivity analysis in the course of the estimation process is an underestimated improvement of the trial and error method. If applied during the calibration of a model, and not after its completion, sensitivity analysis makes it possible to better understand the structure of a model, thereby improving the process of estimation. Both methods can improve the equations of a model in situations where the parameters that are being estimated assume values differing from so-called reasonable values (e.g. values quoted in the literature, with ecological interpretations or measured data), or where repeated efforts fail to bring a satisfactory consistency to simulation results with measured data. This latter situation occurred in the study of a model of phosphorus cycling in the epilimnion of Lake Glebokie. Figures presented in the paper indicate a poor consistency of the simulation results with measured data. A model with a variable form of the equation defining the dynamics of bacteria gives a far better consistency of simulation results with measurement data. (Sand-PTT)
W91-00004

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM. XIX. SUSPENDED-MATTER SEDIMENTATION.
Polish Academy of Sciences, Krakow. Zaklad Ochrony Przyrody i Zasobow Naturalnych.
A. Lajczak.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 407-424, 1988. 9 fig, 1 tab, 26 ref.

Descriptors: *Goczalkowice Reservoir, *Poland, *Reservoir sediments, *Reservoir silting, *Sedimentation, *Suspended sediments, Bottom sediments, Erosion, Reservoir operation, Seasonal variation, Sediment erosion.

Long-term and seasonal variation in the silting rate of the Goczalkowice Reservoir, Poland, has been described on the basis of suspended material loads, and input and output, calculated during the first 25 years of operation. The course of the silting process in this large, shallow foreland reservoir, with intensive waves, differs significantly from that seen in other shallow water bodies in southern Poland. The first 12-year period of permanent retention of suspended material was followed by increasingly intensive erosion of the bottom sediments of the reservoir, and their output outside the dam. After the reservoir had operateded for 20 years it's capacity for suspended material retention was found to have dropped from 90 to 0%. This zero retentive capacity of the reservoir for suspended matter, provides optimistic prospects for future water management within the reservoir. (See also W90-00006) (Sand-PTT)
W91-00005

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: XX. LONG-TERM CHANGES IN THE ABUNDANCE AND COMPOSITION OF MICROBIAL COMMUNITIES.
Politechnika Slaska, Gliwice (Poland). Inst. of Engineereing.
J. Mrozowska, and H. Petrycka.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 427-443, 1988. 5 fig, 4 tab, 21 ref.

Descriptors: *Aquatic bacteria, *Dam effects, *Ecosystems, *Goczalkowice Reservoir, *Limnology, *Poland, *Population dynamics, *Reservoirs, *Saprophytic bacteria, *Vistula River, Cycling nutrients, Microbiological studies.

Microbiological analyses were made using standard methods on water samples from the Vistula River, Poland, prior to construction of the Goczalkowice Reservoir. These analyses showed that the river had self-purification abilities indicating a good prognosis for the future reservoir. In the first years after damming up the waters in 1953, the number of saprophytic bacteria greatly fluctuated, and only limited detection of some physiological groups of bacteria, e.g., denitrifying, nitrifying and cellulolytic. Decreasing bacteria numbers toward the dam indicated the possibility of a self-purifying process in the water. Results of microbiological investigations from 1959-1970, conducted in the lower zone of the reservoir, point to a gradual formation of bacterial biocoenosis and thus, a periodic or continuous intensification of specified physiological processes (e.g., denitrification, nitrification) together with the reservoir's stability. Results allow for the assumption that between 1956 and 1966, bacterial microflora development attained a specified balance, whereas between 1967 and 1982, a kind of stability was observed. Microflora stability was displayed by smaller numbers of saprophytic bacteria at relatively low fluctuations of average seasonal and annual numbers of bacteria. Water in the lower zone of the reservoir was relatively clean from the bacteriological point of view, especially after 1967. Thus, it can be said that the physicochemical processes and biological behaviors in the reservoir were conducive to self-purification of the waters. (See also W90-00005) (Sand-PTT)
W91-00006

POPULATIONS, GROWTH, BIOMASS AND PRODUCTION OF FISH IN A SMALL STREAM IN NORTH-WEST POLAND.
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
E. Mortensen, and T. Penczak.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 445-458, 1988. 3 fig, 5 tab, 42 ref.

Descriptors: *Bullhead, *Fish populations, *Poland, *Population dynamics, *Stream fisheries, *Trout, Biomass, Growth, Streams.

The population density, growth, biomass and production of brown trout, Salmo trutta, and bullhead, Cottus gobio, were investigated in a small stream in Poland. Population densities ranged from 5067 to 9066 fish/ha for brown trout, and 5468 to 7266 fish/ha for bullhead. Mean annual biomass and total production were 10.1 kg/ha and 36.6 kg/ha/yr for brown trout and 19.7 kg/ha and 30.8 kg/ha/yr for bullhead. The O age group production of brown trout was similar to production found in other small streams in Europe. (Author's abstract)
W91-00007

SEASONAL HABITAT USE BY WALLEYE IN A WARMWATER RIVER SYSTEM, AS DETERMINED BY RADIOTELEMETRY.
Iowa Dept. of Natural Resources, Manchester. Northeast District Headquarters.
For primary bibliographic entry see Field 8I.
W91-00009

SALMON STOCKS AND SALMON FISHERIES IN THE BALTIC SEA (ITAMEREN LOHIKANNAT JA LOHENKALASTUS).
Finnish Game and Fisheries Research Inst., Helsinki.
For primary bibliographic entry see Field 8I.
W91-00015

REINTRODUCTION OF SALMON AND SEA TROUT INTO THE VANTAANJOKI AND KYMIJOKI RIVERS (LOHEN JA MERITAIMENEN PALAUTTTAMINEN VANTAANJOKEEN JA KYMIJOKEEN).
Finnish Game and Fisheries Research Inst., Helsinki.
For primary bibliographic entry see Field 8I.
W91-00017

CULTIVATON AND MANAGEMENT OF LANDLOCKED SALMON AND CHARR IN LAKE SAIMAA (SAIMAAN JARVILOHEN JA NIERIAN VILJELY JA HOITO).
Finnish Game and Fisheries Research Inst., Helsinki.
For primary bibliographic entry see Field 8I.
W91-00018

MACROPHYTE ASSOCIATED INVERTEBRATES AND THE EFFECT OF HABITAT PERMANENCE.
Lund Univ. (Sweden). Dept. of Ecology.
A. Hargeby.
OIKOS OIKSAA, Vol. 57, No. 3, p 338-346, 1990. 2 fig, 3 tab, 44 ref.

Descriptors: *Aquatic habitats, *Eutrophic lakes, *Invertebrates, *Limnology, *Macrophytes, *Species composition, Algae, Ecosystems, Population density, Population dynamics, Stonewort.

Invertebrate abundance differed in stands of two characeans Chara tomentosa L. and Nitellopsis obtusa (Desv.) J. Groves in a shallow eutrophic lake. The plants are similar in morphology but differ in growth cycle. In stands of the wintergreen Chara tomentosa, Asellus aquaticus L. (Isopoda) dominated in abundance over Chironomidae (Diptera) and Gammarus lacustris G. O. Sars (Amphipoda) occurred frequently. In stands of N. obtusa, which dies off during winter, Chironomidae dominated, while the abundance of Asellus was one of two orders of magnitude lower than in Chara and Gammarus was not found. Field and laboratory preference tests showed that Asellus and Gammarus did not colonize or prefer Chara over Nitellopsis, suggesting that active avoidance

was not the cause of their low abundance in Nitellopsis. Exclusion of fish for 90 days in a Nitellopsis stand did not increase the density of Asellus, but introduction of Asellus to enclosures showed that the species was able to grow rapidly and reproduce in the habitat. In a recently established Chara stand the species structure of associated invertebrates shifted from a dominance of Chironomidae in September of the first year to a dominance of Asellus the following year. These results support the hypothesis that the die-off of Nitellopsis in autumn limits slow colonizers like Asellus and Gammarus from establishing dense populations in this habitat. The invertebrate community in this seasonally changing habitat is thus suggested to be in an early phase of colonization, where animal interactions are less important and the species composition is mainly determined by colonization ability. In the more permanent Chara habitat, density dependent animal interactions are suggested to determine the abundance and species composition. (Author's abstract)
W91-00052

LATERALLY AVERAGED HYDRODYNAMICS MODEL FOR RESERVOIR PREDICTIONS.
Toronto Univ. (Ontario). Dept. of Physics.
S. R. Karpik, and G. D. Raithby.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 783-798, June 1990. 8 fig, 30 ref.

Descriptors: *Computer models, *Density currents, *Mathematical models, *Model studies, *Reservoirs, *Thermal stratification, Turbulent flow, Water quality.

The prediction of flows in reservoirs is of significant practical interest from a water quality perspective, the choice of an appropriate withdrawal point for drinking water, and the use of the cooling capacity of reservoirs for waste heat rejection. LAHM is a new two-dimensional model for the prediction of thermally stratified reservoir flows. Unlike many other reservoir models, this model does not employ the hydrostatic approximation. The full general orthogonal three-dimensional anelastic equations of motion are laterally averaged to produce a set of two-dimensional equations in a vertical plane that is oriented along the principal axis of the reservoir. Using an orthogonal boundary fitted mesh, the governing differential equations are rendered discrete by a finite volume technique. The resulting set of coupled difference equations for momentum, mass, and energy are solved by a method that is especially appropriate to reservoirs in which the depth is small compared to the length. The model applies to turbulent flow and to cases where the flow is somewhat nonuniform in the lateral direction if turbulence and dispersion models are added. Comparisons between the predictions of the model and previously published flume data show that the model is well able to predict the important features of density underflows. (Author's abstract)
W91-00062

WATER WAVES GENERATED BY DISTANT LANDSLIDES.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 3, p 307-322, 1988. 5 fig, 18 ref.

Descriptors: *Landslides, *Mathematical models, *Model studies, *Reservoirs, *Wave runup, *Waves, Tsunamis.

Waves generated in a reservoir by a landslide were modeled by injecting an instantaneous point source of fluid through the bottom of a reservoir of infinite extent. Linearized wave theory was used to calculate solutions for dispersive waves when the wave patterns are either axisymmetric or one dimensional in a reservoir of constant depth and infinite extent. This assumes that times are large relative to the duration time of the landslide and that distances are large relative to a characteristic horizontal dimension of the volume of water displaced by the slide material. Solutions were obtained for two-dimensional and axisymmetric problems, and the asymptotic forms of these solutions were used to obtain expressions for maximum wave amplitudes, length, period, and position. Since the solution assumes a constant reservoir depth, and since maximum wave amplitudes always occur along shorelines of sloping beaches, it is suggested that these solutions may be of most use for providing boundary conditions for models of wave runup on sloping beaches. A comparison with experimental results was made, and agreement between the calculated and measured results is found to be good. (Author's abstract)
W91-00071

WATER BALANCE OF LAKE ROTOITI, NORTH ISLAND: FLOODS AND SHORT-CIRCUITING OF INFLOWS FROM LAKE ROTORUA.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
R. H. Spigel.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 47-61, 1989. 4 fig, 2 tab, 27 ref, append.

Descriptors: *Floods, *Hydrologic budget, *Lake Rotoiti, *Lake Rotorua, *Lakes, *Water circulation, Density currents, New Zealand, Rainfall, Storms, Streamflow, Surface-groundwater relations.

The water balance of Lake Rotoiti, North Island, New Zealand, was examined to clarify the role of floods and residual flows in the transport of Lake Rotorua water into the main body of Lake Rotoiti. A 28-yr (1957-1984) dataset for inflows, outflows, water levels, rainfall, and evaporation was used to construct a long-term monthly water balance and to compare daily flows for the entire study period. Four storms were examined in detail to explain observed lake level rises during the storms. The transport of Lake Rotorua water to Lake Rotoiti during storms is negligible compared with transport governed by density currents, and lake level rises during storms are a response more to rainfall on the lake than to inflows from Lake Rotorua. The residual term in the water balance reflects groundwater input, resulting in a net westward flow through the lake. In the absence of density currents this flow reinforces the tendency of Lake Rotorua water to short-circuit (i.e., to flow directly to the outlet of Lake Rotoiti without mixing with the main body of the lake) because of the proximity of the lake inlet and outlet at the western end of the lake. (Author's abstract)
W91-00077

SEASONAL VARIABILITY IN THE SENSITIVITY OF FRESHWATER LENTIC COMMUNITIES TO A CHRONIC COPPER STRESS.
Miami Univ., Oxford, OH. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-00196

SHORT-TERM PRODUCTIVITY RESPONSES OF ALGAE AND BACTERIA TO ZOOPLANKTON GRAZING IN TWO FRESHWATER LAKES.
Georgia Univ., Athens. Inst. of Ecology.
S. A. Shoenberg.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 395-410, June 1990. 7 fig, 4 tab, 71 ref. National Science Foundation Grant BSR 82-15587.

Descriptors: *Algae, *Bacteria, *Lakes, *Limnology, *Plankton, *Productivity, Biomass, Chlorophyll a, Dissolved organic carbon, Primary productivity, Tracers, Tritium.

The specific productivities of algae and bacteria were measured in short-term (4 day) experiments consisting of enclosures with natural or reduced zooplankton biomass. Experiments were repeated five times over a season in each of two lakes that differed in the background concentration of dissolved organic carbon (DOC). Algal biomass as estimated by chlorophyll a was suppressed in enclosures with ambient grazer levels in six of ten experiments and enhanced in one experiment. Distribution of chlorophyll among net and nanoplankton was not significantly affected by grazing. Relative to enclosures with reduced zooplankton, normal grazer biomass (97-466 micrograms/L dry weight) enhanced specific algal productivity in only one of five experiments in the low DOC lake and had no effect in all five experiments in the high DOC lake. The main effect of grazers on algae was through removal of biomass rather than through indirect changes in turnover rate. Between experiments, bacterial density was either unaffected, or mildly enhanced (4-87%) in enclosures with ambient macrozooplankton compared to those with reduced levels. Bacterial productivity and turnover estimated by incorporation of tritium labelled thymidine into DNA showed different responses across experiments; increasing, declining or remaining the same with grazer manipulation. This variability was not related to differences in dissolved primary production or to background DOC between lakes or experiments. Comparison of bacterial productivities based on thymidine incorporation rates with changes in cell densities indicated that control of bacterial loss processes by macrozooplankton is more important than control of growth rates. (Author's abstract)
W91-00418

DISTRIBUTION OF MICRO-ARTHROPODS IN SOME SOUTHERN ENGLISH STREAMS: THE INFLUENCE OF PHYSICOCHEMISTRY.
Queen Mary Coll., London (England). School of Biological Sciences.
S. R. Rundle, and A. G. Hildrew.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 411-431, June 1990. 8 fig, 8 tab, 59 ref, append.

Descriptors: *Copepods, *Waterfleas, *Watermites, *England, *Physicochemical properties, *Running waters, *Species diversity, *Statistical analysis, *Streams, Benthic fauna, Conductivity, Copepods, Harpacticoida, Hydrachnellae, Hydrogen ion concentration, Mathematical analysis, Multivariate analysis, Regression analysis, Seasonal distribution, Temperature effects, Waterfleas.

Micro-arthropods were surveyed during October 1986 at thirty stony, stream riffle sites in the Ashdown Forest, southern England. The importance of a number of physicochemical variables in determining both the distribution of micro-arthropod taxa and community structure was assessed. Acidic sites had impoverished fauna. Total micro-arthropod species richness and densities were highest under circumneutral conditions, and the same patterns were shown by the Hydrachnellae, Harpacticoida and Cladocera. A number of species seemed indifferent to acidic conditions and were widespread and, as a group, the cyclopoid copepods showed no relationship with pH. Multiple regression showed that other environmental variables, in particular annual mean temperature and maximum discharge, were also important in explaining the between-site distribution of separate micro-arthropod groups and individual species. Other multivariate techniques (ordination, classification and multiple discriminant analysis) showed that impoundment linkage, source distance and conductivity, along with pH, were the most important variables in explaining patterns of species composition between sites. (Author's abstract)
W91-00419

COMPARATIVE STUDY OF MATHEMATICAL MODELS FOR THE RELATIONSHIP BETWEEN WATER TEMPERATURE AND BROOD DEVELOPMENT TIME OF GAMMARUS FOSSARUM AND G. ROESELI (CRUSTACEA: AMPHIPODA).
Vienna Univ. (Austria). Limnologische Lehrkanzel.
M. Pockl, and W. Timischl.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 433-440, June 1990. 2 fig, 2 tab, 21 ref.

Descriptors: *Amphipods, *Aquatic animals, *Crustaceans, *Growth rates, *Limnology, *Mathematical models, *Model studies, *Physical properties, *Streams, *Water temperature, Austria, Com-

parison studies, Hatching, Running waters, Statistical analysis.

The relationship between water temperature (T) and brood development time (d days for embryonic development time plus 'post hatch time') was investigated experimentally using animals from four populations of Gammarus fossarum (populations 1-4) and two populations of G. roeseli (populations 5 and 6) in Austrian streams. Eleven mathematical models were examined as suitable functions to describe the relationship between d and T. The models were compared with respect to their goodness-of-fit and suitability for further quantitative, statistical analyses of intraspecific and interspecific differences between natural populations of G. fossarum and G. roeseli. Statistical analyses were performed with logarithmically transformed values of d, in order to provide homogeneous variances between the different constant temperatures used. A three-parameter model was found to be the most suitable for the data. (Author's abstract)
W91-00420

INTERACTIONS AMONG NUTRIENTS, ALGAE AND INVERTEBRATES IN A NEW ZEALAND MOUNTAIN STREAM.
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2E.
W91-00422

COMPETITION AND COEXISTENCE IN SUBMERGED AQUATIC PLANT COMMUNITIES: THE EFFECTS OF SPECIES INTERACTIONS VERSUS ABIOTIC FACTORS.
Alberta Univ., Edmonton. Dept. of Zoology.
P. A. Chambers, and E. E. Prepas.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 541-550, June 1990. 4 fig, 3 tab, 34 ref.

Descriptors: *Competition, *Lakes, *Limnology, *Species composition, *Species diversity, *Submerged plants, Alberta, Aquatic plants, Biomass, Canada, Chlorophyta, Long Lake, Myriophyllum, Phosphorus, Physicochemical properties, Sediments, Water depth.

Aquatic plant biomass and species composition were studied at three sites in Long Lake, Alberta, Canada, to examine the role of biotic and abiotic factors in determining species diversity. Results of controlled in situ experiments to test for interspecies competition showed that biomass of plants in four different mixed communities did not increase in response to selected species removals ($P>0.1$, $n=6$). In contrast, biomass of the dominant taxa (Myriophyllum exalbescens, Ceratophyllum demersum and Chara sp.) were correlated ($P<0.5$) with abiotic factors (i.e. distance from shore, water depth, sediment exchangeable phosphorus concentration and/or sediment organic content). These results suggest that interspecific competition between naturally coexisting species of submerged aquatic plants is slight and that spatial heterogeneity of differential utilization of abiotic resources promotes species diversity in submerged plant communities. (Author's abstract)
W91-00423

GROWTH RESPONSES OF PLANKTONIC DESMID SPECIES IN A TEMPERATURE-LIGHT GRADIENT.
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
P. F. M. Coesel, and K. Wardenaar.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 551-560, June 1990. 5 fig, 2 tab, 26 ref, append.

Descriptors: *Aquatic life, *Chlorophyta, *Desmids, *Growth, *Growth rates, *Lakes, *Lighting, *Limnology, *Temperature gradient, *Trophic level, Culturing techniques, Distribution patterns, Mesotrophy, Nutrient concentrations, Oligotrophy, Seasonal variation.

The intrinsic growth rates in a number of planktonic desmid species originating from lakes with different trophic status, under nutrient-saturated conditions at various combinations of temperature and light were assessed. Isolates of twelve planktonic desmid species were tested for their growth response in a batch culture, using an apparatus that generates cross gradients of temperature and light intensity. Up to 15 C, growth was mainly temperature-limited. At higher temperatures, there was an increasing effect of light limitation. Optimal growth temperatures were in the range 25-30 C. Highest specific growth rates varied from 0.28 to 1.34 per day. Species with lowest growth rates originated from oligo-mesotrophic habitats, those with highest growth rates originated from eutrophic ones. Results suggest that eutrophic species are characterized by a lower affinity to limiting nutrients than oligotrophic ones and thus are disadvantaged in oligotrophic habitats. The marked differences between the species in their growth response to various light-temperature combinations may be of help in explaining distributional and seasonal patterns of desmid species in nature. (Agostine-PTT)
W91-00424

RESPONSES OF ZOOPLANKTON AND ZOOBENTHOS TO EXPERIMENTAL ACIDIFICATION IN A HIGH-ELEVATION LAKE (SIERRA NEVADA, CALIFORNIA, U.S.A).
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-00425

MINERALIZATION, PORE WATER CHEMISTRY AND PHOSPHORUS RELEASE FROM PEATY SEDIMENTS IN THE EUTROPHIC LOOSDRECHT LAKES, THE NETHERLANDS.
Limnologisch Inst., Nieuwersluis (Netherlands).
A. J. C. Sinke, A. A. Cornelese, P. Keizer, O. F. R. Van Tongeren, and T. E. Cappenberg.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 587-599, June 1990. 5 fig, 4 tab, 43 ref.

Descriptors: *Eutrophic lakes, *Interstitial water, *Lakes, *Mathematical studies, *Mineralization, *Peat, *Phosphorus, *Sediments, *The Netherlands, *Water chemistry, Ammonia, Methane, Organic matter, Redundancy analysis, Seasonal variation, Sediment-water interfaces.

Phosphorus release experiments were carried out under standard laboratory conditions to relate the seasonal variation in pore water chemistry to environmental variables and thus gain insight into the phosphorus regeneration in peaty sediments. Pore water chemistry in peaty sediment was monitored for a year at two representative locations of the eutrophic shallow Loosdrecht lakes, The Netherlands. Phosphorus fluxes over the sediment-water interface were calculated using measured concentration gradients in the pore water and compared to fluxes measured under laboratory conditions. Results were analyzed with redundancy analysis to detect patterns of variation in pore water chemistry and in measured and calculated fluxes, that could be ascribed to environmental variables. It was demonstrated that phosphorus fluxes measured in long-term laboratory incubations were not correlated to any pore water characteristics. Initial phosphorus fluxes measured in sediment columns, which varied between -7.7 and 1330 micromoles/sq m/day, were correlated significantly to the calculated phosphorus flux over the sediment-water interface. The high correlation between calculated fluxes of ammonia, phosphorus and methane and measured initial flux of phosphorus, conclusively pointed to mineralization of organic matter as the driving force for phosphorus release from the sediment. Redundancy analysis demonstrated that the rates of mineralization and phosphorus release were only weakly related to temperature. They appeared to be especially stimulated by the autumnal decrease in temperature which was probably related to an extra input of organic matter. (Author's abstract)
W91-00426

WATER TEMPERATURE IN A STREAM GRAVEL BED AND IMPLICATIONS FOR SALMONID INCUBATION.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
For primary bibliographic entry see Field 8I.
W91-00427

MANIPULATING LAKE COMMUNITY STRUCTURE: WHERE DO WE GO FROM HERE.
York Univ., Toronto (Ontario). Dept. of Biology.
D. J. McQueen.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 613-620, June 1990. 1 fig, 69 ref.

Descriptors: *Aquatic life, *Biocontrol, *Ecology, *Fish management, *Food chains, *Freshwater, *Lakes, *Limnology, Algae, Algal blooms, Aquatic plants, Biomass, Competition, Cycling nutrients, Deep water, Fish, Grazing, Lake management, Macrophytes, Physical properties, Shallow water, Water quality.

More than 10 years experience with whole lake pelagic manipulation has suggested some general trends applicable to all freshwater pelagic communities and some specific trends related to lake depth. Among the general trends is the observation that in shallow lakes, changes in fish community structure are more likely to have cascading impacts on phytoplankton than are changes in deep lakes. In shallow lakes, fish removal frequently results in decreased turbidity which is associated with the development of dense macrophyte populations and significant reductions of algal standing stocks. The mechanisms involve: increased grazing by zooplankton, the removal of fish induced bioturbation and nutrient recycling. and direct and indirect macrophyte effects (shading, zooplankton refuges and competition for nutrients). In shallow lakes, where planktivore biomass can be regulated and macrophyte development is acceptable, fish biomanipulations are likely to result in reduced algal populations and improved water quality. In deep lakes, where macrophytes are not as important, long-term effects of fish manipulations are strongly dependent upon the probability of nongrazable algal bloom development. This is determined by many factors (chemical, physical and grazer related) which modify the impact that grazers have on phytoplankton biomass. In deep lakes, successful fish biomanipulations may only be effective when chemical and physical factors are altered to produce algal species compositions that permit strong top-down control of prey by predators. (Author's abstract)
W91-00428

MONITORING LAKE NASSER BY SPACE SENSING.
Boston Univ., MA. Center for Remote Sensing.
For primary bibliographic entry see Field 7B.
W91-00473

EFFECTS OF COPPER (II) ON THE PRODUCTION OF TRIHALOMETHANES IN MODEL AND NATURAL WATERS.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
For primary bibliographic entry see Field 5B.
W91-00529

FIVE YEAR PROGRAM STRATEGY FOR THE GREAT LAKES NATIONAL PROGRAM OFFICE, FY 1989-1993.
Environmental Protection Agency, Chicago, IL. Great Lakes National Program Office.
For primary bibliographic entry see Field 5G.
W91-00552

INTERACTIONS OF CONTAMINANTS WITH SEDIMENT AND WATER IN RESERVOIRS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W91-00560

SYLVAN LAKE RESTORATION PROJECT.
Utility Engineering Corp., Rapid City, SD.

For primary bibliographic entry see Field 5G.
W91-00562

LAKE RESTORATION PROJECT, NORTH HUDSON PARK LAKE, BERGEN, NEW JERSEY.
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
For primary bibliographic entry see Field 5G.
W91-00563

DREDGING OF NORTH PARK LAKE, COUNTY OF ALLEGHENY, PENNSYLVANIA.
Pennsylvania Dept. of Environmental Resources, Harrisburg.
For primary bibliographic entry see Field 5G.
W91-00564

PESTICIDES AND WETLANDS OVERSEAS: A FRAMEWORK FOR MITIGATING ADVERSE IMPACTS.
California Univ., Berkeley. Graduate School of Public Policy.
For primary bibliographic entry see Field 5G.
W91-00570

RESOURCE LIMITATION IN A STREAM COMMUNITY: PHOSPHORUS ENRICHMENT EFFECTS ON PERIPHYTON AND GRAZERS.
Academy of Natural Sciences of Philadelphia, PA.
D. D. Hart, and C. T. Robinson.
Ecology ECOLAR, Vol. 71, No. 4, p 1494-1502, August 1990. 1 tab, 80 ref. NSF Grant DEB-8111305 and Grant BSR-8312629.

Descriptors: *Caddisflies, *Ecology, *Limiting nutrients, *Periphyton, *Phosphorus, *Stream biota, Benthic fauna, Biomass, Enrichment, Field tests, Grazing, Insects, Michigan, Population density.

A field experiment was used to test whether stream periphyton was nutrient limited, and if so, whether the grazing insects that consumed this resource were food limited. Eight replicate wooden flumes were placed in an unshaded riffle in Augusta Creek, a third-order, hardwater trout stream in southwestern Michigan. Phosphorus (P), in the form of calcium phosphate, was added to four of these flumes for 105 days. The average concentration of soluble reactive phosphorus (SRP) maintained in P-enriched flumes (85 micrograms/L) was greater than 5 times as great as in control flumes (15 micrograms/L). After 77 days of nutrient enrichment, periphyton biomass per unit area on substrates with reduced grazer densities was 1.8 times as great in P-enriched flumes as in control flumes. The larvae of two species of grazing caddisflies (Leucotrichia pictipes and Psychomyia flavida) in P-enriched flumes also had higher individual mass, developmental rates, and population densities. Theses responses resulted in standing crops of final-instar larvae in P-enriched flumes that were 2.1 times and 1.5 times as great as those in control flumes for Psychomyia and Leucotrichia, respectively. This demonstration of food limitation supplements previous behavioral studies showing that both grazer species aggressively defend feeding territories, and contributes to a growing body of evidence suggesting that resource limitation is more important in some stream food webs than previously recognized. Resource limitation of these grazer populations may be due in part to the rarity of catastrophic flooding and drying in Augusta Creek. Such stable flows could permit consumer populations to reach higher densities than in frequently disturbed streams. (Author's abstract)
W91-00618

REDUCTION OF PHOSPHORUS AND CHLOROPHYLL A CONCENTRATIONS FOLLOWING CACO3 AND CA(OH)2 ADDITIONS TO HYPEREUTROPHIC FIGURE EIGHT LAKE, ALBERTA, CANADA.
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 5F.
W91-00625

INFERRED EFFECTS OF LAKE ACIDIFICATION ON DAPHNIA GALEATA MENDOTAE.
Ontario Ministry of the Environment, Sudbury.
For primary bibliographic entry see Field 5C.
W91-00626

NUTRIENT STATUS OF OMBROTROPHIC PEAT BOGS.
Connecticut Univ., Storrs. Dept. of Ecology and Evolutionary Biology.
A. W. H. Damman.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 5-14, 1990. 11 fig, 1 tab, 23 ref. NSF Grants GS-8744 and DEB-7905195.

Descriptors: *Bogs, *Cycling nutrients, *Limnology, *Nutrients, *Ombrotrophic bogs, *Peat bogs, *Wetlands, Climates, Fire, Flow rates, Hydrology, Organic matter, Spatial distribution, Water chemistry.

The nutrient status of ombrotrophic bogs is controlled by: (1) atmospheric inputs; (2) processes affecting ion concentrations in bog water; and (3) processes affecting nutrient supply. Geographic trends result from nutrient input differences and variations in length of vegetative season and temperatures occurring during the growing season. Differences in peat accumulation and water flow rate appear to play an important role, but are rarely considered when accounting for regional differences in fertility. The chemistry of bog water changes seasonally. These changes also show geographic trends because they are under climatic control. The rate of organic matter accumulation, water flow, fire, and other disturbances are the principal factors causing fertility differences within ombrotrophic bogs. Because these differences in nutrient supply often are not reflected in the chemical composition of the bog water, water chemistry appears to be a poor indicator of fertility differences in ombrotrophic bogs. The role of organic matter accumulation and water flow in causing local and regional differences in ombrotrophic bogs is overlooked in most studies and warrants closer study. (Rochester-PTT)
W91-00640

COMPARATIVE DEVELOPMENT OF BOGS AND FENS IN CENTRAL SWEDEN: EVALUATING THE ROLE OF CLIMATE CHANGE AND ECOSYSTEM DEVELOPMENT.
Harvard Univ., Petersham, MA. Harvard Forest.
D. R. Foster, and H. A. Jacobson.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 15-26, 1990. 8 fig, 65 ref. NSF Grant BSR-8906386.

Descriptors: *Bogs, *Ecosystems, *Fens, *Limnology, *Paleoclimatology, *Peat bogs, *Sweden, *Wetlands, Climates, Geomorphology, Hydrology, Paleolimnology, Water chemistry.

The role of climate change versus autogenic processes and local factors in the development of three mires of Sweden is being studied. Studies focus on a comparison of raised bogs and minerotrophic bogs and are addressing three critical aspects of mire development: initiation, growth, and landform dynamics. Results suggest that autogenic processes, especially hydrologic changes that accompany peat accumulation, play a major role in driving mire development and controlling stratigraphic changes including peat type and peat accumulation rates. Both the raised bogs studied were initiated approximately 6000 yr B.P., whereas the fen dates to 9040 yr B.P. All three mires exhibit progressive lateral expansion through time from initiation to the present as documented by a series of basal radiocarbon dates. Similarly, the formation of hummock-hollow topography and pools occurs progressively through time and appears depend on local hydrology within the mire. The results suggest that the interplay of autogenic and allogenic factors control mire development and argue for careful interpretation of paleoenvironmental information from peat stratigraphy. The work shows the need for further hydrological study of mires, comparative investigation of mires and regional environment, and consideration of minerotrophic mires and more complex models of mire formation. (Author's abstract)
W91-00641

VEGETATION AND PALEOECOLOGY OF A BOG COMPLEX IN S FINLAND.
Oulu Univ. (Finland). Dept. of Botany.
A. Huttunen.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 27-37, 1990. 7 fig, 1 tab, 45 ref.

Descriptors: *Bogs, *Finland, *Limnology, *Paleoecology, *Vegetation, *Wetlands, Cottongrass, Ecosystems, Fens, Forests, Nutrients, Ombrotrophic bogs, Sedges, Sphagnum, Succession.

The bog of Ylimysneva is morphologically typical of the region of concentric raised bogs comprising the coast of Finland and southern Ostrobothnia. The ombrotrophic mire vegetation has regionally typical features, but the mire complex has quite large minerotrophic parts as well. The vertical distribution of some elements was studied in two monoliths. A radiocarbon-dated pollen diagram covers most of the Holocene history of the vegetation. The macrosubfossil diagram reflects local history of the site from a shore lake to a poor mire. The open swamp vegetation was replaced by a forest swamp, with further succession towards a poorer vegetation, ultimately leading to a fen dominated by sedges and cottongrass. Only in the uppermost half meter does the vegetation indicate indifferent conditions; Sphagnum magellanicum is a typical indifferent plant found on the boundary between minerotrophic and ombrotrophic phases. (Rochester-PTT)
W91-00642

PRESERVATION OF PLANT POLYMERS IN PEAT AND LIBERATION OF THEIR MONOMERS DUE TO ARTIFICIAL DRAINAGE.
Oulu Univ. (Finland). Dept. of Biochemistry.
P. Lahdesmaki, and R. Piispanen.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 39-43, 1990. 3 fig, 1 tab, 33 ref.

Descriptors: *Bogs, *Environmental impact, *Finland, *Peat, *Wetlands, Amino acids, Ammonia, Carbon dioxide, Cellulose, Chemical reactions, Drainage, Drying, Enzymes, Forests, Lignin, Polymers, Proteins, Starch.

Concentrations of cellulose, protein, lignin, and starch in peat from two ombrotrophic pine bogs in Muhos and Ylikiiminki, northern Finland, were determined as a function of peat depth. The concentration of cellulose decreased to about half of the original concentration at a depth of 1 m and to 1/3 of the original concentration at 2 m, whereas the concentrations of protein and lignin remained relatively constant. Starch was found only in the surface peat. The activities of cellulase, protease, and polyphenoloxidase varied between 50 and 100 picomoles of liberated monomers/sec (pkat) per kg dry weight, with of polyphenol-oxidase increasing as a function of peat depth. Drying of peatlands by artificial drainage liberates a number of amino acids and ammonia from the peat, with marked geobotanical and environmental consequences, including an acceleration of forest growth and an increase in carbon dioxide production. (Author's abstract)
W91-00643

PERIODIC MOISTURE FLUCTUATION AS A FACTOR AFFECTING MIRE VEGETATION.
Oulu Univ. (Finland). Dept. of Botany.
J. Laitinen.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 45-55, 1990. 1 tab, 53 ref.

Descriptors: *Limnology, *Mires, *Soil water, *Swamps, *Vegetation, *Wetlands, Classification, Ecology, Finland, Flooding, Grasses, Hydrology, Nutrients, Sedges.

A significant factor for the classification of mire vegetation-nutrient status is often the fluctuation of moisture and its forms in the vegetation. The most distinct periodic moisture fluctuation is seen in flooded heaths. Flooded conditions are combined

with the concept 'surface-water influence' within which it is possible to separate out 'true swamp influence' and an extreme case 'flood and desiccation influence.' Flooding, combined with desiccation, must be regarded as a stress factor for plants that strongly controls the flora at a site. Certain mire species of the flark and intermediate levels are very tolerant of desiccation. In the case of hummock-level mire vegetation, examples can be presented in which moisture fluctuations may have had an influence on the vegetation. The species group indicative of flood and desiccation influence, the extreme case of surface-water influence, includes Juncus filiformis, Carex nigra, C canescens, C magellanica, C lasiocarpa, Eriophorum angustifolium, Warnstorfia fluitans, and Polytrichum commune. Fluctuation in moisture is unquestionably a variable with a floristically characterized gradient that should be considered when defining the ecological bases of the mire type system. It has importance at every nutrient level and in terms of both mire-inherent and supplementary nutrient effects, with the exception of the spruce mire influence. (Author's abstract)
W91-00644

CONSTANT OR INCREASING NITROGEN CONCENTRATIONS IN SPHAGNUM MOSSES ON MIRES IN SOUTHERN SWEDEN DURING THE LAST FEW DECADES.
Lund Univ. (Sweden). Dept. of Ecology.
N. Malmer.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 57-65, 1990. 3 fig, 1 tab, 33 ref.

Descriptors: *Acid rain, *Limnology, *Mires, *Nutrients, *Sphagnum, *Sweden, *Wetlands, Air pollution, Ash, Biomass, Calcium, Chemical analysis, Growth, Iron, Magnesium, Manganese, Nitrogen, Phosphorus, Potassium, Sodium, Sulfur.

The concentrations of N, P, Na, K, Mg, Ca, Mn, Fe, and acid-insoluble ash (AIA) during the periods 1955-1958 and 1979-1985 in samples of Sphagnum mosses from three mires in the central part of the Swedish upland were compared. Only minor changes in concentrations were found, particularly an increase in N and a decrease in P in some of the samples. It is suggested that the Sphagnum mosses have responded to atmospheric deposition of N and S during the last few decades mainly through an increased growth and biomass accumulation. (Author's abstract)
W91-00645

DIVERGENT SUCCESSIONS IN MIRES, A COMPARATIVE STUDY.
Uppsala Univ. (Sweden). Dept. of Ecological Botany.
H. Sjors.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 67-77, 1990. 2 fig, 65 ref.

Descriptors: *Ecology, *Limnology, *Mires, *Succession, *Waterlogging, *Wetlands, Bogs, Classification, Europe, Fens, Hydrology, Peat.

The patterns in both ombrotrophic and minerotrophic mires are regarded as resulting from divergent succession under the influence of hydrology, causing wetter parts to have less net peat accumulation than drier parts. The rate of decay, which is more decisive for the rate of peat accumulation than is primary production, seems to have its maximum at the hollow level in ombrotrophic sites (bogs) where the maximum peat accumulation then would be at a higher level, such as under hummocks. In minerotrophic sites (fens) the net accumulation usually is smaller and, in the north, would have its maximum in 'lawns' and not in waterlogged parts, whereas in warmer climates it would be located in the 'carpets,' which are wetter than the 'lawns.' This would explain the considerably greater waterlogging needed to produce flarks in fens than hollows in bogs, and the absence of typical patterns in southern lowland fens. The more northern distribution of patterning in fens than in bogs could be related, at least in part, to the abundance of meltwater on the northern fens and 'mixed mires' of the aapa type. Fens also exhibit different mud-bottom network patterns. (Author's abstract)
W91-00646

SYNOPSIS AND NUMERICAL ANALYSIS OF THE PRE-, SUB-, AND LOW-ALPINE MIRE VEGETATION OF THE ULEBERG-SKRUBBEN AREA, NORTH NORWAY.
Tromsoe Univ. (Norway). Inst. for Biologi og Geologi.
K. D. Vorren, and B. E. Johansen.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 79-92, 1990. 5 fig, 4 tab, 29 ref.

Descriptors: *Ecology, *Limnology, *Mires, *Norway, *Swamps, *Vegetation, *Wetlands, Classification, Cluster analysis, Finland, Numerical analysis, Soil properties, Trophic level, Water chemistry.

Vegetation of mires in the Uleberg-Skrubben area of Norway was examined and a synopsis and numerical analysis of the vegetation was conducted. The synopsis was achieved by numerical treatment of vegetation relevees. Thirteen (plus one) different vegetation units (noda) and nine variants (subunits) were established by group-average clustering of qualitative data (presence/absence). A new clustering of the quantitative 'average relevees,' constructed on the basis of the frequency data, showed that the original 13 (+1) vegetation units were differentiated on a level higher than the association syntaxon. According to both numerical and binary clusterings of the total species assemblage and the species assemblage above 40% frequency, 5-8 clusters representing the total mire vegetation of the area could be distinguished. The clusters are thought to represent syntaxa at the alliance level or higher. The establishment of a new syntaxon on a higher level is suggested: a boreal (sub-alpine and pre-alpine) Salix borealis-Filipendula ulmaria-Sphagnum warnstorfii vegetation, representing the O2-rich swamps. The original, numerically based, 13 (+1) vegetation units match the Finnish mire vegetation better than the Central European one. Numerical treatment of important soil chemical and physical parameters result in three main clusters: (1) eu-, and mesotrophic communities characterizing open and wooded sub-, and pre-alpine mires with Sphagnum warnstorfii, (2) oligotrophic Sphagnum fuscum and Sphagnum lindbergii communities, and (3) mountain mires and rich lowland mires influenced by spring water from dolomite. Field pH and conductivity records support the soil chemistry data. (Author's abstract)
W91-00647

OCCURRENCE OF HYPOLIMNETIC BLOOMS OF THE PURPLE SULFUR BACTERIUM, THIOPEDIA ROSEA, AND THE GREEN SULFUR BACTERIUM, CHLOROBIUM LIMICOLA, IN AN AUSTRALIAN RESERVOIR.
University of New England, Armidale (Australia). Dept. of Resource Engineering.
For primary bibliographic entry see Field 5C.
W91-00652

PHYSICOCHEMISTRY AND VEGETATION OF PICCANINNIE PONDS, A COASTAL AQUIFER-FED POND IN SOUTH-EASTERN SOUTH AUSTRALIA.
Monash Univ., Clayton (Australia). Dept. of Botany.
O. Scholz.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 2, p 273-246, 1990. 3 fig, 5 tab, 19 ref.

Descriptors: *Aquatic habitats, *Aquatic plants, *Australia, *Coastal marshes, *Limnology, *Physicochemical properties, *Ponds, *Wetlands, Ecology, Macrophytes, Piccaninnie Ponds, Succession, Surface-groundwater relations, Vegetation.

The aquatic vegetation and physicochemistry of Piccaninnie Ponds are described and recent annual losses of aquatic vegetation were investigated. The aquifer-derived waters of the Ponds are characterized by their clarity, low nutrient content, low salinity, and lack of thermal and chemical stratification. In 1985, large areas of aquatic vegetation within the Ponds degraded and were lost. Subsequent faster regeneration of denuded areas by Ruppia polycarpa resulted in the displacement of Lepilaena cylindrocarpa. The annual uprooting of R. polycarpa, which has occurred since, results from Ruppia's comparatively poorer anchorage capacity in the loose sediment floc. Gradual expansion of L. cylindrocarpa into freshly uprooted regions restricts the regrowth of R. polycarpa and hence the area susceptible to denudation in the following year. It is expected that the displacement of R. polycarpa will continue until there remain only small, isolated stands, which will be prevented from uprooting by the root matrix of the surrounding vegetation. (Author's abstract)
W91-00653

GRAZING ON BACTERIA BY ZOOPLANKTON IN AUSTRALIAN BILLABONGS.
Murray-Darling Freshwater Research Centre, Albury (Australia).
P. I. Boon, and R. J. Shiel.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 2, p 247-257, 1990. 3 fig, 3 tab, 32 ref.

Descriptors: *Australia, *Bacteria, *Billabongs, *Limnology, *Zooplankton, Bacteriovory, Food habits, Rotifers, Staining.

Five species of rotifer (Brachionus lyratus, Conochilus dossuaris, Keratella cochlearis, K. quadrata, and Trichotria tetractis) ingested bacteria at prey density of 5-7 billion cells/L and a sixth species (K. procurva) did so at a higher bacterial concentration (40 billion cells/L). Gastropus minor, Polyarthra vulgaris, Synchaeta pectinata, and Trichocerca similis were not bacteriovores. Fluorescent-stained (5-(4,6-dichlorotriazin-2-yl)aminofluorescein or acridine orange) bacteria were not suitable for determining which rotifers were potential grazers. However, bacteriovory was detected easily with bacteria stained with safranin-red or methylene-blue. Clearance rates for the zooplankton community larger than 51 micrometer, determined with 3H-thymidine-labeled bacteria, varied from <0.1-71 mL/hr, but usually were <5 mL/hr. Significant grazing was detected in >200 micrometer, 90-200 micrometer, and 51-90 micrometer fractions. It was impossible to ascribe bacteriovory to discrete taxonomic groups because zooplankton were not separated completely by these mesh sizes. (Author's abstract)
W91-00654

LAKE THETIS, WESTERN AUSTRALIA: AN EXAMPLE OF SALINE LAKE SEDIMENTATION DOMINATED BY BENTHIC MICROBIAL PROCESSES.
Geological Survey of Western Australia, Perth.
K. Grey, L. S. Moore, R. V. Burne, B. K. Pierson, and J. Bauld.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 2, p 275-300, 1990. 13 fig, 6 tab, 45 ref.

Descriptors: *Australia, *Limnology, *Microorganisms, *Saline lakes, *Stromatolites, Algal mats, Benthos, Climates, Coastal waters, Cyanophyta, Diatoms, Lake Thetis, Precambrian era.

Lake Thetis is a saline coastal lake in southwestern Australia, a region of winter rainfall and summer drought. The lake demonstrates the close relationships between environmental variation and the nature of resident benthic microbial communities. Crenulate cyanobacterial mats occur in the low-lying areas adjacent to the lake. Lithified stromatolites with patches of living coccoid cyanobacterial mat characterize the littoral area, whereas a thick flocculent mat composed of phototrophic prokaryotes (principally the purple sulfur bacteria) and diatoms has accumulated in the central lake basin. Lake Thetis is distinguished from other coastal saline lakes by the presence of the unusual flocculent mat and by the juxtaposition of this microbial community to the marginal lithified stromatolites. Further, some of the latter exhibit internal digitate columnar branching, which, though common in

Precambrian examples, is rare in modern environments. (Author's abstract)
W91-00655

RETENTION AND RESUSPENSION OF PHOSPHORUS, NITROGEN, AND IRON IN A CENTRAL ONTARIO LAKE.
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
P. J. Dillon, R. D. Evans, and L. A. Molot.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1269-1274, July 1990. 2 fig, 2 tab, 44 ref.

Descriptors: *Limnology, *Nutrients, *Ontario, *Sediment transport, Comparison studies, Iron, Lakes, Mass balance methods, Nitrogen, Phosphorus, Sediment sampler, Suspended sediments.

Sediment traps were used to estimate the downward flux of total phosphorus, total Kjeldahl nitrogen, and iron in a small Precambrian shield lake for 4 yr. The flux as determined by the sediment trap method was much higher than the retention of the same elements as measured by mass balance methods (input-outflow). Total phosphorus (TP) sedimentation was about 17 times higher than retention while N was about 3 times higher and Fe was about 31 times higher. Very high N/P ratios in epilimnetic waters (36/1 by weight) and low N/P ratios in trap material (8/1) and surficial sediments (mean 8/1, range 4-11/1), in conjunction with high sedimentation to retention ratios, strongly suggest that resuspended sediment is a major component of trap material. Fe/TP ratios suggest that surficial sediment from shallow waters (<13 m) was the largest contributor to resuspended sediment. Large amounts of biologically available phosphorus originating with resuspended sediments may enter upper waters. The difference between N/P ratios in surficial sediments (4-11/1) and nutrients retained from mass balance calculations (50/1) is attributed to denitrification. (Author's abstract)
W91-00656

USE OF EXTANT POPULATIONS OF SCALED CHRYSOPHYTES FOR THE INFERENCE OF LAKEWATER PH.
Connecticut Coll., New London. Dept. of Botany.
For primary bibliographic entry see Field 5A.
W91-00658

PHYTOPLANKTON COMMUNITIES OF LAKES EXPERIMENTALLY ACIDIFIED WITH SULFURIC AND NITRIC ACIDS.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W91-00659

VARIATION IN LAKE WATER TEMPERATURE IN THE NANTICOKE REGION OF LONG POINT BAY, LAKE ERIE, DURING THE OPEN-WATER SEASON.
Ontario Hydro, Toronto. Research Div.
T. G. Dunstall, D. W. Lawler, R. Farooqui, and G. T. Haymes.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1427-1433, July 1990. 5 fig, 1 tab, 20 ref.

Descriptors: *Lake Erie, *Limnology, *Ontario, *Water temperature, Climates, Long Point Bay, Seasonal variation, Upwelling.

Lake water temperature on the north shore of Long Point Bay near Nanticoke (Lake Erie) over the years 1971-1983 varied considerably during the lake warming cycle. Upwellings, resulting in temperature drops of 5-10 C over a 2-3 day period, were common from mid-May to mid-August. Warmer surface waters returned within 6 days (usually 3 days) following summer upwellings. In spring, the recovery times were variable, but typically lasted longer, up to 25 days. Temperature fluctuations that exceeded 5 C but lasted less than 48 hr also were frequent during the lake warming cycle. The progressive deepening of the epilimnion to the 12-m depth of Long Point Bay and the associated increase in the heat content of the Bay resulted in a stable temperature regime by mid-August. Diurnal heating and cooling of surface waters, by as much as 4 C, was apparent under calm conditions. Mean April-November temperatures varied by more than 2 C, reflecting annual variation in atmospheric warming. (See also W91-00662) (Author's abstract)
W91-00661

INFLUENCE OF UPWELLINGS, STORMS, AND GENERATING STATION OPERATION ON WATER CHEMISTRY AND PLANKTON IN THE NANTICOKE REGION OF LONG POINT BAY, LAKE ERIE.
Ontario Hydro, Toronto. Research Div.
T. G. Dunstall, J. C. H. Carter, B. P. Monroe, G. T. Haymes, and R. R. Weiler.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1434-1445, July 1990. 8 fig, 4 tab, 28 ref.

Descriptors: *Electric powerplants, *Lake Erie, *Limnology, *Nutrients, *Ontario, *Storms, *Thermal pollution, *Upwelling, *Water pollution effects, Climates, Copepods, Long Point Bay, Seasonal variation, Water temperature, Zooplankton.

Storms and upwellings resulted in significant alterations to the aquatic environment in the Long Point Bay region of Lake Erie, contributing to short-term variability in water chemistry and plankton. Both storms and upwellings resulted in nutrient enrichment (filtered reactive phosphorus, total inorganic nitrogen, reactive silicates, and organic nitrogen) in lake surface waters during the period of lake warming, prior to mid-August. Storms and upwellings also differentially affected the distributions of specific zooplankton taxa in the lake surface stratum. The most prominent effect was the increased abundance of Diacyclops bicuspidatus thomasi during upwellings, particularly towards shore. The once-through cooling process of the generating station also affected zooplankton distributions, most notably that of D. bicuspidatus thomasi, which exhibited a nearshore increase in abundance that was similar to the influence exerted by upwelling. (See also W91-00661) (Author's abstract)
W91-00662

PHOSPHORUS AND NITROGEN LIMITATION OF PHYTOPLANKTON GROWTH IN THE FRESHWATERS OF NORTH AMERICA: A REVIEW AND CRITIQUE OF EXPERIMENTAL ENRICHMENTS.
California Univ., Davis. Div. of Environmental Studies.
J. J. Elser, E. R. Marzolf, and C. R. Goldman.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1468-1477, July 1990. 1 fig, 5 tab, 65 ref. NSF Grants BSR-8705170 and BSR-8801084.

Descriptors: *Eutrophication, *Limiting nutrients, *Limnology, *Nitrogen, *Nutrients, *Phosphorus, *Phytoplankton, Algal growth, Experimental design, Freshwater, Literature review, North America.

While phosphorus is generally considered to be the primary nutrient limiting algal growth in lakes, limitation of algal growth by nitrogen has been observed in freshwater. It also commonly observed that the most pronounced phytoplankton responses to enrichment occur when both N and P are added together. Nitrogen's status as a secondary nutrient in freshwater was re-evaluated through a systematic literature search. A survey of enrichment bioassays showed considerable differences in the degree to which investigators applied sufficient replication, performed and reported statistical tests, and assessed seasonal and spatial differences in algal nutrient limitation. Given these limitations, however, it was found that combined N+P enrichment enhanced algal growth much more frequently and more substantially than did addition of N or P singly. On average, the frequency and degree of algal response did not differ for P vs N enrichment. Review of whole-lake fertilizations led to the conclusion that the roles of N and P in constraining algal growth in the whole-lake scale have not been separated completely. However, examination of the distribution between treatments (+N, +P, +N and P) of lake-years in which substantial algal growth response occurred indicated that combined N and P enrichment was required to consistently produce substantial algal growth response. A more important role than has been recognized previously for N as a limiting nutrient in freshwaters is indicated. We suggest that greater attention should be given to both and P and N in the future. (Author's abstract)
W91-00664

CYANOBACTERIA IN FISH PONDS.
Laboratoire d'Ichtyologie Generale et Appliquee, Paris (France).
J. Sevrin-Reyssac, and M. Pletikosic.
Aquaculture AQCLAL, Vol. 88, No. 1, p 1-20, July 1990. 4 fig, 3 tab, 99 ref.

Descriptors: *Cyanobacteria, *Cyanophtya, *Eutrophication, *Fish ponds, *Water pollution prevention, Aeration, Algicides, Fisheries, Fishkill, Nutrients, Phytoplankton.

In many fish ponds, blue-green algae (cyanobacteria) constitute the greater part of the phytoplanktonic biomass during the summer. They sometimes form spectacular water blooms, often with harmful consequences such as massive mortality among the fish due to depletion of oxygen after the bloom collapses. Their specific properties render cyanobacteria better able than other phytoplankton to adapt to certain conditions usually encountered in fish-ponds: reduced light penetration, and nitrogen depletion in the upper layer. Cyanobacteria which are able to assimilate dissolved atmospheric nitrogen gain a selective advantage over competitors when combined nitrogen fails, and many of them are capable of vertical migration due to buoyancy regulation. Blue-green algae are of poor food value to zooplankton, their large size making them inaccessible to the filter-feeding entomostraca. The substances produced by many species of cyanobacteria are toxic to aquatic plants and animals. The algicides used to limit the development of cyanobacteria are effective but are often detrimental to the environment. Increasing the N:P ratio to 5 or more benefits chlorophyceae and reduces the number of cyanobacteria. Aerators break vertical stratification and increase concentrations of oxygen making water conditions unfavorable to blue-green algae. (Author's abstract)
W91-00665

LIMNOLOGICAL STUDIES OF FOUR POLLUTED PONDS IN AND AROUND DHAKA CITY WITH REFERENCE TO INDICATOR SPECIES.
Dacca Univ. (Bangladesh). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-00672

EFFECTS OF NUTRIENTS AND WATER LEVELS ON EMERGENT MACROPHYTE BIOMASS IN A PRAIRIE MARSH.
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
C. Neill.
Canadian Journal of Botany CJBOAW, Vol. 68, No. 5, p 1007-1014, May 1990. 2 fig, 5 tab, 40 ref.

Descriptors: *Emergent aquatic plants, *Fertilizers, *Limnology, *Macrophytes, *Marshes, *Nutrients, *Water level fluctuations, *Water pollution effects, *Wetlands, Biomass, Cattails, Marsh plants, Nitrogen, Phosphorus, Plant growth.

Nitrogen and phosphorus fertilizers were added over two growing seasons to marshes dominated by whitetop grass (Scolochloa festucacea) or cattail (Typha glauca) in a prairie lacustrine marsh to assess nutrient limitation and the interaction of nutrient limitation with water depth. For each species, stands were selected at the deep and shallow extremes of its water depth range. Water levels were high during the first year of fertilization and low during the second year, exposing the

fertilized stands to a variety of water depths. Nitrogen limited growth in whitetop and cattail marshes. Water level, by controlling whether the soil was flooded or the water table was below the soil surface, affected growth and the degree of nitrogen limitation. In whitetop marshes, nitrogen increased biomass more when the soil was flooded or when standing water was deeper and in cattail marshes, it increased biomass more under intermediate water depths (approximately 0-20 cm) than under more deeply flooded (20-40 cm) or dry conditions. Nitrogen reduced biomass in whitetop marshes the second year, apparently because growth was inhibited by fallen litter from the previous year. Nitrogen did not limit cattail marsh biomass in the driest locations during a year of low water levels. Phosphorus caused a small increase in growth of both species after 2 years. Changes of nitrogen limitation with flooding suggest that annual water level fluctuations, by creating alternating flooded and dry conditions, may influence the primary production of emergent macrophytes through effects on nitrogen cycling. (Author's abstract)
W91-00673

EFFECTS OF NUTRIENTS AND WATER LEVELS ON SPECIES COMPOSITION IN PRAIRIE WHITETOP (SCOLOCHLOA FESTUCACEA) MARSHES.
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
C. Neill.
Canadian Journal of Botany CJBOAW, Vol. 68, No. 5, p 1015-1020, May 1990. 4 tab, 32 ref.

Descriptors: *Grasses, *Limnology, *Marsh plants, *Nutrients, *Plant growth, *Species composition, *Water level fluctuations, *Wetlands, Biomass, Fertilizers, Nitrogen, Phosphorus, Water pollution effects.

Nitrogen and phosphorus fertilizers were added over two growing seasons to whitetop marshes growing at the shallow and deep extremes of whitetop's water depth range in a northern prairie marsh to assess the effects of nutrient additions and water levels on species composition and understory species biomass. Nitrogen and nitrogen plus phosphorus additions reduced understory species biomass and caused only small changes in marsh species composition after 1 yr, but dramatically decreased whitetop biomass and increased the biomass of the understory moist soil annual Atriplex patula at both water depths after 2 yr. Phosphorus alone had little effect on species composition. Water levels influenced both the biomass of understory species and their potential response to nutrient additions. Biomass of understory species during both years was lower in deeper water. Nutrients had no effect on understory species biomass when standing water was present because standing water prevented seed germination. A mulching effect caused by greater whitetop litter accumulation and weaker whitetop stems associated with nitrogen fertilization appeared to be more important influences on understory species composition than differential understory species growth responses to added nutrients. Predicting responses of whitetop marshes to multiyear fertilization requires an understanding of the interactions between the physical conditions caused by increased biomass of whitetop, the relative abilities of understory moist soil species to grow under those conditions, and water levels, which control understory species seed germination and plant survival. (Author's abstract)
W91-00674

ECOLOGICAL STUDIES ON THE PLANKTON AND BENTHOS OF WADI ELRAYAN, A NEW LAKE IN EGYPT.
Ain Shams Univ., Cairo (Egypt). Faculty of Science.
I. A. Aboul-Ela, and M. T. Khalil.
Tropical Freshwater Biology, Vol. 2, No. 1, p 101-111, 1989. 1 fig, 6 tab, 20 ref.

Descriptors: *Benthos, *Egypt, *Lakes, *Limnology, *Zooplankton, Colonization, Phytoplankton, Species composition, Species diversity, Succession.

Production of plankton and benthos were investigated for the first time in a new Egyptian lake, Wadi Elrayan, during the period June 1979 to June 1980. The average abundance of phytoplankton in the lake was estimated at about 519,000 cells/L. The seasonal mean primary production estimated at 12.4 gm O2/sq m/day is closer to the maximum levels recorded for other African freshwater lakes. Zooplankton and benthic communities have not yet reached a level of stability comparable to that of phytoplankton. The seasonal mean abundance of zooplankton is about 12,500 organisms cu m while that of macrobenthos is about 1200 organisms/sq m. The lake is still in its developing stages. (Author's abstract)
W91-00679

LITTORAL BENTHIC FAUNA OF LAKE MANAGUA, NICARAGUA: A STUDY COMPARING ARTIFICIAL AND NATURAL SUBSTRATA.
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
L. Bijlmakers, and A. E. Sobalvarro.
Tropical Freshwater Biology, Vol. 2, No. 1, p 121-129, 1989. 3 fig, 2 tab, 15 ref.

Descriptors: *Invertebrates, *Lakes, *Limnology, *Littoral zone, *Nicaragua, *Sampling, Colonization, Quantitative analysis, Species composition.

An attempt was made to standardize the sampling of littoral invertebrate fauna of a lake by use of artificial substrata. Baskets of stones were placed in the littoral zone of Lake Managua, Nicaragua, at different locations. Monthly samples at the same location did not show distinct differences in faunal composition or relative abundance. On the other hand, between location differences were found in faunal composition as well as relative abundance. The fauna found on natural substrates and artificial substrata was shown to be very similar. This provides the opportunity to characterize the invertebrate fauna of the different locations quantitatively by means of artificial substrata. (Author's abstract)
W91-00681

ECOLOGY OF CYCLOPOID COPEPODS (COPEPODA: CRUSTACEA) IN A TROPICAL BACKWATER POND.
Benin Univ., Benin City (Nigeria). Dept. of Zoology.
R. Victor, and A. S. Mathews.
Tropical Freshwater Biology, Vol. 2, No. 1, p 130-140, 1989. 5 fig, 40 ref.

Descriptors: *Copepods, *Crustaceans, *Limnology, *Ponds, *Population dynamics, *Tropical regions, Benthos, Ecology, Nigeria, Pesticides, Species composition, Species diversity, Water pollution effects.

Some aspects of the ecology of cyclopoid copepods were studied in a backwater pond in Southern Nigeria. Five species, Mesocyclops salinus, Thermocyclops crassus, Tropocyclops prasinus, Eucyclops serrulatus and Ectocyclops c.f. ilariensis were recorded. M. salinus and T. crassus, the abundant species, were distributed both in water column and in benthos; the relative abundance of other species, found only in the water column were low. The dominant species in this pond at any one time was either M. salinus or T. crassus depending on the season; M. salinus was dominant during the dry season, while T. crassus was dominant during the wet season. Monthly fluctuations in actual abundance showed two peaks each for M. salinus and T. crassus; the abundance patterns of these two species in water column and in benthos were similar. The peak abundance of M. salinus occurred earlier in benthos than in water column. The major peak of abundance for T. crassus occurred both in water column and in benthos at the same time, while the minor peak was recorded earlier in benthos than in water column. M. salinus was more resistant to pesticide treatment than other species; all species were capable of rapid recolonization. (Author's abstract)
W91-00682

ESTIMATION OF THE CRITICAL OXYGEN TENSION FOR AND RECOVERING CAPABILITIES OF RED TILAPIA (OREOCHROMIS NILOTICUS X OREOCHROMIS MOSSAMBICUS) HYBRIDS.
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. of Animal Production in the Tropics and Subtropics.
K. Becker, D. Noffz, and L. Fishelson.
Tropical Freshwater Biology, Vol. 2, No. 1, p 141-148, 1989. 1 fig, 2 tab, 14 ref.

Descriptors: *Oxygen requirements, *Oxygen uptake, *Respiration, *Tilapia, Adaptation, Fisheries, Oxygen demand.

Studies were carried out to determine the level of independency of oxygen consumption in Oreochromis niloticus X Oreochromis mossambicus hybrids from the oxygen pressure (PO2) of water in a closed recirculating system. Mean critical oxygen tension (Pc) was 65.1 + or -13.4 millibars, varying from 45.1 to 73.8 among the four individuals tested. Standard metabolic rate (SMR) and routine metabolic rate (RMR) were 101.6 + or -20.2 and 113.7 + or -20.1 milligrams O2/0.8 kg/hr, respectively. When Pc had been reached, oxygen consumption (VO2) values remained stable for some time before falling, indicating some adaptation mechanism not revealed when measurements were made in static sealed systems. Complete recovery under experimental conditions was reached after 12 to 18 hr. (Author's abstract)
W91-00683

VEGETATIVE GROWTH OF SPIRODELA POLYRRHIZA AS AFFECTED BY MEDIUM CONCENTRATION, DAYLIGHT INTENSITY AND AGE.
Benin Univ., Benin City (Nigeria). Dept. of Botany.
J. M. O. Eze, and J. E. Dolor.
Tropical Freshwater Biology, Vol. 2, No. 1, p 149-157, 1989. 3 fig, 14 ref.

Descriptors: *Aquatic weed control, *Drinking water, *Duckweed, *Eutrophication, *Growth media, *Light intensity, *Plant growth, Catchment areas, Chlorophyll, Developing countries, Nigeria, Nutrients, Water supply.

The vegetative growth of the duckweed, Spirodela polyrrhiza (Linn.) Schleid in 100 ml glass beakers containing water culture medium of different concentrations was measured under various daylight intensities (0-100% daylight intensity). The basal nutrient medium supported maximum root development, but the best overall growth in terms of fresh or dry weight and total number of thalli was obtained in half the strength of the basal medium. Increasing the nutrient medium concentration beyond half the basal strength generally led to progressive reduction in growth. Increase in daylight intensity resulted in increase in total fresh or dry weight, number, surface area, root length and chlorophyll contents of the thalli. High light intensity increased the rate of budding at the expense of dry weight accumulation in the individual thalli. In all media, the productivity of individual thalli as represented by rate of multiplication diminished with the increase in age. These findings may be relevant to preventing duckweed growth in reservoirs in Nigeria and other developing countries that store drinking water in catchment areas, and in duckweed eutrophication prevention in local natural habitats. (Author's abstract)
W91-00684

WATERBIRDS DYNAMICS AT BOOL LAGOON, SOUTH AUSTRALIA, 1983-87.
Australian National Parks and Wildlife Service, Berri.
M. J. Harper.
Australian Wildlife Research AWLRAO, Vol. 17, No. 2, p 113-122, 1990. 7 fig, 2 tab, 11 ref.

Descriptors: *Australia, *Bool Lagoon, *Limnology, *Population dynamics, *Water birds, Rainfall, Seasonal variation, Water depth, Wetlands.

Monthly waterbird counts from July 1983 to June 1987 at Bool Lagoon Game Reserve and Hacks Lagoon Conservation Park in the southeast of South Australia were used to investigate relationships between the numbers of each species, and season, water depth and rainfall. Numbers of little black cormorant, great crested grebe, sacred ibis, straw-necked ibis and whiskered tern were most influenced by season. Little pied cormorant, royal spoonbill, musk duck, white-faced heron, yellow-billed spoonbill, black swan, brolga, masked lapwing and silver gull numbers were associated with variation in water level of the lagoon. Pacific black duck numbers were inversely related to lagoon levels and local rainfall, while numbers of Australian shelduck varied inversely with local rainfall. Numbers of most waterbirds were highest at the Bool Lagoon complex in either spring or early autumn, indicating the importance of this wetland as a breeding site and dry season refuge respectively. (See also W91-00687) (Author's abstract)
W91-00686

LEAD POISONING IN MAGPIE GEESE ANSERANUS SEMIPALMATA FROM INGESTED LEAD PELLET AT BOOL LAGOON GAME RESERVE (SOUTH AUSTRALIA).
Australian National Parks and Wildlife Service, Berri.
For primary bibliographic entry see Field 5C.
W91-00687

MAGPIE GOOSE, ANSERANUS SEMIPALMATA, NESTING ON THE MARY RIVER FLOODPLAIN, NORTHERN TERRITORY, AUSTRALIA: EXTENT AND FREQUENCY OF FLOODING LOSSES.
Conservation Commission of the Northern Territory, Darwin (Australia).
P. J. Whitehead, and K. Tschirner.
Australian Wildlife Research AWLRAO, Vol. 17, No. 2, p 147-157, 1990. 5 fig, 3 tab, 16 ref.

Descriptors: *Australia, *Flooding, *Geese, *Population dynamics, *Water birds, *Water depth, Rainfall, Seasonal variation.

Magpie geese, Anseranus semipalmata, nest synchronously in large colonies on the seasonally inundated floodplains of the Northern Territory. Erratically variable wet season rainfalls may cause rises in floodplain water levels that destroy many nests. An event is described on the Mary Plain floodplain in which all of the nests within a monitored study area were drowned. Vulnerability to flooding (as indicated by variation in depth at which eggs first submerged) varied significantly among vegetation types. Mean rises in water levels causing inundation of eggs varied from 67 cm in nests constructed on a base of Oryza rufipogon to 118 cm on nests constructed on Eleocharis brassii. Nests close to major river channels are more vulnerable to flooding. Analysis of patterns of river level rises since 1959 indicate that such catastrophic nest losses are relatively common, perhaps occurring as often as one year in seven. Lesser flooding losses probably occur in most years. Nesting colonies on the Mary River are likely to suffer higher flooding mortalities than on many other river systems. (Author's abstract)
W91-00688

PIGMENT STRATIGRAPHY AND TROPHIC STATUS: AN EVALUATION OF RADIONUCLIDE-DATED LACUSTRINE SEDIMENT.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
C. L. M. Steenbergen, G. W. Berger, H. J. Korthals, and H. Verdouw.
Geomicrobiology Journal GEJODG, Vol. 7, No. 4, p 207-222, 1989. 5 fig, 2 tab, 44 ref.

Descriptors: *Lacustrine environment, *Limnology, *Pigments, *Radionuclides, *Stratigraphy, Carotenoids, Cesium radioisotopes, Chlorophyll, Eutrophication, Lake Vechten, Lead radioisotopes, Pheophytins, Sediment chemistry, Sedimentation, The Netherlands.

Sediment cores from the profundal region of relatively young (circa 45 years), warm-monomictic Lake Vechten were dated with cesium-137 and lead-210 and analyzed for major carotenoids, chlorophyll, and pheophytin. Vertical sediment accretion rates determined from clay/sand horizon and from the radionuclide datings varied between 0.60 and 0.74 cm/year. Sedimentation rates based on particulate matter collected in sediment traps agreed with results of the cesium-137 method with average values of respectively 2.9 and 2.3 kg dry weight/sq m/year. The profundal sediment appears to be fairly undisturbed. Pigments showed a severalfold increase from the deepest to the superficial sediment layers. The sediment profiles were compared with limnological data obtained during previous studies of Lake Vechten. The distribution of pigments reflected clearly the trophic history of the lake, which became more eutrophic during the last two decades. Pigment analyses of sediment cores may be a useful tool to rapidly obtain rough basic information on the recent trophic development of stratified lakes liable to eutrophication. (Author's abstract)
W91-00692

EFFECTS OF INVERTEBRATE PREDATION ON THE SEASONAL SUCCESSION OF A ZOOPLANKTON COMMUNITY: A TWO YEAR STUDY IN LAKE AYDAT, FRANCE.
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. d'Hydrobiologie.
N. Lair.
Hydrobiologia HYDRB8, Vol. 198, p 1-12, July 30, 1990. 10 fig, 1 tab, 85 ref.

Descriptors: *France, *Invertebrates, *Lake Aydat, *Limnology, *Predation, *Seasonal variation, *Spatial distribution, *Succession, *Temporal distribution, *Zooplankton, Ciliates, Midges, Population dynamics, Rotifers.

Direct observations on living animals, examination of gut contents, spatio-temporal distribution analysis, demographic data and a two year comparative study of zooplankton population dynamics illustrate the importance of invertebrate predation on the seasonal succession of the zooplankton in Lake Aydat, Central Massif, France. Three invertebrate predators living in this eutrophic lake contribute to regulate the populations' development. The rotifer Asplanchna priodonta exerts a predation pressure on Keratella cochlearis, Polyarthra remata and Polyarthra dolichoptera. The copepod Cyclops vicinus vicinus exerts a predation pressure on the latter two rotifer species. The larvae of the dipteran Chaoborus cristallinus consumes Asplanchna priodonta, Kellicottia longispina, Bosmina longirostris, Daphnia longispina, Ceriodaphnia quadrangula and ovigerous females of Cyclops vicinus vicinus. Adults of Acanthodiaptomus denticornis, which consume large ciliates in this lake, may contribute to the rotifer decline at the end of the summer. The interactions between invertebrate predators and their preys are reflected in quantitative changes in community dynamics. (Author's abstract)
W91-00694

PREDATION ON AND BY PELAGIC TURBELLARIA IN SOME LAKES IN BRAZIL.
Universidade Federal de Sao Carlos (Brazil). Lab. of Limnology.
O. Rocha, T. Matsumura-Tundisi, J. G. Tundisi, and C. P. Fonseca.
Hydrobiologia HYDRB8, Vol. 198, p 91-101, July 30, 1990. 5 fig, 9 tab, 21 ref.

Descriptors: *Animal behavior, *Ecosystems, *Lakes, *Limnology, *Platyhelminthes, *Predation, Brazil, Population dynamics, Zooplankton.

Planktonic Turbellaria commonly occur in both natural and manmade lakes in Brazil. Experiments were performed in 1987 and 1989 to determine which zooplankton species are consumed by predatory Mesostoma sp. from three natural lakes in the Rio Doce Valley. Experiments were also performed in 1989 with a yet unidentified flatworm from Barra Bonita reservoir. Both predators consumed Daphnia and Ceriodaphnia at a high rate: four individuals per day in the case of Mesostoma sp., a large species, and 1.5 individuals per day in the case of the smaller species from the Barra Bonita reservoir. Consumption of copepod nauplii, copepodids, and adults was much lower, and Ostracoda were not consumed at all. Experiments on food selectivity showed a clear preference by the flatworms for cladocerans. In the lakes studied, flatworms are heavily preyed upon by larvae of Chaoborus and Mesocyclops species. Turbellaria densities in the natural lake were around three hundred per cubic meter, whereas in Barra Bonita reservoir, one thousand individuals per cubic meter was a mean value in a fifteen-day study. (Author's abstract)
W91-00695

CYCLOMORPHOSIS IN DAPHNIA: AN ADAPTATION TO AVOID INVERTEBRATE PREDATION.
Warsaw Univ. (Poland). Dept. of Hydrobiology.
J. Pijanowska.
Hydrobiologia HYDRB8, Vol. 198, p 41-50, July 30, 1990. 9 fig, 1 tab, 16 ref.

Descriptors: *Animal physiology, *Daphnia, *Ecosystems, *Invertebrates, *Lakes, *Limnology, *Predation, Allometry, Morphology, Seasonal variation.

Seasonal morphological changes in three Daphnia species were followed over a two-year period in two lakes that differ in invertebrate and fish pressure. Whereas the morphology of Daphnia hyalina, the biggest of the three species, varied little from season to season, Daphnia cucullata, the smallest, exhibited the most pronounced seasonal changes in head height/carapace length ratio. The pattern of seasonal changes of body proportions was similar in all size classes and isometric growth of the head was reported for Daphnia cucullata. Unlike the head, tail spine length/carapace length ratio almost did not vary seasonally. Strong negative allometry of tail spine growth was observed. These results are consistent with the hypothesis that helmets and tail spines provide protection against invertebrates in the two smallest, thus most endangered species. (Author's abstract)
W91-00696

CREATING CONDITIONS FOR CHANGES IN PREY COMMUNITY STRUCTURE BY CHAOBORUS SPP. IN A LAKE IN SWEDEN.
Goeteborg Univ. (Sweden). Dept. of Zoology.
J. A. E. Stenson.
Hydrobiologia HYDRB8, Vol. 198, p 205-214, July 30, 1990. 7 fig, 5 tab, 32 ref.

Descriptors: *Acid lakes, *Lake restoration, *Lakes, *Liming, *Population dynamics, *Predation, *Species composition, *Sweden, Cladocerans, Copepods, Lake Gardsjon, Rotifers, Zooplankton.

In Lake Gardsjon (Southwest Sweden), liming as an experimental improvement of living conditions for pelagic algae, resulted in a significant increase of algal biomass and a reduction of mean cell size. The algal development was beneficial for small sized filter feeding zooplankton, particularly rotifers, which showed a significant increase. The increase in abundance of small sized zooplankton created better food conditions for the smaller instars, and thus a much better overall survival of Chaoborus larvae. The resulting, six to seven times larger population of Chaoborus larvae significantly changed the structure of the crustacean zooplankton community. Bosmina coregoni populations were strongly reduced by the increased predation from Chaoborus. The share of cladocerans decreased, while copepods increased in abundance. (Author's abstract)
W91-00697

BENTHIC TURFS VS FLOATING MATS OF ALGAE IN RIVER FOOD WEBS.
California Univ., Berkeley. Dept. of Zoology.
M. E. Power.
OIKOS OIKSAA, Vol. 58, No. 1, p 67-79, May 1990. 8 fig, 3 tab, 56 ref. NSF grant RII-8600411, California State Water Resources Center Grant W-726.

Descriptors: *Algae, *Ecosystems, *Midges, *River systems, Algal growth, Food chains, Invertebrates.

In the Eel River of northern California, as in many other sunlit rivers worldwide, large growths of filamentous green algae accumulate during summer low flow periods. Algae initially grow as turfs, attached to the river bed, but over time detach to form floating mats. Floating mats differ from attached turfs as habitats for invertebrates in a number of respects. In paired trials, larval chironomids were 15 to 16 times more likely to be consumed by fishes when exposed in algal turfs on the river bed than when exposed in floating algal mats on the river surface. On average, 2.7 and 6.1 times more adult insects emerged from floating mats than from benthic algal turfs in shallow (< 30 cm deep) and deep (30 to 60 cm deep) habitats, respectively. Differences between algal mats and turf as cover and habitat for resident insects lead to the hypothesis that the timing, abundance and duration of floating mat habitats strongly influences the routing of insect production in river food webs, to aquatic consumers or to the land. (Author's abstract)
W91-00708

RESISTANCE OF LOTIC ECOSYSTEMS TO A LIGHT ELIMINATION DISTURBANCE: A LABORATORY STREAM STUDY.
Oak Ridge National Lab., TN. Environmental Sciences Div.
A. D. Steinman, P. J. Mulholland, A. V. Palumbo, T. F. Flum, and J. W. Elwood.
OIKOS OIKSAA, Vol. 58, No. 1, p 80-90, May 1990. 5 fig, 4 tab, 52 ref. DOE Contract DE-AC05-840R21400, Interagency Agreement 40-689-78 with NSF Ecosystems Studies Programs.

Descriptors: *Aquatic ecosystems, *Light intensity, *Species diversity, *Streams, Biomass, Grazing, Nutrient concentrations.

Black plastic was placed over eight laboratory stream channels for 92 days to examine the resistance of lotic ecosystems to light elimination. Prior to the disturbance, four treatments (high grazing-recirculated flow, high grazing-once-through flow, low grazing-recirculated flow, low grazing-once-through flow) were imposed on the streams, resulting in systems with different biomass levels and recycling indices. Light elimination resulted in significant declines of all functional and most structural properties associated with the streams, irrespective of treatment. Declines in species diversity and number were greater in high grazed than low grazed streams. However, high grazed streams appeared more resistant than low grazed streams with respect to autotrophic biomass and carbon fixation. Nutrient levels had little influence on resistance. The relatively small effect of the treatments on system resistance may be more dependent on the qualities of the disturbance (e.g. magnitude and duration) than those of the system. (Author's abstract)
W91-00709

MONTHLY VARIATIONS IN ENTROPY PRODUCTION IN LAKE BIWA.
Osaka Univ. (Japan). Dept. of Physics.
I. Aoki.
Ecological Modelling ECMODT, Vol. 51, No. 3/4, p 227-232, June 1990. 2 fig, 1 tab, 14 ref.

Descriptors: *Energy transfer, *Entropy, *Japan, *Limnology, *Thermodynamics, Comparison studies, Ecology, Energy, Eutrophication, Lake Biwa, Lake Mendota, Succession, Trophic level.

Monthly entropy fluxes in the northern basin of Lake Biwa (Japan) were calculated from corresponding energy data for the lake. That is, the lake absorbs 'negative entropy' from its surroundings according to the terminology of Schrodinger: the lake is structured by its surroundings. From the net entropy flow and the change of entropy content, entropy production in the lake was estimated. Entropy production, which is positive in all months, is larger in summer and smaller in winter. The monthly entropy production (Sprod in units of MJ/cu m/K) increases linearly with the monthly solar radiation energy absorbed by the lake (Esolar in units of MJ/sq m/mo); Sprod = a + b Esolar, where a = 0.002 (MJ/cu m/mo/K)), b = 0.000060 (per m/K). The values a and b are holistic indices characterizing the lake from an entropy point of view. Another index (b'), which is similar to b also is introduced. Comparison of these indices for the northern basin of Lake Biwa (oligotrophic) with those for Lake Mendota (Wisconsin, USA, eutrophic) shows that process of eutrophication or succession are accompanied by the increase of these entropy production indices. (Author's abstract)
W91-00717

BACTERIAL REGENERATION OF AMMONIUM AND PHOSPHATE AS AFFECTED BY THE CARBON:NITROGEN:PHOSPHORUS RATIO OF ORGANIC SUBSTRATES.
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
For primary bibliographic entry see Field 5B.
W91-00732

SEASONAL CHANGES OF THE ENVIRONMENTAL CONDITIONS IN DIMICTIC LAKES DIFFERING AS TO THEIR TROPHIC STATE (SEZONOWE ZMIANY WARUNKOW SRODOWISKA W JEZIORACH DYMIKTYCZNYCH O ROZNYM STOPNIU EUTROFIZACJI).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
S. Prusik, B. Zdanowski, and A. Hutorowicz.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 2, p 41-75, 1990. 11 fig, 3 tab, 27 ref. English summary.

Descriptors: *Dissolved oxygen, *Lakes, *Limnology, *Poland, *Trophic level, *Water temperature, Ammonia, Aquatic habitats, Chlorophyll, Cycling nutrients, Mazurian Lake District, Mixing, Phosphates, Phosphorus, Seasonal variation, Stratification, Transparency.

Studies were carried out in 1982 on the seasonal variations in thermal and oxygen conditions, nutrient cycling, Secchi disk visibility, and chlorophyll content of eight dimictic lakes of the Mazurian Lake District. Lake trophy corresponded with susceptibility to degrading factors as indicated by Ohle's and Schindler's indices and by the annual levels of lake loading with phosphorus. Along with increasing trophy, content of basic nutrients increased as did the electrical conductivity of the water. Seasonal variations in oxygen conditions were the primary factor differentiating the environmental conditions of the lakes. Changes of oxygen content in the epilimnion and below this water layer were related strictly to lake trophy. The least variation in oxygen levels in the epilimnion was observed in the least oligotrophic lakes. Several indices estimate the trophic status of the lakes: seasonal variations in epilimnial oxygen content; rate of oxygen deficit formation in the near-bottom water layers, hypolimnion, and metalimnion; stratification of the oxygen content in the water column and the shape of the vertical oxygen profile; Secchi disk visibility and chlorophyll content in summer; amplitude of variations in the chlorophyll content in summer; P and N content in the epilimnion in spring and summer; nitrate content in spring; rate of liberation of phosphates and ammonia from bottom sediments and accumulation of these compounds in the hypolimnion and epilimnion after stratification; absolute content of total phosphorus, phosphates, and ammonia in the near-bottom water layers at the peak of summer stagnation; content of calcium and carbonates and electrical conductivity of the water; and intensity of accumulation of mineral salts in the hypolimnion and the range of the seasonal variations in amount of calcium, carbonates, and electrical conductivity between spring and summer and between the epilimnion and hypolimnion. (Rochester-PTT)
W91-00735

SEDIMENT-WATER INTERACTION AS A CONTROL ON GEOCHEMICAL EVOLUTION OF PLAYA LAKE SYSTEMS IN THE AUSTRALIAN ARID INTERIOR.
Queensland Univ. of Technology, Brisbane (Australia). Dept. of Applied Geology.
A. V. Arakel, G. Jacobson, and W. B. Lyons.
Hydrobiologia HYDRB8, Vol. 197, p 1-12, May 31, 1990. 7 fig, 28 ref.

Descriptors: *Australia, *Geochemistry, *Lakes, *Limnology, *Playas, *Saline lakes, *Sediment-water interfaces, *Water chemistry, Aquifers, Basins, Carbonates, Catchment areas, Evaporation, Evolution, Groundwater, Hydrology, Minerals, Sediments, Silica, Silicates.

Saline playa lakes represent major geomorphic and hydrologic components of internal drainage basins in the arid to semiarid interior of Australia. These lakes mark the outcrop areas of regional shallow groundwater; thus, they are effective hydro-chemical sinks for elemental concentration and authigenic formation of carbonate, evaporite, and silica/silicate minerals. Field observations and petrochemical characterization of playa sediments from drainage basins in Western and Central Australia indicate that localized discharge of groundwater, from shallow aquifers in calcrete deposits, plays a fundamental role in geochemical evolution of playa-lake marginal facies. The available data also indicate that although evaporative concentration and salt recycling are major controls on geochemistry of the playas, a simple evaporative model does not provide a complete explanation for brine evolution and particularly the geochemical process-product relationships observed in the individual playa lakes. The distribution of the chemical facies in the playas, in relation to geomorphic setting of the internal drainage basins, reflects a significant impact of variation in groundwater discharge pattern on geochemical evolution of the playa lakes. Accordingly, the development of chemical facies in individual playas have progressed through repeated episodes of evaporative concentration, groundwater-level fluctuations and ion-exchange processes. (Author's abstract)
W91-00736

METAL CONCENTRATIONS IN SURFICIAL SEDIMENTS FROM HYPERSALINE LAKES, AUSTRALIA.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
For primary bibliographic entry see Field 2K.
W91-00737

HEAVY METALS IN THE DEAD SEA AND THEIR COPRECIPITATION WITH HALITE.
Weizmann Inst. of Science, Rehovoth (Israel).
M. Stiller, and L. Sigg.
Hydrobiologia HYDRB8, Vol. 197, p 23-33, May 31, 1990. 1 fig, 4 tab, 21 ref.

Descriptors: *Chemical precipitation, *Dead Sea, *Geochemistry, *Halite, *Heavy metals, *Lakes, *Limnology, *Metals, *Saline lakes, *Salts, *Water chemistry, Analytical techniques, Anodic stripping voltammetry, Hydrochemistry, Meromictic lakes, Sediments, Stratification, Voltammetry.

After a prolonged period of stratification (about 300 years) the Dead Sea overturned in 1979 and again in 1982. Its waters became saturated with respect to halite and the massive precipitation which occurred in winter 1982/1983 was monitored. The fate of the heavy metals was followed during this period of physical and chemical changes. The concentrations of Zn, Cd, Pb and Cu in the Dead Sea waters were measured by anodic stripping voltammetry (ASV) which provided sensitive measurement of these elements after a minimal pretreatment of the samples (dilution 1:1 and acidification). In the meromictic lake (prior to 1979), the concentrations of all four elements were larger in the deep anoxic layers. With the onset of halite precipitation a decline in their concentrations was observed. Most dramatic was the decrease in Cd, which practically disappeared from the water column in 1985. The coprecipitation of heavy metals with halite (collected by sediment traps in 1983) was examined, as well as that of older halite recovered from a sediment core. Although concentrations of heavy metals were some-

what larger in recent halite, all halite samples had the same concentration pattern: the concentration of Pb was the largest, followed by Cd, and Cu was the smallest. The apparent distribution coefficient was larger for Cd than for Pb. The amount of Cd which may have accompanied the deposition of halite during 1983-85 was estimated. It is compatible with its observed disappearance from the water column in 1985. The amounts of Zn and Pb which are missing from the Dead Sea of 1985 are much larger than can be accounted for by coprecipitation with halite. A possible explanation is that the formation of halite crystals may have enhanced settling of particulates which in turn may have scavenged Pb and Zn from the Dead Sea waters. Cu seems to be much less affected by the physical and chemical events which occurred in the Dead Sea waters during 1976-1985. (Author's abstract)
W91-00738

EVOLUTION OF SALINE LAKE WATERS: GRADUAL AND RAPID BIOGEOCHEMICAL PATHWAYS IN THE BASOTU LAKE DISTRICT, TANZANIA.
Michigan Univ., Ann Arbor. Dept. of Biology.
P. Kilham, and P. L. Cloke.
Hydrobiologia HYDRB8, Vol. 197, p 35-50, May 31, 1990. 10 fig, 3 tab, 50 ref. NSF Grants GB-8328X and OCE81-17377.

Descriptors: *Basotu Lakes, *Biochemistry, *Geochemistry, *Lakes, *Limnology, *Saline lakes, *Tanzania, *Water chemistry, Calcite, Calcium, Chemical properties, Closed lakes, Evolution, Illite, Minerals, Solutes, Sulfates.

The biogeochemical evolution of solutes markedly alters the chemistry in the closed-basin maar lakes that comprise the Basotu Lake District (Tanzania, East Africa). Examination of 11 (out of 13) lakes in the Basotu Lake District identified two distinct evolutionary pathways: a gradual path and a rapid path. During the course of biogeochemical evolution these waters follow either the gradual path alone or a combination of the gradual and rapid paths. Solute evolution along the gradual path is determined by all of the biogeochemical processes that for these waters appear to be tightly coupled to evaporative concentration (e.g. mineral precipitation, sorption and ion exchange, CO2 degassing, and sulfate reduction). Rapid evolution occurs when mixing events suddenly permit H2S to be lost to the atmosphere. The chemistry of waters undergoing rapid evolution is changed abruptly because loss of every equivalent of sulfide produces an equivalent permanent alkalinity. The Basotu Lake District in north central Tanzania is comprised of 13 maar lakes. They range in surface water conductivity from 592 to 24,000 micro S/cm (at 20 C). Within these lake basins only a few of the variety of geochemical and biogeochemical processes known to occur in lakes of this type are actually responsible for the gain and/or loss of individual solutes. For example, potassium appears to be taken up in the formation of illite. Calcium is precipitated as calcite. Magnesium interacts with alumino-silicate precursors to form a variety of clay minerals that contain magnesium (e.g. stevensite). This process is also known as reverse weathering. Sulfate is reduced to sulfide and subsequently lost as H2S and/or metal sulfides. Alkalinity is lost owing to calcite precipitation and as a consequence of reverse weathering. (Author's abstract)
W91-00739

HYDROGEOCHEMISTRY OF LAKE GALLOCANTA (ARAGON, NE SPAIN).
Barcelona Univ. (Spain). Dept. de Ecologia.
F. A. Comin, R. Julia, M. P. Comin, and F. Plana.
Hydrobiologia HYDRB8, Vol. 197, p 51-66, May 31, 1990. 10 fig, 4 tab, 23 ref. CAYCIT-CSIC (IO851).

Descriptors: *Geochemistry, *Geohydrology, *Hydrogeochemistry, *Lake Gallocanta, *Lakes, *Limnology, *Saline lakes, *Spain, *Water chemistry, Chemical precipitation, Dissolved solids, Interstitial water, Ions, Minerals, Salts, Seasonal variation, Sediment analysis.

Lake Gallocanta has undergone drastic changes during the last thirteen years. Variations in the major dissolved ions were related to water volume fluctuations from data at two different stages, one corresponding to the drying phase and another to the refilling phase. Mineralogical composition of the salts precipitated at different stages was examined by X-ray diffraction. Interstitial water and mineralogical composition of recent sediments were also studied along a transect through the lake. The water column decrease form 1977 to 1985 is related to decreasing annual rainfall. The refilling in 1986 to 1988 is due to high annual rainfall. In addition to these fluctuations, seasonal changes of the water level between 20 and 50 cm occurred every year. Gallocanta is a Na-Mg-Cl-(SO4) type lake. During the drying period a typical salt enrichment occurs with linear relationships between total dissolved solids, Cl, Na and K. Alkalinity is linearly correlated with Ca at relatively low salinities. As salinity increases a linear relationship between Ca and SO4 is observed. Minerals formed from the brine are halite, bischofite, epsomite, hexahydrite, mirabilite, gypsum, aragonite, calcite and dolomite. The molar ratio Mg/Ca of the interstitial water changes from 1.5 along the shorelines, where calcite and aragonite precipitate, to 40 in the center of the lake. Sediment cores from the central part of the lake show aragonite in the top layers, magnesium calcite and low proportions of quartz and illite, while at 20 cm depth a high proportion of gypsum is present. In contrast, cores from the shore of the lake are mainly composed of low magnesium calcite in the top layers and low magnesium calcite together with high magnesium calcite and dolomite between 30 and 70 cm depth. Gypsum deposits only occur in significant proportions at 80-100 cm depth. The refilling process showed relationships between volume and salt concentration following the Langbein model. The salt mass in solution decreased about 50% from the drying to the refilling phase. Mg content decreased about 70% for the same period. (Author's abstract)
W91-00740

RECENT CARBONATE SEDIMENTATION AND BRINE EVOLUTION IN THE SALINE LAKE BASINS OF THE CARIBOO PLATEAU, BRITISH COLUMBIA, CANADA.
Saskatchewan Univ., Saskatoon. Dept. of Geological Sciences.
R. W. Renaut.
Hydrobiologia HYDRB8, Vol. 197, p 67-81, May 31, 1990. 6 fig, 1 tab, 43 ref.

Descriptors: *Brines, *British Columbia, *Canada, *Carbonates, *Geochemistry, *Lakes, *Limnology, *Saline lakes, *Sedimentation, *Water chemistry, Cariboo Plateau, Closed lakes, Ephemeral lakes, Evolution, Lake basins, Minerals, Plateaus, Playas, Runoff, Salts, Sediments.

There are more than 100 closed, saline lakes in the semiarid, intermontane plateaus of British Columbia. They range from shallow perennial lakes to ephemeral playas. Most are groundwater-fed and lie within glaciofluvial deposits and till. Some have permanent salts. Where underlain by basalts, sodium carbonate brines predominate. Magnesium sulfate brines occur where catchments lie within Paleozoic sedimentary rocks, metasediments and basic volcanics. A few sodium sulfate brines are also present. A reconnaissance study of the sediments and mineralogy of 21 lake basins has shown that carbonates, including extensive magnesite and hydromagnesite deposits, and several occurrences of protodolomite, are widely precipitated in lake basins of each brine type. Analyses of stream, spring, ground and lake waters from the Cariboo Plateau region demonstrate that carbonate precipitation probably constitutes the major chemical divide responsible for producing the two dominant types of brine. (Author's abstract)
W91-00741

NUTRIENTS IN PORE WATERS FROM DEAD SEA SEDIMENTS.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
A. Nissenbaum, M. Stiller, and A. Nishri.
Hydrobiologia HYDRB8, Vol. 197, p 83-89, May 31, 1990. 2 fig, 4 tab, 14 ref.

Descriptors: *Dead Sea, *Interstitial water, *Lakes, *Limnology, *Nutrients, *Saline lakes, *Sediments, Ammonia, Carbonates, Chemical properties, Organic matter, Phosphates, Phosphorus removal, Sediment analysis, Sediment-water interfaces, Sinks, Sulfates.

Pore waters were separated from 50 cm-long cores of Dead Sea sediments raised from water depths of 25, 30 and 318 m. The salinity of the pore water is close to that of the overlying water at 225-230 g/L chloride. The titration alkalinity of the pore water is about 60% of the overlying water, and sulfate is also depleted. Ammonia and phosphate concentrations are higher than those of the water column with up to 50 mg/L N-NH3 (ten times increase) and 350 micro g/L P-PO4(3-) (four to eight times increase). Early diagenetic reactions are a result of decomposition of organic matter and of water-sediment interactions which result in aragonite precipitation and phosphate removal to the sediments, probably by absorption of iron-oxyhydrides followed by remobilization, reduction of sulfate and formation of iron sulfides and accumulation of ammonia. Mass balance calculations show that pore water contributes about 80% of the ammonia and 30% of the phosphate input into the Dead Sea water column. The Dead Sea behaves in many respects as a 'marine' system where the sediments are a very important source of nutrients. This differs from the situation in many lakes where various types of surface water input can be a major source of nutrient. (Agostine-PTT)
W91-00742

SOLUBILITY OF OXYGEN IN THE DEAD SEA BRINE.
Kinneret Limnological Lab., Tiberias (Israel).
For primary bibliographic entry see Field 2K.
W91-00744

VERNAL MICROSTRATIFICATION PATTERNS IN A MEROMICTIC SALINE LAKE: THEIR CAUSES AND BIOLOGICAL SIGNIFICANCE.
British Columbia Univ., Vancouver. Dept. of Zoology.
T. G. Northcote, and K. J. Hall.
Hydrobiologia HYDRB8, Vol. 197, p 105-114, May 31, 1990. 5 fig, 22 ref. NSERC Grants 67-3454 and 67-8935.

Descriptors: *British Columbia, *Lakes, *Limnology, *Meromictic lakes, *Saline lakes, *Seasonal variation, *Stratification, Anoxic conditions, Chemocline, Dissolved oxygen, Interfaces, Nutrients, Organic matter, Particulate matter, Photosynthesis, Runoff, Snowmelt.

Periodic high spring runoff, in addition to lake surface snow and ice melt, is shown to be a major cause of sharp secondary chemocline formation in a small (20 ha) lake in arid south-central British Columbia. Initially detected in 1982 at about 1 m and enhanced by high inflow of low salinity meltwater in spring 1983, the secondary chemocline gradually deepened and broke down over four subsequent years. Associated with microstratification layers (major changes within a few cm of depth), exhibited very high temperatures (> 30 C), and very high dissolved oxygen (> 200% saturation) as well as very low (close to 0% saturation) levels. Oxygen supersaturation resulted from photosynthetic production at the microstratification boundaries. In the springs of 1982 and 1983, formation of an anoxic layer between regions of high oxygen concentration separated the phytoplankton and zooplankton communities into two layers above the primary chemocline. The several year persistence of the secondary chemoclines and associated interface processes (concentration of particulate organic matter, bacterial decomposition, nutrient regeneration, phytoplanktonic production) attest to their functional importance in this meromictic lake. (Author's abstract)
W91-00745

PRODUCTION AND DECOMPOSITION IN A SALINE MEROMICTIC LAKE.

British Columbia Univ., Vancouver. Westwater Research Centre.
K. J. Hall, and T. G. Northcote.
Hydrobiologia HYDRB8, Vol. 197, p 115-128, May 31, 1990. 3 fig, 5 tab, 40 ref. NSERC Grants 67-8935 and 67-3454.

Descriptors: *Aquatic productivity, *Decomposition, *Lakes, *Limnology, *Meromictic lakes, *Productivity, *Saline lakes, Aquatic bacteria, British Columbia, Chemocline, Light penetration, Microorganisms, Mixolimnion, Phosphorus, Phytoplankton, Radioactive tracers, Seasonal variation, Stratification, Sulfur bacteria, Tritium.

Bacterial and phytoplankton cell number and productivity were measured in the mixolimnion and chemocline of saline meromictic Mahoney Lake during the spring (Apr.-May) and fall (Oct.) between 1982 and 1987. High levels of bacterial productivity (tritium labelled thymidine incorporation), cell numbers, and heterotrophic assimilation of C-14 glucose and C-14 acetate in the mixolimnion shifted from near surface (1.5 m), at a secondary chemocline, to deeper water (4-7 m) as this zone of microstratification gradually weakened during a several year drying trend in the watershed. In the mixolimnion, bacterial carbon (13-261 microgram C/L) was often similar to phytoplankton carbon (44-300 microgram C/L) and represented between 14-57% of the total microbial (phytoplankton + bacteria) carbon depending on the depth interval. Phototrophic purple sulfur bacteria were stratified at the permanent primary chemocline (7.5-8.3 m) in a dense layer (POC 250 mg/L, bacteriochlorophyll a 1500-7000 microgram/L) where H2S changed from 0.1 to 2.5 mM over a 0.2 m depth interval. This phototrophic bacterial layer contributed between 17-66% of the total primary production (115-476 mg C/sq m/d) in the vertical water column. Microorganisms in the phototrophic bacterial layer showed a higher uptake rate for acetate (0.5-3.7 microgram C/L) and this heterotrophic activity as well as bacterial productivity were 1 to 2 orders of magnitude higher in the dense plate than in the mixolimnetic waters above. Primary phytoplanktonic production in the mixolimnion was limited by phosphorus while light penetration appeared to regulate productivity of the purple sulfur bacteria. (Author's abstract)
W91-00746

AUTUMNAL MIXING IN MAHONEY LAKE, BRITISH COLUMBIA.

British Columbia Univ., Vancouver. Dept. of Civil Engineering.
P. R. B. Ward, K. J. Hall, T. G. Northcote, W. Cheung, and T. Murphy.
Hydrobiologia HYDRB8, Vol. 197, p 129-138, May 31, 1990. 6 fig, 1 tab, 19 ref.

Descriptors: *British Columbia, *Lakes, *Limnology, *Mixing, *Saline lakes, *Seasonal variation, Convection, Mahoney Lake, Meteorological data, Physical properties, Salinity, Stratification, Wind.

Salinity, water temperature and meteorological measurements were made over a 5 month period (June-Oct.) at Mahoney Lake, British Columbia to study autumnal mixing. The measurements were made during a time when the lake had been well stratified by a much larger than average runoff the previous spring. The potential energy of stratification decreased from 50 to 24 MJ, in the top 8 m of the water column, from mid August to mid October. Analysis of the energy available from wind shear on the water surface and from penetrative convection during the autumn cooling period was made. Winds were found to be weak (av. 2.17 m/s) at Mahoney Lake, and their average contribution to mixing energy during the study period was less than 30%. Penetrative convection from thermals descending from the cool surface contributed an average of 2.21 J/sq m/d to mixing which represented 72% of the energy available. An efficiency factor of 0.20 for the penetrative convection energy, larger than values previously reported in the literature, was found to fit the measured loss of potential energy of stratification during the period. (Author's abstract)
W91-00747

CHANGES IN LAKE LEVELS, SALINITY AND THE BIOLOGICAL COMMUNITY OF GREAT SALT LAKE (UTAH, USA), 1847-1987.

Geological Survey, Salt Lake City, UT.
D. W. Stephens.
Hydrobiologia HYDRB8, Vol. 197, p 139-146, May 31, 1990. 5 fig, 18 ref.

Descriptors: *Great Salt Lake, *Lakes, *Limnology, *Saline lakes, *Salinity, *Utah, *Water chemistry, Algae, Aquatic life, Brine shrimp, Ecosystems, Elevation, Evaporation, Killifish, Precipitation.

The effect of major changes in lake elevation and salinity on the biological community of Great Salt Lake were studied. Great Salt Lake is the fourth largest terminal lake in the world, with an area of about 6000 square kilometers at its historic high elevation. Since its historic low elevation of 1277.52 meters in 1963, the lake has risen to a new historic high elevation of 1283.77 meters in 1986-87, a net increase of about 6.25 meters. About 60 percent of this increase, 3.72 meters, has occurred since 1982 in response to greater than average precipitation and less than average evaporation. Variations in salinity have resulted in changes in the composition of the aquatic biological community which consists of bacteria, protozoa, brine shrimp and brine flies. These changes were particularly evident following the completion of a causeway in 1959 which divided the lake. Subsequent salinities in the north part of the lake have ranged from 16 to 29 percent and in the south part from 6 to 28 percent. Accompanying the rise in lake elevation from 1982 to 1987 have been large decreases in salinity of both parts of the lake. This has resulted in changes in the biota from obligate halophiles, such as Dunaliella salina and D. viridis, to opportunistic forms such as a blue-green alga (Nodularia spumigena). The distribution of brine shrimp (Artemia salina) in the lake have also closely followed the salinity. In 1986, when the salinity of the south part of the lake was about 6 percent, a population of brackish-water killifish (Lucania parva) was observed along the shore near inflow from a spring. (Author's abstract)
W91-00748

LARGE-SCALE PATTERNS OF NODULARIA SPUMIGENA BLOOMS IN PYRAMID LAKE, NEVADA, DETERMINED FROM LANDSAT IMAGERY: 1972-1986.

Arizona State Univ., Tempe. Dept. of Zoology.
D. L. Galat, J. P. Verdin, and L. L. Sims.
Hydrobiologia HYDRB8, Vol. 197, p 147-164, May 31, 1990. 7 fig, 1 tab, 59 ref. U.S. EPA Contract 68-03-6242.

Descriptors: *Algal blooms, *Cyanophyta, *Lakes, *Limnology, *Nevada, *Pyramid Lake, *Remote sensing, *Saline lakes, *Satellite technology, *Telemetry, Analytical techniques, Biomass, Calcium carbonate, Chlorophyll a, Fluvial sediments, Landsat images, Meromixis, Periodicity, Quantitative analysis, Spectral analysis, Statistical analysis.

Magnitude and long-term periodicity of the nitrogen-fixing cyanobacterium, Nodularia spumigena, were characterized for hyposaline Pyramid Lake, Nevada, from Landsat multispectral scanner (MSS) band 3 film negatives. Predicted lakewide mean chlorophyll a concentrations for Landsat overpasses during the July-October Nodularia bloom season ranged from 27 to 72 mg/ cu m with an overall average concentration of 32 plus or minus 7 mg/ cu m between 1972 and 1986. Nodularia blooms were usually annual events. Blooms were not observed on Landsat images in only three of 15 years (1973, 1980, 1982) and midsummer calcium carbonate whitings occurred in two of these years (1973, 1980). Magnitude of Nodularia blooms was highly variable among years and 'very large' blooms, where maximum mean chlorophyll a concentration exceeded one standard deviation of the 15 year overall mean (>39 mg/cu m), appeared in 1974, 1975, 1977, 1979, 1984, 1985 and 1986. Very large early-July blooms always occurred during or following years of above average fluvial discharge to Pyramid Lake (1984-1986) and were associated with meromixis produced by the large influx of freshwater. Several problems arise using Landsat remote sensing to estimate magnitude and periodicity of scum-forming blue-green algal blooms which complications may reduce accuracy and precision of phytoplankton biomass estimates made from Landsat images. Nevertheless, Landsat remote sensing enabled quantitation of relative bloom magnitude with limited collection of ground-based data and at large-scale temporal and spatial resolution not possible using alternative methodologies. (Author's abstract)
W91-00749

PHOTOSYNTHESIS OF DUNALIELLA PARVA LERCHE AS A FUNCTION OF TEMPERATURE, LIGHT AND SALINITY.

Malaga Univ. (Spain). Dept. de Ecologia.
C. Jimenez, F. X. Niell, and J. A. Fernandez.
Hydrobiologia HYDRB8, Vol. 197, p 165-172, May 31, 1990. 7 fig, 2 tab, 24 ref. C.A.I.C.Y.T. 1063/85.

Descriptors: *Algae, *Chlorophyta, *Flagellates, *Photosynthesis, *Salinity, *Temperature effects, Lagoons, Light intensity, Michaelis-Menten functions, Model studies, Sodium chloride.

The photosynthetic behavior of Dunaliella parva Lerche from the athalassic lagoon of Fuente de Piedra (Malaga, Southern Spain) was studied experimentally at three NaCl concentrations (1, 2 and 3 M), five temperatures (15, 23, 31, 38 and 42 C) and nine different irradiances between 82 and 891 mol/sq m/s. Results were analyzed to define the best growing conditions for the algae. D. parva showed the highest photosynthetic rates at a NaCl molarity of 2 M, under a moderate light intensity (600 mol/sq m s) at 31 C. Above this light intensity a clear photoinhibition of the photosynthesis was found at 2 M and 3 M of NaCl. D. parva is a halotolerant and a thermoresistant species as evidenced by its net photosynthesis rate and positive values of oxygen evolution at 42 C. Two methods for modeling photosynthesis versus irradiation curves were used. The first was a single model, based on third-order polynomial equations, and the second was a double model, based on hyperbolical Michaelis-Menten type functions and negative exponential to define photoinhibition. It was found that a double model seemed to be very accurate. (Author's abstract)
W91-00750

DISTRIBUTION AND ABUNDANCE OF LITTORAL BENTHIC FAUNA IN CANADIAN PRAIRIE SALINE LAKES.

Saskatchewan Univ., Saskatoon. Dept. of Biology.
U.T. Hammer, J. S. Sheard, and J. Kranabetter.
Hydrobiologia HYDRB8, Vol. 197, p 173-192, May 31, 1990. 7 fig, 6 tab, 27 ref. NSERC Grant 1412.

Descriptors: *Aquatic animals, *Benthic fauna, *Canada, *Lakes, *Limnology, *Littoral environment, *Prairies, *Saline lakes, Biomass, Crustaceans, Organic matter, Salinity, Seasonal variation, Sediments, Species diversity, Statistical analysis, Water chemistry.

The littoral benthos of 18 lakes in Alberta and Saskatchewan ranging in Salinity from 3 to 126 ppt (g/L total dissolved solids(TDS)) was investigated twice, in the spring and in the summer of 1986. Multiple Ekman dredge samples were taken at water depths of about 0.5, 1.0 and 2 meters in each transect. A total of 76 species was present varying from 29-31 species in the three lakes of lowest salinity (means of 3.1-5.55 ppt) to only 2 species in lakes exceeding 100 ppt. Species richness decreased rapidly in salinities greater than 15 ppt. Biomass maximum mean of 10.91 g/sq m dry weight (maximum 63.0 g/sq m) occurred in culturally eutrophic Humboldt Lake (3.1 ppt) but was one third as great in other low salinity lakes. However, biomass again increased to about 4.5 g/sq m in two lakes of 15 ppt. As the salinity increased still further, biomass declined steadily until a minimum of 0.0212 g/sq m was recorded in the most saline Aroma Lake (mean 119 ppt). Summer biomass (11 lakes) was greater than spring biomass (4 lakes) because some groups such as amphipods, corixids and ostracods became more abundant in

summer. Seasonality (spring or summer), sediment texture and organic matter content, water depth, pH, salinity (TDS) and the presence of aquatic plants (% plant cover) were considered in the matrix involving species dry weight biomass at each of 117 stations. TWINSPAN classification of the samples yielded a dendrogram with 18 indicator species. Successive dichotomies divided these indicator species into four main lake groups based on salinity, i.e., Group (I): 3-10 ppt (Gammarus, Glyptotendipes I, Chironomus cf. plumosus), Group (II): 10-38 ppt (Hyalella, Engallagma, Bezzia), Group (III): 38-63 ppt (Hygrotus salinarius, Cricotopus ornatus), Group (IV): >63 ppt (Dolichopodidae, Ephydra hians). Each of these main four groups was subdivided into smaller groups of lakes based on factors such as pH, seasonality (spring or summer species dominance), % organic matter and % plant cover. Depth of samples played no apparent role. (Author's abstract)
W91-00751

DISTRIBUTION AND ABUNDANCE OF THE ALKALI FLY (EPHYDRA HIANS) SAY AT MONO LAKE, CALIFORNIA (USA) IN RELATION TO PHYSICAL HABITAT.
Sierra Nevada Aquatic Research Lab., Mammoth Lakes, CA.
D. B. Herbst.
Hydrobiologia HYDRB8, Vol. 197, p 193-205, May 31, 1990. 7 fig, 2 tab, 21 ref. NSF Grant DCB-8608664.

Descriptors: *Aquatic habitats, *Aquatic insects, *California, *Ecological distribution, *Lakes, *Limnology, *Saline lakes, Alkali fly, Aquatic populations, Distribution, Life cycles, Mono Lake, Substrates, Temperature effects.

The distribution and abundance of larval, pupal, and adult stages of the alkali fly Ephydra hiens Say were examined in relation to location, benthic substrate type, and shoreline features at Mono Lake. Generation time was calculated as a degree-day model for development time at different temperatures, and compared to the thermal environment of the lake at different depths. Larvae and pupae have a contiguous distribution and occur in greatest abundance in benthic habitats containing tufa (a porous limestone deposit), and in least abundance on sand or sand/mud substrates. Numbers increase with increasing areas of tufa present in the sample, but not on other rocky substrates (alluvial gravel/cobble or cemented sand). Standing rock densities are greatest at locations around the lake containing a mixture of tufa deposits, detrital mud sediments, and submerged vegetation. Shoreline adult abundance is also greatest in areas adjacent to tufa. The shore fly (ephydrid) community varies in composition among different shoreline habitats and shows a zonation with distance from shore. The duration of pupation becomes shorter as temperature increases. The temperature dependence of pupa development time is not linear and results in prolonged time requirements to complete development at temperatures below 20 C. About 700 to 1000 degree-days are required to complete a generation. Degree-days of time available in nature declines by 10 to 50% at depths of 5 and 10 meters relative to surface waters (depending on the extent of mixing), resulting in fewer possible generations. Essentially no growth would be expected at 15 m, where temperature seldom exceeds the developmental minimum. It is concluded that reduced substrate availability and low temperatures may limit productivity of the alkali fly at increasing depths in Mono Lake. (Author's abstract)
W91-00752

DISTRIBUTION PATTERNS OF OSTRACODS IN IBERIAN SALINE LAKES. INFLUENCE OF ECOLOGICAL FACTORS.
Museo Nacional de Ciencias Naturales, Madrid (Spain).
A. Baltanas, C. Montes, and P. Martino.
Hydrobiologia HYDRB8, Vol. 197, p 207-220, May 31, 1990. 5 fig, 2 tab, 58 ref. C.A.I.C.Y.T. project PR84-0181.

Descriptors: *Crustaceans, *Distribution patterns, *Ecological effects, *Lakes, *Ostracods, *Saline lakes, *Spain, Iberian Peninsula, Limnology, Mediterranean Sea, Salinity, Sulfates, Waterfowl.

A limnological survey of the Iberian mesosaline and hypersaline lakes was conducted that included a study of the biogeographical and ecological aspects of their ostracod populations. Eucypris aragonica Brehm and Margalef; Eucypris mareotica (Fischer) and Heterocypris barbara inermis (Gauthier) are the only species found in waters with salinities between 10 and 100 ppt. Each species tends to be restricted to one of the three large Iberian Tertiary depressions: E. aragonica in the Ebro River basin; E. mareotica in the Guadalquivir River basin (South Spain) and H. barbara inermis in the tableland of La Mancha (Central Spain). Both E. mareotica and H. barbara inermis are distributed in inland waters of regions around the Mediterranean Sea, while E. aragonica is only known from Spain. Historical factors have been traditionally used to account for the distribution of several crustacean species and recent faunas have been seen as the remnant of those inhabiting Tertiary Depressions around the ancient Mediterranean Sea. Ecological factors, mainly ion composition, account for their observed pattern in Spanish lakes. E. mareotica typically inhabits high chloride waters while H. barbara inermis 'prefers' lakes with high sulfate. E. aragonica seems to be restricted to chloride waters with a high sulfate content and very irregular (or aperiodic) hydrological regimes. Presence of parthenogenetic populations and waterfowl exchange between different saline-lake areas in the Iberian Peninsula facilitate ostracod dispersion. (Author's abstract)
W91-00753

ANOSTRACA, CLADOCERA AND COPEPODA OF SPANISH SALINE LAKES.
Barcelona Univ. (Spain). Dept. de Ecologia.
M. Alonso.
Hydrobiologia HYDRB8, Vol. 197, p 221-231, May 31, 1990. 4 fig, 4 tab, 34 ref.

Descriptors: *Crustaceans, *Lakes, *Limnology, *Saline lakes, *Spain, *Waterfleas, Cladocera, Copepods, Distribution patterns, Fairy-shrimp, Mediterranean Sea, Salinity.

A study of 102 samples from almost all salt water bodies in Spain resulted in a comprehensive list of anostracans, cladocerans and copepods living in such extreme environments. Among the 26 species recorded, 9 are halobionts, but 17 can exist in less saline waters. Of the halobionts, several are widely distributed throughout arid areas around the Mediterranean (Arctodiaptomus salinus, Cletocamptus retrogressus, Branchinectella media, Branchinella spinosa, Daphnia mediterranea, Moina salina); Branchinecta orientalis (= B. cervantesi) only appears in the Guadiana watershed and toward the east of Hungary, and the Alona belonging to the A. elegans complex is a Spanish endemic. In the second group there are many typically freshwater species which also appear occasionally in saline waters, and colonizers of wetlands in steppes, characteristically adapted to a wide range of salinity; one of the typically freshwater species, Diaphanosoma cf. mongolianum deserves closer study. The Spanish halobiontic fauna seems to be very old judging by the existence of some isolated species. e.g., B. orientalis may be a tertiary relic. Persistence through time could have resulted from the continuous aridity of some Iberian localities during the Pleistocene and the ecological constancy of wetlands maintained by regional groundwater discharges. (Author's abstract)
W91-00754

ARTEMIA MONICA CYST PRODUCTION AND RECRUITMENT IN MONO LAKE, CALIFORNIA, USA.
California Univ., Santa Barbara. Marine Science Inst.
G.L. Dana, R. Jellison, and J. M. Melack.
Hydrobiologia HYDRB8, Vol. 197, p 233-243, May 31, 1990. 4 fig, 1 tab, 22 ref.

Descriptors: *Brine shrimp, *California, *Crustaceans, *Lakes, *Saline lakes, Aquatic populations, Eggs, Life cycles, Mixolimnion, Population density, Recruitment, Seasonal variation, Temperature effects.

Annual egg production was determined for Artemia monica in Mono Lake, California, from 1983 to 1987. Annual oviparous (overwintering cyst) production was 3 and 7 million cysts/sq m/y in 1986 and 1987, respectively, as measured by in situ sediment traps. Cyst production for the entire five year period was calculated using Artemia census data and inter-brood duration derived from mixolimnetic temperature. These estimates ranged from 2 to 5 million cysts/sq m/y. This method underestimated annual production by 30%, when compared to estimates using sediment traps. Cyst production was similar during 1983-1986 and showed a significant increase in 1987, which was due primarily to a larger reproductive population later in the year. Recruitment into the adult populations of the following spring ranged between 1.4 to 3.2%. Overall abundance of this generation reflected the patterns in annual cyst production. Compensatory effects must operate on the second generation of each year, since summer populations were similar in all years despite differences in cyst production. (Author's abstract)
W91-00755

COMPARATIVE LIMNOLOGY OF SAMBHAR AND DIDWANA LAKES (RAJASTHAN, NW INDIA).
Jodhpur Univ. (India). Dept. of Zoology.
G. R. Jakher, S. C. Bhargava, and R. K. Sinha.
Hydrobiologia HYDRB8, Vol. 197, p 245-256, May 31, 1990. 7 fig, 3 tab, 24 ref.

Descriptors: *India, *Lakes, *Limnology, *Saline lakes, *Water chemistry, Alkalinity, Aquatic life, Aquatic plants, Brine shrimp, Chemical properties, Comparison studies, Dissolved oxygen, Environmental effects, Nutrients, Plankton, Salinity, Seasonal variation.

Two alkaline saline inland lakes of the Indian arid region were studied during 1984 and 1985 to assess the function and interaction of various environmental and biological factors. Changes in physical and chemical variables, planktonic composition, chlorophyll content and phytoplankton primary productivity were examined. Salinity in both lakes fluctuated from almost fresh water (1.80 ppt), to hypersaline (300 ppt) and acted as the main controlling factor for almost all the biotic parameters. Maximum total alkalinities were 2162 mg/L and 2090 mg/L, respectively in Sambhar and Didwana lakes. Dissolved oxygen ranged from completely anoxic conditions to maxima of 11.68 and 7.29 mg/L, respectively in Sambhar and Didwana lakes. Nutrient enrichment in the lakes was low. The phytoplankton species composition of Sambhar lake was reduced from an earlier reported 20 genera to only 11, including Nostoc and Microcystis. Phytoplankton of Didwana was composed of only 9 genera including Anabaena and Nodularia. Sambhar lake, which once contained Artemia, is now devoid of them. On the other hand, Artemia was the most abundant zooplankter in Didwana lake at a salinity range of 15-288 ppt. Other zooplankters such as Moina, Cyclops and Brachionus flourished at lower salinity levels in Didwana lake. Species number decreased in Sambhar and Didwana lakes as salinity increased. A high carbonate concentration has also been mentioned as a limiting factor for many algal species, because it can be the reason for absence of free CO2. Low species number has also been reported from many other saline lakes around the world. (Agostine-PTT)
W91-00756

SALINITY AS A DETERMINANT OF SALT LAKE FAUNA: A QUESTION OF SCALE.
Adelaide Univ. (Australia). Dept. of Zoology.
W. D. Williams, A. J. Boulton, and R. G. Taaffe.
Hydrobiologia HYDRB8, Vol. 197, p 257-266, May 31, 1990. 3 fig, 2 tab, 35 ref.

Descriptors: *Australia, *Lakes, *Limnology, *Saline lakes, *Salinity, *Species diversity, *Water chemistry, Distribution, Ecological effects, Fauna, Invertebrates, Species composition.

High and often variable salinity is an obvious feature of salt lakes. Correspondingly, salinity is usually assumed to be an important ecological determinant in such lakes. An investigation of the macroinvertebrate fauna of 79 lakes (salinities from 0.3 to 343 g/L) in the Western District of Victoria, Australia, examined this assumption. Over the total range of salinity, species richness and composition were highly correlated with salinity. However, these relationships became nonsignificant over intermediate ranges of salinity. Furthermore, many taxa have very broad tolerances to salinity at these intermediate ranges, implying that factors other than salinity may determine their distribution. An appreciation of scale (that is, the range of salinity over which observations are considered) resolved the paradox that, despite these broad tolerances by most taxa, species richness and composition strongly reflect salinity over the entire salinity range. (Author's abstract)
W91-00757

MULTIVARIATE ANALYSIS OF DIATOMS AND WATER CHEMISTRY IN BOLIVIAN SALINE LAKES.
Museume National d'Histoire Naturelle, Paris (France). Lab. de Geologie.
S. Servant-Vildary, and M. Roux.
Hydrobiologia HYDRB8, Vol. 197, p 267-290, May 31, 1990. 8 fig, 7 tab, 42 ref.

Descriptors: *Bolivia, *Diatoms, *Lakes, *Limnology, *Mathematical studies, *Multivariate analysis, *Saline lakes, *South America, *Statistical analysis, *Water chemistry, Cluster analysis, Ecological distribution, Ecological effects, Flora, Lake classification, Model studies, Physical properties.

Diatom assemblages from thirteen salt lakes in the southern Bolivian Altiplano (Lipez) were studied. The study involved: (1) an inventory of the diatom species; (2) a classification of the lakes based on the diatom flora using correspondence factor and cluster analysis; (3) an ordering of the species inside a cluster, using an 'interpreting help' method to determine the degree of relation of the subdominant or scarce species to a given milieu; (4) the determination of the ionic elements which mostly influence a diatom assemblage, using the 'variables/classes' and 'classes/variables' contributions program; and (5) the quantification of the chemical variables, using an 'interactions species/ionic variables' program which puts into the same graph, samples and/or species and ionic elements whose concentration is expressed in categories. These new methods are proposed to establish the qualitative and quantitative relationships between diatom floras and ecological parameters. Results indicate that diatom assemblages are linked more to the ionic elements than to the salinity, pH, depth, temperature or elevation. Environmental variables are divided into three modalities which allow considerations of many different variables not under the same units: (i) comparisons between published and local affinities to the salinity; (ii) relationships between salinity, number of species and diversity in the Lipez area; and (iii) relationships between salinity and dominant species. (Agostine-PTT)
W91-00758

HYDROCHEMISTRY FROM SR AND MG CONTENTS OF OSTRACODES IN PLEISTOCENE LACUSTRINE DEPOSITS, BAZA BASIN (SE SPAIN).
Instituto de Investigaciones Geologicas Jaime Almera, Barcelona (Spain).
P. Anadon, and R. Julia.
Hydrobiologia HYDRB8, Vol. 197, p 291-303, May 31, 1990. 8 fig, 1 tab, 24 ref.

Descriptors: *Crustaceans, *Heavy metals, *Lacustrine environment, *Limnology, *Magnesium, *Paleolimnology, *Saline lakes, *Spain, *Strontium, *Water chemistry, Baza Basin, Calcite, Carbonates, Environmental effects, Littoral environment, Ponds, Salinity.

A reconstruction of the early Pleistocene paleohydrochemistry based on the Mg, Sr and Ca content of the Cyprideis valves is presented for shallow lacustrine sequences of the Baza basin. A large number of environmental changes in this marginal area has been recorded by the recurrent alternation of two fossil assemblages which differ in their salinity requirements. Measurements of the Sr/Ca and Mg/Ca ratios of individual calcite shells of Cyprideis show that the water in the higher saline stages (with thalassic organisms indicating marine-like conditions) was of non-marine origin. The Sr/Ca values of Cyprideis valves from sands deposited during a saline water phase show lower values than those from an overlying carbonate sequence which was formed under lower salinity conditions. These unexpected values are assumed to be the result of major changes in the chemical composition of water in shallow, littoral ponded areas of a hydrologically complex lake. In the sequences that originated in these areas, Sr/Ca values may be used only as salinity indicators within each portion of the sequence formed in a single, continuous evolution. In more open areas, the wide fluctuations of Sr/Ca and Mg/Ca recorded in ostracods from individual layers of rippled ostracode-shell sands probably reflect the mixing of valves from changing short-term environmental conditions. (Author's abstract)
W91-00759

ABSOLUTE DATING OF SEDIMENTATION ON LAKE TORRES WITH SPRING DEPOSITS, SOUTH AUSTRALIA.
Zambia Univ., Lusaka. School of Mines.
R. M. Schmid.
Hydrobiologia HYDRB8, Vol. 197, p 305-308, May 31, 1990. 1 fig, 5 ref.

Descriptors: *Australia, *Lakes, *Radioactive dating, *Sedimentation, Alluvial deposits, Calcium carbonate, Carbon radioisotopes, Playas, Radioisotopes, Sediments, Tectonics, Travertine.

The travertine structure containing Mountford Spring is in the only surface accumulation of CaCO3 on Lake Torrens, a playa in South Australia. Samples from the travertine structure on Lake Torrens were collected in August 1984 and analyzed through thin section interpretation. The first C-14 data on Lake Torrens for travertine samples surrounding Mountford Spring range from 13,770 plus or minus 130 years BP to 22,700 plus or minus 290 years BP, giving a time frame for lacustrine sediments in between. In the absence of recent tectonic movements, the old travertine (22,700 +/- 290 years) on the cliff top, surrounded by younger spring deposits (13,770 +/-130 years) at a lower level, prove a deflation event at this playa. This compares well with a period of alluvation and dune building in the surroundings of Lake Torrens, occurring between 5000-12,000 years BP. (Agostine-PTT)
W91-00760

CONTROL OF PHYTOPLANKTON GROWTH IN NUTRIENT RECYCLING ECOSYSTEMS. THEORY AND TERMINOLOGY.
Bergen Univ. (Norway). Dept. of Microbiology and Plant Physiology.
T. F. Thingstad, and E. Sakshaug.
Marine Ecology Progress Series MESEDT, Vol. 63, No. 2/3, p 261-272, May 29, 1990. 6 fig, 2 tab, 43 ref.

Descriptors: *Cycling nutrients, *Nutrients, *Phytoplankton, *Theoretical analysis, Biomass, Food chains, Growth, Mathematical studies, Model studies, Oligotrophic lakes, Species composition.

Some of the principles governing phytoplankton growth, biomass, and species composition in 2-layered pelagic ecosystems are explored using an idealized, steady-state, mathematical model based on simple extensions of Lotka-Volterea type equations. In particular, the properties of a food web based on 'small' and 'large' phytoplankton are investigated. Features of the phytoplankton community that may be derived from this conceptually simple model include co-existence of more than one species on one limiting nutrient, a rapid growth rate for a large fraction of the phytoplankton community in oligotrophic waters, a long food chain starting from a population of small phytoplankton in waters with moderate mixing over the nutricline, and a transition to dominance of a food chain based on large phytoplankton when mixing is increased. As pointed out by other authors, careless use of the concept of one limiting factor may be potentially confusing in such systems. To avoid this, a distinction in terminology between 'controlling' and 'limiting' factors is suggested. (Author's abstract)
W91-00765

CLASSIFICATION OF THE MACROINVERTEBRATE FAUNA OF TWO RIVER SYSTEMS IN SOUTHWESTERN AUSTRALIA IN RELATION TO PHYSICAL AND CHEMICAL PARAMETERS.
Western Australia Univ., Nedlands. Aquatic Research Lab.
A. W. Storey, S. E. Bunn, P. M. Davies, and D. H. Howard.
Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 217-232, June/July 1990. 4 fig, 4 tab, 38 ref.

Descriptors: *Australia, *Invertebrates, *River systems, *Species composition, *Species diversity, Agriculture, Classification, Geomorphology, Ordination, Seasonal variation, Spatial distribution, Temporal distribution, Urban planning, Water chemistry.

Benthic macroinvertebrates were quantitatively sampled from thirty sites along two river systems in southwestern Australia, and patterns in community structure related to physical and chemical parameters. Classification and ordination showed a major separation between upland and lowland sites, irrespective of river systems. The change in benthic community structure reflected the rapid transition in geomorphology, stream hydraulics, and water chemistry as upland forested streams exit the Darling Escarpment to give rise to open rivers, disturbed by agriculture and urban development. One upland site was clearly influenced by a storage reservoir immediately upstream and consistently grouped with lowland sites; evidence of recovery was apparent at sites downstream. The remaining upland sites were separated on the basis of catchment; this was most likely related to stream flow permanence than any inherent catchment difference. A seasonal pattern was also detected for upland sites. Samples taken in the summer or autumn were distinct from those taken in winter or spring. In contrast, lowland sites could not be separated into distinct groups on the basis or season or drainage basin. The presence of cosmopolitan and tolerant species with a high likelihood of dispersal, together with the homogeneous nature of the sites, may account for the high degree of similarity among benthic communities of sites along the lowland rivers. Much of the spatial and temporal variation in benthic community structure was explained by physical characteristics of the sites. Prediction of community type using chemical data alone was poor, but might be improved by combining physical and chemical data, particularly for upland sites, and was likely the result of the abrupt changes in the physical nature of the streams and the absence of large spatial differences in water quality. The successful predictive relationship between benthic community structure and physical data will enable water management authorities to detect subsequent changes in water quality in these two river systems. (Author's abstract)
W91-00774

VARIABILITY OF RESULTS FROM THE USE OF PHABSIM IN ESTIMATING HABITAT AREA.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W91-00775

EFFECTS OF SEDIMENT AND FLOW REGIME ON THE AQUATIC INSECTS OF A HIGH MOUNTAIN STREAM.
Wyoming Univ., Laramie. Dept. of Plant Science.
L. D. DeBrey, and J. A. Lockwood.

Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 241-250, June/July 1990. 5 fig, 2 tab, 39 ref.

Descriptors: *Flow rates, *Insects, *River systems, *Sedimentation, *Stream biota, *Wyoming, Disturbance, Species diversity, Surber sampler.

In 1984, a broad size range of sediment (boulder to sand) was introduced into a high elevation Rocky Mountain stream in southeastern Wyoming, USA. In the spring of 1986, this stream was exposed to a high discharge of 7.5 cubic meters per second. From 1985 to 1987 a study was conducted to assess the impact of sediment deposition and flow regime on the aquatic insect community based on the substrate type where the insects were collected. Using a modified Surber sampler, samples were collected from June through September each year at nine stations which were rated as unimpacted, slightly-impacted, and impacted. The addition of the sediment had minimal impact on the abundance and diversity of aquatic insects. However, high water discharge severely reduced the abundance of aquatic insects and diversity was also negatively impacted. Recovery from these impacts was very rapid. The greatest insect abundance was found in samples taken in gravel and most taxa occurred predominantly on gravel or rubble substrates. (Author's abstract)
W91-00776

ENHANCEMENT OF BENTHIC MACROINVERTEBRATES BY MINIMUM FLOW FROM A HYDROELECTRIC DAM.
Versar, Inc., Columbia, MD.
For primary bibliographic entry see Field 6G.
W91-00778

MARGINAL ZOOBENTHOS OF A SOUTHERN BRAZILIAN DAM (ZOOBENTHOS LITORANEOS DE UM ACUDE SUL-BRASILEIRO).
Museu de Ciencias Naturais de Fundacao Zoobotanica do Rio Grande do Sul, Porto Alegre (Brazil).
For primary bibliographic entry see Field 6G.
W91-00780

CHEMICAL CHARACTERISTICS OF THE WATER OF CHASCOMUS POND (PROVINCIA DE BUENOS AIRES, ARGENTINA): LIMNOLOGICAL IMPLICATIONS (CARACTERISTICAS QUIMICAS DAS AGUAS DA LAGOA DE CHASCOMUS (PROVINCIA DE BUENOS AIRES, ARGENTINA). IMPLICANCIAS LIMNOLOGICAS).
Universidad Nacional de La Plata (Argentina). Inst. de Limnologia.
V. H. Conzonno, and E. F. Claverie.
Revista Brasileira de Biologia RBBIAL, Vol. 50, No. 1, p 15-21, February 1990. 3 fig, 4 tab, 28 ref.

Descriptors: *Argentina, *Lakes, *Limnology, *Water chemistry, Algal growth, Biological oxygen demand, Chascomus Pond, Chlorophyll a, Hydrogen ion concentration, Lake circulation, Limiting nutrients, Nitrogen, Nutrient concentrations, Phosphorus, Salinity.

The chemical characteristics of the waters of Chascomus pond were oligohaline, with mean total dissolved solids of 649 mg/L; alkaline, with a mean pH of 8.6; and of the bicarbonate sodium chloride type. The pond was found in a state of constant vertical mixing, which caused saturated dissolved oxygen levels even near the pond bottom. This vertical mixing promoted the existence of a high concentration of suspended particulate matter (mean of 112.8 mg/L) that greatly affected the transmission of light in the water column. Nutrient concentrations (mean total nitrogen, 1.56 mg nitrogen/L; mean total phosphorus 249 microg phosphorus/L) and pigment concentrations (mean chlorophyll a, 25.3 microg/L) indicated the high trophic status of the pond. Values of total nitrogen/total phosphorus ratios suggested nitrogen, rather than phosphorus, was the limiting nutrient for algal growth. Soluble organic matter levels, measured as chemical oxygen demand, were high, reaching a mean of 13.4 mg of oxygen consumed per L. Heavy rain caused important changes in the characteristics of the water. (Author's abstract)
W91-00781

SEASONAL VARIATION OF SIRODOTIA DELICATULA SKUJA (RHODOPHYTA, BATRACHOSPERMACEAE) IN A SMALL STREAM FROM SAO PAULO STATE, SOUTHEASTERN BRAZIL.
Universidade Estadual Paulista, Sao Jose do Rio Preto (Brazil). Inst. de Biociencias.
D. Pascoaloto, and O. Necchi.
Revista Brasileira de Biologia RBBIAL, Vol. 50, No. 1, p 37-44, February 1990. 13 fig, 28 ref.

Descriptors: *Algae, *Brazil, *Rhodophyta, *Seasonal variation, *Stream ecology, Algal growth, Algal reproduction, Correlation analysis, Population dynamics, Stream order, Water chemistry, Water depth.

Seasonal variation of Sirodotia delicatula was investigated in a first-order stream in Juqutiba, Sao Paulo State, southeastern Brazil, from April, 1987 to April 1988. Seasonality was evaluated on the basis of frequency, percent cover, and phenology, as well as its relation to some physical and chemical variables (current velocity, water temperature, turbidity, width, depth, discharge rate, pH, carbon dioxide levels, oxygen levels, oxygen saturation, water color, and daylength). The alga population revealed no significant variation in frequency, presenting maximum values in June (33.6%) and minimum in September (25.2%) with a narrow range during the study period. Percentage cover showed no seasonality remaining in the level 2 (1-10%) of the cover scale. All plants were fertile and monoecious; most (90-100%) were carposporophytic. In situ carpospore germination, resulting in the development of microscopic plants of Chantrasia stage, epiphytically on the gametophyte, was observed in a variable percentage (5-20%) of plants of the populations from April, May, September, October, and November, 1987 and April, 1988. The alternation between gametophyte and Chantrasia stage, typical of members of Batrachospermales, was not observed. Frequency was positively correlated with depth ($r = 0.55$, $p < 0.05$), suggesting a relationship with luminosity. The relative stability of the Sirodotia delicatula population seems to be due to maintenance of chemical and physical variables within favorable conditions for the growth of the alga. The joint occurrence of carposporophytic and monoecious plants was interpreted as the major factor, as well as an alternative reproductive strategy, for population maintenance under favorable seasonal conditions. (Author's abstract)
W91-00782

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: I. CHARACTERISTICS AND EVALUATION OF FEEDING CONDITIONS (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: I. CHARAKTERYSTYKA I OCENA WARUNKOW POKARMOWYCH).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 8I.
W91-00783

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: II. QUALITATIVE AND QUANTITATIVE ANALYSES OF NUTRITION AND NUTRITIONAL SELECTIVITY (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: II. JAKOSCIOWA I ILOSCIOWA ANALIZA POKARMU ORAZ WYBIORCZOSC POKARMOWA).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 8I.
W91-00784

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: III. ATTEMPT TO EVALUATE THE PRESSURE ON PLANKTON OF THE INTRODUCED FISH POPULATION (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: III. PROBA OCENY PRESJI INTRODUKOWANEJ POPULACJI RYB NA PLANKTON).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 8I.
W91-00785

MICROBIOLOGICAL INVESTIGATIONS OF LAKE NIEGOCIN (BADANIA MIKROBIOLOGICZNE JEZIORA NIEGOCIN).
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Zaklad Mikrobiologii Sanitarnej.
For primary bibliographic entry see Field 5B.
W91-00787

SPECTROSCOPIC INVESTIGATIONS OF PEAT-WATER INTERACTIONS: AN ESR, FT-IR, AND NMR STUDY.
Umea Univ. (Sweden). Dept. of Physical Chemistry.
A. Holmgren, G. Wikander, and B. Norden.
Soil Science SOSCAK, Vol. 149, No. 5, p 279-291, May 1990. 8 fig, 2 tab, 39 ref.

Descriptors: *Bonding, *Limnology, *Peat soils, *Soil chemistry, *Water chemistry, *Wetlands, Correlation analysis, Decomposition, Fourier transformed-infrared spectroscop, Humification, Nuclear magnetic resonance.

Despite the existence of naturally occurring paramagnetic species in peat, it is difficult to use them unambiguously for determination of the water-binding properties of peat. In the present investigation extrinsic probe molecules, viz stable nitroxide radicals, are used. By means of these reporter molecules, it is possible to follow the rate of disappearance of water in peat at various temperatures. Samples from different sorts of peat (Sphagnum and Carex) with various degrees of humification have been investigated and the binding between water and peat have been estimated. The DRIFT technique was used to investigate the interaction between water and homogenized batches of Sphagnum and Carex peat of both high and low degrees of decomposition. As an aid to spectral interpretations, the hydrogen bonding (3700 to 3000 /cm) region of the spectra was analyzed using principal component analysis and partial least squares modeling with latent variables. A very good correlation is obtained between DRIFT data and the water content of the peat samples. Water molecules are more strongly bound to the surface of a high-humified peat sample than to a surface of low-humified peat. The hydrogen bonding interaction between water and functional groups in the peat structure is also reflected by the vibrational spectrum of peat. Carbon-13 labeled CP/MAS nuclear magnetic resonance to monitor changes in chemical composition was used revealing a decrease of carbohydrates and a relative increase in aromatic and aliphatic structures as humification proceeds. Proton spin-spin relaxation measurements were used to detect different fractions of water in peat. The data indicate the existence of a multitude of fractions, which can be interpreted as hard bound water, capillary water, and bulk water. (Author's abstract)
W91-00789

DEGRADATION OF POLYPHENOLS IN FIVE PLANT SPECIES IN THE AQUATIC ENVIRONMENT (DEGRADACAO DE PLOIFENOIS EM CINCO ESPECIES VEGETAIS EM AMBIENTES AQUATICOS).
Convenio Eletronorte/CNPq/INPA, Brazil.
M. N. S. Ribeiro, M. J. C. Varejao, M. G. B. Zoghbi, and J. S. B. Ribeiro.
Acta Amazonica AAMZAZ, Vol. 18, No. 3/4, p 189-197, 1989. 6 fig, 17 ref. English summary.

Descriptors: *Aquatic plants, *Biodegradation, *Degradation, *Fate of pollutants, *Phenols, *Plant physiology, *Polyphenols, *Water chemistry, Aquatic environment, Brazil, Chemical analysis, Lakes, Vegetation effects.

Degradation studies of polyphenols of leaves and branches of Inga species Mabea caudata Pax ex K. Hoffn., Mezilaurus itauba (Messn.) Taub ex Mez., Vatairea sericea Ducke and Protium species were carried out for 155 days in two experimental lakes in the state of Amazonas, Brazil. In the first lake the vegetation remained intact and in the second lake the vegetation was defoliated. Phenolic compound determinations were based on the Follin-Denis method. The object of the present study was to know the degradation rate of phanerogam vegetation in the aquatic environment. Inga sp. and Mezilaurus itauba showed greater decomposition in the first lake than in the second while Mabea caudata and Mezilaurus itauba had a high decomposition in the second lake. (Author's abstract)
W91-00821

INCREASE IN THE OXYGEN CONCENTRATION IN AMAZON WATERS RESULTING FROM THE ROOT EXUDATION OF TWO NOTORIOUS WATER PLANTS, EICHHORNIA CRASSIPES (PONTEDERIACEAE) AND PISTIA STRATIOTES (ARACEAE).
Kiel Univ. (Germany, F.R.). Botanisches Inst.
A. Jedicke, B. Furch, U. Saint-Paul, and U. B. Schluter.
Amazoniana AMAZAP, Vol. 11, No. 1, p 53-69, 1989. 14 fig, 1 tab, 26 ref.

Descriptors: *Aquatic plants, *Floating plants, *Limnology, *Oxygen transfer, *Plant physiology, Amazon, Aquatic environment, Fish, Hypoxia, Photosynthesis, Roots, Tropical regions.

Qualitative and quantitative analyses were carried out to determine the amount of oxygen that enters the water through the root systems of two floating Neotropical plants, Eichhornia crassipes and Pistia stratiotes, under nearly anaerobic conditions. The physiological analyses were supplemented by anatomical investigations. A measurable oxygen input from both plants was detected: that from E. crassipes was 116 mg oxygen/h/sq m and from P. stratiotes, 58 mg oxygen/h/sq m. Water surface area represented 4 kg and 2.9 kg fresh weight, respectively. The oxygen input from E. crassipes seemed to be independent of the amount of photosynthesis, suggesting that a pressure ventilation was responsible for the input. In the case of P. stratiotes, a relationship was found between photosynthetic activity and the oxygen input. These floating plant species which are feared in many tropical ecosystems, because they can quickly cover the entire water surface in a very short time, can play important roles in their natural ecosystems, and the endemic ichthyofauna seems to be well adapted to their activities. (MacKeen-PTT)
W91-00822

NUTRIENT DYNAMICS OF DECOMPOSING LEAVES FROM AMAZONIAN FLOODPLAIN FOREST SPECIES IN WATER.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
K. Furch, W. J. Junk, and Z. E. S. Campos.
Amazoniana AMAZAP, Vol. 11, No. 1, p 91-116, 1989. 14 fig, 7 tab, 62 ref.

Descriptors: *Flood plains, *Forest ecosystems, *Leaves, *Litter, *Nutrient transport, *Nutrients, Amazon River, Calcium, Decomposition, Magnesium, Negro River, Nitrogen, Nutrient concentrations, Phosphorus, Potassium, Rivers, Sodium.

Decomposition experiments were performed in freshwater tanks using fresh leaves of four Amazonian tree species from blackwater and whitewater floodplain forests. Weight loss, loss of the major elements, Na, K, Mg, Ca, N and P from the leaves, and release of these elements into the water were studied during a four month period. Great nutrient loss (up to 89% of total) and dry weight loss (up to 86% of initial biomass) were observed from the nutrient rich leaves of three tree species from the Amazon River floodplain forest. The nutrient poor leaves of a common species from the Negro River floodplain forest decomposed much more slowly. A large portion of the total nutrients lost from the leaves (37-59%) was detected in the water in the form of inorganic ions. Based on the nutrient contents of fresh multispecies leaf litter and data on the shedding of this litter, nutrient inputs from leaves into bodies of blackwater and whitewater in the forests during flood period were calculated. The input of dissolved inorganic N, P and K may be as great or even greater than input from river water, indicating the importance of the floodplain forest as a nutrient pump from sediments into the water. (MacKeen-PTT)
W91-00824

SEASONAL, HYDROLOGICAL, AND LAND MANAGEMENT FACTORS CONTROLLING DISSOLVED ORGANIC CARBON CONCENTRATIONS IN THE LOCH FLEET CATCHMENTS, SOUTHWEST SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
I. C. Grieve.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 231-239, July/September 1990. 3 fig, 2 tab, 26 ref.

Descriptors: *Acid rain effects, *Catchment areas, *Dissolved organic carbon, *Environmental effects, *Forestry, *Liming, *Loch Fleet, *Scotland, *Water quality, *Watershed management, Flow discharge, Organic matter, Peat soils, Stream discharge, Watersheds.

As part of a program investigating the effects of forestry and catchment liming on streams in the Loch Fleet catchment in southwest Scotland, a large number of measurements of dissolved organic carbon (DOC) were made. The catchment covers an area of some 111 ha and the annual rainfall is 2150 mm. Soils are peats and peaty gleys over thin drift and granite bedrock. DOC was measured at hourly or two-hourly intervals during more than 30 events in one forested and two moorland subcatchments of the Loch Fleet catchment. The dominant peaty soils in the catchments resulted in small discharge-related DOC variations within individual events, with a maximum range of about 2 mg/l. At low discharges flow was probably from the basal peat horizon with consequently higher DOC and less variation with discharge. Seasonal variations were larger with an amplitude of 8-9 mg/l and maximum concentrations in the summer months. Variations can probably be explained by the effects of temperature on decomposition rates. The forested stream had the highest mean DOC, twice as large as the comparable moorland stream in the preliming phase. Applications of lime to the catchments increased stream DOC concentrations, with the largest increases in the moorland catchments. This increase may be due either to the lower Al concentrations and reduced precipitation of DOC within the stream, or to the role of higher pH and Ca in stimulating decomposition in the peaty soils. (Korn-PTT)
W91-00862

SPATIAL AND TEMPORAL VARIATION IN FISHES OF RIFFLE HABITATS: A COMPARISON OF ANALYTICAL APPROACHES FOR THE ROANOKE RIVER.
Oklahoma Univ., Kingston. Biological Station.
For primary bibliographic entry see Field 8I.
W91-00868

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM I. OCCURRENCE AND DISTRIBUTION WITH PARTICULAR REFERENCE TO THE DIATOMS.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
E. J. Cox.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 83, No. 4, p 525-552, 1990. 11 fig, 5 tab, 64 ref.

Descriptors: *Algae, *Aquatic habitats, *Diatoms, *Germany, *Stream biota, Acid streams, Ecological distribution, Epilithon, Microenvironment, Periphyton, Seasonal distribution, Seasonal variation, Spatial distribution.

Algal occurrence and distribution, with particular emphasis on the diatoms, were investigated over a 3 year period in a small, softwater upland stream (the Breitenbach). In contrast to most other diatom studies, the species analyses have largely been performed on live material, thus excluding errors introduced by the inwash of species which grew outside the sampling area. Different species dominated in contrasting habitats, e.g. epipelon, epilithon, epiphyton, the first being richest in species and showing the greatest variation over the year. Both species complement and abundance varied along the main part of the stream, while a spring region had a contrasting flora and demonstrated little seasonal periodicity. Although some species have clear seasonal maxima, the presence of many others seems more closely related to their microhabitat. One striking feature of the attached diatom flora is the absence of the almost ubiquitous Cocconeis. Although this species is designated alkaliphilous and is more common in alkaline, eutrophic waters, it grows over a pH range 6.2-9.0 and could therefore be expected in the Breitenach. Several other species common in the Breitenbach are also alkaliphilous or are found in more eutrophic waters so that neither low pH nor low oligotraphy can be invoked to explain the absence of Cocconeis. C. placentula was also found at different times of the year in upland streams in Sauerland. The algal floras in these streams were similar to those in the Breitenbach. However, it is possible that some, at present undetermined, chemical factor, whether limiting or inhibitory, prevents the growth of Cocconeis in the stream. Linked with, if not the cause of, difficulties in interpreting contradictory ecological preferences or responses, are questions of identification and species delimitation. (Hoskin-PTT)
W91-00869

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM II. ALGAL STANDING CROP (MEASURED BY CHLOROPHYLL-A) ON SOFT AND HARD SUBSTRATA.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
E. J. Cox.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 83, No. 4, p 553-566, 1990. 7 fig, 27 ref.

Descriptors: *Algae, *Aquatic habitats, *Chlorophyll a, *Stream biota, Artificial substrates, Chemical analysis, Ecological distribution, Epilithon, Microenvironment, Periphyton, Sandstones, Seasonal distribution, Seasonal variation, Spatial distribution.

Variation in the algal standing crop on different substrata in an upland stream was assessed using chlorophyll-a as a measure. Chlorophyll levels were considerably higher on soft sediments than on natural stones or sandstone tiles, and often approached levels recorded in lowland streams, estuarine or marine coastal habitats. After the flood period, spring and autumn peaks were observed on the epipelon in the middle reach of the stream. A dramatic reduction in chlorophyll levels occurred in March/April due to the spate. Seasonal fluctuations in standing crop were less obvious on natural stones, but spate discharge had a similarly drastic effect on the epilithon. In the spring region epilithic populations were less affected by flood while no clear effect was observed on the epipelon. The use of sandstone tiles as a hard substratum revealed that algal accumulation varied within and between sites, and with season. This was to some extent related to grazing pressure. (See also W91-00869 and W91-00871) (Author's abstract)
W91-00870

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM III. INTERACTION BETWEEN DISCHARGE, SEDIMENT COMPOSITION AND DIATOM FLORA.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
E. J. Cox.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 83, No. 4, p 567-584, 1990. 12 fig, 30 ref.

Descriptors: *Algae, *Aquatic habitats, *Diatoms, *Sediment analysis, *Stream biota, Ecological distribution, Epilithon, Periphyton, Seasonal distribution, Seasonal variation, Stream discharge.

Grain size analysis was carried out on dried sediments whose epipelic diatom floras had been previously investigated. Changes in the percentages of different particle fractions over a two year period were plotted and compared with changes in percentage abundance of different diatom genera, or groups of genera. Fluctuations in stream discharge were reflected in the relative proportions of coarser and finer sediment, and their relative stability of discharge in a spring region by a more constant, contrasting grain size distribution. Epipsammic and epilithic species were more abundant when the coarser sediment fraction was larger; epipelic Navicula and Nitzschia species increased on finer sediments. Different Navicula species showed contrasting occurrence patterns. The sediments probably act as nutrient traps which results in more eutrophic species on finer sediments. The activity of epipelic algae themselves also modifies the nature of the sediment, fostering more rapid accumulation of fine particles and contributing organic matter. (See also W91-00869 and W91-00870) (Author's abstract)
W91-00871

NON-LINEAR SYSTEM TO DESCRIBE MOVEMENTS OF WATER MASSES AT THE LG-2 RESERVOIR (LA GRANDE, QUEBEC).
Sherbrooke Univ. (Quebec). Dept. of Chemical Engineering.
M. De Broissia, B. Colin, B. Coupal, B. Marcos, and G. Payre.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 193-217, July 1990. 7 fig, 1 tab, 5 ref, append. FCAR no. E.Q. 2452.

Descriptors: *Dam effects, *Flow models, *Hydrologic models, *Limnology, *Model studies, *Quebec, *Reservoirs, Data analysis, Hydrodynamics, Mathematical models.

The movement of water masses in the 'La Grande' (P.Q.) LG-2 reservoir under various operating conditions is considered. Biological models were designed to represent a reservoir of the magnitude of LG-2 as an assemblage of several large homogeneous zones related at their boundaries by means of interzonal flows. The implementation of these models therefore requires knowledge of the flows corresponding to various scenarios, and the work performed provides a practical means of obtaining these quantities. The phenomena are essentially large scale, both in space (zones of several hundreds of square kilometers) and in time, the motion of water in the reservoir being generally slow. This is why average situations have been modeled, in defining various typical regimes, as well as exceptional transitory situations such as flooding periods of limited duration. The winter period during which the reservoir is covered by ice was not considered, nor was the influence of wind. This could have an influence on the movements of the surface, but limited to a period of 10 hours. The model was applied to 15 characteristic situations. For all simulations, the calculated velocities were relatively low, and the highest speeds were observed in the channel at the mouth of LG-3. Since the velocities were quite different, each simulation required two graphics; the first showed the gropu of velocities excluding those in the channel from LG-3; the second provided the velocities in the channel. The results were generally satisfactory. The Newton-Raphson algorithm chosen for solving the nonlinear system converged in all cases, in five iterations, and the speeds obtained were in first analysis, realistic. (Hoskin-PTT)
W91-00885

2I. Water In Plants

COMPARISON OF VESICULAR-ARBUSCULAR MYCORRHIZAE IN PLANTS FROM DISTURBED AND ADJACENT UNDISTURBED REGIONS OF A COASTAL SALT MARSH IN CLINTON, CONNECTICUT, USA.
Connecticut Univ., Storrs. Dept. of Ecology and Evolutionary Biology.
J. C. Cooke, and M. W. Lefor.
Environmental Management EMNGDC, Vol. 14, No. 1, p 131-137, January/February 1990. 7 fig, 1 tab, 47 ref.

Descriptors: *Coastal marshes, *Connecticut, *Marsh plants, *Salt marshes, *Soil fungi, *Wetlands, Cord grasses, Marsh management, Plant populations, Roots, Symbiosis, Vegetation establishment, Wetland restoration.

The association of rhizosphere microorganisms and host roots may be mutually beneficial and may also represent a mutual dependency. Roots of salt marsh plant species Spartina alterniflora, S. patens, Distichlis spicata, and others were examined for the presence of vesicular-arbuscular mycorrhizal (VAM) fungi. Samples were taken from introduced planted material in a salt marsh restoration project and from native material in adjacent marsh areas along the Indian River, Clinton, Connecticut. After ten years the replanted area still has sites devoid of vegetation. The salt marsh plants introduced there were devoid of VAM fungi, while high marsh species from the adjacent undisturbed region showed consistent infection, leading the authors to suggest that VAM fungal infection of planting stocks may be a factor in the success of marsh restoration. (Author's abstract)
W91-00029

EFFECTS OF THE DRY SEASON ON THE VEGETATION CANOPY OF SOME RIVER BASINS OF WEST AFRICA AS DEDUCED FROM NOAA-AVHRR DATA.
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
J. M. Gregoire.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 323-338, June 1990. 6 fig, 3 tab, 20 ref.

Descriptors: *Africa, *Canopy, *Radiometry, *Remote sensing, *River basins, *Vegetation, Evapotranspiration, Groundwater recharge, Hydrologic models, Infrared imagery, NOAA-AVHRR Imagery, Normalized Difference Vegetation Index, Rainfall-runoff relationships, Satellite technology, Seasonal variation, Sediment transport, Soil erosion.

The vegetation status was characterized over 13 river basins in the Sudanese area of West Africa using the Normalized Difference Vegetation Index (NDVI), computed from channels 1 and 2 of National Oceanographic and Atmospheric Administration Advanced Very-High-Resolution Radiometer (NOAA-AVHRR) imagery, and the radiometric behavior in the middle thermal infrared, channel 3. The frequency distribution of radiometric values, both NDVI and thermal infrared, within the watersheds clearly shows the effect of the dry season on the vegetation canopy. Thermal infrared data seem to be more efficient than NDVI data for characterizing changes in density and vigor of the vegetation canopy, at least at that stage in the year. Channel 1 of AVHRR, being very sensitive to atmospheric conditions, introduces a masking effect on the NDVI temporal behavior during the dry season. Depending on which climatological zone the river basins are in, they react in a specific way in terms of changes in the vegetation canopy status. Also radiometric behavior in the middle thermal infrared band, channel 3 of AVHRR, supplies information on bush fire activity. This process is one of the main agents of vegetation degradation in this part of the world. Here again, results show an evident ecological zoning. Low resolution satellite imagery can be highly efficient for the monitoring of vegetation response to seasonal factors on a regional scale. Vegetation dynamics or changes represent an indispensable set of data for hydrological modeling. They are input for: (a) rainfall-runoff models; (b) ground water recharge studies; and (c) evaluation of evapotranspiration, soil erosion and sediment transport. (Author's abstract)
W91-00410

COMPETITION AND COEXISTENCE IN SUBMERGED AQUATIC PLANT COMMUNITIES: THE EFFECTS OF SPECIES INTERACTIONS VERSUS ABIOTIC FACTORS.
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00423

VARIABILITY OF BIOGENIC SULFUR FLUX FROM A TEMPERATE SALT MARSH ON SHORT TIME AND SPACE SCALES.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
For primary bibliographic entry see Field 2L.
W91-00847

DEPLETION AND RECHARGE OF SOIL WATER IN TWO STANDS OF NORWAY SPRUCE (PICEA ABIES (L.) KARST).
Sveriges Lantbruksuniversitet, Umea. Dept. of Forest Site Research.
For primary bibliographic entry see Field 2G.
W91-00860

MONITORING SPATIAL VARIABILITY OF FOREST INTERCEPTION.
Montreal Univ. (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2D.
W91-00861

INTERCEPTION LOSS AND RAINFALL REDISTRIBUTION BY THREE SEMI-ARID GROWING SHRUBS IN NORTHEASTERN MEXICO.
Toronto Univ. (Ontario). Faculty of Forestry.
J. Navar, and R. Bryan.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 51-63, July 1990. 6 fig, 39 ref.

Descriptors: *Interception loss, *Plant physiology, *Rainfall distribution, *Semiarid lands, *Vegetation effects, Ecosystems, Semiarid climates, Simulated rainfall, Stemflow, Throughfall.

The role of interception and redistribution of rainfall in water resource management has been a major focus of attention for both temperate and tropical ecosystems. The information available has limited application to semi-arid ecosystems where only a few studies have been carried out. Interception loss and rainfall redistribution were measured in individual shrubs of Diospyrus texana, Acacia farnesiana and Prosopis laevigata from a semi-arid vegetal community in northeastern Mexico in the summer of 1987. In this period 230 mm of precipitation were recorded from 17 storms. Net precipitation averaged 167.6 mm, of which throughfall formed 160.5 and stemflow 7.1 mm. Interception loss was 27.2% of the total gross precipitation. Significant differences in stemflow were noted both among species and within the species D. texana. Stemflow inputs averaged 321 and 115 ml/min for a 40 mm/h simulated storm for the species D. texana and A. farnesiana-P. laevigata, respectively. The theoretical areas and distances over which stemflow spread averaged 0.320 square meters and 0.115 square meters and 0.30 and 0.15 m, respectively. These areas were calculated to receive 3030 and 2650 mm as annual precipitation. (Author's abstract)
W91-00878

EVAPORATION FROM DAMPLAND VEGETATION ON A GROUNDWATER MOUND.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2D.
W91-00879

GROUNDWATER RESPONSE TO REFORESTATION IN THE DARLING RANGE OF WESTERN AUSTRALIA.
Water Authority of Western Australia, Perth.
For primary bibliographic entry see Field 2F.
W91-00892

2J. Erosion and Sedimentation

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM. XIX. SUSPENDED-MATTER SEDIMENTATION.
Polish Academy of Sciences, Krakow. Zaklad Ochrony Przyrody i Zasobow Naturalnych.
For primary bibliographic entry see Field 2H.
W91-00005

LOCAL SCOUR PROFILES DOWNSTREAM OF HYDRAULIC JUMP.
Ministry of Energy, Tehran (Iran).
For primary bibliographic entry see Field 8B.
W91-00032

DEPTH-INTEGRATED MODEL FOR SUSPENDED SEDIMENT TRANSPORT.
Technische Hogeschool Delft (Netherlands).
G. Galappatti, and C. B. Vreugdenhil.
Journal of Hydraulic Research JHYRAF, Vol. 23, No. 4, p 359-377, 1985. 8 fig, 6 ref, append.

Descriptors: *Mathematical models, *Model studies, *Nonuniform flow, *Sediment transport, *Suspended sediments, *Unsteady flow, Entrainment, Hydrodynamics, Mass balance, Mathematical studies, Model testing.

A model for suspended-sediment transport in unsteady and non-uniform flow was derived. In this model, the vertical dimension was eliminated by means of an asymptotic solution. The resulting depth-integrated model was tested for unidirectional flow cases. If the mass-balance equation is depth averaged, the process of vertical readjustment of concentration profiles, arguably the most important mechanism involved, is obscured and replaced by an empirical or semi-empirical entrainment function. The verification of an entrainment function usually has to be done indirectly. Thus, there was a need to develop other approximate solutions for the mass-balance equation based on more explicit, easily-verifiable assumptions. The adjustment of the concentration distribution was formulated in terms of similarity profiles, including the deviation from local equilibrium. The coefficients of the similarity profiles depend on the depth-averaged concentration and its horizontal derivatives. Thus, for a vertically two-dimensional situation, the equations to be solved were reduced to one-dimensional. The resulting model can be used together with the depth-averaged hydrodynamic equations in large regions. It is believed that this solution will allow the gap between the depth-averaged solutions and the full two-dimensional solutions to be bridged. The asymptotic approach yields equations that can be written in terms of depth-averaged quantities and has the potential for extension to a third dimension. This model could not be verified extensively, but a comparison with a full two-dimensional approach indicated that reasonable results were obtained. A reasonably-successful indirect test was done by reproducing an experiment for the siltation of a trench. (Stoehr-PTT)
W91-00033

CONCENTRATION OF VERY FINE SILTS IN A STEADY VORTEX.
Colorado State Univ., Fort Collins.
P. Y. Julien.
Journal of Hydraulic Research JHYRAF, Vol. 24, No. 4, p 255-264, 1986. 5 fig, 11 ref.

Descriptors: *Particle size, *Sediment concentration, *Sediment transport, *Silt, *Suspended sediments, *Vortices, Diffusion, Fluid mechanics, Hydraulics, Particulate matter, Sediment sorting.

The presence of fine sediment particles in a steady horizontal vortex was examined theoretically and experimentally. Starting from an homogeneous mixture, particles denser than the surrounding fluid are moved outside of the vortex core by centrifugal action. As a sediment concentration gradient gradually builds up across the vortex, a diffusive flux opposite to the centrifugal flux is induced. Equilibrium is reached when the two fluxes are equal. Under steady state conditions, the sediment concentration profiles of fine particles in suspension were theoretically derived and plotted using dimensionless scales. Preliminary experiments verified the theoretical profiles. Experimental evidence supports the assumption that the diffusion coefficient remains constant throughout the vortex. (Author's abstract)
W91-00035

GEOCHEMICAL STUDY OF SEDIMENT CONTAMINATION IN NEW BEDFORD HARBOR, MASSACHUSETTS.
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W91-00043

GEOMORPHOLOGICAL EFFECTS OF CATASTROPHIC FLOODING ON A SMALL SUBTROPICAL ESTUARY.
Council for Scientific and Industrial Research, Congella (South Africa). Estuaries and Coastal Processes Programme.
J. A. G. Cooper, T. R. Mason, J. S. V. Reddering, and W. K. Illenberger.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 1, p 25-41, February 1990. 9 fig, 3 tab, 42 ref.

Descriptors: *Estuaries, *Geomorphology, *Historic floods, *Sediment erosion, *Sedimentation, *Subtropic zone, Annual floods, Bed load, Sediment transport, South Africa, Tidal prism.

The Mgeni Estuary is situated on the east coast of South Africa. Tidal salinity changes commonly extend 2.5 km upstream from the mouth. The subtropical climatic regime causes seasonal flooding, the geomorphological effects of which are increased by a steep river gradient. A 120-150 year flood event during September 1987, with an estimated peak discharge of 10800 cumecs, resulted in the erosion of 1.86 million cu m of sediment from the estuary. The normal high tide volume of the estuary (0.35 million cu m) increased to 1.85 million cu m after the flood. The post flood intertidal volume (tidal prism) of the estuary was 0.43 million cu m compared to 0.19 million cu m before the event. The nature and extent of the erosion in the estuary was controlled by the composition of the estuary banks and bed material. Gravel and sand substrates were preferentially eroded from the estuary bed before the cohesive bank materials were undercut in sections of the estuary. Mud and fine sand were deposited on overbank areas when the flood waned and a lag of coarse sand and gravel was produced on the estuary bed. Approximately 46% of the bedload sediment supplied to the estuary since 1917 was retained in the estuary until the 1987 flood. The remainder was transported through the system and into the Indian Ocean. Results show that catastrophic floods play an important role in sedimentation in small estuaries. (Author's abstract)
W91-00049

EXPERIMENTAL STUDY OF COMPLEX RESPONSE IN RIVER CHANNEL ADJUSTMENT DOWNSTREAM FROM A RESERVOIR.
Academia Sinica, Beijing (China). Inst. of Geography.
J. Xu.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 1, p 43-53, February 1990. 5 fig, 9 ref.

Descriptors: *Channel morphology, *Channel stability, *Dam effects, *Geomorphology, *River forecasting, *River mechanics, Boundary conditions, Equilibrium, River systems, Sediment discharge.

An experimental study is described which attempts to reveal the complex response process of river channel adjustment downstream from a reservoir. A descriptive model was established which identifies three adjustment stages. In stage I following the change of water and sediment input, the width-depth ratio of the river channel (w/d) and the river channel gradient (s) both decrease, but the river channel sinuosity (r) increases. In stage II, because of feedback from the changing boundary conditions, w/d starts to increase, r decreases, and the rate of gradient decrease becomes very slow. In stage III, equilibrium is reestablished, w/d, r, and s tend toward constant values, and the system recovers its stable state. (Author's abstract)
W91-00050

BED FORM RESISTANCES IN OPEN CHANNEL FLOWS.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00063

DIMENSIONLESS ANALYTICAL SOLUTIONS FOR DAM-BREACH EROSION.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W91-00069

ONE-DIMENSIONAL MODEL FOR THE TRANSPORT OF A SEDIMENT MIXTURE IN NON-EQUILIBRIUM CONDITIONS.
Trento Univ. (Italy).
A. Armanini, and G. di Silvio.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 3, p 275-292, 1988. 4 fig, 27 ref.

Descriptors: *Bed load, *Erosion rates, *Mathematical models, *Model studies, *Sediment transport, *Suspended load, Sedimentation, Streamflow.

The numerical simulation of erosion-deposition processes in rivers presents a number of problems of a conceptual nature, including the differences in behavior of bedload and suspended load. Non-stationary one-dimensional continuity equations of each granulometric class of sediments were written for the water stream (suspended transport), the bottom layer (bedload transport), and the mixing layer below the bottom surface. Proper closure equations were introduced to express the transversal sediment fluxes between these three layers, accounting for the different adaptation length of each grain size class. The model is able to address the lag between the suspended transport and the transport capacity of the stream, as well as the lag between the actual grainsize composition of the streambed and the streambed composition when equilibrium with the transport is attained. A number of examples are given, showing the importance of non-equilibrium for non-uniform particles in erosion-deposition processes at a short time scale. (Author's abstract)
W91-00070

WATER WAVES GENERATED BY DISTANT LANDSLIDES.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W91-00071

COMPREHENSIVE GENERALIZED STUDY OF SCOUR AT CANTILEVERED PIPE OUTLETS.
Agricultural Research Service, Stillwater, OK. Water Conservation Structures Lab.
For primary bibliographic entry see Field 8B.
W91-00072

CONVERSION OF BRAIDED GRAVEL-BED RIVERS TO SINGLE-THREAD CHANNELS OF EQUIVALENT TRANSPORT CAPACITY.
Canterbury Regional Council, Christchurch (New Zealand).
G. A. Griffiths.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 63-75, 1989. 4 fig, 1 tab, 27 ref.

Descriptors: *Bed load, *Braided streams, *Channel morphology, *Erosion rates, *Mathematical

models, *River training, *Sediment transport, *Streamflow, Channel flow, Mannings equation, Sedimentation.

A set of design equations was developed for determining the characteristics of a single-thread gravel-bed channel equivalent in water and bedload transport capacity to a given braided gravel-bed river or stream. The main components of the set are the Meyer-Peter and Muller formula for bedload transport and the Manning formula for flow resistance. In the specification of the design problem, water discharge and sediment size are always assumed known in the single-thread channel along with at least two of width, depth, bedslope, gravel discharge and resistance coefficient. For design cases the set was shown to replicate the behavior of small-scale braided sand-bed streams with steady flow, as well as producing results and predictions in accord with field observations on braided gravel-bed rivers. A procedure is illustrated for a braided to single-thread conversion in natural rivers where water and gravel discharges vary with time. It is founded on the assumption of equivalence of transported load over time, that is, reaches in a braided state, when converted to a single-thread state, discharge similar gravel loads over periods of 5-10 yr or longer. As a corollary the method provides a starting point for theoretical analysis of changes in channel sediment storage in gravel-bed rivers. (Author's abstract)
W91-00078

RECONSTRUCTION OF THE RECENT FLOW HISTORY OF A BRAIDED GRAVEL RIVER.
Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-00079

STREAM-CHANNEL INCISION FOLLOWING DRAINAGE-BASIN URBANIZATION.
King County Basin Planning, Seattle, WA.
For primary bibliographic entry see Field 4C.
W91-00082

STORMFLOW AND SEDIMENT LOSS FROM INTENSIVELY MANAGED FOREST WATERSHEDS IN EAST TEXAS.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 4C.
W91-00087

TEMPORAL LAG EFFECT IN BED LOAD SEDIMENT TRANSPORT.
Willing and Partners, Canberra (Australia).
B. C. Phillips, and A. J. Sutherland.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 5-23, 1990. 7 fig, 3 tab, 30 ref, append.

Descriptors: *Bed load, *Model studies, *Sediment transport, *Streamflow, *Temporal lag, Floods, Sediment-carrying capacity, Streambeds.

Temporal lag effects, which are viewed as the inability of an alluvial system to respond immediately to changing flow conditions, were investigated under bed load sediment transport conditions. A temporal lag model was formulated from an analysis of the derived bed load transport rated from a series of instantaneous stepped flow non-equilibrium transport experiments. The temporal response of the alluvial system was characterized by a single variable, the equivalent steady flow rate. An impulse model was then used to develop a general temporal solution. The performance of the temporal lag model was tested by comparing measured and predicted flow depths and sediment yields from four series of inclined stepped discharge non-equilibrium transport experiments. A comparison of measured and predicted sediment hydrographs and sediment yields for three triangular flood waves was undertaken and it was concluded from both series of comparisons that the temporal lag model was well able to predict the temporal variation of bed roughness and sediment transport capacity under nonsteady flow conditions. (Mertz-PTT)
W91-00093

PREDICTION OF ENTRAINMENT CONDITIONS FOR NONUNIFORM, NONCOHESIVE SEDIMENTS.
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
C. S. James.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 25-41, 1990. 5 fig, 1 tab, 52 ref.

Descriptors: *Bed load, *Entrainment, *Model studies, *Sediment transport, Computer models, Sediment analysis, Sediment distribution, Sediments, Streamflow, Tractive forces.

The entrainment of sediment particles by flowing water is a very important process in sediment dynamics. Many sediment transport models are expressed in terms of a critical value of boundary shear stress at which particles are just able to move. Reliable application of these models depends on accurate specification of this critical shear stress. Results are not useful, however, where sediments are nonuniform and the behavior of particles with distinct size, shape or density characteristics in the mixture need to be described. A general model was established for predicting entrainment conditions for nonuniform, noncohesive sediments. The model is based on an analysis of the moments of forces acting on a particle at the condition of incipient motion. Particle geometry and packing arrangement are accounted for as well as variations of near bed flow velocity and drag and lift coefficients for a wide range of flow conditions. Model predictions agree well with laboratory and field measurements for uniform sediments and for protrusion and relative size effects. (Mertz-PTT)
W91-00094

INFLUENCE OF SAND OR GRAVEL ON THE EROSION OF COHESIVE SEDIMENT.
Queen's Univ., Kingston (Ontario).
J. W. Kamphuis.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 43-53, 1990. 9 fig, 2 tab, 13 ref.

Descriptors: *Channel erosion, *Cohesive sediments, *Erosion, *Stream erosion, Bottom sediments, Canada, Clays, Erosion rates, Gravel, Lake Erie, River sediments, Sand, Sediment transport, Sediments, Streambeds, Streamflow.

The erosion of consolidated cohesive sediments which make up some river beds and shorelines has long been considered a complex process, involving the structural as well as the physicochemical properties of the eroding cohesive sediment. Three disparate examples were studied in the field and the laboratory, these included: (1) The construction of artificial islands in the Mackenzie River at Norman Wells in the Canadian Northwest Territories. These islands were constructed on a river bottom, consisting of a consolidated clay material and could be subjected to currents of up to 5 m/sec, resulting from ice jam release in spring; (2) The North Shore of Lake Erie consists of eroding glacial till bluffs. An extensive study was initiated to determine what influences the rate of erosion of such a shoreline; and (3) Four series of tests were performed on undisturbed samples of lacustrine clays found at four Ontario bridge crossing sites. It was found that the erosion of consolidated cohesive soils is very much a function of the transport properties of even sparse amounts of granular material overlying the cohesive soil or carried by the eroding stream. Since erosion of consolidated cohesive sediments by clear water is a complex function of the characteristics of the cohesive sediment and not readily understood, while sediment transport of granular material is relatively much better known, this concept greatly simplifies understanding of erosion of a cohesive bed. (Mertz-PTT)
W91-00095

WEAKLY DEPOSITING TURBIDITY CURRENT ON A SMALL SLOPE.
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
S. Altinakar, W. H. Graf, and E. J. Hopfinger.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 55-80, 1990. 18 fig, 1 tab, 25 ref.

Descriptors: *Sedimentation, *Turbidity currents, *Water currents, Gravity currents, Salinity currents, Sedimentation effects, Sedimentation rates, Sediments, Streamflow.

Turbidity currents are defined as gravity currents, where the denser phase contains settling granular material. The influence of a small slope and weak sedimentation on the behavior of non-conservative turbidity current heads were experimentally investigated. Experiments were carried out on a slope ranging between 0-2.1 degrees with two different sediments to get a reasonably wide range of the ratio of fall velocity of particles to the velocity of the head. The limiting case when the fall velocity of particles equals 0 (conservative gravity current) was investigated by a series of saline gravity current experiments. The importance of sedimentation on the head behavior was demonstrated by plotting the variation of the head velocity against the slope, for different current types. By showing that a relative submergence ratio, varying along the flume causes a slight increase in the head velocity for saline gravity currents, attention is drawn to a possible scale effect in laboratory modelling of the gravity current phenomena, which is often neglected. The experimental data showed that the downslope head growth rate is increased by sedimentation. Since the Reynolds numbers are sufficiently high, the dimensionless nose heights fluctuate about 0.14. (Mertz-PTT)
W91-00096

DESIGN OF SETTLING BASINS.
Indira Gandhi National Open Univ., New Delhi (India).
R. J. Garde, K. G. Ranga Raju, and A. W. R. Sujudi.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 81-91, 1990. 9 fig, 1 tab, 9 ref.

Descriptors: *Canals, *Sediment-carrying capacity, *Settling basins, Canal design, Channel flow, Flow pattern, Sediment discharge, Sedimentation, Sediments, Streamflow.

It is an accepted practice in canal design that sediment in excess of the carrying capacity is either excluded at the head works or ejected from the canal little downstream from the head. The settling basin is a popular type of ejector which is well suited for the removal of fine material. Experiments were carried out in the laboratory concerning the efficiency of settling basins. Experiments were conducted for subcritical flow under steady conditions. The rate of injection of material as sediment load for all the runs was ensured to be equal to or less than the capacity of the channel to transport sediment. The limit was also checked visually while conducting the experiments by ensuring that significant deposition of sediment did not occur along the channel reach. The data indicated that the existing methods of settling basin design are not satisfactory. Analysis of all the available data has led to a new relationship for the efficiency. The parameters length of settling basin/depth of flow in the settling basin and fall velocity of the sediment in clear water/shear velocity in the settling basin, were found to govern the efficiency. (Mertz-PTT)
W91-00097

STATISTICAL ZONATION OF SEDIMENT SAMPLES USING RATIO MATCHING AND CLUSTER ANALYSIS.
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
D. J. Poulton.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 379-404, November 1989. 6 fig, 9 tab, 15 ref.

Descriptors: *Chemical stratification, *Cluster analysis, *Path of pollutants, *Port Hope, *Sediment contamination, *Statistical analysis, Canada, Great Lakes, Hamilton Harbor, Lake sediments,

Pollution load, Statistical methods, Water pollution sources.

Contaminants in sediments have long been recognized as a significant problem in polluted areas, such as Areas of Concern in the Great Lakes. Full problem definition in any polluted area thus requires a knowledge of the role of sediments as a component in the overall ecosystem. A zonation technique for sediment samples based upon contaminant ratios of a series of samples utilizes the statistical technique of ratio matching. The technique is based on the fact that sediment samples of common origin will tend to have similar ratios of concentrations of trace pollutants such as heavy metals and PCBs, despite dilution by variable amounts of inert materials such as silica or calcite. Comparisons of these ratios between individual samples yields a matrix of similarity coefficients, which are then analyzed by a hierarchical agglomerative cluster analysis procedure, which uses average linkage and complete linkage clustering methods. Sediment samples of similar origin will tend to group together in a single cluster, whereas samples influenced by unique factors such as a transport pattern or proximity to point source discharges will appear as separate individual clusters. The results of application of this methodology to Great Lakes samples from Hamilton Harbour and Port Hope document the value of the method in defining uniquely impacted zones in contaminated areas. The Hamilton Harbour data are characterized by one large cluster representative of all stations in the main basin of the harbor plus several other clusters representing areas impacted by point sources or exchange with Lake Ontario and Cootes Paradise. The Port Hope data produced clusters representative of the depositional environment of the turning basin, the transitional environment of the river and west slip, and the high energy nearshore zone, plus a cluster showing the impact of the major cooling water discharge for the Eldorado uranium refinery. (Tappert-PTT)
W91-00137

MENU OF COUPLED VELOCITY AND SEDIMENT-DISCHARGE RELATIONS FOR RIVERS.
Pima County Dept. of Transportation and Flood Control, Tucson, AZ.
M. F. Karim, and J. F. Kennedy.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 8, p 978-996, August 1990. 2 fig, 4 tab, 34 ref.

Descriptors: *Channel morphology, *Computer models, *Flow velocity, *Hydraulic engineering, *Model studies, *Sediment discharge, *Sediment transport, Channel improvement, Numerical analysis, Regression analysis, River beds, Water depth.

Nowhere in the field of hydraulics have computers' impacts been more evident and pervasive than in river engineering, and in particular in the prediction via numerical simulation of long-term, large-distance responses of alluvial rivers to alterations of their channels, or of their hydrologic or sediment-transport regimes. Nonlinear multiple-regression analysis was used to derive relations among the velocity, sediment discharge, bed-form geometry, and friction factor of alluvial rivers. A data base comprising 339 river flows and 608 flume flows was used in this analysis. A hierarchy of formulations involving progressively more interdependencies among velocity, depth, sediment discharge, and bed-form geometry was developed. Procedures have been devised for computing velocity-rating and sediment-rating curves, and for preparing depth-discharge relations for streams with strongly discontinuous rating curves. Rating curves were calculated for four rivers, and computed depths and velocities for two others. The accuracies of the different methods were evaluated in terms of the mean normalized errors of predicted friction factors, depths, velocities, and sediment discharges. It was concluded that these formulations yield velocity-rating and sediment-rating curves that are as reliable as is permitted by the accuracy of the available data, which is limited by, among other things, the inherent short-term temporal variability of streamflow properties. (Author's abstract)
W91-00149

DESIGN OF STABLE ALLUVIAL CHANNELS.
Kuwait Inst. for Scientific Research, Safat. Hydraulics and Coastal Engineering Group.
M. M. Abou-Seida, and M. Saleh.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 4, p 433-446, 1987. 6 fig, 3 tab, 6 ref.

Descriptors: *Alluvial channels, *Canal design, *Channel morphology, *Channel stability, *Hydraulic engineering, *Model studies, *Sediment transport, Channel flow, Channel scour, Computer models, Flow resistance, Model testing.

For a channel in an alluvial material, stable conditions are achieved through the adjustment of three factors: channel width, channel depth, and channel slope. The three factors, to each of which nature gives definite equilibrium values to suit definite imposed conditions, require three equations. The imposed conditions are the rate of flow and the rate of sediment transport to be carried through the channel. The channel is considered stable if the sediment admitted to it is sufficient to balance the scour due to the bed movement. Two equations are available by means of which the proper dimensions of a stable channel can be obtained together with the channel longitudinal slope; the Liu-Hwang flow resistance equation was coupled with the Einstein-Brown sediment transport expression to develop the live-bed concept/model. The model was developed to predict the bed width, water depth, and longitudinal slope for an alluvial channel for a pre-assigned water flow, sediment discharge, median diameter of bed particles, and temperature. This model was verified using field data from Pakistan, India, the United States, and Egypt. A computer program was developed to facilitate the calculation procedure; limitations for flow regime and the shape factor were imposed to render the design to practical conditions. (Fish-PTT)
W91-00154

LONGSHORE-TRANSPORT MODEL FOR SOUTH INDIAN AND SRI LANKAN COASTS.
National Inst. of Oceanography, Panaji (India).
For primary bibliographic entry see Field 2L.
W91-00176

2-D BED EVOLUTION IN NATURAL WATERCOURSES: NEW SIMULATION APPROACH.
Energoprojekt, Belgrade (Yugoslavia).
M. Spasojevic, and F. M. Holly.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 116, No. 4, p 425-443, July/August 1990. 7 fig, 27 ref. U.S. National Science Foundation Grant MSM-85-166.

Descriptors: *Alluvial channels, *Bed load, *Channel morphology, *Model studies, *Natural watercourses, *Sediment transport, *Unsteady flow, Coastal waters, Coasts, Computer models, Estuaries, Finite difference methods, Iowa, Mathematical models, Reservoirs, Simulation analysis, Suspended load.

A new mathematical formulation was established for two-dimensional (plan view) unsteady water flow, sediment transport, and bed evolution in natural watercourses such as reservoirs, estuaries, and coastal waters, where depth averaging is appropriate. Sediment mixtures in natural watercourses were represented through a suitable, and unlimited, number of discrete size classes, any of which may be subject to either suspended load or bed load transport (or both) depending on prevailing local hydraulic conditions. Governing equations for water and sediment were transformed (completely) into curvilinear coordinates and then depth-averaged, when appropriate. The system of governing sediment equations at a computational point was solved in a new implicit, finite difference, fully coupled manner. Furthermore, the sediment equations were coupled with the water flow in an iterative manner in order to account for the feedback between the flow field and changes in both bed elevation and bed-surface size distribution. The mathematical formulation and associated numerical solution, incorporated into the new MOBED2 computational code, were tested through simulation of mobile-bed dynamics in the Coralville Reservoir on the Iowa River, Iowa. Initial proof-of-concept tests confirm the feasibility of the new approach by reproducing the proper qualitative behavior of the overall modeling concept. (Author's abstract)
W91-00177

SEDIMENT AND THE ENVIRONMENT.
Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. 218p. Edited by R. F. Hadley, and E. D. Ongley.

Descriptors: *Agricultural runoff, *Erosion control, *Path of pollutants, *Sediment transport, *Sediments, *Water pollution sources, Construction, Drainage, Mining, Nonpoint pollution sources, Sediment analysis, Sediment contamination, Simulation analysis, Waste disposal.

The proceedings of a symposium on sediment and the environment held in Baltimore, Maryland on 17-18 May 1989 are presented. The symposium was part of the Third Scientific Assembly of the Association of Hydrological Sciences (IAHS) and was organized by the IAHS International Commission on Continental Erosion. The papers in this volume are divided into four categories: (1) sediment-associated transport of contaminants in nonpoint pollution and impacts on hydrologic systems (12 papers); (2) erosion control for mining, construction, and waste disposal activities (4 papers); (3) time lag in the movement of sediments through drainage networks (four papers); and (4) modelling of agricultural runoff pollution and physical habitat simulation (3 papers). (See W91-00281 thru W91-00303) (MacKeen-PTT)
W91-00280

NITROGEN AND PHOSPHORUS IN ERODED SEDIMENT FROM CORN AND SOYBEAN TILLAGE SYSTEMS.
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W91-00281

ROLE OF SEDIMENT IN METOLACHLOR TRANSPORT FROM AGRICULTURAL FIELDS.
Trent Univ., Peterborough (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W91-00282

TRANSPORT OF MINE TAILINGS AS SUSPENDED SEDIMENT IN THE BELLE FOURCHE RIVER, WEST-CENTRAL SOUTH DAKOTA, USA.
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-00283

RATE OF SEDIMENTATION AND GEOCHEMISTRY OF SOUTHEASTERN HUDSON BAY, CANADA.
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
G. Biksham, and B. d'Anglejan.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p. 27-36, 2 fig, 7 tab, 15 ref.

Descriptors: *Geochemistry, *Sediment analysis, *Sedimentation rates, *Suspended sediments, Canada, Carbon, Hudson Bay, Nitrogen, Seasonal variation, Sediment transport, Silica, Silicon.

Suspended particulate matter (SPM) of Hudson Bay was estimated by collecting 60 samples at

three stations and four different depths. The mean SPM in the study area was 0.642 mg/L. The sediments collected in traps indicated that the rate of accumulation increased with depth. Seasonal variation provided a rate that was 2 to 4 times higher during the month of May. The rate of sedimentation estimated by Pb-210 data was 51 to 63 mm/100 yr, which is in general agreement with the trap data. Carbon and nitrogen together constituted more than 50% of SPM. In the trap sediments, carbon ranged from 17 to 38% and nitrogen from 1.6 to 6.3%. In underlying sediments, the carbon was very uniform at a mean 1.96% of total, of which more than 85% was in the organic fraction. Elemental analysis on core sediments showed uniform bulk chemistry. High Si/Al ratio indicated that the source of sediments to the Bay may include other than fluvial transport. The amorphous silica content in the sediments ranged from 0.77 to 2.36%, which is 2 to 8% of total silica; in trap sediments amorphous silica content was more than 6%. Size studies indicated the breakdown of SPM, resulting in collection of relatively more fine sediments in the deeper traps. A gradual increase of sand fraction in the last 1000 years indicates a change in supply of the sediments to the Hudson Bay. (See also W91-00280) (Author's abstract)
W91-00284

SEDIMENT-ASSOCIATED TRANSPORT AND REDISTRIBUTION OF CHERNOBYL FALLOUT RADIONUCLIDES.
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W91-00285

CROSS-SECTIONAL VARIABILITY IN SUSPENDED SEDIMENT AND ASSOCIATED TRACE ELEMENT CONCENTRATIONS IN SELECTED RIVERS IN THE US.
Geological Survey, Denver, CO. Water Resources Div.
A. J. Horowitz, F. A. Rinella, P. Lamothe, T. L. Miller, and T. K. Edwards.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 57-66, 4 tab, 7 ref.

Descriptors: *River sediments, *Sampling, *Sediment analysis, *Sediment chemistry, *Sediment sampler, *Suspended sediments, *Trace elements, Arkansas River, Colorado, Cowlitz River, Cross-sections, Emission spectrometry, Kelso, Portland, Sediment concentration, Variability, Washington.

Suspended sediment samples from the Arkansas River at Portland, Co and Cowlitz River at Kelso, WA were analyzed for physical and chemical properties. Particle surface area and suspended sediment concentration were determined for each sample; trace metal concentrations were measured by direct-reading emission spectrometry. The results indicated that there were substantial differences in suspended sediment concentrations and possibly in some associated trace element concentrations depending on whether depth-integrated, point, or pumping samplers were used. In addition, the data from time-series, depth-integrated sampling indicated that there were substantial short-term (on the order of 30 min) spatial variations in suspended sediment concentrations. Despite this, major element concentrations were remarkably stable spatially and temporally. Trace element concentrations were stable; however, occasional spatial and temporal variations may occur. (See also W91-00280) (MacKeen-PTT)
W91-00287

CROPPING SYSTEMS EFFECTS ON RUNOFF, EROSION, WATER QUALITY, AND PROPERTIES OF A SAVANNA SOIL AT ILORIN, NIGERIA.
Ohio State Univ., Columbus. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W91-00288

SOIL EROSION AND FLOODPLAIN SOIL POLLUTION: RELATED PROBLEMS IN THE GEOGRAPHICAL CONTEXT OF A RIVER BASIN.
Utrecht Rijksuniversiteit (Netherlands). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W91-00289

CASE STUDY OF APPROACHES FOR DETERMINING DIFFUSE SUSPENDED SEDIMENT SOURCES AND PROCESSES.
Alberta Research Council, Edmonton. Resource Technologies Dept.
H. R. Hudson.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 85-94, 1 fig, 6 ref.

Descriptors: *Data acquisition, *Sediment analysis, *Sediment transport, *Sediment yield, *Suspended sediments, Aerial photography, Alberta, Analytical methods, Canada, Erosion, Oldman River, River sediments.

Methods of differentiating sources and processes governing suspended sediment transport in the 4400 square km Upper Oldman River basin, southwest Alberta, were evaluated. Long term records showed that the average annual suspended sediment yield of 275,000 tons was largely transported in a period of days during the spring freshet. The majority of this material is thought to be derived from channel and near channel (riparian) sources from a short reach of the river in the Cardston Plains. Sediment sources and process interferences were determined in a static approach by (a) reconnaissance survey of sediment sources (aerial photograph interpretation and site surveys); (b) quantification of sediment sources (sediment budgets for sub-basins and erosional volume estimates of selected sites from sequential aerial photos); and (c) examination of spatial variations in sediment attributes (size distribution, lithology, cesium content). A combination of these approaches is required to obtain a reasonable assessment of the sediment sources and processes. (See also W91-00280) (Author's abstract)
W91-00290

FLOCCULATION OF SUSPENDED SOLIDS IN SOUTHERN ONTARIO RIVERS.
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
I. G. Droppo, and E. D. Ongley.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 95-103, 3 fig, 15 ref.

Descriptors: *Flocculation, *Path of pollutants, *Rivers, *Sampling, *Sediment analysis, *Suspended solids, Analytical methods, Bacteria, Canada, Microscopy, Oakville Sixteen Mile Creek, Ontario, Storms.

Suspended solids play a primary role in fluvial transport of hydrophobic contaminants. Evidence suggests that in many rivers primary particles are frequently transported as flocs within the aquatic medium. The changes in floc size and shape between two sampling sites during the summer low flow period and in a storm event were examined for the Oakville Sixteen Mile Creek in southern Ontario, Canada. Samples were collected directly in settling chambers and flocs were analyzed by microscopy, photography and digitization. Bacteria associated with flocs were quantitated by epifluorescent microscopy after 1.0 micrometer filtration. While there were fewer flocs than primary particles in suspension (flocs composed 10-27% of the total number of particles), the flocs comprised 92-98% of the total suspended solid volume. There was no significant difference in floc size between sampling sites, one of which was in a rural, forested area and the other in the harbor of an urban area. Mean floc area decreased from 173.5 sq micrometers during a dry period to 94.97 sq micrometers after a high intensity rainstorm of 45 minutes followed by light rain. It was concluded that while the digitizing method has some limitations, especially for grain size distributions, it is useful in evaluating physical and biological controls over flocculation. (See also W91-00280) (MacKeen-PTT)
W91-00291

HYSTERESIS AND NONLINEARITY OF DISCHARGE-SEDIMENT RELATIONSHIPS IN THE ATCHAFALAYA AND LOWER MISSISSIPPI RIVERS.
Louisiana Geological Survey, Baton Rouge. Coastal Geology Section.
J. Mossa.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 105-112, 3 fig, 1 tab, 15 ref.

Descriptors: *Atchafalaya River, *Data interpretation, *Flow discharge, *Hysteresis, *Mississippi River, *River sediments, *Sediment transport, *Statistical analysis, Discharge measurement, Louisiana, Regression analysis, Sand, Sediment analysis, Sediment concentration, Silt-clay, Suspended sediments.

The Atchafalaya and lower Mississippi Rivers in south Louisiana are two of the largest rivers in the United States and are an important source of fresh water and sediment for the Louisiana coastal zone. The physical relationships between discharge and sediment in these rivers were examined by linear least squares regression analysis of discharge versus sediment characteristic (concentration, sand concentration, silt-clay concentration, suspended sediment load and percentage sand). Several relationships between discharge and sediment in the Atchafalaya and Mississippi Rivers emerged: (1) hysteresis effects were pronounced, especially during high discharge years where the sediment concentration and load maxima preceded discharge maxima by several months and showed decreased sediment concentrations by the time discharge peaks; (2) the silt-clay and sand components of the suspended sediment operated distinctively; (3) the total suspended sediment concentration and the suspended silt-clay concentration followed quadratic power relationships; and (4) downstream differences in discharge-sediment relationships existed. (See also W91-00280) (MacKeen-PTT)
W91-00292

PLACER MINING OPERATIONS AND MODIFICATIONS OF THE PHYSICAL CHEMICAL NATURE OF THE WATERS OF THE RIO KAKA DRAINAGE BASIN (ANDES, BOLIVIA).
Office de la Recherche Scientifique et Technique Outre-Mer, La Paz (Bolivia).
For primary bibliographic entry see Field 5B.
W91-00293

SOIL EROSION IN THE YELLOW RIVER BASIN AND ITS IMPACTS ON RESERVOIR SEDIMENTATION AND THE LOWER YELLOW RIVER.
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China). Dept. of Sedimentation Engineering.
Q. Zeng, and W. Zhou.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 123-130, 4 fig, 6 ref.

Descriptors: *Erosion control, *River sediments, *Sediment control, *Sedimentation, *Soil erosion, *Yellow River, Bed load, Channel morphology, China, Flood control, Reservoir sediments, Runoff, Silting, Structural engineering.

The Yellow River in China has a drainage area of 750,000 sq km and a total length of 5464 km and is known for its enormous sediment load. The features of soil erosion and its impacts on reservoir sedimentation and channel deposition of the lower Yellow River were examined. Long term data

reflect an annual precipitation for the Yellow River basin of 478 mm, an annual runoff of 46.4 x 10(9) cu/m and an annual sediment load of 1.56 x 10(9) tons (at Sanmenxia Station). Comparing the time periods from 1970-1984 and from 1950-1969, there were decreases in runoff and sediment load of 14.8% and 33.7%, respectively. While part of the decrease is ascribed to decreased precipitation in the more recent period, the water and soil conservation engineering works were also thought to have alleviated the problem of soil erosion. For some reservoirs on the main branch of the Yellow River, 50-87% of their storage capacities were lost due to sedimentation within 5 to 7 years. The tremendous sedimentation on the flood plain and channel bed results the river bed of the Lower Yellow River rising at a rate of 0.10-0.15 m/yr. Flood prevention is the most important problem in the area, with embankment breach occurring twice in three years historically. (See also W91-00280) (MacKeen-PTT)
W91-00294

COST IMPACTS OF SEDIMENTS IN SOUTH AFRICAN RIVERS.
Hydrological Research Inst., Pretoria (South Africa).
E. Braune, and U. Looser.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 131-143, 1 fig, 8 tab, 40 ref.

Descriptors: *Cost analysis, *Drainage basins, *Erosion rates, *Sedimentation, *Sediments, *Soil erosion, *South Africa, Agriculture, Cropland, Environmental effects, Reservoir capacity, Reservoir sediments, River sediments, Soil conservation, Water treatment.

Soil erosion is a serious problem in South Africa. Erosion rates have increased considerably due to human impacts. Off-site damages as a result of high sediment yields from drainage basins are discussed in terms of loss of reservoir storage capacity, damage to agricultural land and crops, enhanced water treatment costs and impacts on the aquatic environment. From a hydrographic survey database for 170 reservoirs, an average storage loss rate of 0.35% per year was indicated. The total off-site cost impact, excluding environmental damage, was estimated at R90 million per year (R1 = U.S. $0.40). This is an order of magnitude higher than the annual national expenditure on soil conservation. (See also W91-00280) (Author's abstract)
W91-00295

LONG AND SHORT-TERM EPISODIC STORAGE AND REMOVAL OF SEDIMENT IN WATERSHEDS OF SOUTHWESTERN WISCONSIN AND NORTHWESTERN ILLINOIS.
Wisconsin Univ.-Madison. Dept. of Geography.
J. C. Knox.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 157-164, 4 fig, 16 ref. NSF Grant EAR-8707504.

Descriptors: *Agriculture, *Erosion rates, *Flood plain sediments, *Land use, *Sediment erosion, *Sediment transport, *Sedimentation rates, *Soil erosion, Dating, Flooding, Illinois, Mississippi, Mississippi Valley, River sediments, Slopes, Surface runoff, Watersheds, Wisconsin.

Average annual rates of erosion and sedimentation commonly are used to evaluate long-term movement and storage of sediment in watersheds. Average rates often poorly represent actual rates because changing environmental factors may dramatically alter surface runoff, flooding, and channel stability. Dating of historical, Holocene (postglacial), and late-Wisconsin (late glacial) hillslope and flood plain sediments in southwestern Wisconsin and northwestern Illinois indicated that rates of sediment erosion, storage, and transportation fluctuate episodically due to changing watershed environmental conditions. In the humid climate of the Upper Mississippi Valley, periods of sediment storage tend to be relatively slow and progressive whereas removal of sediment from storage tends to be episodic with short periods of dramatically high rates separating longer periods of relatively low rates. Historical erosion and sedimentation rates usually poorly represent long-term natural rates because of anthropogenic disturbance of land cover. The replacement of prairie and forest by agricultural land use in the Upper Mississippi Valley resulted in accelerated flood plain sedimentation that averages 30-50 cm deep on tributary flood plains and as much as 3-4 m deep on flood plains in lower reaches of main valleys near the Mississippi River. The use of lead and zinc trace metals associated with historical mining shows that decadal-scale average historical rates of overbank flood plain sedimentation range from about 0.3 cm/yr to 4.0-5.0 cm/yr and greatly exceed the average presettlement post-glacial flood plain vertical accretion rate of 0.02 cm/yr that was determined for radiocarbon dated alluvial deposits. (See also W91-00280) (Author's abstract)
W91-00297

CONSTRAINTS ON DURATION OF SEDIMENT STORAGE IN A WIDE, GRAVEL-BED RIVER, NEW ZEALAND.
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Geography.
J. B. Laronne, and M. J. Duncan.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 165-172, 4 fig, 2 tab, 11 ref.

Descriptors: *Alluvial channels, *Braided streams, *Channel storage, *River beds, *River sediments, *Sediment distribution, *Sediment load, *Sediment transport, Channel accretion, Channel scour, Gravel bed rivers, New Zealand, North Branch Ashburton River, River flow, Sediment storage, Streambeds.

The area of inactive zones in a braided gravel bed river (North Branch Ashburton River, New Zealand) shrinks as the magnitude and duration of competent flow events increase. In a narrower and aggrading reach the entire bed is activated by events that recur twice annually and bed material is stored by actual fill exceeding actual scour. In the wide, braided and stable reach, bed material is stored in bars and its residence time increases as bar height and bar width increase. The depth of bed activity also increases as event flow increases. Amouring of branch channel bed and banks is particularly noticeable in the wide reach; it is the main sedimentologic constraint on the residence time of bed material. (See also W91-00280) (Author's abstract)
W91-00298

SEDIMENT STORAGE AND MOVEMENT ON THE SOUTHERN HIGH PLAINS OF TEXAS AS INDICATED BY BERYLLIUM-TEN.
Geological Survey, Lakewood, CO.
W. R. Osterkamp.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 173-182, 3 tab, 25 ref.

Descriptors: *Beryllium, *Playas, *Sediment storage, *Sediment transport, *Sedimentation rates, *Tracers, Ephemeral lakes, Lake basins, Mathematical models, Soil erosion, Southern High Plains, Texas, Wind erosion.

The Southern High Plains is an area in which most runoff and water-entrained sediment collects and is stored in ephemeral-lake basins, or playas. Ponded playa water recharges the High Plains aquifer. Measured thicknesses and carbon isotope analyses of playa sediment lead to calculated rates of net playa deposition up to 0.48 m/1000 yr, of which 0.09 m/1000 yr is estimated as the maximum possible contribution due to slope-wash processes. Most other sediment movement, including fluxes in and from playa bottoms, is inferred to occur by eolian processes. Beryllium-10 (Be-10) is a naturally occurring cosmogenic radioisotope (half-life 1.5 Ma) of known accumulation rate with precipitation. Because Be-10 becomes tightly bound and concentrated on soil sediment, its movement and storage are closely related to those of sediment. By measuring inventories, accountings of Be-10 per unit area, at playa and interplaya sites, comparisons were made with the known accumulation rate. The comparisons suggest that wind erosion removes an average depth of 0.1 mm of sediment annually, and that deflation accounts for roughly 35 times as much sediment transport as does flowing water. Measured Be-10 concentrations with depth at playa and interplaya areas show significant transport of Be-10 into the unsaturated zone from playas; numerical modelling suggests that much of the Be-10 moves in solution, but movement on sediment through natural conduits may occur as well. The numerical model provides estimates of playa age, and suggests that those playas studied developed in late Pleistocene time. (See also W91-00280) (Author's abstract)
W91-00299

HILLSLOPE AND CHANNEL SEDIMENT DELIVERY AND IMPACTS OF SOIL EROSION ON WATER RESOURCES.
East Carolina Univ., Greenville, NC. Dept. of Geography and Planning.
J. D. Phillips.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 183-190, 1 tab, 23 ref.

Descriptors: *Model studies, *Sediment discharge, *Sediment transport, *Sediment yield, *Slopes, *Soil erosion, *Water quality, Drainage basins, Mathematical models, North Carolina, Upper Tar River, Water quality management, Water resources, Watershed management.

Total soil erosion is less important than the amount of sediment which is retained in stream channels, from a water quality perspective. A physical model for estimating channel sediment delivery ratios is proposed. The sediment delivery ratio (SDR) for a drainage basin is defined as sediment yield at the basin mouth divided by total upland erosion. A stream power based method is used for determining the channel SDR. The model requires two basic components: (1) the estimation of an SDR for the entire basin, via field measurements or estimates, empirical equations or nomographs, or simulation modeling; and (2) measurements or estimates of a reference discharge or associated hydraulic geometry at the basin mouth and at a number of locations upstream. The model was applied to the Upper Tar River basin in the lower Piedmont of North Carolina, with good agreement found for qualitative tests on watersheds where sediment erosion and transport patterns were relatively well known. (See also W91-00280) (MacKeen-PTT)
W91-00300

DEVELOPING ACCURATE AND RELIABLE SEDIMENT YIELDS.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 7C.
W91-00301

PHYSICAL HABITAT SIMULATION AND SEDIMENTATION.
National Ecology Center, Fort Collins, CO.
For primary bibliographic entry see Field 4C.
W91-00303

SPELEOLOGICAL PHENOMENA OF DINARIC KARST.
Institute for Karst Research, Postojna (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00322

KARST POLJES IN DINARIDES.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00323

REVIEW OF SOME SIGNIFICANT PONORS IN SINJSKO AND DUVANJSKO POLJES.
Institute of Geology, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00324

GUIDE FOR SELECTING MANNING'S ROUGHNESS COEFFICIENTS FOR NATURAL CHANNELS AND FLOOD PLAINS.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2E.
W91-00335

STORM RUNOFF AND ITS EFFECTS ON THE WATER QUALITY AND BOTTOM-MATERIAL QUALITY OF CEDAR CREEK, WEST-CENTRAL ILLINOIS, 1985-6.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-00339

SIGNIFICANCE OF SEDIMENT TRANSPORT IN ARROYO DEVELOPMENT.
Geological Survey, Vancouver, WA. Water Resources Div.
D. F. Meyer.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Supply Paper 2349. 61p, 39 fig, 5 tab, 63 ref, 2 append.

Descriptors: *Arroyos, *Channel erosion, *Channel morphology, *Geomorphology, *Model studies, *Sediment transport, Bed load, Braided streams, Meanders, New Mexico, Particle size.

When bed material is predominantly sand, the channel pattern within initial arroyos is typically braided, and both arroyo walls are actively eroded. Alternate bars may form within single-thread, high-flow channels, but they are reworked during recessional flows, and the low-flow channel is again braided. With progressive arroyo widening, fine sand, silt, and clay carried in suspension are deposited across a flood plain within the wide arroyo, causing the channel to meander. This fine-grained arroyo development model is based on observations of arroyo development through time using physical models and interpretation of the channel and arroyo morphology and sedimentology during a short period along the Rio Puerco, New Mexico. Experimental investigations using physical models in which incised channels were monitored through time indicate that the rate of arroyo widening is dependent on the amount of bedload transported through a reach. This is documented by the relations between the rate of arroyo erosion and the observed sediment transport, the channel slope, the channel width and the channel width-to-depth ratio. When a small amount of bed material is being transported, arroyos do not widen whether they are narrow (arroyo width-to-depth ratios between 1.5 and 3.1), intermediate (between 2.5 and 4.8), or wide (greater than 4.9). Arroyo widening resumes when a larger supply of bed material is introduced. Arroyo widening decreases through time because with progressive increases of arroyo width, the frequency with which unstable channels within the arroyo impinge upon arroyo walls decreases. Arroyos become wider in a downstream direction in response to the cumulative effect of upstream sediment production. (Author's abstract)
W91-00346

LOCAL SCOUR AROUND BRIDGE PIERS.
Nanyang Technological Inst., Singapore.
Y. M. Chiew, and B. W. Melville.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 1, p 15-26, 1987. 7 fig, 2 tab, 13 ref.

Descriptors: *Bridge design, *Bridges, *Flow around objects, *Piers, *Scour, *Sediment erosion, Flow depth, Sediment size, Velocity of approach.

Local scour around cylindrical bridge piers in uniform, cohesionless sediment was investigated experimentally. Scour is defined as the removal of bed material by the erosive action of water. Three empirical functions which relate equilibrium scour depth with approach velocity, sediment size and flow depth were obtained. The variations of equilibrium scour depth with approach velocity show that the depth of scour decreases at velocities just above the threshold until it reaches the minimum at about twice the threshold velocity. Thereafter, it increases again until a maximum is reached at the transition flat bed condition. At still higher velocity, the equilibrium scour depth decreases due to the formation of antidunes. Both the effects of sediment size and flow depth were found to be independent of the stage of bed particle motion and the approach velocity. Adjustment factors for the effects of sediment size and flow depth were defined and evaluated. The equilibrium clear water scour depth is always < 2.3 times the pier diameter while the equilibrium live-bed scour depth is always < 2.0 times the pier diameter. In live-bed conditions the contribution to the total scour depth from bed features may be significant, especially in flow where the size of the bed features is large. (MacKeen-PTT)
W91-00397

PRELIMINARY ASSESSMENT OF THE POTENTIAL FOR USING CESIUM-137 TO ESTIMATE RATES OF SOIL EROSION IN THE LOESS PLATEAU OF CHINA.
Xian Lab. of Loess and Quaternary Geology (China).
X. Zhang, D. L. Higgitt, and D. E. Walling.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 243-252, June 1990. 2 fig, 2 tab, 17 ref.

Descriptors: *Cesium radioisotopes, *China, *Environmental tracers, *Erosion rates, *Soil erosion, *Tracers, Land use, Loess, Slope degradation, Soil profiles, Topography.

The radionuclide cesium-137 shows potential as an environmental tracer to indicate sources of soil erosion in the Chinese Loess Plateau. The cesium-137 contents of soil profiles were used to estimate soil erosion losses from different topographic and land use conditions at Lishi, Shanxi, Province, and Luochuan, Shaanxi Province. At uncultivated sites, the cesium-137 was found to accumulate in the upper soil profile, while it was evenly mixed within the plow layer of cultivated soils. Eroded soils contained relatively less cesium-137, and simple calibration techniques were applied to quantify soil loss. The results point to considerable spatial variation in erosion rates within the two study areas. Based on these preliminary results, it is suggested that cesium-137 may be of considerable value in assembling data on the rates and spatial distribution of soil loss and in identifying the source areas of eroded sediment. (Author's abstract)
W91-00405

BIAS AND VARIANCE OF SOME ESTIMATORS OF SUSPENDED SEDIMENT LOAD.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
R. T. Clark.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 253-261, June 1990. 1 tab, 9 ref.

Descriptors: *Estimating equations, *Sediment load, *Sediment yield, *Statistical analysis, *Suspended sediments, Correlation analysis, Probability distribution, Sampling, Sediment concentration, Sediment discharge, Standard deviation.

Expressions for the means and variance of three estimates of suspended sediment load are presented. These estimates assume that suspended sediment concentration, c, and mean daily discharge, q, are bivariate lognormally distributed. With this assumption, not inconsistent with the literature and with sedimentological data from the Rio Uruguai (Brazil/Argentina), one of the three estimates was unbiased and the other two were found to be biased, the bias being an exponential function of the correlation and standard deviations in the log-normal distribution. This confirms empirical findings and supports theoretical results which were established without distributional assumptions. Expressions for the variances of the three estimators of suspended sediment loads also confirmed the empirical results, the unbiased estimate having variance of order $1/n$ while the biased estimates had variances of order $1/n$ squared. These results are limited in that they are concerned only with what have been termed interpolation procedures, and not with the more widely used procedures that employ rating curves to express the relation between sediment concentration and discharge. It has also been assumed throughout that the concentration measurements can be regarded as randomly sampled from the time series of concentration values, and the results that are given apply only where this assumption is valid. In particular, the results will not apply if concentration is sampled more frequently at higher discharge, or if the inaccessibility of sampling sites during periods of heavy flooding causes samples to be missed. (Fleishman-PTT)
W91-00406

COUPLED SIMULATION OF TRANSIENT BED EVOLUTION IN ALLUVIAL CHANNELS.
National Chiao Tung Univ., Hsinchu (Taiwan). Dept. of Civil Engineering.
J. C. Yang, and J. Y. Wang.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 263-284, June 1990. 10 fig, 2 tab, 19 ref, 2 append.

Descriptors: *Alluvial channels, *Channel morphology, *Flow models, *River beds, *Sediment transport, *Simulation analysis, Flood peak, Flow discharge, Momentum equation, Performance evaluation, Taiwan.

In dealing with the transient sediment transport problem, the commonly used uncoupled model may not be suitable. The uncoupling technique is intended to separate the physical coupling phenomenon of water flow and sediment transport into two independent processes. Very often, as a result, severe numerical oscillation and solution instability problems appear in the simulation of transient sediment transport in alluvial channels. The coupled model, which simultaneously solves water flow continuity, momentum and sediment continuity equations, gives fewer numerical oscillation and solution instability problems. A coupled model using a matrix double-sweep method to solve the system of nonlinear algebraic equations has been developed. Several test runs designed on the basis of a schematic model have been performed. The numerical oscillation and solution instability problems have been investigated through a comparison with those obtained from an uncoupled model. Based on the proposed case studies, it can be concluded that, for transient bed evolution, the performance of the coupled model is much better than that of the uncoupled model. The numerical oscillation is reduced and the solution more stable. This newly developed coupled model was also applied to the Cho-Shui River in Taiwan. This application study implied that the effect of the peaky flood wave propagation on the bed evolution could be simulated better by the coupled model than by the uncoupled model. (Author's abstract)
W91-00407

MINERALIZATION, PORE WATER CHEMISTRY AND PHOSPHORUS RELEASE FROM PEATY SEDIMENTS IN THE EUTROPHIC LOOSDRECHT LAKES, THE NETHERLANDS.
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2H.
W91-00426

HYDROLOGIC AND CHEMICAL-QUALITY DATA FROM FOUR RURAL BASINS IN GUILFORD COUNTY, NORTH CAROLINA, 1985-88.

Geological Survey, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W91-00433

CHANNEL CHANGES AT CROSS SECTIONS OF THE POWDER RIVER BETWEEN MOORHEAD AND BROADUS, MONTANA, 1975-88.
Geological Survey, Denver, CO.
J. A. Moody, and R. H. Meade.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-407, 1990. 252p, 94 fig, 29 tab, 4 ref.

Descriptors: *Channel erosion, *Channel morphology, *Channel stability, *Dam effects, *Montana, *Powder River, Cross-sections, Deposition, Floods, River beds.

Bed elevations were measured at 23 cross sections along a 95-kilometer reach of the Powder River between Moorhead and Broadus, Montana. The measurements were repeated each year (except 1976, 1981, and 1983) after the peak runoff and include measurements made before and after the flood of May 1978. As a result of the flood, the average of the changes in the minimum riverbed elevations at 17 cross sections indicated a decrease in elevation of 0.15 m, but this change was followed by a 0.17-m increase in the minimum riverbed elevation during the years after the flood (1978-88). There was essentially no net change in the minimum riverbed elevation for the study reach during 1977-88. The areas of erosion and deposition calculated for successive years at each cross section as a measure of channel change indicated that, during the 1978 flood, the average net channel change (deposition minus erosion) for the study reach was the erosion of 16 cu m of sediment/m of channel length. After the 1978 flood, the channel changes were characterized by multiple areas of erosion, which became areas of deposition during the following year and areas of deposition which became areas of erosion. The average net channel change for the entire study reach during the years since the 1978 flood was the average deposition of about 1 cu m of sediment/m of channel length. Thus, during 1977-88 there was a net erosion of about 15 cu m of sediment/m of channel length within the study reach. (Author's abstract)
W91-00436

CHANNEL AND BANK STABILITY OF OSBORNE CREEK AT U.S. HIGHWAY 45 NEAR WHEELER, PRENTISS COUNTY, MISSISSIPPI.
Geological Survey, Jackson, MS.
K. Van Wilson, and D. P. Turnipseed.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-581, 1989. 13p, 4 fig, 3 tab, 20 ref. Prepared in cooperation with the Mississippi State Highway Department.

Descriptors: *Bank erosion, *Channel stability, *Highway relocation, *Mississippi, *Osborne Creek, Bankfull stage, Channel scour, Floods, Soil properties, Streambeds.

The channel of Osborne Creek at existing U.S. Highway 45 near Wheeler, Mississippi, has degraded about 8 ft and widened about 33 ft since 1936. Channel degradation has totaled about 6 ft in the channel reach in the vicinity of the proposed U.S. Highway 45 relocation. Botanical evidence indicates that several bank failures downstream of the proposed relocation occurred during floods in 1983 and 1987-88. Rates of channel gradation and widening--as determined from channel descriptions and botanical evidence along the banks--were used in conjunction with soil properties to estimate probable future channel degradation and widening at the proposed relocation through the year 2010. By assuming that channel-bed elevations can be expressed as a power function with time, additional channel degradation through the year 2010 could approach 1 to 2 ft at the existing and proposed crossing of Osborne Creek. By comparison of projections of slough lines and temporary angles of stability with bankfull channel widths as a power function with time, about 10 ft of additional widening could reasonably be expected through the year 2010. These projections are based on the assumption that no additional channel modifications and no unusually large and destructive flooding will occur by the year 2010. (Author's abstract)
W91-00437

CHANNEL AND BANK STABILITY OF TWENTYMILE CREEK AT U.S. HIGHWAY 45 NEAR WHEELER, PRENTISS COUNTY, MISSISSIPPI.
Geological Survey, Jackson, MS.
D. P. Turnipseed, and K. Van Wilson.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 90-111, 1990. 16p, 4 fig, 4 tab, 21 ref. Prepared in cooperation with the Mississippi State Highway Department.

Descriptors: *Bank erosion, *Channel stability, *Highway relocation, *Mississippi, *Twentymile Creek, Channel scour, Channeling, Floods, Riparian vegetation, Soil properties.

The channel of Twentymile Creek at existing U.S. Highway 45 near Wheeler, Mississippi, has degraded about 8 ft and widened about 73 ft since it was channelized in about 1912. No recent (at least since 1968) channel degradation or widening is evident on Twentymile Creek near the proposed U.S. Highway 45 relocation. Botanical evidence indicates that both banks in the vicinity of the proposed relocation are fairly stable, but the removal of mature riparian vegetation from channel banks could result in near-future instability. Rates of channel gradation and widening--as determined from channel descriptions, discussions with local residents, and botanical evidence along the banks--were used in conjunction with soil properties to estimate probable future channel degradation and widening through the year 2010. No additional channel degradation through the year 2010 is expected at the existing and proposed crossing of Twentymile Creek. At existing U.S. Highway 45, the channel width could increase about 15 ft through the year 2010; at the proposed relocation, the channel width could increase about 20 ft in the next 10 to 20 years if mature riparian vegetation is removed from the channel banks. These projections are based on the assumption that no additional channel modifications and no unusually large and destructive flooding will occur by the year 2010. (Author's abstract)
W91-00439

INTERACTIONS OF CONTAMINANTS WITH SEDIMENT AND WATER IN RESERVOIRS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W91-00560

SPATIAL VARIATIONS IN THE RATE OF FLUVIAL EROSION (SEDIMENT PRODUCTION) OVER SOUTH AFRICA.
Orange Free State Univ., Bloemfontein (South Africa).
J. S. Le Roux.
Water SA WASADV, Vol. 16, No. 3, p 185-194, July 1990. 8 fig, 1 tab, 50 ref.

Descriptors: *Denudation, *Erosion, *Erosion rates, *Reservoir sediments, *South Africa, *Stream erosion, Data interpretation, Fluvial sediments, Precipitation, Rainfall-runoff relationships, Regional analysis, Spatial variation, Watersheds.

This study was based on the rate of sedimentation of 87 major storage dams in South Africa with sedimentation records exceeding 15 years. The catchments cover a 23% sample of the total land area of South Africa and represent the main climatic zones. The rate of denudation of the past 10 to 50 years was calculated from sediment accumulated in the man-made reservoirs. The rate of surface lowering generally increases from west to east over the subcontinent. This increase more or less coincides with both an increase in annual precipitation and an increase in the number of storms of high intensity. On the whole there is an increase in relief from west to east, but relief seems to be only a secondary factor in the explanation of denudation rate. The rate of erosion is probably at least twice to three times or more the rate of replacement by weathering. It is concluded that the rate of denudation is mostly a function of rainfall parameters and several passive factors and it is unlikely that a single parameter can be devised which would be able to explain the regional denudation pattern. No conclusive evidence could be found from reservoir sedimentation rates that denudation rates have either decreased or increased over the last 10 to 50 years. (Author's abstract)
W91-00635

EFFECT OF TIDAL ACTION ON THE TRANSFORMATIONS OF NITROGEN IN FRESHWATER TIDAL FLAT SEDIMENTS.
Hamburg Univ. (Germany, F.R.). Fachbereich 14 - Biologie.
For primary bibliographic entry see Field 5B.
W91-00649

SEASONAL VARIATION IN THE STRUCTURE OF THE MICROBIAL COMMUNITY CAPABLE OF NITRATE RESPIRATION IN AN INTERTIDAL MUD FLAT SEDIMENT FROM THE ELBE ESTUARY.
Hamburg Univ. (Germany, F.R.). Fachbereich 14 - Biologie.
For primary bibliographic entry see Field 2L.
W91-00650

RETENTION AND RESUSPENSION OF PHOSPHORUS, NITROGEN, AND IRON IN A CENTRAL ONTARIO LAKE.
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 2H.
W91-00656

PIGMENT STRATIGRAPHY AND TROPHIC STATUS: AN EVALUATION OF RADIONUCLIDE-DATED LACUSTRINE SEDIMENT.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
For primary bibliographic entry see Field 2H.
W91-00692

POREWATER MIXING BY MICROORGANISMS, MONITORED BY A RADIOTRACER METHOD.
Stockholm Univ. (Sweden). Dept. of Geology.
P. Ostlund, R. O. Hallberg, and L. Hallstadius.
Geomicrobiology Journal GEJODG, Vol. 7, No. 4, p 253-264, 1989. 6 fig, 1 tab, 10 ref.

Descriptors: *Bioturbation, *Interstitial water, *Microorganisms, *Radioactive tracers, *Sediment chemistry, Diffusion coefficient, Xenon radioisotopes.

Bioturbation is an important process for the transport and mixing of solutes and particles in sediments. Mixing of porewater caused by motile microorganisms has not previously been considered to be of significance in this context. A radiotracer method using Xe-133 has been developed for the direct comparison of mixing of a soluble inert substance in microbially active and sterile sediments. Results showed clear evidence of porewater mixing caused by motile microorganisms. Estimated diffusion coefficients (expressed as mixing coefficients) were found to be 20% larger in microbially active sediments than in sterile ones. (Author's abstract)
W91-00693

TWO HYDRODYNAMICALLY STABLE SELF-SUSPENDED BUOYANT SEDIMENT TRAPS.
Stockholm Univ. (Sweden). Dept. of Zoology.
D. Broman, J. Kugelberg, and C. Naf.
Estuarine, Coastal and Shelf Science ECSSD3, .

Vol. 30, No. 4, p 429-436, April 1990. 2 fig, 19 ref.

Descriptors: *Samplers, *Sampling, *Sediment sampler, *Sedimentation, Design criteria, Limnology, Oceanography.

Two self-buoyant sediment traps using straight cylindrical sediment collection vessels have been designed and tested. The constructions are hydrodynamically stable and the vertical alignment of the sediment collection vessels are retained both in laminar and moderately turbulent water currents with flow rates up to 40 cm/sec for the nondisplacing, and at least 45 cm/sec for the displacing, sediment trap type. Both constructions are simple and easily handled. (Author's abstract)
W91-00721

SEDIMENT-WATER INTERACTION AS A CONTROL ON GEOCHEMICAL EVOLUTION OF PLAYA LAKE SYSTEMS IN THE AUSTRALIAN ARID INTERIOR.
Queensland Univ. of Technology, Brisbane (Australia). Dept. of Applied Geology.
For primary bibliographic entry see Field 2H.
W91-00736

METAL CONCENTRATIONS IN SURFICIAL SEDIMENTS FROM HYPERSALINE LAKES, AUSTRALIA.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
For primary bibliographic entry see Field 2K.
W91-00737

INFLUENCE OF SALINITY ON THE CONCENTRATION AND RATE OF INTERCHANGE OF DISSOLVED PHOSPHATE BETWEEN WATER AND SEDIMENT IN FUENTE PIEDRA LAGOON (S. SPAIN).
Malaga Univ. (Spain). Facultad de Ciencias.
For primary bibliographic entry see Field 2L.
W91-00743

ABSOLUTE DATING OF SEDIMENTATION ON LAKE TORRES WITH SPRING DEPOSITS, SOUTH AUSTRALIA.
Zambia Univ., Lusaka. School of Mines.
For primary bibliographic entry see Field 2H.
W91-00760

SEDIMENT YIELD AND DISCHARGE IN MOUNTAINOUS SMALL RIVER BASINS: ACTUAL CONDITION OF SEDIMENT DISCHARGE AFTER DAMAGE CAUSED BY SAND AND STONE AVALANCHES (IN JAPANESE).
K. Tsunamoto, M. Kimura, and S. Mutou.
Research Bulletin of the Faculty of Agriculture Gifu University, No. 54, p 29-38, December 1989. 7 fig, 5 tab, 3 ref. English summary.

Descriptors: *Avalanches, *Landslides, *Mountain streams, *Sediment yield, *Sedimentation, *Storm runoff, *Watershed management, Check dams, Dams, Disasters, Environmental effects, Forest watersheds, Rivers, Runoff, Sediment discharge, Streams.

To obtain fundamental data for disaster prevention in mountainous small river basins, actual conditions of sediment yield and discharge were investigated in 19 rivers after a disaster. It was found that the landslide occurrence ratio was low and on a scale that was small considering that it was in a rainy district. Most debris passed through the forest into the channel causing an increase in sediment deposition. Most check dams constructed after disaster were not filled up with sediment, and no large sediment discharge caused by rain has occurred since. When the stream length was large, the slope of the stream bed was small, and sediment deposition increased. In view if these results, it was inferred that sediment deposition was affected by the river itself when the river basin was small and there was no change in environmental conditions. Since these rivers tend to have extensive sediment deposition in valley outlets when it rains heavily, appropriate forest treatment must be carried out. (Agostine-PTT)
W91-00766

DISTRIBUTION AND TRANSPORT OF SEDIMENT-BOUND METAL CONTAMINANTS IN THE RIO GRANDE DE TARCOLES, COSTA RICA (CENTRAL AMERICA).
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W91-00804

EFFECT OF WATER DEPTH AND CLIPPING FREQUENCY ON THE GROWTH AND SURVIVAL OF FOUR WETLAND PLANT SPECIES.
Iowa State Univ., Ames. Dept. of Botany.
B. A. Middleton.
Aquatic Botany AQBODS, Vol. 37, No. 2, p 189-196, July 1990. 1 fig, 15 ref. Smithsonian Grant 43600.

Descriptors: *Aquatic plants, *Geese, *Herbivores, *Limnology, *Plant growth, *Wetlands, Clipping frequency, Experimental data, Field tests, India, Keoladeo National Park, Monsoonal wetlands, Rooted aquatic plants, Water depth.

Geese and other herbivores seem to be responsible for the creation of openings in many wetlands. The hypothesis that underwater clipping can kill wetland plants was tested in an experimental study conducted in north-central India. Four plant species were either clipped weekly, clipped every 2 weeks, or left unclipped while growing at one of three water levels (0, 3 or 13 cm above the soil surface). When clipped underwater, individuals of three emergent species, Ipomoea aquatica, Paspalidium punctatum and Paspalum distichum, usually died, but those of Nymphoides cristatum Kuntze did not. Clipped plants of N. cristatum had as much total biomass as unclipped plants, with increased mean shoot biomass but reduced mean root biomass in 3 cm of water. The three emergent species lived when clipped every 2 weeks in 0 cm of water. Clipped plants of emergents had less total mass and less root mass than unclipped plants in 0 cm of water. In a field study in a monsoonal wetland in the Keoladeo National Park, plants of Ipomoea aquatica and Paspalum distichum died when clipped underwater. (Author's abstract)
W91-00836

TOPOGRAPHIC EFFECTS ON FLOW PATH AND SURFACE WATER CHEMISTRY OF THE LLYN BRIANNE CATCHMENTS IN WALES.
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 2E.
W91-00888

INFLUENCE OF THE ANGLE OF INCIDENCE OF THE RAINFALL ON THE OVERLAND FLOW PROCESS.
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
J. L. M. le Lima.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 73-82. 7 fig, 12 ref.

Descriptors: *Computer models, *Erosion, *Kinematic wave theory, *Model studies, *Overland flow, *Rainfall, *Rainfall impact, *Rainfall-runoff relationships, *Wind velocity, Computer programs, Mathematical models, Soil erosion.

The influence of the angle of incidence of rainfall in the overland flow process and soil erosion was examined. A method, based on the kinematic wave theory, was developed in which overland flow, under rainfall from any dominant direction, is simplified by taking a one-dimensional flow process by means of spatial rotation of the surface (assumed to be a plane). The acceleration of gravity is modified at every instant to take into account the effect of the impinging raindrops. A computer program was developed to numerically solve the kinematic wave equations for overland flow under inclined rainfall and also considering the effect of the wind shear stress and of the splash. Wind tunnel experiments in the laboratory were conducted to verify the model. Although the model is not the most sophisticated one possible, it may prove to be accurate enough for practical purposes in assessing factors that affect overland flow under inclined rainfall. Further improvement could be obtained by coupling the model with a sediment transport model. (See also W91-00961) (Sand-PTT)
W91-00969

REVIEW OF THE SEARCH FOR A QUANTITATIVE LINK BETWEEN HYDROLOGIC RESPONSE AND FLUVIAL GEOMORPHOLOGY.
Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 2E.
W91-00977

GEOMORPHOCLIMATIC DERIVATION OF FLOOD FREQUENCY (PEAK AND VOLUME) AT THE BASIN AND REGIONAL SCALE.
Politecnico di Milano (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 2E.
W91-00978

2K. Chemical Processes

MEASUREMENTS OF GAS CONCENTRATION FLUCTUATIONS AT WATER SURFACE.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
G. H. Jirka, and A. H. W. Ho.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 835-847, June 1990. 11 fig, 9 ref. NSF Grant CEE-8004621.

Descriptors: *Air-water interfaces, *Laboratory methods, *Oxygen, *Water boundary, *Water chemistry, *Water properties, Solubility, Volatility.

The transfer of gases across the air-water interface is a critical element in the natural geochemical cycling of materials, as well as for the transport of pollutants in the environment. Experiments in a grid-stirred laboratory tank (0.5 m x 0.5 m x 0.4 m) have been conducted to investigate the details of the surface transfer mechanisms, including the structure of up or downwelling motions and existence of various boundary layers. In addition to earlier two-component measurements of the turbulent near-surface velocity field, a gas microprobe has been constructed and used for measurements of gas fluctuations. The gas probe uses the polarographic principle for the measurement of oxygen and has tip dimensions on the order of a few microns. Measurements are presented that display the conditions in the gas boundary layer (about 400-microns thickness), including mean and fluctuating conditions. The mean gas concentration profile indicates a monotonic decrease with depth within the surface gas boundary layer. Turbulent fluctuations appear to reach much deeper, well below the lowest near-surface measuring point (500 microns). (Author's abstract)
W91-00065

LONGITUDINAL AND SEASONAL WATER CHEMISTRY VARIATIONS IN A NORTHERN APPALACHIAN STREAM.
Marian Coll., Indianapolis, IN. Dept. of Biology.
R. A. Phillips, and K. M. Stewart.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 489-498, June 1990. 5 fig, 1 tab, 37 ref.

Descriptors: *Acid rain effects, *Acid streams, *Buffer capacity, *Chemical properties, *Soil types, *Water chemistry, Alkalinity, Conductivity, Hydrogen ion concentration, New York, Nitrates, Rainfall, Seasonal variation, Snowmelt, Temporal distribution.

Quaker Run, a fourth order stream located in southwestern New York State, exhibits a highly unusual chemical gradient along its upper reaches. Weekly water samples showed an increase in the mean annual pH from 5.07 to 7.01 along a stretch of only 2.2 km. Mean alkalinity, calcium, magnesium, sodium, potassium, nitrate-nitrite-nitrogen,

silica, and conductivity also increased appreciably over this distance. The study area receives some of the most highly acidic atmospheric deposition in the United States. Minimal buffering of these acidic inputs in the extreme upper watershed, and an abrupt downstream increase in buffering associated with changes in soil type, apparently produce the observed streamwater chemistry gradient. In contrast, a comparison between 11 midstream, downstream, and tributary sites showed relatively little variation in streamwater chemistry. In addition to the pronounced longitudinal chemistry changes along the upper portion of the stream, pronounced temporal chemistry variations were also observed at all sampling sites. High flow during snowmelt and heavy rains produced more dilute, acidic conditions, while streamwater pH and dissolved base cations were generally highest during low flow. Much of this temporal variation in streamwater chemistry is attributed to seasonal variation in residence times of soil water. (Author's abstract)
W91-00089

HYDROCHEMICAL CHARACTERIZATION OF GROUNDWATER MIXING IN SEDIMENTARY AND METAMORPHIC RESERVOIRS WITH COMBINED USE OF PIPER'S PRINCIPLE AND FACTOR ANALYSIS.
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
M. Razack, and J. Dazy.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 371-393, May 1990. 9 fig, 6 tab, 50 ref.

Descriptors: *Geochemistry, *Groundwater quality, *Groundwater recharge, *Metamorphic aquifers, *Sedimentary aquifers, *Water chemistry, Aquifer systems, Data interpretation, Factor analysis, France, Groundwater movement, Groundwater pollution, Mixing, Physicochemical properties.

The understanding of flow and water quality in groundwater systems, and the identification of recharge areas is a present need, especially as hydrogeologists are increasingly confronted with groundwater contamination problems. To compare and identify water masses, a large amount of water quality data may be needed. Hydrogeologists have turned to mathematical tools such as factor analysis for interpretation. A procedure to interpret hydrochemical data based on a combined use of factor analysis (correspondence analysis) and Piper's classification principle was applied to the study of a multireservoir hydrothermal system located in the French Western Alps. Values of physicochemical parameters determined on 95 water samples related to a single point and gathered from previous studies extending over several decades were submitted to this procedure. The approach proved successful in differentiating groundwater masses of different hydrogeological origin which mix and discharge at the outlet of the system. The statistical analysis, supported by structural and isotopic information, allowed formulation of a flow and mixing model in agreement with geological evidence and comprising near-surface, subsurface and deep subsystems. (Author's abstract)
W91-00164

GEOCHEMISTRY OF WATER ASSOCIATED WITH THE NAVAJO SANDSTONE AQUIFER, SAN RAFAEL SWELL AREA, UTAH.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00312

METHODS AND PRELIMINARY RESULTS OF GEOCHEMICAL SAMPLING, SAN JUAN BASIN, NEW MEXICO, COLORADO, ARIZONA, AND UTAH.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00317

STREAMFLOW AND WATER-QUALITY DATA FOR LITTLE SCRUBGRASS CREEK BASIN, VENANGO AND BUTLER COUNTIES, PENNSYLVANIA, DECEMBER 1987 - NOVEMBER 1988.
Geological Survey, Harrisburg, PA.
For primary bibliographic entry see Field 2E.
W91-00357

SOLINPUT: A COMPUTER CODE TO CREATE AND MODIFY INPUT FILES FOR THE GEOCHEMICAL PROGRAM SOLMINEQ.88.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7C.
W91-00359

SUGGESTED METHODS FOR CALCULATING AND INTERPRETING CALCIUM CARBONATE SATURATION INDEXES.
D. T. Merrill, R. W. Lane, R. A. Pisigan, G. C. Richards, and J. R. Rossum.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 7, p 71-77, July 1990. 3 tab, 45 ref.

Descriptors: *Calcium carbonate, *Chemical analysis, *Saturation index, *Water analysis, *Water chemistry, *Water treatment, Alkalinity, Calcium, Chemical precipitation, Computers, Deposition, Hydrogen ion concentration, Mathematical equations, Water delivery, Water distribution.

Calcium carbonate ($CaCO_3$) saturation indexes are commonly used to evaluate the scale-forming and scale-dissolving tendencies of water. Assessing these tendencies is useful in corrosion control programs and in preventing $CaCO_3$ scaling in piping and equipment. Several water quality characteristics must be measured to calculate the $CaCO_3$ saturation indexes, with minimum requirements being total alkalinity, total calcium, ionic strength, pH and temperature. $CaCO_3$ saturation indexes are grouped into two categories: (1) Indexes that indicate $CaCO_3$ precipitation or dissolution tendencies define whether a water is oversaturated, saturated or undersaturated with respect to $CaCO_3$. These include the Saturation Index (SI); the Relative Saturation (RS; also known as the Driving Force Index); and the Ryzner Index (RI). The RS and SI are related. The RI has been used for many years, sometimes with good results, however, it is semiempirical and therefore may be less reliable than SI. A positive SI connotes a water oversaturation with respect to $CaCO_3$; a negative SI signifies an undersaturated water; an SI of zero represents a water in equilibrium with $CaCO_3$. (2) An index that the quantity of $CaCO_3$ that may be precipitated or dissolved is the Calcium Carbonate Precipitation Potential (CCPP). The CCPP is defined as the quantity of $CaCO_3$ that theoretically can be precipitated from oversaturated waters or dissolved by undersaturated waters during equilibration. The CCPP is negative for undersaturated waters and positive for oversaturated waters. None of the calculations of $CaCO_3$ saturation indexes adequately describe exception conditions, such as the inhibition of $CaCO_3$ deposition by the presence of phosphates. Similarly, the effects predicted by the indexes do not always conform to expectations. Thus, estimates of corrosion rates should not be based on $CaCO_3$ indexes alone. There is a source listing and description of diagrams and computer software for $CaCO_3$ indexes. (Hoskin-PTT)
W91-00380

DETERMINATION OF GOLD AT FEMTOMOLAR LEVELS IN NATURAL WATERS BY FLOW INJECTION INDUCTIVELY COUPLED PLASMA QUADRUPOLE MASS SPECTROMETRY.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
K. K. Falkner, and J. M. Edmond.
Analytical Chemistry ANCHAM, Vol. 62, No. 14, p 1477-1481, July 15, 1990. 2 fig, 4 tab, 28 ref.

Descriptors: *Analytical methods, *Chemical analysis, *Gold, *Mass spectrometry, *Pollutant identification, *Seawater, *Water analysis, Anion exchange, Atlantic Ocean, Detection limits, Laboratory methods, Mediterranean Sea, Pacific Ocean, Precision, Radioactive tracers.

A method for the determination of Au in seawater at femtomolar (fm) levels (10 fm/L) levels involves preconcentration by anion exchange of Au as a cyanide complex using Au-195 radiotracer (half-life= 183 days) to monitor recoveries. Samples are then introduced by flow injection into an inductively coupled plasma quadrupole mass spectrometer for analysis. The method has a detection limit of approximately 10 fM for 4 L of seawater preconcentrated to 1 ml and a relative precision of 15% at the 100 fM level. Au levels of 10-100 fM were confirmed in seawater at Atlantic and Pacific Ocean and Mediterranean Sea locations. With slight modifications, the technique can also be applied to the analysis of hydrothermal fluids and freshwaters. (Author's abstract)
W91-00388

ESTIMATES OF ION SOURCES IN DECIDUOUS AND CONIFEROUS THROUGHFALL.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-00415

GEOCHEMISTRY OF IRON IN A SAND DUNE AQUIFER, NEAR COOS BAY AND NORTH BEND, OREGON.
Geological Survey, Portland, OR.
G. C. Bortleson, M. A. Jones, and P. P. Hearn.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. US Geological Survey Open-File Report 88-734, 1989. 37p, 1 plate, 14 fig, 13 tab, 26 ref. Prepared in cooperation with the Coos Bay-North Bend Water Board.

Descriptors: *Geochemistry, *Iron, *Oregon, *Sand aquifers, *Water chemistry, Carbon dioxide, Carbonates, Coniferous forests, Coos Bay, Dunes, Organic compounds.

Geochemical processes that control dissolved iron concentrations were studied in a sand dune aquifer used for municipal and industrial water supply near Coos Bay and North Bend, Oregon. Elevated concentrations of dissolved organic compounds and carbon dioxide produced from the root zone and litter of lodgepole pine forest (Pinus contorta) increase the capacity of shallow groundwater to dissolve iron-bearing minerals. Dissolved iron concentrations are largest (7,300 to 27,000 mg/L) in shallow groundwater that has infiltrated areas of dense lodgepole pine forest and smallest (15 to 3,900 mg/L) in water that has infiltered bare sand. Water beneath both forested and bare sand areas is devoid of oxygen and pH is similar in all areas (pH 5.6 to 6.7). The pH of shallow groundwater that had infiltered forested areas tends to be higher than in bare sand areas, but differences are slight. In contrast to shallow water beneath forested areas, water from the deeper parts of the aquifer in the southern part of the dunes has concentrations of dissolved iron that range from a few tens to a few hundreds of mg/L. Large carbonate-bicarbonate concentrations from the dissolution of marine shell fragments causes precipitation of siderite ($FeCO_3$) and removal of little or no shell material, and iron concentrations are not limited by carbonate equilibria. Therefore, dissolved iron concentrations in these areas generally increase with depth, but these concentrations may not be solely a function of depth or residence time. (Author's abstract)
W91-00430

STREAMFLOW AND WATER-QUALITY DATA FOR MEADOW RUN BASIN, FAYETTE COUNTY, PENNSYLVANIA, DECEMBER 1987 - NOVEMBER 1988.
Geological Survey, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W91-00431

DESTRUCTION OF HAZARDOUS CHEMICAL WASTE BY OXIDATION IN SUPERCRITICAL WATER.
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5D.

W91-00450

CHEMISTRY OF BROMINE TRANSFER: DISPROPORTIONATION AND HYDROLYSIS IN BROMAMINE SYSTEMS.
Hartford Univ., West Hartford, CT. Dept. of Chemistry.
E. T. Gray, and H. J. Workman.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 833-847, 5 fig, 5 tab, 15 ref, 2 append.

Descriptors: *Bromination, *Bromine, *Chemical analysis, *Chemical reactions, *Hydrolysis, *Water analysis, *Water chemistry, Organic compounds, Water treatment.

A systematic determination of the equilibrium constants, rate constants and reaction mechanisms associated with the bromination of amine moieties, with an emphasis on organic amines is presented. Concentration is placed on the transfer of active bromine using the bromamines of dimethylamine and beta-aniline, since these exemplars of organic bromamines can be stable to reductive loss for at least a period of a few minutes. The equilibrium constant for the hydrolysis of dimethylbromamine and the equilibrium constant for the disproportionation of N-bromo-beta-alanine have been obtained. Also N,N-dibromo-beta-alanine has been shown to hydrolyze in mildly acidic conditions. In general, the concentration of uncombined halogen is much greater for bromamine solutions than for comparable chloramine solutions. Furthermore, it appears that almost all the important constants describing bromamine chemistry in aqueous solutions can be measured directly, with the notable exception of the protonation constant of the monobromamine species. The continued goal of this research is to make the determination of these constants routine, so that critical equilibrium and rate constants for bromamine systems may be rapidly determined across a wide range of amine species. (See also W91-00476) (Lantz-PTT)
W91-00540

COKRIGING TO ASSESS REGIONAL STREAM QUALITY IN THE SOUTHERN BLUE RIDGE PROVINCE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W91-00589

COMPARATIVE ANALYSIS OF ALUMINUM BIOGEOCHEMISTRY IN A NORTHEASTERN AND A SOUTHEASTERN FORESTED WATERSHED.
Maine Univ., Orono. Dept. of Botany.
C. S. Cronan, C. T. Driscoll, R. M. Newton, J. M. Kelley, and C. L. Schofield.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1413-1430, July 1990. 10 fig, 8 tab, 85 ref. EPRI Contract RP2356.

Descriptors: *Acid rain effects, *Aluminum, *Chemical analysis, *Forest watersheds, *Path of pollutants, *Water chemistry, Acidity, Adirondack Mountains, Alkalinity, Aluminum cycling, Anions, Cations, Comparison studies, Cumberland Plateau, Forest ecosystems, Ion transport, New York, Nitrates, Organic carbon, Sulfates, Tennessee.

A comparative biogeochemical analysis focused on aluminum cycling in two small watersheds, one in the west-central Adirondacks of New York and the other on Cumberland Plateau of eastern Tennessee. Despite similarities in soil acidity, soil exchangeable Al concentrations, and elevated inputs of acidic deposition, the northern and southern sites exhibited strong differences in aqueous Al chemistry and transport. Soil and stream drainage waters in the northern watershed were more acidic, and contained higher concentrations of base cations, sulfate, nitrate, and organic carbon than waters in the southern ecosystem. Mean concentrations of biologically active inorganic Al ranged from 17 to 46 micromol/L in soil solutions and stream water in the northern drainage basin, and from 0 to 2 micromol/L in the southern system. The major differences in Al chemistry and transport between the two watersheds were related to different patterns of alkalinity and anion transport in these contrasting systems. In the northern watershed, atmospheric inputs of acidity were partially neutralized through the release of cations (Ca, Al, Mg, K, and Na) from soils and detritus. Because of the high mobility of sulfate and nitrate in the northern watershed, there was significant transport of Al through the soil and into stream water. At the southern watershed, soil sulfate adsorption, biological retention of nitrate, and base cation release were the major sources of acid neutralizing capacity for soil drainage waters and surface waters. Because these processes resulted in both the release of alkalinity and the removal of mobile strong acid anions, concentrations of labile Al remained low throughout most of the drainage profile in the southern watershed. At the ecosystem level, results indicated that Al cycling at the southern site was controlled more by biotic transfers (e.g., plant uptake and litterfall), while solution transfers (e.g., soil leaching) dominated Al cycling at the northern site. (Author's abstract)
W91-00590

GAS EXCHANGE RATES FOR A FIRST-ORDER STREAM DETERMINED WITH DELIBERATE AND NATURAL TRACERS.
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2A.
W91-00606

IDENTIFICATION OF SOLUBILITY-CONTROLLING SOLID PHASES IN A LARGE FLY ASH FIELD LYSIMETER.
Battelle Memorial Inst., Richland, WA. Pacific Northwest Labs.
For primary bibliographic entry see Field 5B.
W91-00621

SYNCHRONOUS FLUORESCENCE SPECTROSCOPY OF DISSOLVED ORGANIC MATTER IN SURFACE WATERS: APPLICATION TO AIRBORNE REMOTE SENSING.
Cornell Univ., Ithaca, NY. Cornell Lab. for Environmental Applications of Remote Sensing.
For primary bibliographic entry see Field 5A.
W91-00639

POTENTIAL BIO-AVAILABLE PHOSPHORUS IN SEDIMENTS OF THE RIVER ELBE IN NORTHERN GERMANY.
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Chemie.
For primary bibliographic entry see Field 2L.
W91-00651

EFFECT OF FLUORIDE COMPLEXATION ON ALUMINUM TOXICITY TOWARDS JUVENILE ATLANTIC SALMON (SALMO SALAR).
INRS-Eau, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5C.
W91-00663

PHYSICAL CHEMICAL PROPERTIES OF UNCHARGED WATER CLUSTERS AND ONE-DIMENSIONAL ICE BASED ON QUANTAL CALCULATIONS.
Missouri Univ.-Rolla. Dept. of Physics.
For primary bibliographic entry see Field 2C.
W91-00667

OXIDATION OF S(IV) IN RAIN-WATER COLLECTED IN JAPAN.
Institute of Public Health, Tokyo (Japan).
For primary bibliographic entry see Field 5B.
W91-00668

WET DEPOSITION OF VOLCANIC GASES AND ASH IN THE VICINITY OF MOUNT SAKURAJIMA.
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
For primary bibliographic entry see Field 5B.
W91-00669

ORIGIN OF SOLUBLE CHEMICAL SPECIES IN BULK PRECIPITATION COLLECTED IN TOKYO, JAPAN: STATISTICAL EVALUATION OF SOURCE MATERIALS.
Tokyo Inst. of Tech. (Japan). Dept. of Environmental Chemistry and Engineering.
For primary bibliographic entry see Field 5B.
W91-00670

MESOSCALE MODELING OF ACIDITY PRODUCTION IN OROGRAPHIC CLOUDS AND RAIN.
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. Associe de Meteorologie Physique.
For primary bibliographic entry see Field 5B.
W91-00671

HEAVY METALS DISTRIBUTION AND ENRICHMENT IN THE SEDIMENTS OF SOUTHERN EAST COAST OF INDIA.
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W91-00701

NEGATIVE OXYGEN TRENDS IN SWEDISH COASTAL BOTTOM WATERS.
Kristenebergs Marinbiologiska Station, Fiskebackskil (Sweden).
R. Rosenberg.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 335-339, July 1990. 3 fig, 1 tab, 29 ref.

Descriptors: *Dissolved oxygen, *Fjords, *Sweden, *Water depth, Brackish water, Eutrophication, Halocline.

Temporal trends in annual minimum oxygen concentrations in the bottom water of fourteen marine coastal areas, from the open coast to semi-enclosed areas, have been investigated from the early 1950's or 1960's up to 1984. The water at all locations is stratified more or less all year round, with brackish water at the surface, a halocline at 10 to 20 m, and deeper oceanic water below. The variation in bottom oxygen concentrations was great, with low minimum values (< 1 ml/L) recorded at the most enclosed stations. At twelve stations a significant declining trend could be demonstrated, but at three of these that trend could have been caused by slightly increased recordings over time. The likely reason for the decline is suggested to be increased large scale eutrophication, and such deterioration in the coastal marine environment could be interpreted as a serious warning signal. (Brunone-PTT)
W91-00703

COMPARATIVE DATA ON PRIMARY PRODUCTIVITY AND MINERAL PHOSPHORUS UPTAKE IN THE EUPHOTIC ZONE OF THE MEDITERRANEAN AND BLACK SEA.
Institutul Roman de Cercetari Marine, Constanta (Romania).
For primary bibliographic entry see Field 2L.
W91-00710

TRANSFORMATION AND TRANSPORT OF AMMONIUM NITROGEN IN A FLOODED ORGANIC SOIL.
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
For primary bibliographic entry see Field 5B.
W91-00716

NITROGENOUS NUTRIENT TRANSFORMATIONS IN THE SPRING AND FALL IN THE CHESAPEAKE BAY.

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 2L.
W91-00718

DETERMINATION OF WARFARIN IN DRINKING WATER BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY AFTER SOLID-PHASE EXTRACTION.
Gacell Labs. A.B., Malmo (Sweden). Analytical and Quality Development Dept.
For primary bibliographic entry see Field 5A.
W91-00723

DETERMINATION OF FUNGISTATIC QUATERNARY AMMONIUM COMPOUNDS IN BEVERAGES AND WATER SAMPLES BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY.
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Elintarvikelaboratorio.
For primary bibliographic entry see Field 5A.
W91-00724

DETERMINATION OF BORATE AT TRACE LEVELS IN ENVIRONMENTAL SAMPLES BY ION-EXCLUSION CHROMATOGRAPHY.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5A.
W91-00725

DETERMINATION OF RESIN AND FATTY ACIDS IN PULP AND PAPER MILL EFFLUENTS AND WHITE WATERS BY GAS-LIQUID CHROMATOGRAPHY.
Ukrainskii Nauchno-Issledovatel'skii Inst. Tselliuloznoii Bumazhno Promyshlennosti, Kiev (USSR).
For primary bibliographic entry see Field 5A.
W91-00726

SIMPLE DEVICE FOR THE DETERMINATION OF VOLATILE CHLORINATED HYDROCARBONS IN WATER BY GAS CHROMATOGRAPHY.
Vyzkumny Ustav Vodohospodarsky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 5A.
W91-00727

SIMULTANEOUS DETERMINATION OF NITRITES, NITRATES AND AMINES BY ION-INTERACTION REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY.
Turin Univ. (Italy). Dipt. di Chimica Analitica.
For primary bibliographic entry see Field 5A.
W91-00728

SEDIMENT-WATER INTERACTION AS A CONTROL ON GEOCHEMICAL EVOLUTION OF PLAYA LAKE SYSTEMS IN THE AUSTRALIAN ARID INTERIOR.
Queensland Univ. of Technology, Brisbane (Australia). Dept. of Applied Geology.
For primary bibliographic entry see Field 2H.
W91-00736

METAL CONCENTRATIONS IN SURFICIAL SEDIMENTS FROM HYPERSALINE LAKES, AUSTRALIA.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
W. B. Lyons, A. R. Chivas, R. M. Lent, S. Welch, and E. Kiss.
Hydrobiologia HYDRB8, Vol. 197, p 13-22, May 31, 1990. 3 fig, 5 tab, 23 ref.

Descriptors: *Australia, *Geochemistry, *Heavy metals, *Lakes, *Limnology, *Metals, *Saline lakes, *Sediments, *Water chemistry, Cyanophyta, Gold mining, Groundwater, Mine drainage, Minerals, Radioisotopes, Sinks, Sulfides.

A preliminary survey of analyzed surface sediment samples from approximately twenty lakes in Australia for Fe, Cu, Pb and Zn concentrations was conducted. In addition lake sediments from the gold mining areas of Western Australia (WA) were analyzed for Ag, and samples from NW Victoria were analyzed for Mn, Ni, Co, Cr and V. These lakes are discharge zones for regional and/or local saline groundwaters. The groundwaters entering many of these lakes have very low pH's (pH 3-4) and contain extremely high dissolved Fe concentrations. These low pH waters may also contain high concentrations of trace metals and radionuclides from the U-238 decay series. The WA data yield the following information: (1) with the possible exception of Ag, these sediments show no trace metal enrichments above average shale/sandstone values; (2) some lakes draining Archean gold mining terrain have high Ag concentrations; (3) the highest Pb concentrations are in a lake where acid groundwater input occurs; and (4) the acid mineral alunite does not appear to be a metal 'sink' in the acid groundwater lakes. In the two NW Victorian lakes, the sulfide zone below the cyanobacterial mat is enriched about 100 times for Cu, 30 times for Zn and 78 times for Pb compared to the sediments outside the discharge zone. The Victorian data set indicates a correlation between Cu and Zn and also between Cr and Ni concentrations. Three generations of 'ironstone-like' sediments were also analyzed. These iron-oxide rich sediments gained Cu but lost Co with age and maturation. The Mn concentration appears to be important in controlling the Zn and Cu in these 'ironstones'. It appears from the data that neither the oxide-rich nor the acid-rich authigenic sediment phases are major sinks for groundwater metal in these systems. (Author's abstract)
W91-00737

HEAVY METALS IN THE DEAD SEA AND THEIR COPRECIPITATION WITH HALITE.
Weizmann Inst. of Science, Rehovoth (Israel).
For primary bibliographic entry see Field 2H.
W91-00738

EVOLUTION OF SALINE LAKE WATERS: GRADUAL AND RAPID BIOGEOCHEMICAL PATHWAYS IN THE BASOTU LAKE DISTRICT, TANZANIA.
Michigan Univ., Ann Arbor. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-00739

HYDROGEOCHEMISTRY OF LAKE GALLOCANTA (ARAGON, NE SPAIN).
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W91-00740

RECENT CARBONATE SEDIMENTATION AND BRINE EVOLUTION IN THE SALINE LAKE BASINS OF THE CARIBOO PLATEAU, BRITISH COLUMBIA, CANADA.
Saskatchewan Univ., Saskatoon. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2H.
W91-00741

NUTRIENTS IN PORE WATERS FROM DEAD SEA SEDIMENTS.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2H.
W91-00742

INFLUENCE OF SALINITY ON THE CONCENTRATION AND RATE OF INTERCHANGE OF DISSOLVED PHOSPHATE BETWEEN WATER AND SEDIMENT IN FUENTE PIEDRA LAGOON (S. SPAIN).
Malaga Univ. (Spain). Facultad de Ciencias.
For primary bibliographic entry see Field 2L.
W91-00743

SOLUBILITY OF OXYGEN IN THE DEAD SEA BRINE.
Kinneret Limnological Lab., Tiberias (Israel).
A. Nishri, and S. Ben-Yaakov.
Hydrobiologia HYDRB8, Vol. 197, p 99-104, May 31, 1990. 6 fig, 2 tab, 12 ref.

Descriptors: *Analytical methods, *Dead Sea, *Dissolved oxygen, *Lakes, *Oxygen, *Saline lakes, *Solubility, *Water chemistry, Brines, Polarographic analysis, Temperature effects, Volumetric analysis, Winkler method.

Three analytical approaches were evaluated to determine the oxygen solubility in the Dead Sea waters (DSW) and the feasibility of using different analytical methods for determining the concentration of dissolved oxygen in this brine. The solubility of the oxygen in the Dead Sea brine was determined over the temperature range 5 to 50 C using a modified Winkler titration, volumetric analysis, and a polarographic sensor. The modified Winkler titration procedure is shown to be a reliable technique for measuring dissolved oxygen concentration in the highly saline DSW. At this time, the Clark type polarographic electrode is of value only for short duration dissolved oxygen measurements in DSW; its application for routine analysis is difficult. The solubility at room temperature and 1 atmosphere pressure was approximately 1 mg/L, and the temperature coefficient was 0.006 mg/L C. The data were nearly consistent with sea water solubility extrapolated to Dead Sea brine salinity. (Agostine-PTT)
W91-00744

VERNAL MICROSTRATIFICATION PATTERNS IN A MEROMICTIC SALINE LAKE: THEIR CAUSES AND BIOLOGICAL SIGNIFICANCE.
British Columbia Univ., Vancouver. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00745

PRODUCTION AND DECOMPOSITION IN A SALINE MEROMICTIC LAKE.
British Columbia Univ., Vancouver. Westwater Research Centre.
For primary bibliographic entry see Field 2H.
W91-00746

CHANGES IN LAKE LEVELS, SALINITY AND THE BIOLOGICAL COMMUNITY OF GREAT SALT LAKE (UTAH, USA), 1847-1987.
Geological Survey, Salt Lake City, UT.
For primary bibliographic entry see Field 2H.
W91-00748

PHOTOSYNTHESIS OF DUNALIELLA PARVA LERCHE AS A FUNCTION OF TEMPERATURE, LIGHT AND SALINITY.
Malaga Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W91-00750

COMPARATIVE LIMNOLOGY OF SAMBHAR AND DIDWANA LAKES (RAJASTHAN, NW INDIA).
Jodhpur Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00756

SALINITY AS A DETERMINANT OF SALT LAKE FAUNA: A QUESTION OF SCALE.
Adelaide Univ. (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00757

MULTIVARIATE ANALYSIS OF DIATOMS AND WATER CHEMISTRY IN BOLIVIAN SALINE LAKES.
Museume National d'Histoire Naturelle, Paris (France). Lab. de Geologie.
For primary bibliographic entry see Field 2H.
W91-00758

HYDROCHEMISTRY FROM SR AND MG CONTENTS OF OSTRACODES IN PLEISTOCENE LACUSTRINE DEPOSITS, BAZA BASIN (SE SPAIN).
Instituto de Investigaciones Geologicas Jaime Almera, Barcelona (Spain).
For primary bibliographic entry see Field 2H.
W91-00759

SPECTROSCOPIC INVESTIGATIONS OF PEAT-WATER INTERACTIONS: AN ESR, FT-IR, AND NMR STUDY.
Umea Univ. (Sweden). Dept. of Physical Chemistry.
For primary bibliographic entry see Field 2H.
W91-00789

SURVEY OF THE PROTEIN CONTENT IN ESTUARINE WATERS.
Cochin Univ. of Science and Technology (India). School of Marine Sciences.
For primary bibliographic entry see Field 2L.
W91-00795

WATER CHEMISTRY OF THE SOLIMOES/AMAZON RIVER (A HIDROQUIMICA DO RIO SOLIMOES/AMAZONAS).
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
U. M. Santos, and M. N. G. Ribeiro.
Acta Amazonica AAMZAZ, Vol. 18, No. 3/4, p 145-172, 1989. 8 fig, 2 tab, 29 ref. English summary.

Descriptors: *Amazon River, *Brazil, *Physicochemical properties, *Solimoes River, *Water chemistry, *Water quality, Humic substances, Oxygenation, Seasonal variation, Sediments.

Physical and chemical studies were conducted at 11 sites on the Solimoes/Amazon River and in thirty-one tributaries and branches from the Brazil-Peru-Columbia border, in Tabatinga, to the town of Santarem, in the state of Para. A total distance of 2457 km was covered. All the muddy water rivers form varzeas (rich humic lowlands formed during the low water period), which are rich in mineral nutrients and contain along lakes, paranas (branches of a river that conducts water downstream to the same river, or another river altogether), igapos (flooded forests) along their entire length. A large amount of floating vegetation is present which decomposes and produces toxic gases, such as hydrogen sulfide, methane, and carbon dioxide. The lakes and the varzea work as a 'sponge', absorbing suspended sediments, mineral and organic nutrients. The dark water rivers do not form varzeas, but rather beaches (dry season) and igapos (rainy season), due to the low amount of sediments. The dark color is due to colored substances, such as humic material, that limit the production of phytoplankton. The clear water rivers do not form varzeas either, but rather beaches with a few igapos. They show a blue-green color due to large formations of Cyanophyta. The muddy water rivers which contain higher concentrations of sediments during the period from November to April are supplied with resuspended sediments due to an increase in flow and partially due to the phenomenon of 'falling land'. It is possible that the Solimoes/Amazon River receives mineral and organic supplies from muddy water rivers, small rivers barraged in its mouth, rivers with small flushes of limestone, and rivers with large amounts of colored substances. The lowest temperatures in the Solimoes-Amazon River occur in the period of main channel flooding, while the highest occur in the summer. The lowest concentrations of oxygen occur during the period from April to July, and are due to oxidized water coming from varzeas and lakes. (Author's abstract)
W91-00820

DEGRADATION OF POLYPHENOLS IN FIVE PLANT SPECIES IN THE AQUATIC ENVIRONMENT (DEGRADACAO DE PLOIFENOIS EM CINCO ESPECIES VEGETAIS EM AMBIENTES AQUATICOS).
Convenio Eletronorte/CNPq/INPA, Brazil.
For primary bibliographic entry see Field 2H.
W91-00821

ATMOSPHERIC CHEMISTRY OF PEROXIDES: A REVIEW.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-00841

CHEMICAL COMPOSITION DIFFERENCES IN FOG AND CLOUD DROPLETS OF DIFFERENT SIZES.
California Inst. of Tech., Pasadena. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2B.
W91-00854

CHEMICAL STUDIES OF CHLORIDE AND STABLE OXYGEN ISOTOPES IN TWO CONIFER AFFORESTED AND MOORLAND SITES IN THE BRITISH UPLANDS.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W91-00890

CLASSIFICATION OF SHALLOW GROUNDWATER TYPES IN A DUTCH COVERSAND LANDSCAPE.
Amsterdam Univ. (Netherlands). Landscape and Environmental Research Group.
B. Pedroli.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 361-375, July 1990. 3 fig, 4 tab, 29 ref.

Descriptors: *Aquifers, *Geochemistry, *Groundwater chemistry, *Statistical analysis, *The Netherlands, *Water chemistry, Calcium, Chemical analysis, Classification, Cluster analysis, Data interpretation, Geohydrology, Groundwater level, Groundwater movement, Hydrogen ion concentration, Magnesium, Piezometers, Sand aquifers.

The numerical classification of shallow groundwater samples was determined on the basis of their chemical composition. Seven times in the course of one year, water was sampled from 50 piezometric tubes installed in a sandy lowland area of 20 square kilometers, used as a nature reserve and farming land. Water-table depth varies between 0 and 5 m below soil surface in the study area. A total of 416 samples was analyzed. Cluster analysis and subsequent discriminant analysis were applied to the log-transformed concentrations. Two subsets were considered, one with samples of pH < 5, the other with samples of pH > 5. In both cases the 8-cluster solution of a maximum likelihood clustering method appeared to be stable. The characteristics of the resulting 16 water types were readily interpretable with reference to landscape setting and temporal variation. The spatial distribution of the water types was mapped. The chemical composition of groundwater proved to be relatively constant over a large part of the area, owing to high inputs of mineralization products or fertilizers in the recharge areas. Variation was largest around the relatively small seepage area, in zones where infiltrating water interferes with discharging deep groundwater, comparable to Van Wirdum's poikilotrophic zones. Key factors for statistical classification of groundwater types differed depending on the nature of the water types considered. Mg appeared to discriminate better than Ca between the water types in both subsets. pH discriminated only in the near-neutral subset and the anions in the acid subset. (Author's abstract)
W91-00895

EFFECTS OF CATCHMENT LIMING AND AFFORESTATION ON THE CONCENTRATION AND FRACTIONAL COMPOSITION OF ALUMINUM IN THE LOCH FLEET CATCHMENT, SW SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 5G.
W91-00897

METHOD TO EXTRACT SOIL WATER FOR STABLE ISOTOPE ANALYSIS.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2G.
W91-00898

2L. Estuaries

EFFECTS OF A FIXED-CREST WEIR ON BROWN SHRIMP PENAEUS AZTECUS GROWTH, MORTALITY, AND EMIGRATION IN A LOUISIANA COASTAL MARSH.
Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
For primary bibliographic entry see Field 8I.
W91-00010

COMPARISON OF VESICULAR-ARBUSCULAR MYCORRHIZAE IN PLANTS FROM DISTURBED AND ADJACENT UNDISTURBED REGIONS OF A COASTAL SALT MARSH IN CLINTON, CONNECTICUT, USA.
Connecticut Univ., Storrs. Dept. of Ecology and Evolutionary Biology.
For primary bibliographic entry see Field 2I.
W91-00029

TIDES IN THE ENGLISH CHANNEL AND SOUTHERN NORTH SEA. A FREQUENCY DOMAIN ANALYSIS USING MODEL TEA-NL.
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
A. M. Baptista, J. J. Westerink, and P. J. Turner.
Advances in Water Resources AWREDI, Vol. 12, No. 4, p 166-183, December 1989. 16 fig, 8 tab, 25 ref. USGS Cooperative Agreement No. 13-08-001-A0510.

Descriptors: *Coastal waters, *English Channel, *Finite element method, *Mathematical models, *Model studies, *North Sea, *Tides, Data collections, Model testing, Performance evaluation, Water circulation.

The frequency-time finite element model TEA-NL (Non-linear Tidal Embayment Analysis) was used to investigate tidal propagation and circulation in the English Channel and the southern North Sea, in the context of the Tidal Flow Forum (TFF) benchmark. The nonlinear load terms were generated at each cycle of the iteration in the time domain using previously-computed harmonic responses. Major tidal propagation features were fairly well reproduced, except for sexto-diurnal constituents, which suffered from excessive spurious spatial oscillations. Results at control stations for elevations compared favorably with those obtained with other state-of-the-art circulation models, especially at Christchurch and Walton. An appropriate choice of internal parameters (Relaxation factor, tolerance criterion, number of auxiliary frequencies, and number of sampling points) was found to be critical for TEA-NL's computational efficiency: for different combinations, processing time (and, hence, computational cost) could vary by an order of magnitude without noticeable change in accuracy. The present representation of the 'sea truth' of the TFF database, at the boundaries and at the 11 control stations, raises questions of reliability and completeness (e.g., the database severely constrains the ability to study tidal nonlinearities in the system). (Medina-PTT)
W91-00045

COMPARISON OF TWO FINITE ELEMENT MODELS OF TIDAL HYDRODYNAMICS USING A NORTH SEA DATA SET.
Geological Survey, Tacoma, WA. Water Resources Div.
R. A. Walters, and F. A. Werner.
Advances in Water Resources AWREDI, Vol. 12, No. 4, p 184-193, December 1989, 9 fig, 1 tab, 19 ref. NSF Grant CEE-8352226.

Descriptors: *Finite element method, *Hydrodynamics, *Mathematical models, *Model studies, *North Sea, *Tides, Comparison studies, Data col-

lections, English Channel, Flow friction, Flow velocity.

The results of two independent finite-element models of tidal hydrodynamics, a time-stepping model and a harmonic model, were compared. The regions of the English Channel and the southern bight of the North Sea were used in the comparison. The model results were in close agreement with each other, and differed most in those areas of large current velocity and large velocity gradient such as the region near Cherbourg, France. In addition, comparison of the two models indicated that the nonlinear terms in the equations of motion can be properly treated in the frequency domain through a truncated series representation for bottom friction, and through a direct representation for the advective and wave-drift terms. It was also found that the use of high-order numerical quadrature schemes led to noisy and unacceptable results for the residual velocity. This model intercomparison provides a means for increasing the understanding of the relevant physical processes in the region in question as well as a means for the evaluation of certain algorithmic procedures of the two models. (Medina-PTT)
W91-00046

TIDAL FLOW SIMULATION IN THE ENGLISH CHANNEL AND SOUTHERN NORTH SEA.
Katholieke Univ. Leuven (Belgium). Dept. of Civil Engineering.
C. S. Yu, M. Fettweis, I. Hermans, and J. Berlamont.
Advances in Water Resources AWREDI, Vol. 12, No. 4, p 194-203, December 1989. 8 fig, 4 tab, 20 ref.

Descriptors: *Coastal waters, *English Channel, *Mathematical models, *Model studies, *North Sea, *Simulation, *Tidal currents, Bathymetry, Chezy equation, Data collections, Error analysis, Friction, Mannings equation, Sensitivity analysis, Tidal amplitude.

The results of the II ('revised') Tidal Flow Forum experiment for the English Channel and the southern North Sea are presented. The FADI (falsified alternating direction implicit) scheme and the data base of the Tidal Flow Forum were used for modeling. Discrepancies between the model results and the distributed field data of 11 tide stations and 8 tidal current measurement points were quantified by calculating the RMS (root mean square) errors and the standard deviations. Tidal amplitudes were generally underestimated except for one station. In order to investigate these discrepancies, experiments were carried out to test the sensitivity of the model to certain parameters. The influences of different coordinate systems, time steps, Chezy coefficient values, friction laws (Manning instead of Chezy), and the expression of the Coriolis acceleration were investigated. The results which best fit the reference data were obtained by using Manning's friction law. By doing so, the model can be more appropriately adapted to the complex bathymetry and geometry in the model area. This complexity is due to the presence of many sand banks and gullies in the southern North Sea and of many islands and tidal flats in the English Channel. (Medina-PTT)
W91-00047

SIMULATION OF THE TIDAL FLOW IN THE ENGLISH CHANNEL AND THE SOUTHERN NORTH SEA BY A CURVILINEAR FINITE DIFFERENCE MODEL.
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
N. Praagman, J. Dijkzeul, R. van Dijk, and R. Plieger.
Advances in Water Resources AWREDI, Vol. 12, No. 4, p 204-210, December 1989. 5 fig, 1 tab, 13 ref.

Descriptors: *English Channel, *Finite difference methods, *Mathematical models, *Model studies, *North Sea, *Tidal currents, Coastal waters, Comparison studies, Model testing, Simulation, The Netherlands.

A curvilinear finite-difference model was used to simulate tidal flow in the southern North Sea and the English Channel and its results were compared with those from linear finite differences models. This mathematical model was developed primarily for the simulation of flood levels in the major Dutch rivers but, through the use of deformed meshes, it also seemed appropriate for computing flow patterns and water elevations in coastal areas. The model also permitted locally increasing the density of computational points in order to represent local flow patterns and elevations more accurately. In general, the results of the curvilinear model were at least as accurate as the results of the linear models. However, the number of computational points was increased by a factor of 1.5 and the computation time increased by a factor of 3 due to these extra points and to the calculation of the extra terms and coefficients in the curvilinear equations. Thus, the advantages over the linear method are not as evident in this application as they are in the case of river computations. (Medina-PTT)
W91-00048

GEOMORPHOLOGICAL EFFECTS OF CATASTROPHIC FLOODING ON A SMALL SUBTROPICAL ESTUARY.
Council for Scientific and Industrial Research, Congella (South Africa). Estuaries and Coastal Processes Programme.
For primary bibliographic entry see Field 2J.
W91-00049

ECOLOGY OF MARINE BENTHIC DIPTERANS IN A TIDAL CREEK OF HOOGHLY ESTUARY, SAGAR ISLAND, INDIA.
Calcutta Univ. (India). Dept. of Marine Science.
S. Ray, and A. Choudhury.
Journal of Bengal Natural History Society, Vol. 9, No. 1, p 4-14, June 1990. 3 fig, 3 tab, 12 ref.

Descriptors: *Aquatic insects, *Ecological distribution, *Estuaries, *Estuarine ecosystems, *India, *Marine animals, *Tidal rivers, Rainfall, Salinity, Soil organic matter, Soil temperature, Soil water.

Larvae and pupae of marine benthic Diptera were sampled from the sand flats of a tidal creek of Hooghly estuary, Sagar Island. A total of 14 species of dipterans belonging to 5 families and 11 genera were recorded. Ceratopogonids were the most dominant fauna followed by ephydrids, tabanids, chironomids and psychodids. Soil moisture, soil temperature, rainfall, and salinity appear to be major factors controlling their distribution and abundance in the littoral habitat as evident from correlation coefficient analysis. Correlation data also indicate a direct relationship between organic nutrients and abundance of some species. (Medina-PTT)
W91-00051

PROPAGATION OF PERIODIC WAVES IN THE LIDO CHANNEL OF THE VENICE LAGOON.
F. Mattioli.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 41-48, March 1990. 11 fig, 21 ref.

Descriptors: *Finite element method, *Italy, *Lido Channel, *Mathematical models, *Model studies, *Periodic waves, *Venice Lagoon, *Wave propagation, Wave action, Wave refraction.

An elliptical approach to numerical modeling of the propagation of periodic waves in the Lido Channel, connecting the Adriatic sea to the Venice lagoon, was enhanced by the use of a finite element, series-expansion technique. The main numerical difficulties arose from the large size of the sea region to be modeled, which was on the order of 1 sq km, and from the wide variations in water depth. The wave field was evaluated both in the presence and absence of a breakwater which partially closes access to the lagoon. Since the model is linear, only a crude representation of the shallow sea regions was possible. Nevertheless, the model was able to answer problems that could not be easily handled by other techniques, because of the complicated interaction of refraction, reflection and diffraction phenomena. (Author's abstract)
W91-00121

LONGSHORE-TRANSPORT MODEL FOR SOUTH INDIAN AND SRI LANKAN COASTS.
National Inst. of Oceanography, Panaji (India).
P. Chandramohan, B. U. Nayak, and V. S. Raju.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 116, No. 4, p 408-424, July/August 1990. 8 fig, 1 tab, 16 ref.

Descriptors: *Coastal engineering, *Coasts, *Erosion rates, *India, *Longshore currents, *Sediment transport, *Sedimentation rates, *Silting, *Sri Lanka, Estuarine sediments, Littoral drift, Tidewater.

The Indian coastline has direct bearing on the socioeconomic development of the nation's sea trade, fishing and marine industry, and human settlement. Erosion near the ports and siltation in most of the tidal inlets is of great concern to Indian coastal engineers. Longshore sediment transport rates for the south Indian coast from Allur to Cochin and for Sri Lanka were estimated from ship-reported wave data (1968-1986). Annual gross sediment transport rate is high (1,500,000 to 2,000,000 cu m) along the coasts of north Tamil Nadu and south Kerala and is less (500,000 to 1,000,000 cu m) along the south Tamil Nadu and Sri Lankan coasts. The annual net transport is southerly along the west coast of India and predominantly northerly along the east coast except near Durgarajupatnam in Andhra Pradesh. Coasts near Tharangampadi, Karaikal, Nagore, Tuticorin, Virapandianpatinam, and Manakkodam in India and Kuchchaveli, Betticola, Pottuvil, Chilaw, and Negombo in Sri Lanka appear to be nodal drift points, with an equal volume of transport in either direction annually. (Fish-PTT)
W91-00176

IMPROVEMENT OF BYPASSING AND BACKPASSING AT TIDAL INLETS.
For primary bibliographic entry see Field 8A.
W91-00178

OPTIMIZATION OF FRESHWATER INFLOW TO ESTUARIES.
Wyoming Univ., Laramie. Water Resources Research Inst.
Y. K. Tung, Y. Bao, L. W. Mays, and G. Ward.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 567-584, July/August 1990. 9 fig, 5 tab, 7 ref, append.

Descriptors: *Estuaries, *Freshwater, *Model studies, *Optimization, *Saline-freshwater interfaces, *Water resources management, Estuarine fisheries, Fish harvest, Nonlinear programming, Regression analysis, Saline water intrusion, Shrimp, Texas.

A method has been developed that can be used to determine the optimal freshwater inflows into bays and estuaries for the purpose of balancing freshwater demands with the harvest of various types of estuarine resources (e.g., finfish and shrimp). The optimization problem is a nonlinear programming problem solved using a generalized reduced gradient technique. Salinity is expressed as a function of freshwater inflow in a nonlinear regression equation and used as a constraint. Additional nonlinear constraints are the harvest regression equations for the various species that express harvest as a function of the quantity of freshwater inflow. Because of the uncertainty associated with the regression equations for salinity and harvest, these constraints are expressed in a chance-constrained formulation. The method was applied to the Lavaca-Tres Palacios Estuary in Texas. The results indicated that the minimum freshwater inflow requirement increases as the required reliability of chance constraints increases. The uncertainty in the regression equations limits the maximum achievable reliability. (Author's abstract)
W91-00187

POTENTIAL FOR AGRICULTURAL PESTICIDE RUNOFF TO A PUGET SOUND ESTUARY: PADILLA BAY, WASHINGTON.
Western Washington Univ., Bellingham. Inst. for Watershed Studies.
For primary bibliographic entry see Field 5B.
W91-00204

BENTHIC MACROFAUNA AND ANCILLARY DATA FOR SAN FRANCISCO BAY, CALIFORNIA, JANUARY TO NOVEMBER 1988.
Geological Survey, Sacramento, CA.
L. E. Schemel, A. Y. Ota, J. G. Harmon, J. M. Shay, and R. M. Adorador.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-596, 1990. 65p, 1 fig, 7 tab, 9 ref. Prepared in cooperation with the California State Water Resources Control Board.

Descriptors: *Benthic fauna, *California, *Estuarine environment, *Physicochemical properties, *San Francisco Bay, *Suspended sediments, Introduced species, Monitoring, Salinity, Species composition, Water temperature.

Benthic macrofauna and ancillary data were collected during 1988 as part of the U S Geological Survey Regional Effects Monitoring Program in San Francisco Bay, California. Data were collected during six cruises at 2-month intervals from January to November. Benthic macrofauna for identification and counting of species and sediments for size analysis were collected at eight stations. Temperature, salinity, and concentrations of dissolved oxygen and suspended sediment were measured at 12 stations. Salinity was measured at three stations that coincided with continuous monitoring stations. The percentage of benthic macrofauna specimens that could be identified to the species level varied among sampling stations. Based on annual averages at each station, this percentage ranged from 60 to 95 percent. Three or fewer species represented from 25 to 75 percent of the total number of specimens at all stations. This percentage changed over time, as did the species. The annual average number of species per sample ranged from 4 to 21. Stations in the southern bay were typically higher in number of species and number of specimens per sample than those in the northern bay. The newly introduced species of clam, Potamocorbula amurensis, persisted as an abundant species in the northern bay, and became more abundant at all stations in the southern bay except one. (Author's abstract)
W91-00343

LOCATING AND IDENTIFYING HYDRAULIC CONTROLS FOR LAYERED FLOW OVER AN OBSTRUCTION.
California Univ., Berkeley. Dept. of Civil Engineering.
R. A. Denton.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 281-299, 1987. 9 fig, 2 tab, 23 ref. NSF Grant CEE-8212073.

Descriptors: *Fjords, *Hydraulics, *Mathematical models, *Model studies, *Saline-freshwater interfaces, *Stratified flow, Hydraulic grade, Hydraulic models, Mathematical analysis, Mathematical equations.

The density stratification in a fjord can be approximated as a shallow layer of brackish water overlying a layer of ocean water. During the period of maximum tidal currents the flow over the fjord sill can become critical with respect to the first mode internal wave and produce, internally, a flow very similar to the classical case of critical control of open-channel flow over a hump. The build-up of internal energy upstream of the flow obstruction is dissipated downstream through interfacial mixing. A methodology is presented for locating the hydraulic controls for layered flow, when both the bed elevation and flow width are varying. The model is, based on singular points in the solution of the gradually varying flow equations for the free surface and interface slopes. The hydraulic control of two-layer flow through an obstruction can be explained in terms of the gradually varying flow equation for the interface slope. The controls occur at a transition from subcritical to supercritical flow and the interface can remain smooth and continuous if the control corresponds to a singular point of the saddle kind. Because of the interaction of the variations in flow width and bottom elevation in the obstruction, the type of control changed from maximum constriction control to virtual and approach control as the flow rates or flow constriction increased. The control for two-layer flow in one direction through an obstruction with asymmetric geometry is generally different than the control when the flow is in the opposite direction. This is more complicated than single-layer flow where only maximum constriction control is possible. Although friction effects have been neglected in the two-layer analysis, interfacial and bottom friction can alter the transition curves and thereby change the location of the hydraulic control. (Hoskin-PTT)
W91-00374

DISTRIBUTIONS AND POPULATION STRUCTURES OF TWO INTERTIDAL ESTUARINE POLYCHAETES IN THE LOWER ST. LAWRENCE ESTUARY, WITH SPECIAL REFERENCE TO ENVIRONMENTAL FACTORS.
Quebec Univ., Rimouski. Dept. of Oceanography.
G. Y. Miron, and G. L. Desrosiers.
Marine Biology MBIOAJ, Vol. 105, No. 2, p 297-306, June 1990. 6 fig, 57 ref. NSERC Canada Grant No. A3450.

Descriptors: *Ecological distribution, *Estuarine environment, *Estuarine sediments, *Polychaetes, *Spatial distribution, *St Lawrence Estuary, *Water pollution effects, Aquatic populations, Intertidal areas, Model studies, Seasonal variation, Statistical analysis.

An intensive study of the spatial distribution of Nereis virens (Sars) and Nephtys caeca (Fabricius) was conducted during the spring and autumn of 1986 in the lower St. Lawrence estuary. Statistical analysis showed that spatial variations in density, individual body weight and sexual maturity, particularly in the case of N. virens, are correlated with the intertidal level, with certain sediment characteristics, and with the thickness of the colonizable sediment layer. The density of N. virens increases in an offshore-onshore direction, whereas that of N. caeca decreases in the same direction. For both species, mean body weight increases downshore from the upper intertidal level. Other specific relationships exist in relation to sediment characteristics. Sexually mature N. virens are found only at the lower intertidal level; sexual maturity in N. caeca was not studied. There were no changes in spatial distribution patterns between spring and autumn. The spatial distribution of N. virens parallels depth contours and may reflect its ability to inhabit environments which become more physically unstable in an offshore-onshore direction. This spatial distribution is consistent with a model whereby larvae are recruited in the upper intertidal zone and juveniles migrate downshore. (Author's abstract)
W91-00383

EFFECTS OF WASTES ON THE OCEAN: THE COASTAL EXAMPLE.
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-00385

POTENTIAL FOR ADAPTATION OF THE ESTUARINE COPEPOD EURYTEMORA AFFINIS TO CHLORINE-PRODUCED OXIDANT RESIDUALS, HIGH TEMPERATURE, AND LOW OXYGEN.
Maryland Univ. Baltimore County, Catonsville. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-00512

MULTILAYERED SHARP INTERFACE MODEL OF COUPLED FRESHWATER AND SALTWATER FLOW IN COASTAL SYSTEMS: MODEL DEVELOPMENT AND APPLICATION.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2F.
W91-00591

EFFECT OF TIDAL ACTION ON THE TRANSFORMATIONS OF NITROGEN IN FRESHWATER TIDAL FLAT SEDIMENTS.
Hamburg Univ. (Germany, F.R.). Fachbereich 14 - Biologie.
For primary bibliographic entry see Field 5B.
W91-00649

SEASONAL VARIATION IN THE STRUCTURE OF THE MICROBIAL COMMUNITY CAPABLE OF NITRATE RESPIRATION IN AN INTERTIDAL MUD FLAT SEDIMENT FROM THE ELBE ESTUARY.
Hamburg Univ. (Germany, F.R.). Fachbereich 14 - Biologie.
M. Kerner.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 75, No. 2, p 273-280, 1990. 4 fig, 17 ref.

Descriptors: *Cycling nutrients, *Germany, *Microorganisms, *Nitrates, *Sediments, *Tidal flats, Elbe River, Estuaries, Metabolism, Oxygen, Respiration, Seasonal variation, Temperature.

Temperature-dependent nitrate consumption was determined in a suspension system from the sediment surface layers of an intertidal mud flat sediment in the Elbe Estuary. Sediment samples from depths of 0-2, 2-4, 6-8, and 10-12 cm were incubated under oxygen-free conditions at various temperatures in 2.7-C intervals from 5 to 40 C, and the changes in the concentrations of nitrate were monitored for three hours. From 5 to 11 C, only small changes in respiration rates during the year were found for the sediment layers from the surface to the depth of 12 cm. At 11 C the average rate determined for the sediment surface was 0.00297 micromole/gsec, whereas for the 2-4 cm layer the value was 0.00202 micromole/gsec. Below 4 cm, the average rate was 0.00077 micromole/gsec. In winter no optimum temperature was found for nitrate respiration in the sediment from the surface to the lowest depth tested. Until November, bacteria adapted to the warmth became dominant among those using nitrate for respiration. A single temperature optimum of 32 C was found for the surface layer. In the sediment layers deeper than 4 cm, there were only small changes in the capacity of the microbial community for nitrate respiration during the year, and an optimum temperature was never found. (See also W91-00649) (Author's abstract)
W91-00650

POTENTIAL BIO-AVAILABLE PHOSPHORUS IN SEDIMENTS OF THE RIVER ELBE IN NORTHERN GERMANY.
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Chemie.
K. Wiltshire.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 75, No. 2, p 281-297, 1990. 14 fig, 2 tab, 36 ref. EEC Contract EU40-0124-CBA.

Descriptors: *Cycling nutrients, *Elbe River, *Estuaries, *Germany, *Phosphorus, *Sediments, Anaerobic conditions, Muhlenberger Loch, Neufelder Watt, Oxygen.

Sediments from the Muhlenberger Loch (633 km) and Neufelder Watt (703 km) were obtained from the River Elbe and subjected to a sequential extraction scheme. The types and amounts of different phosphorus species were assessed. The fraction characterization was done according to the solution properties of the various phosphorus components. The non-apatite, easily soluble, fractions were classed as potentially bio-available compounds. They accounted for up to 80% of the total extractable phosphorus present. To allow an assessment of extraction fractions sensitive to the

presence of oxygen, the relevant extraction steps were carried out under anaerobic and aerobic conditions. Under anaerobic conditions the more easily extractable compounds were extracted to a significantly higher degree than under aerobic conditions. (Author's abstract)
W91-00651

PHYSICOCHEMISTRY AND VEGETATION OF PICCANINNIE PONDS, A COASTAL AQUIFER-FED POND IN SOUTH-EASTERN SOUTH AUSTRALIA.
Monash Univ., Clayton (Australia). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-00653

ESTIMATING THE CARRYING CAPACITY OF A COASTAL INLET FOR MUSSEL CULTURE.
Department of Fisheries and Oceans, Halifax (Nova Scotia). Biological Sciences Branch.
C. E. A. Carver, and A. L. Mallet.
Aquaculture AQCLAL, Vol. 88, No. 1, p 39-53, July 1990. 6 fig, 2 tab, 36 ref.

Descriptors: *Carrying capacity, *Coastal waters, *Fisheries, *Growth, *Mussels, Aquatic habitats, Organic matter, Particulate matter, Tidal basins.

Carrying capacity, in the context of mussel culture, may be defined as the stock density at which production levels are maximized without negatively affecting growth rates. Preliminary estimates were made of the carrying capacity for a small (0.5 sq km) semi-enclosed coastal inlet located on the eastern shore of Nova Scotia, Canada. The food supply to the system was determined from measurements of tidal exchange and particulate organic matter (POM) over the period of May to October 1986. The food demand, or the mussels' ration, was estimated from grazing experiments conducted in the field. Filtration rates were obtained for mussels feeding on the natural particle spectrum, without subjecting the inflowing water to disruptive pump action. Estimates of the mussels' daily ration (11 to 41 mg POM/mussel/day) were lower than those from other field studies, but comparable to laboratory-derived values. Food supply (gm POM/week) was divided by food demand (gm POM/kg mussels/week) to obtain weekly estimates of carrying capacity for the system. These values ranged from 200,000 to 600,000 kg of market-size mussels (> 50 mm) depending on temporal variations in the food supply. (Author's abstract)
W91-00666

ECOLOGY OF A MEDITERRANEAN-CLIMATE ESTUARINE WETLAND AT CARPINTERIA, CALIFORNIA: PLANT DISTRIBUTIONS AND SOIL SALINITY IN THE UPPER MARSH.
California Univ., Santa Barbara. Dept. of Biological Sciences.
R. M. Callaway, S. Jones, W. R. Ferren, and A. Parikh.
Canadian Journal of Botany CJBOAW, Vol. 68, No. 5, p 1139-1146, May 1990. 7 fig, 3 tab, 44 ref.

Descriptors: *California, *Ecological distribution, *Estuaries, *Limnology, *Marsh plants, *Saline soils, *Salinity, *Salt marshes, *Wetlands, Ecology, Marshes, Seasonal variation, Soil chemistry, Species composition.

Seasonal changes in soil salinity in four different vegetative zones in a mediterranean-climate estuarine wetland in southern California were studied. Each zone had a characteristic seasonal pattern of soil salinity: (1) the low marsh zone was high in salinity throughout the year; (2) the salt flat zone was hypersaline throughout the year; (3) the transition zone was hypersaline in the summer and fall, and low in salinity in the winter and spring; and (4) the non-flooded grassland was low in salinity throughout the year. The transition zone was densely populated with winter annuals that were distributed along gradients of elevation and soil salinity. This occurrence of annuals is a characteristics feature of mediterranean-climate marshes. The relative growth rates and the germination of each of these annuals in experimental solutions of different salinities corresponded with the winter and spring soil salinities of the subzones they occupied in the field. (Author's abstract)
W91-00675

PILOT STUDIES FOR DESIGNS OF SURVEYS OF HUMAN DISTURBANCE OF INTERTIDAL HABITATS IN NEW SOUTH WALES.
Sydney Univ. (Australia). Inst. of Marine Ecology.
For primary bibliographic entry see Field 4C.
W91-00685

MICROPHYTOPLANKTON OF UPWELLING COASTAL WATERS (STATE OF RIO DE JANEIRO): LIST OF SPECIES AND ECOLOGICAL ASPECTS (O MICROFITOPLANCTON DAS AGUAS COSTEIRAS DO LITORAL FLUMINENSE (ESTADO DO RIO DE JANEIRO)): LISTA DE ESPECIES E ASPECTOS ECOLOGICOS.
Instituto Nacional de Estudos do Mar, Arraial do Cabo (Brazil).
N. M. Linsda Silva, J. L. Valentin, and C. T. B. Bastos.
Boletim do Instituto Oceanografico BOCNAO, Vol. 36, No. 1/2, p 1-16, 1988. 8 fig, 4 tab, 21 ref. English summary.

Descriptors: *Brazil, *Ecosystems, *Phytoplankton, *Species composition, *Upwelling, Algal growth, Cyanophyta, Detritus, Statistical analysis.

Phytoplankton of the coastal water between Cabo Frio and Rio de Janeiro were studied at the upwelling season (October, January, and March). Qualitative and quantitative variations are analyzed in function of the hydrological conditions by means of a multivariate statistical treatment of data. Cabo Frio upwelling is responsible for occurrence of a thermocline in the euphotic layer which induces phytoplankton growth, beginning with small-sized species (Nitzschia sp., Skeletonema costatum) and progressing to a high diversity and quantity of microphytoplanktonic forms (Guinardia, Rhizosolenia, Chaetoceras, Thalassiothrix). When the water column is sharply stratified, the influence of Guanabara Bay was observed in the high growth of Skeletonema costatum and high quantity of detritus together with blue-green algae and nanoplanktonic forms. (Author's abstract)
W91-00689

BIOLOGY AND ECOLOGY OF BRACHYURAN DECAPOD CRUSTACEANS IN THE BAY/ESTUARY SYSTEM OF SANTOS AND SAO VINCENTE (SAO PAULO): 1. OCCURRENCE AND SPECIES COMPOSITION (BIOECOLOGIA DE CRUSTACEOS DECAPODOS, BRAQUIUROS, NO SISTEMA BAIA-ESTUARIO DE SANTOS E SAO VINCENTE, SP: 1. OCORRENCIA E COMPOSICAO).
Sao Paulo Univ. (Brazil). Inst. Oceanografico.
P. S. Moreira, A. M. Paiva Filho, C. M. Okida, J. M. M. Schmiegelow, and R. Giannini.
Boletim do Instituto Oceanografico BOCNAO, Vol. 36, No. 1/2, p 55-62, 1988. 4 fig, 2 tab, 18 ref. English summary.

Descriptors: *Crustaceans, *Ecosystems, *Estuaries, *Population dynamics, *Species composition, Sex ratio, Spatial distribution, Water temperature.

Monthly sampling was performed from June 1985 to May 1986 in estuarine and coastal adjacent habitats. Samples were collected using bottom trawls, beach seines, and bottom pots. Fourteen species (6538 individuals) of decapod brachyurans were identified. Callinectus danae was the most abundant species in all habitats, followed by Callinectes sapidus and Portunus spinimanus. Bottom trawling proved to be the most effective fishing technique, catching fourteen species, while the beach seine technique caught eight species and estuarine catches with bottom pots caught five species (all Callinectes). The number of females was higher than males for all dominant species and, generally, this number was higher in the bay region than in either the beach or estuarine habitats. The increase in total catches during the spring and summer months may be correlated with warmer waters and reproduction patterns. (Author's abstract)
W91-00690

ARSENATE SENSITIVITY IN MARINE PERIPHYTON COMMUNITIES ESTABLISHED UNDER VARIOUS NUTRIENT REGIMES.
Goeteborg Univ. (Sweden). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-00700

NEGATIVE OXYGEN TRENDS IN SWEDISH COASTAL BOTTOM WATERS.
Kristenebergs Marinbiologiska Station, Fiskebackskil (Sweden).
For primary bibliographic entry see Field 2K.
W91-00703

COMPARATIVE DATA ON PRIMARY PRODUCTIVITY AND MINERAL PHOSPHORUS UPTAKE IN THE EUPHOTIC ZONE OF THE MEDITERRANEAN AND BLACK SEA.
Institutul Roman de Cercetari Marine, Constanta (Romania).
A. S. Bologa, A. V. Parkhomenko, and V. Smocov.
Cercetari Marine: Recherches Marines CMARDQ, Vol. 19, p 7-21, 1986. 2 fig, 2 tab, 19 ref.

Descriptors: *Black Sea, *Mediterranean Sea, *Nutrients, *Phosphorus, *Primary productivity, Comparison studies, Euphotic zone, Metabolism, Phytoplankton.

Data on phosphorus in the Mediterranean and Black Seas were collected during the 19th cruise of R/V Professor Vodyanitskiy. Collections of sea water were made in the Strait of Sicily (two sectors), Balearic Sea, Aegean Sea, and Black Sea off Cape Caliacra. During May-July 1985, the planktonic productivity of four different sectors of the Mediterranean Sea ranged between 0.5 and 11.3 mg C/cu m/day and 0.06 to 0.48 g C/sq m/day, and in one sector of the Black Sea between 9.4 to 14.7 and 0.78, respectively. Similar phosphate-P concentrations in the water column to 90 were found. The P concentration in the euphotic zone (i.e., to 90 m) did not exceed 0.016 microgram/L in the Mediterranean nor 0.013 microgram/L in the Black Sea. The maximum rate of assimilation of P by microplankton communities in the Mediterranean occurred at the lower limit of the euphotic zone, but in the Black Sea it was within the euphotic zone at approx 10 m depth. (Author's abstract)
W91-00710

SOME PRELIMINARY DATA ON THE NUTRIENT INFLUX INTO THE WESTERN BLACK SEA.
Water Management Office, Constanta (Romania).
For primary bibliographic entry see Field 5B.
W91-00712

IMPACT OF HEAVY METALS ON THE PRIMARY PRODUCTION.
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W91-00713

NITROGENOUS NUTRIENT TRANSFORMATIONS IN THE SPRING AND FALL IN THE CHESAPEAKE BAY.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
S. G. Horrigan, J. P. Montoya, J. L. Nevins, J. J. McCarthy, and H. Ducklow.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 4, p 369-391, April 1990. 6 fig, 4 tab, 40 ref. NSF Grant OCE-82-14932.

Descriptors: *Chesapeake Bay, *Cycling nutrients, *Nitrogen cycle, *Plankton, Algae, Anaerobic conditions, Bacteria, Chlorophyll a, Dissolved oxygen, Isotope studies, Nitrogen isotopes, Seasonal variation, Tracers.

Measurements of the standing stock of phytoplankton, bacterioplankton and particulate carbon and nitrogen, and dissolved pools of inorganic nitrogen were made at a series of stations located in the main channel of the Chesapeake Bay during cruises in the spring and fall of 1984. On each cruise, two transects were conducted along the long axis (N-S) of the bay; comparison of these transects revealed that the horizontal and vertical distribution of O2, chlorophyll a, and dissolved inorganic N can change dramatically on a time scale of days. Experiments were carried out with 15N-labelled substates (NO2(-), NO3(-), and NH4(+) at a subset of the stations. These experiments were designed to measure the fluxes of nitrogen between the dissolved pools as well as the flux into particles. During the spring cruise, a surprisingly high rate of uptake of NO2(-) by particles was found. In the fall, uptake by particles followed previously reported patterns more closely. The flux of N between dissolved inorganic pools was often greater than the flux into particles. The rate of individual reactions varied spatially, and significant activity throughout the water column was often found. The occurrence of typically anaerobic reactions in well-oxygenated waters suggests that anaerobic microzones may be an important site for N transformations in the bay. The present results indicate that the rates of a number of microbially-mediated processes were enhanced greatly by storm-induced mixing of the water column during the fall cruise. Such transient enhancements may have large, and usually undocumented, effect on the N cycle. (See also W91-00719) (Author's abstract)
W91-00718

NATURAL ISOTOPIC COMPOSITION OF DISSOLVED ORGANIC NITROGEN IN THE CHESAPEAKE BAY.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
S. G. Horrigan, J. P. Montoya, J. L. Nevins, and J. J. McCarthy.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 4, p 393-410, April 1990. 5 fig, 1 tab, 36 ref. NSF Grant OCE-82-14932.

Descriptors: *Chesapeake Bay, *Cycling nutrients, *Nitrogen isotopes, *Phytoplankton, Anaerobic conditions, Denitrification, Organic compounds, Seasonal variation.

The natural abundances of N15 in the dissolved inorganic pools of N in the Chesapeake Bay were measured in the spring and fall of 1984. Changes in the delta N15 of ammonium and the combined pool of nitrate plus nitrite reflected both seasonal and short-term changes in the estuarine N cycle. In the spring, oxidation of ammonium at the head of the bay in the region of the turbidity maximum and in localized regions throughout the bay led to elevated values of delta N15 in the ammonium pool. The delta N15 of the nitrate plus nitrite pool tended to increase toward the south, enabling an estimate of the isotopic fractionation factor for the consumption of nitrate to be derived. The estimate (1.0070), is similar to literature values of the fractionation factor for nitrate uptake by phytoplankton, supporting previous research suggesting that phytoplankton uptake is the major sink for nitrate in the bay. Denitrification led to elevated values of delta N15 in the nitrate plus nitrite pool in deep water. Over the course of the summer, the delta N15 of ammonium increased throughout the bay. A significant correlation was found between the delta N15 of the ammonium pool and the concentration nitrite both above and below the pycnocline during the fall cruise, suggesting that the increase in the delta N15 of the ammonium pool was due to the oxidation of ammonium. In the fall, changes also were observed in the delta N15 of both the ammonium and nitrate plus nitrite pools that were consistent with the occurrence of ammonium oxidation. From these changes, a fractionation factor for ammonium oxidation between 1.0120 and 1.0167 was derived, which is similar to published values. (See also W91-00718) (Author's abstract)
W91-00719

QUALITATIVE AND NUMERICAL ANALYSES OF THE EFFECTS OF RIVER INFLOW VARIATIONS ON MIXING DIAGRAMS IN ESTUARIES.
Carnegie Institution of Washington, DC. Geophysical Lab.
L. A. Cifuentes, L. E. Schemel, and J. H. Sharp.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 4, p 411-427, April 1990. 8 fig, 1 tab, 26 ref. NOAA Grant NA83AA-d-0017.

Descriptors: *Estuaries, *Mixing, *River flow, *Water chemistry, Advection, Alkalinity, California, Delaware Bay, Dispersion, Mathematical equations, Numerical analysis, Qualitative analysis, Salinity, San Francisco Bay, Simulation, Theoretical analysis.

The effects of river inflow variations on alkalinity/salinity distributions in San Francisco Bay and nitrate/salinity distributions in Delaware Bay were examined. One-dimensional, advective-dispersion equations for salinity and the dissolved constituents were solved numerically and used to simulate mixing in the estuaries. These simulations account for time-varying river inflow, variations in estuarine cross-sectional area, and longitudinally varying dispersion coefficients. The model simulated field observations better than models that use constant hydrodynamic coefficients and uniform estuarine geometry. Furthermore, field observations and model simulations were consistent with theoretical 'predictions' that the curvature of property-salinity distributions depends on the relation between the estuarine residence time and the period of river concentration variation. (Author's abstract)
W91-00720

EFFECT OF H2S ON HETEROTROPHIC SUBSTRATE UPTAKE, EXTRACELLULAR ENZYME ACTIVITY AND GROWTH OF BRACKISH WATER BACTERIA.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
H. G. Hoppe, K. Gocke, and J. Kuparinen.
Marine Ecology Progress Series MESEDT, Vol. 64, No. 1/2, p 157-167, June 28, 1990. 4 fig, 4 tab, 29 ref. DFG Grant 715/3-2.

Descriptors: *Baltic Sea, *Dissolved oxygen, *Heterotrophic bacteria, *Hydrogen sulfide, Anaerobic conditions, Brackish water, Carbon isotopes, Isotope studies, Metabolism, Tracers.

In some parts of the Baltic Sea, establishment of anoxia, H2S accumulation, and reaeration of the water column are common processes that have a bearing on the heterotrophic microbial community. The influence of these conditions on natural aerobic bacteria populations was studied in 24-hr batch cultures. Measured parameters were: saprophyte number and total number of bacteria, active bacteria (leucine microautoradiography), heterotrophic substrate uptake (14C-labeled glucose, leucine, and lactate), extracellular enzyme activity (beta-glucosidase and peptidase), and growth of bacteria (3H-methyl thymidine incorporation). Anoxia established by N2 had a minor effect on these parameters and values approximated those from the oxic control within one incubation period. Addition of H2S led immediately to a strong, but variable, reduction in all the activity measurements and recovery was weak when H2S conditions were maintained over the experimental period. Re-aeration after 12 hr of H2S incubation caused a progressive increase of the activity measurements, which then greatly exceeded those from the continuously oxic control. An exception was peptidase, which recovered only slowly after H2S depletion. Short-term application of H2S caused clear changes in the metabolic and community structure of the originally aerobic bacterial population, which also were documented by a reduction of the spectrum of morphological cell characters. Cells that survived H2S stress developed vigorously after H2S depletion. Values of bacterial production calculated from increases in absolute bacterial numbers and from thymidine uptake showed the same tendency, but their absolute values differed considerably. This discrepancy may indicate that after H2S stress many of the surviving cells were reactivated, but only a fraction of these started reproduction. (Author's abstract)
W91-00730

INFLUENCE OF SALINITY ON THE CONCENTRATION AND RATE OF INTERCHANGE OF DISSOLVED PHOSPHATE BETWEEN WATER AND SEDIMENT IN FUENTE PIEDRA LAGOON (S. SPAIN).
Malaga Univ. (Spain). Facultad de Ciencias.
V. Clavero, J. A. Fernandez, and F. X. Niell.
Hydrobiologia HYDRB8, Vol. 197, p 91-97, May 31, 1990. 5 fig, 3 tab, 22 ref. Spanish Commission Interministery of Science and Technology Grant PB86-0677.

Descriptors: *Chemical properties, *Cycling nutrients, *Lagoons, *Lakes, *Phosphates, *Salinity, *Sediments, *Spain, *Water chemistry, Dissolved solids, Kinetics, Phosphate removal, Saline lakes.

Relationships between water and sediment have been recognized as important factors in the phosphorus cycle of fresh and seawater systems. Fluxes between water and sediment are influenced by physical, chemical and biological factors. The influence of salinity in: (a) the kinetics of phosphate interchange between water and sediment, and (b) the final equilibrium phosphate concentration in water with different salinities were investigated using sediment as the source of phosphate. Short (60 minutes) and long term (3 hours) experiments were performed to measure the final equilibrium concentration in water and the net fluxes of phosphate interchange between water and sediment at different salinities. The rate of phosphate release from the sediment increased with the salinity increment, as well as the final phosphate concentration. In both short and long term experiments the net rate of dissolved phosphate removal followed saturation kinetics except for long term experiments at 70 g/L salinity. In this case, the relationship between net removal and dissolved phosphate concentration was linear. The experiments show that salinity stimulates phosphate release from sediment. (Agostine-PTT)
W91-00743

PHOTOSYNTHESIS OF DUNALIELLA PARVA LERCHE AS A FUNCTION OF TEMPERATURE, LIGHT AND SALINITY.
Malaga Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W91-00750

HYDROCHEMISTRY FROM SR AND MG CONTENTS OF OSTRACODES IN PLEISTOCENE LACUSTRINE DEPOSITS, BAZA BASIN (SE SPAIN).
Instituto de Investigaciones Geologicas Jaime Almera, Barcelona (Spain).
For primary bibliographic entry see Field 2H.
W91-00759

INFLUENCE OF SEWAGE POLLUTION ON A ROCKY INTERTIDAL COMMUNITY DOMINATED BY THE MYTILID BRACHIDONTES RODRIGUEZI.
Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Buenos Aires.
For primary bibliographic entry see Field 5C.
W91-00764

EFFECTS OF CHANGES IN SEWAGE POLLUTION ON SOFT-BOTTOM MACROFAUNA COMMUNITIES IN THE INNER OSLOFJORD, NORWAY.
Tromsoe Univ. (Norway). Inst. of Fisheries.
For primary bibliographic entry see Field 5C.
W91-00788

SURVEY OF THE PROTEIN CONTENT IN ESTUARINE WATERS.
Cochin Univ. of Science and Technology (India). School of Marine Sciences.
A. N. Balchand, S. M. Nair, and P. N. K. Nambisan.
Toxicological and Environmental Chemistry TXECBP, Vol. 27, No. 4, p 285-296, 1990. 3 fig, 1 tab, 47 ref.

Descriptors: *Estuaries, *Nutrient concentrations, *Proteins, *Water chemistry, Chlorophyll, Dissolved organic carbon, Nitrates, Nitrogen, Phosphates, Phosphorus, Runoff, Statistical analysis, Ureas.

A survey of the protein content in a tropical estuary and its nearshore regions are reported for two seasons (postmonsoon (November 1987) and monsoon (June 1988)) using a modified dye binding method. The interest in the study of protein content in aquatic waters is generated by the fact that much of the organic fraction of dissolved and particulate matter is proteinaceous. Study of this parameter is related to planktonic nutritional state, metabolic activities based empirically on the ratio of protein to carbohydrate and recognized on the magnitude of its contribution to both detritus and plankton. The content of protein varied from 0.05 to 8.0 microg/L in the fresh and estuarine waters with little variability between surface and bottom values. The enhanced biological production during postmonsoon months causes a higher level of protein in the lower estuary compared to low values in the freshwater, riverine end. Increased terrestrial runoff and discharge of industrial waste mainly from seafood processing units are linked to the higher concentrations of protein in monsoon, more than double the content during postmonsoon. Auxiliary data on chlorophyll, organic nitrate nitrogen, phosphate phosphorus, urea and dissolved organic carbon support the above contentions. Interparametric relationships suggest seasonally varying correlation between protein and chlorophyll, urea and dissolved organic carbon, signifying the role of biological control. (Author's abstract)
W91-00795

RADIOACTIVITY LEVEL OF BLACK SEA MARINE ALGAE BEFORE AND AFTER THE CHERNOBYL ACCIDENT.
Istanbul Univ. (Turkey). Dept. of Pharmaceutical Technology.
For primary bibliographic entry see Field 5B.
W91-00796

DISTRIBUTION AND CORRELATION OF ELEMENTS IN WATERS, SUSPENSIONS, SEDIMENTS, AND MARINE ORGANISMS FROM THE BLACK SEA.
Bulgarian Academy of Sciences, Varna. Inst. of Oceanography.
For primary bibliographic entry see Field 5A.
W91-00797

WATER MASSES AND EUTROPHICATION IN A GREEK ANOXIC MARINE BAY.
National Centre for Marine Research, Athens (Greece).
For primary bibliographic entry see Field 5B.
W91-00798

SPECTRAL IRRADIANCE AND DISTRIBUTION OF PIGMENTS IN A HIGHLY LAYERED MARINE MICROBIAL MAT.
University of Puget Sound, Tacoma, WA. Dept. of Biology.
B. K. Pierson, V. M. Sands, and J. L. Frederick.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2327-2340, August 1990. 10 fig, 4 tab, 23 ref. NSF Grant BSR-8521724.

Descriptors: *Marine bacteria, *Phototropism, *Pigments, *Salt marshes, *Wetlands, Bacterial mats, Chlorophyll, Cyanophyta, Great Sippewissett Salt Marsh, Marine environment, Massachusetts, Spectral irradiance, Sulfur bacteria.

The spectral irradiance from 400 to 1,100 nm was measured with depth in the intertidal sand mats at Great Sippewissett Salt Marsh, Mass. These mats contained at least four distinct layers, composed of cyanobacteria, purple sulfur bacteria containing bacteriochlorophyll a (Bchl a), purple sulfur bacteria containing Bchl b, and green sulfur bacteria. Spectral irradiance was measured directly by layering sections of mat on a cosine receptor. Irradiance was also approximated by using a calibrated fiber-optic tip. With the tip, irradiance measurements could be obtained at depth intervals less than 250 micrometers. The irradiance spectra were correlated quantitatively and qualitatively with the distribution of the diverse chlorophyll pigments in this mat and were compared with spectra recorded in plain sand lacking pigmented phototrophs. The shorter wavelengths (400 to 550 nm) were strongly attenuated in the top 2 mm of the mat. The longer wavelengths (red and near infrared) penetrated to much greater depths, where they were attenuated by Bchl a, b, and c-containing anoxygenic phototrophic bacteria. The specific attenuation bands in the irradiance spectra correlated with the specific in vivo absorption bands of the Bchl-protein complexes in the bacteria. It is concluded that the pigments in the phototrophs had a profound affect on the light environment within the mat. It seems likely that the diverse Bchl-protein complexes found in the anoxygenic phototrophs evolved in dense mat environments as a result of competition for light. (Author's abstract)
W91-00826

VARIABILITY OF BIOGENIC SULFUR FLUX FROM A TEMPERATE SALT MARSH ON SHORT TIME AND SPACE SCALES.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
M. C. Morrison, and M. E. Hines.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1771-1779, July 1990. 7 fig, 1 tab, 35 ref. NASA Grant NAGW-512.

Descriptors: *Biochemistry, *Biogas, *Methane, *Salt marshes, *Spartina, *Sulfur compounds, Biogenic sulfur emissions, Carbonyls, Dimethyl sulfide, Ecosystems, Fluctuations, Sulfides, Vegetation.

Three emission chambers were deployed simultaneously to measure rates of emission of dimethyl sulfide, methane thiol and carbonyl sulfide within or across vegetation zones in a New Hampshire salt marsh. Short term (a few hours) variation in fluxes of all S gases from replicate sites were small within a monospecific stand of either Spartina alterniflora or S. patens. The quantity of emergent biomass and the type of vegetation present were the primary factors regulating the rate of emission. Dimethyl sulfide fluxes from the S. alterniflora soils ranged from 800 to 18000 nmol/sq m/hr compared to emissions of 25-120 nmol/sq m/hr from S. patens. This difference was probably due to the presence of the dimethyl-sulfide precursor dimethylsulfoniopropionate which is an osmoregulator in S. alterniflora but not in S. patens. Methane thiol emissions form S. alterniflora were 20-280 nmol/sq m/hr and they displayed a similar diel trend as dimethyl sulfide, although at mush lower rates, suggesting that methane thiol is produced primarily by leaves. Methane thiol emission form S. patens were 20-70 nmol/sq m/hr. Net uptake of carbonyl sulfide of 25-40 nmol/sq m/hr occurred in stands of S. alterniflora while net efflux of 10-36 nmol/sq m/hr of carbonyl sulfide occurred in stands of S. patens. In general, ranges of emissions of sulfur gases were similar to most other published values. (Author's abstract)
W91-00847

MATHEMATICAL MODELLING OF SEA WATER INTRUSION, NAURU ISLAND.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
F. Ghassemi, A. J. Jakeman, and G. Jacobson.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 269-281, July/September 1990. 7 fig, 4 tab, 18 ref.

Descriptors: *Finite element method, *Groundwater quality, *Model studies, *Nauru Island, *Saline water intrusion, *Water resources development, *Water resources management, Brackish water, Desalination, Geohydrology, Islands, Seawater, Simulation analysis, Water quality management, Water supply.

A two dimensional finite element model for density dependent groundwater flow was calibrated to simulate sea water intrusion in Nauru Island in the Central Pacific Ocean. Nauru Island occupies an area of 22 square km and supports a population of 8500. The island has been mined for its phosphate deposits and current reserves indicate that the mine has about eight years life remaining. The water supply of the island is about one third dependent on imported water which is also used as ballast on the phosphate ships. Imported water will not be available in the future, and a hydrogeological investigation shows that the island is underlain by a fresh water layer, less than 5 m thick. The freshwater layer overlies a thick transition zone of brackish water which in turn overlies sea water. Simulation of several management options shows that it is possible to substitute current importation of fresh water by careful extraction form the groundwater resources of the island. This can be accomplished only by pumping in properly designed skimming wells which prevent the upward movements of the brackish and saline waters. Clearly, other alternatives to overcome the shortfall in water supply such as construction of additional storage capacity to collect the rainfall or desalination of sea water should be considered and the cost-effectiveness of each alternative be carefully investigated. (Author's abstract)
W91-00865

MOTION OF COASTAL GROUNDWATER IN RESPONSE TO THE TIDE.
Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
For primary bibliographic entry see Field 2F.
W91-00884

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

LOGGING EFFECTS ON STREAMFLOW: WATER YIELD AND SUMMER LOW FLOWS AT CASPAR CREEK IN NORTHWESTERN CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
E. T. Keppeler, and R. R. Ziemer.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1669-1679, July 1990. 7 fig, 4 tab, 40 ref.

Descriptors: *Forest management, *Logging, *Low flow, *Streamflow, *Water yield improvement, California, Caspar Creek, Forest watersheds, Selective harvesting, Small watersheds, Streamflow data.

In rain-dominated portions of the Pacific Northwest, annual water yield may be enhanced by the removal of forest vegetation from small upland watersheds. Streamflow data for a 21-yr period were analyzed to determine the effects of selective tractor harvesting of second-growth Douglas fir and redwood at the Caspar Creek watershed on the volume, timing, and duration of low flows and annual water yield in northwestern California. Streamflow was augmented both for the low-flow season and the annual period. Increases were greatest in the year after logging was completed, 1974, and diminished irregularly thereafter. Increases in summer flow volume were detected between 1972 and 1978, although not all of these increases were considered statistically significant. Enhancement of summer flow volume was less persistent than annual flow increases. Selective harvesting of second-growth forest along California's north coast for increasing water yield is not considered promising for two reasons: (1) difficulty of predicting the timing and extent of streamflow increases, and (2) the quality of the supply could be adversely affected by increases in suspended sediment and turbidity. (See also W91-00610) (MacKeen-PTT)
W91-00611

WATER QUALITY AND PAM INTERACTIONS IN REDUCING SURFACE SEALING.
Volcani Inst. of Agricultural Research, Bet-Dagan

(Israel).
For primary bibliographic entry see Field 4D.
W91-00791

3C. Use Of Water Of Impaired Quality

INACTIVATION OF ENTERIC VIRUSES IN CHLORINATED WASTEWATER SPRAYED ON VEGETABLES.
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5D.
W91-00548

SIMULATING PHYSICAL PROCESSES AND ECONOMIC BEHAVIOR IN SALINE, IRRIGATED AGRICULTURE: MODEL DEVELOPMENT.
Geological Survey, Menlo Park, CA.
L. J. Lefkoff, and S. M. Gorelick.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1359-1369, July 1990. 9 fig, 3 tab, 60 ref. NSF Grant BCS-8957186.

Descriptors: *Cost analysis, *Groundwater irrigation, *Irrigation design, *Irrigation practices, *Saline water, *Saline-water irrigation, *Water resources management, Agriculture, Aquifer systems, Arkansas Valley, Colorado, Computer models, Crop yield, Mathematical models, Salinity, Surface-groundwater relations, Water resources planning, Water use.

A model of an irrigated, saline stream-aquifer system was constructed to simulate economic, agronomic and hydrologic processes. The model was applied to a section of the Arkansas Valley in southeastern Colorado and was used to examine the effect of crop-mixing strategies on long-term profits. Mixing in excess of crop rotation requirements provides an index of farmers' willingness to exchange some profit for a reduction in the risk of short-term loss. The model contains three components. The economic component simulates water use decisions that maximize annual profit for each farm. The hydrologic component simulates salt transport by employing regression equations that predict changes in groundwater salinity as a function of hydrologic conditions and water use decisions. The agronomic component approximates changes in corn and alfalfa production in response to the depth and salinity of irrigation applications. Results from the model were compared to limited hydrologic and economic data from the site. The regression functions used in the model provided reasonable salinity values for 1982 when compared to observed data. The economic component of the model gave a mean profit of $80/acre, and the actual mean value was $75/acre. (See also W91-00586) (Author's abstract)
W91-00585

BENEFITS OF AN IRRIGATION WATER RENTAL MARKET IN A SALINE STREAM-AQUIFER SYSTEM.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 3F.
W91-00586

RECLAIMED WATER HELPS FIGHT DROUGHT.
R. G. Saunders.
Public Works PUWOAH, Vol. 121, No. 8, p 53-55, 1990. 1 fig, 1 tab.

Descriptors: *California, *Drought, *Potable water, *Reclaimed water, *Water resources management, *Water reuse, Chlorination, Economic aspects, Effluents, Irrigation, Water quality.

In 1989, local public and private water agencies in the Santa Clara Valley, California communities agreed to reduce water use by at least 25 percent from 1987 usage because of the long term drought conditions in the region. Despite the drought, Santa Clara had a new water source, reclaimed water, helping to replace some of the potable water shortage. Reclaimed water was used for construction projects, dust control and soil compaction at the city's landfill, and landscape irrigation. Santa Clara's reclaimed water source is treated effluent from the San Jose/Santa Clara Water Pollution Control Plant. In 1978, and again in 1980, regional studies identified potential uses for reclaimed water. Although several potential industrial users and irrigation sites were identified, few projects were economically feasible. The high cost of installing and operating a reclaimed water system together with low cost potable water supplies made water reclamation too expensive. In addition, many potential irrigation sites nearest the bay have soils that are least able to accommodate the high salt and total dissolved solids contained in typical effluent. An appropriate reclaimed water application was the new city golf course, built upon imported soil on top of a former landfill. The reclaimed water system was required to deliver a peak flow of 1600 gpm through 13500 ft of pipeline. To meet the demand, the reclaimed water pump station has four Peabody-Flowaway, Inc., vertical turbine pumps, a 10000 gallon hydro-pneumatic tank, and a motor control center. The reclaimed water is such a high quality effluent that no added treatment was considered necessary. However, there is some bacterial regrowth in the channel and in the pipeline, which could be eliminated via an added chlorination system. Another problem with having the pumping station at the outfall channel is the plants and algae growing in this open channel. To limit the plant growth, a post-construction design change added an in-line filter. The reclaimed water rate is set at ninety percent of the retail rate, not including any surcharge, and the economics for new reclaimed water services continue to be favorable. (Brunone-PTT)
W91-00772

GROUNDWATER RECHARGE WITH RECLAIMED WATER IN CALIFORNIA.
Camp, Dresser and McKee, Inc., Clearwater, FL.
For primary bibliographic entry see Field 4B.
W91-00800

PHOTOCHEMICAL DISINFECTION OF EFFLUENTS-PILOT PLANT STUDIES.
Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
For primary bibliographic entry see Field 5D.
W91-00807

3D. Conservation In Domestic and Municipal Use

WATER SUPPLY FOR MEXICO CITY.
Universidad Autonoma Metropolitana, Mexico City. Unidad Iztapalapa.
H. H. Blasig, and R. A. Juarez.
Aqua AQUAAA, Vol. 39, No. 2, p 79-85, April 1990. 4 fig, 9 tab, 14 ref.

Descriptors: *Mexico City, *Municipal water, *Water conservation, *Water demand, *Water resources management, *Water supply, Human population, Interbasin transfers, Urban planning, Water loss, Water policy, Water reuse, Water shortage.

A severe shortage of potable water is imminent for Mexico City. Continuous population growth is causing an increasing potable-water demand. There are also inadequacies in the water-supply system which result in a chronic potable-water shortage. Proposed solutions to this problem include (a) curtailment of population growth, (b) water reuse, (c) administrative and technical measures to obtain savings in water consumption, (d) a reduction in losses in the distribution system, and (b) better management of the local water resources. An alternative is to import water from other basins, but this would affect other water users and would result in unnecessary expenditure. Only a set of intelligent and well-coordinated political and technical measures, enforced as soon as possible, can assure future water supply for Mexico City and avoid a major shortage that could be the origin of an impending social crisis in the country's capital. (Stoehr-PTT)
W91-00020

EFFECT OF DROUGHT ON URBAN WATER SUPPLIES. I: DROUGHT ANALYSIS.
Resource Consultants, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 6D.
W91-00059

EFFECT OF DROUGHT ON URBAN WATER SUPPLIES. II: WATER-SUPPLY ANALYSIS.
Resource Consultants, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 6D.
W91-00060

RECLAIMED WATER HELPS FIGHT DROUGHT.
For primary bibliographic entry see Field 3C.
W91-00772

3E. Conservation In Industry

COMPETITIVE ASSESSMENT OF THE U.S. WATER RESOURCES INDUSTRY.
International Trade Administration, Washington, DC.
For primary bibliographic entry see Field 6D.
W91-00561

3F. Conservation In Agriculture

WATER AUCTIONS AS AN ALLOCATION MECHANISM IN VICTORIA, AUSTRALIA.
Department of the Interior, Washington, DC. Office of Program Analysis.
For primary bibliographic entry see Field 6C.
W91-00080

EFFECT OF SYSTEM LAYOUT ON SUBSURFACE DRAINAGE COST IN FLAT IRRIGATED LAND.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Center for Drainage Studies.
For primary bibliographic entry see Field 4B.
W91-00081

DYNAMICS OF SIMULATED EFFECTS OF IRRIGATION OVER DRYLAND FARMING IN SASKATCHEWAN.
Saskatchewan Univ., Saskatoon. Dept. of Agricultural Economics.
R. A. Schoney, W. J. Brown, and S. N. Kulshreshtha.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 509-517, June 1990. 2 fig, 5 tab, 6 ref.

Descriptors: *Economic evaluation, *Irrigation efficiency, *Irrigation programs, *Saskatchewan, Agriculture, Canada, Drought, Economic aspects, Farm income, Public policy.

Irrigation development in Saskatchewan was initiated as an instrument to bring forth regional stability through drought proofing and diversification in the agricultural sector. This development has been surrounded by controversy, particularly, questions concerning its economic value to the farmer. A study was conducted to compare irrigation on a farm as a growth alternative to the expansion of dryland farming. Under relatively conservative machine replacement policies, modest family withdrawals, government subsidized irrigation loans, and relatively favorable gross operating margins, irrigation can be a profitable undertaking in the South Saskatchewan River Basin. (Author's abstract)
W91-00091

DESIGN OF SETTLING BASINS.
Indira Gandhi National Open Univ., New Delhi (India).

For primary bibliographic entry see Field 2J.
W91-00097

DRIP IRRIGATION NONLINEAR OPTIMIZATION MODEL.
Concepcion Univ. (Chile). Dept. of Agricultural Engineering.
E. A. Holzapfel, M. A. Marino, and A. Valenzuela.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 479-496, July/August 1990. 2 fig, 7 tab, 15 ref. Research Division of the University of Concepcion at Chillan, Project 202317; Agricultural Research Service Cooperative Agreement 4350-H; Fundacion Andes Project 10463.

Descriptors: *Drip irrigation, *Hydraulic models, *Irrigation engineering, *Model studies, *Nonlinear programming, *Optimization, Agriculture, Computer models, Cost-benefit analysis, Evaluation, Farm income, Irrigation practices, Orchards, Pipes.

Drip irrigation systems were originally introduced for irrigating highly productive crops or orchards in areas where water was scarce and expensive. Drip systems are most profitable when used in areas with hilly topography, poor soils, and/or scarcity of water. In such conditions, the use of drip systems has many advantages over surface irrigation systems. The optimal design of drip irrigation systems can be an important factor to increasing farm profits, and investing money in irrigation most efficiently. A nonlinear optimization model was developed for the design and management of drip irrigation systems. Decision variables are: pipe diameter, pipe length, number of subunits, number of subunits operating simultaneously, irrigation time per set, and emitter discharge. The model is solved using the GAMS-MINOS package. To illustrate the capability of the model, an orchard field of pears was selected. The price effect on the results of the model shows that the cost of the system and its operation are relatively small compared with the benefit obtained. The model shows that the results do not yield the minimum cost of the system when the marginal benefit is greater than the marginal cost. (Fish-PTT)
W91-00168

WATER AND NITROGEN MANAGEMENT IN CENTRAL PLATTE VALLEY OF NEBRASKA.
Nebraska Univ., Clay Center. South Central Research and Extension Center.
R. B. Ferguson, D. E. Eisenhauer, T. L. Bockstadter, D. H. Krull, and G. Buttermore.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 557-565, July/August 1990. 4 fig, 2 tab, 16 ref.

Descriptors: *Groundwater pollution, *Irrigation engineering, *Nebraska, *Nitrates, *Nitrogen, *Nonpoint pollution sources, *Water pollution control, *Water resources management, Corn, Fertilizers, Furrow irrigation, Grain crops, Irrigation practices, Leaching, Path of pollutants, Percolation, Soil water.

Contamination of groundwater by nitrogen leached from fertilizer on irrigated soils is related to the quantity of nitrate-N (NO(-3)-N) present, the leaching potential based on soil texture and the percent depletion of available soil water in the root zone, and the amount of water entering the soil profile. Research and demonstration projects in the Central Platte Valley of Nebraska have shown that NO(-3)-N leaching is influenced by both irrigation and fertilizer-nitrogen (N) management in corn production. Scheduling irrigation according to available soil water depletion can reduce deep percolation to a certain extent. Additional reduction in deep percolation can be achieved by improving the efficiency of water application, particularly on furrow irrigated fields. Testing for NO(-3)-N in irrigation water and soil can provide for substantial reductions in fertilizer N application, if residual levels in the soil are high, or if considerable NO(-3)-N is applied with irrigation water. Grain yields were not appreciably affected by the use of these management practices, while in most cases input costs for fertilizer nitrogen and irrigation water were reduced. (Author's abstract)
W91-00173

CONJUNCTIVE USE FOR IRRIGATION DEVELOPMENT IN ALLUVIAL REGIONS: PROBLEMS, PROSPECTS AND RESEARCH ISSUES.
Bihar Coll. of Engineering, Patna (India). Dept. of Civil Engineeering.
T. Prasad.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 411-422, 2 fig, 7 ref.

Descriptors: *Conjunctive use, *Groundwater irrigation, *India, *Irrigation practices, *Surface-groundwater relations, *Water resources development, Agriculture, Groundwater budget, Irrigation water, Surface water.

Alluvial regions in India, particularly those in the lower Ganga basin, have high agropotential due to good agroclimate, fertile land and ample water resources. Irrigation constitutes an essential requirement for optimal agricultural development, but irrigation exclusively by surface water is not wholly effective or optimally productive on account of the seasonality of flows in the rivers and other ecological factors. As there is ample groundwater of good quality available at relatively low lifts, and a substantial hydrologic interaction constantly going on between the surface water and groundwater regimes, conjunctive use of these two sources is an obvious strategy of irrigation for optimum agricultural development. Several physical and socio-economic issues related to conjunctive irrigation still and unresolved which inhibit adoption and implementation of this strategy in professional practice. Several physical processes related to the interaction of surface water/groundwater regimes in the alluvial plains and their response to conjunctive uses are not quantitatively understood. Also, suitable policies regarding concepts of ownership of surface and groundwater sources, relative economics of the use of water for agriculture from these two sources, administrative and management structure, and energy issues have to be evolved and prescribed for promoting conjunctive irrigation in the alluvial plains. (See also W91-00215) (Lantz-PTT)
W91-00261

TRENDS IN IRRIGATION DEVELOPMENT, AND THEIR IMPLICATIONS FOR HYDROLOGISTS AND WATER RESOURCES ENGINEERS.
G. M. Higgins, P. J. Dieleman, and C. L. Abernethy.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 393-406, 1987. 8 fig, 7 tab, 5 ref.

Descriptors: *Developing countries, *Irrigation, *Irrigation programs, *Water management, Agricultural engineering, Agriculture, Human population, Hydrology, Land use, Population dynamics, Program management, Water potentials.

There are a number of reasons for expecting that we are approaching a period in which irrigated agriculture in developing countries will undergo significant changes. Changes seems likely in the techniques used, the organization and institutions of irrigation, the methods of financing, and perhaps either in the distribution of irrigation. The extent and degree of irrigation around the world are discussed, as well as the rate of new development of irrigation area, the environmental impact of irrigation projects and the need for agricultural production growth to exceed population growth. The population-supporting capacity of land and water requirements of irrigation are analyzed. In the past two decades, a number of technological innovations, such as drip and micro-irrigation and large mechanized water delivery systems, have been developed in industrialized nations. These technologies have not been implemented in many developing nations, and this is an area that should be addressed. There is also a need to improve the management and organization of irrigation projects in developing nations. Africa is an area where all of the above concerns are particularly acute; irrigation data, planning, management, training and research are especially important on this continent. Some possible contributions of hydrology to irrigation are: more measurement of the equity and timeliness of flows within canal distribution networks; better data on droughts and low flow periods; increased attention to quantifying the water resources of smaller streams and non-perennial streams; and, increased data on sediments on rivers. (Hoskin-PTT)
W91-00377

GROUND WATER MANAGEMENT IN THE SOUTH PLATTE BASIN OF COLORADO.
Central Colorado Water Conservancy District, Greeley.
For primary bibliographic entry see Field 4B.
W91-00413

HEURISTIC CLOSED-LOOP CONTROLLER FOR WATER DISTRIBUTION IN COMPLEX IRRIGATION SYSTEMS.
Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung.
H. Hiessl, and E. J. Plate.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1323-1333, July 1990. 7 fig, 2 tab, 41 ref.

Descriptors: *Irrigation design, *Irrigation practices, *Irrigation water, *Water control, Agriculture, Computer models, Crop yield, Saudi Arabia, Simulation analysis, Water conservation, Water distribution, Water resources management, Water resources planning.

The problem of finding an optimal, closed-loop control strategy for irrigation water distribution among crops grown in an irrigation system was investigated. The proposed approach yields a strategy that allows the utilization of prior 'soft' information. The control strategy is then optimized using a mixed simulation-optimization method. The results which are illustrated by a Saudi Arabian case study show that it is possible to improve the annual yields of the crops, both in terms of their expected value as well as in terms of their temporal distribution over the planning horizon. (MacKeen-PTT)
W91-00582

DYNAMIC OPTIMIZATION MODEL FOR IRRIGATION INVESTMENT AND MANAGEMENT UNDER LIMITED DRAINAGE CONDITIONS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
K. C. Knapp, B. K. Stevens, J. Letey, and J. D. Oster.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1335-1343, July 1990. 2 fig, 4 tab, 15 ref, append.

Descriptors: *Irrigation design, *Irrigation practices, *Irrigation water, *Water control, *Water resources management, *Water table rise, Agriculture, Computer models, Drainage practices, Mathematical models, Unconfined aquifers, Water conservation, Water distribution, Water resources planning.

Irrigation management in a field underlain by a water table aquifer is considered. The water table varies with deep percolation which is in turn a function of the irrigation system and applied water quantities. A drainage system is installed once the water table reaches a maximum height. Optimal irrigation systems and applied water quantities were calculated using dynamic programming. For low confining layer conductivities, deep percolation is progressively reduced through time under optimal management by a combination of improved irrigation systems and reduced water applications. This delays the water table build-up and

postpones drainage costs. Optimal management for a moderately conductive confining layer results in a cyclical policy in which periods of improved irrigation systems and reduced water applications are alternated with periods of traditional irrigation systems and water applications to maintain the water table below the depth requiring drainage system installation. (Author's abstract)
W91-00583

SIMULATING PHYSICAL PROCESSES AND ECONOMIC BEHAVIOR IN SALINE, IRRIGATED AGRICULTURE: MODEL DEVELOPMENT.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 3C.
W91-00585

BENEFITS OF AN IRRIGATION WATER RENTAL MARKET IN A SALINE STREAM-AQUIFER SYSTEM.
Geological Survey, Menlo Park, CA.
L. J. Lefkoff, and S. M. Gorelick.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1371-1381, July 1990. 11 fig, 2 tab, 32 ref.
NSF Grant BCS-8957186.

Descriptors: *Cost-benefit analysis, *Economic aspects, *Groundwater irrigation, *Irrigation programs, *Irrigation water, *Management planning, *Saline-water irrigation, *Water management, *Water transfer, Arkansas Valley, Colorado, Computer models, Drought, Economic evaluation, Groundwater, Model studies, Pumping, Salinity, Simulation analysis, Surface water, Surface-groundwater relations, Water control, Water shortage, Water use.

The hydrologic and economic effects of a water market were evaluated for an irrigated, stream-aquifer system in the Arkansas Valley, Colorado. In the hypothetical rental market, surface water is traded annually among farmers, while groundwater is used to augment irrigation supplies. Market simulations account for changes in the value of groundwater and surface water due to salinity differences. Results show that the market increases long-term profit for all participants, reduces the risk of loss due to drought, and decreases average short-term groundwater salinity. The market becomes active during dry years, when farmers without groundwater rights buy surface water from farmers with groundwater rights, who increase pumping to replace sold surface water. Under the rental market the distribution of additional profits partially depends on the pumping costs and higher salinity associated with increased groundwater use. Farmers reduce risk without sacrificing profit, by utilizing higher rates of groundwater pumping to mitigate drought damage. Increased withdrawals may diminish irrigation supplies for downstream users. (See also W91-00585) (Author's abstract)
W91-00586

OPERATION AND MAINTENANCE ACTIVITIES OF AN IRRIGATION SYSTEM IN JAVA (IN JAPANESE).
Y. Matsumoto.
Research Bulletin of the Faculty of Agriculture Gifu University, No. 54, p 171-179, December 1989. 4 fig, 1 tab, 7 ref. English summary.

Descriptors: *Irrigation, *Irrigation design, *Irrigation operation, *Java, Coasts, Drainage, Indonesia.

Effective technical assistance to irrigation projects in Southeast Asia requires sound judgement in actual operation and maintenance activities of the existing irrigation system. In order to obtain information, a progressive irrigation system on Java Island in Indonesia was observed. The Java system has been operated well from the top uptake to the end field and was guaranteed by water user's associations which distribute irrigation water. However, it was found that some districts having difficulty in operating the system had drainage problems in coastal areas and operation and maintenance activities had been clearly separated into two groups: officials managing the main system and farmers managing the tertiary system. Land improvement for more effective operation should be implemented first, and farmers should participate in the maintenance of the main system in order to reduce future costs. (Agostine-PTT)
W91-00767

STATE AGRICULTURAL POLLUTION REGULATION: A QUANTITATIVE ANALYSIS.
Harvard School of Public Health, Boston, MA. Dept. of Health Policy and Management.
For primary bibliographic entry see Field 5G.
W91-00801

RELATIVE PERFORMANCE OF A SOIL MOISTURE ACCOUNTING MODEL IN ESTIMATING RETURN FLOW.
Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 2G.
W91-00887

REAL TIME SIMULATION MODEL AS A DECISION SUPPORT SYSTEM FOR SURFACE WATER MANAGEMENT.
Institute for Land and Water Management Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 4A.
W91-00998

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ESTIMATING STATISTICAL PARAMETERS FOR AN N-SEGMENT DISCRETE HYDROLOGIC DATA SERIES.
Clark Univ., Worcester, MA. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-00074

ERRORS IN ESTIMATED STREAMFLOW PARAMETERS AND STORAGES FOR UNGAUGED CATCHMENTS.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W91-00085

UTILITY APPROACH TO STORMWATER MANAGEMENT.
Jones and Henry Engineers, Inc., Fort Wayne, OH.
H. Wilson.
Public Works PUWOAH, Vol. 121, No. 6, p 82-83, June 1990. 3 tab.

Descriptors: *Flood control, *Storm runoff, *Storm water management, *Urban hydrology, *Utilities, Budgeting, Economic aspects, Financial feasibility, Runoff, Stormwater utility, Urban runoff, Water rates.

Communities with improperly managed stormwater drainage systems experience frequent basement, yard, and street flooding that will continue without a proper stormwater management program. Municipal officials often cite lack of funds as a reason for not addressing the stormwater runoff problem. As a viable funding alternative, communities may which to consider the utility approach. A stormwater utility, like other utilities, provides a service to the public, supported by charging fees to its customers. Each community must tailor a program to its particular situation and political climate. A few general steps should be considered during utility development. It is important to initially document the need for a stormwater utility program and key city personnel must understand the pros and cons of such a system. Once need is established a steering committee should be developed and public participation encouraged. A comprehensive implementation plan that addresses all program activities and phases is essential. Program costs and an estimation of other stormwater revenue needs, such as maintenance costs should be determined. After needs and steps of the projects are prioritized it is time to establish a preliminary budget. From this a rate structure can be created. When the budget and user charges are finalized it will be necessary to draft a local ordinance that explains the need for the stormwater utility and establishes the user charges by land use classification. After everything is in place, an appropriate billing system, either as a separate stormwater bill or as part of the sewer and water billing system, must be established. (Mertz-PTT)
W91-00104

FLOODING CONTROLLED BY BRIDGE RELOCATION.
Edwards and Kelcey, Inc., Minneapolis, MN.
T. E. Wetmore.
Public Works PUWOAH, Vol. 121, No. 6, p 86-87, June 1990. 1 fig.

Descriptors: *Bridge construction, *Flood control, *Flood plain management, *Minnesota, Bridges, Environmental effects, Flood protection, Road construction, Social aspects.

The communities of Mankato, North Mankato, and LeHillier, Minnesota, are located at the confluence of the Minnesota and Blue Earth rivers, at the heart of one of Minnesota's regional economic centers. They have experienced four major floods within two decades. In 1978, work was begun to fulfill the need for bridge location studies. A socio-economic and environmental impact analysis, a draft environmental impact statement, public information program, and feature design memorandums for bridges at three locations were prepared. Flood elevations and drainage outfall elevations greatly restricted flexibility of design, as did meeting existing street, highway, and railroad grades. Traffic signal systems were developed to coordinate with the Mankato business district system. Local accesses were carefully maintained, and provisions for maintaining rail and highway service to a major industry were carefully worked out with the owners. The project included the complete rebuilding of a motor interchange in North Mandato. Critical vertical clearance requirements were met using a post-tensioned concrete slab bridge. A new ramp and arterial street connections in Mankato were designed to maintain the integrity of the central business district. A new gatewell was built for a 102-foot inplace storm drain. With the successful completion of the $100-million flood control project, transportation service has been improved for over 46,000 motorists a day and the new bridges are able to maintain full service even during maximum expected flood. (Mertz-PTT)
W91-00105

RADAR RAINFALL FORECASTING METHOD DESIGNED FOR HYDROLOGICAL PURPOSES.
Ecole Nationale des Ponts et Chaussees, Paris (France).
For primary bibliographic entry see Field 7B.
W91-00156

SINGLE-OUTLET DETENTION-POND ANALYSIS AND DESIGN.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W91-00171

OPPORTUNITIES FOR RESERVOIR-STORAGE REALLOCATION.
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 6E.
W91-00186

OPTIMIZATION OF FRESHWATER INFLOW TO ESTUARIES.
Wyoming Univ., Laramie. Water Resources Re-

search Inst.
For primary bibliographic entry see Field 2L.
W91-00187

ANNUAL YIELD AND SELECTED HYDROLOGIC DATA FOR THE ARKANSAS RIVER BASIN COMPACT ARKANSAS--OKLAHOMA 1989 WATER YEAR.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-00360

ASSESSING OPTIONS FOR STREAM REGULATION USING HYDROLOGIC SIMULATIONS AND CUMULATIVE IMPACT ANALYSIS: FLATHEAD RIVER BASIN, USA.
Montana Power Co., Butte.
For primary bibliographic entry see Field 2E.
W91-00779

URBAN STORM-INDUCED DISCHARGE IMPACTS.
Environmental Protection Agency, Edison, NJ. Storm and Combined Sewer Technology Branch.
R. Field, and R. Pitt.
Water Environment & Technology WAETEJ, Vol. 2, No. 8, p 64-67, August 1990. 7 ref.

Descriptors: *Path of pollutants, *Storm runoff, *Urban runoff, *Water pollution sources, Aquatic organisms, Biochemical oxygen demand, Dissolved oxygen, Heavy metals, Sediment contamination, Sediments, Storm sewers, Surface water, Toxicity.

Toxic heavy metals, organic pollutants, fecal coliform bacteria and pathogens, high flow rates, and sediment are commonly associated with urban receiving-water problems. The U. S. Environmental Protection Agency's (EPA) Storm and Combined Sewer Research Program has sponsored several long-term research projects that are concerned with urban receiving-water problems. Preliminary toxicity results have found that runoff samples vary widely in their relative toxicities. Urban storm runoff occurs for relatively short periods of time; therefore, toxicant concentration standards developed for continuous exposures are not directly applicable for these short term discharges. Monitored mass loadings show that great quantities of these toxic compounds are being discharged in urban storm runoff. Additional long-term receiving-water studies have found that aquatic organism surveys indicate significant toxicity problems. The effects of storm-induced discharges on aquatic, receiving-water organisms and other beneficial water uses is site-specific. Attempts to identify urban storm runoff problems using available data have not been conclusive because of sampling procedures and the practice of pooling data from various sites. Therefore, it is necessary to carefully design comprehensive, long-term studies to investigate urban storm runoff problems on a site-specific basis. (Korn-PTT)
W91-00803

HYDROLOGY AND MANAGEMENT OF DROUGHT IN THE UNITED STATES.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00991

CHARACTERISTICS OF STREAMFLOW DROUGHT.
Ohio Univ., Athens. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00994

GENERALIZED COMPONENTS OF COMPLEX DECISION SUPPORT SYSTEMS FOR WATER RESOURCES MANAGEMENT IN RIVER BASINS.
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
A. Becker, P. Braun, and S. Kaden.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 365-378, 4 fig, 11 ref.

Descriptors: *Databases, *Decision making, *Forecasting, *Model studies, *River basins, *Water quality, *Water resources management, Algal growth, Computer programs, ERNA model, Eutrophication, Hydrologic models.

During the last years remarkable progress has been achieved in the development of complex decision support systems for river basin water development. Two selected aspects and components of such systems were examined: the structure and components of real-time forecasting and control systems in river basins and the aquatic ecosystem model ERNA. The consideration of systems for real-time analysis, forecasting, and control in river basins concerns in particular the role and function of computerized information centers, the developed database system, and applied software for forecasting of water levels, discharges, and selected water quality parameters. The ecosystem model ERNA describes the growth of different algae groups in dependence on relevant environmental variables (meteorological, physical, chemical, and biological). It is capable of simulating the eutrophication processes in eutrophicated flatland rivers. (See also W91-00961) (Author's abstract)
W91-00997

REAL TIME SIMULATION MODEL AS A DECISION SUPPORT SYSTEM FOR SURFACE WATER MANAGEMENT.
Institute for Land and Water Management Research, Wageningen (Netherlands).
P. J. T. Van Bakel.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 379-386. 3 fig, 6 ref.

Descriptors: *Hydrologic models, *Irrigation water, *Model studies, *Simulation, *Subsurface irrigation, *Surface water, *Water management, Crop yield, Decision making, Economic aspects, Netherlands, Transpiration, Water conservation, Water level.

For the purpose of water conservation and subsurface irrigation in the Netherlands, special water management systems are in operation by water boards. To support the water boards with their day-to-day surface water management, a total soil/surface water simulation model was made more suitable to use on a real time basis. This model contains operational rules for water level manipulation, which were derived from a case study. Simulation with this decision support model of a water board's situation in the dry year of 1986 resulted in a calculated increase in crop transpiration and hence crop production, equivalent with 100-500 Dfl/ha (2 Dfl equals approximately 1 US dollar). Actual application of the model in the wet year of 1987 did not result in an increase in crop transpiration. Working conditions in autumn, however, did improve. Based on the model, surface water levels were lowered about 5 wk earlier than would have been the case in the traditional method of water level manipulation. These results demonstrate that application of a real time simulation model improves surface water management, both in dry and wet years. (See also W91-00961) (Author's abstract)
W91-00998

INTELLIGENT GEOGRAPHIC INFORMATION SYSTEMS (IGIS) AND SURFACE WATER MODELING.
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wasserwirtschaft und Inst. fuer Wasserbau.
U. Arnold, B. Datta, and P. Haenscheid.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 407-416, 3 fig, 16 ref.

Descriptors: *Expert systems, *Geographic information systems, *Hydrologic models, *Model studies, *Simulation, *Surface water, *Water resources management.

Geographic Information Systems (GIS) are emerging as major spatial data handling tools for natural resources inventory and management. For simulation model applications to surface water related problems, a GIS can serve as a powerful, interactive, and graphics oriented data platform and user environment. However, prior to utilizing available data and models, analysis of the problem's information requirements, the data base contents, and the given boundary conditions is necessary to configure models and data in a most effective and economical way. Problem diagnosis and preprocessing steps such as domain discretization, model parameter selection and calibration require problem-, method-, and tool-specific expertise. A conceptual approach is proposed towards the development of an intelligent GIS which incorporates knowledge processing capabilities for the surface water problem domain. Special attention is given to object oriented methodology, interfaces between numeric data and symbolic knowledge representation, and to dealing with uncertainty. (See also W91-00961) (Author's abstract)
W91-01001

4B. Groundwater Management

EFFECT OF SYSTEM LAYOUT ON SUBSURFACE DRAINAGE COST IN FLAT IRRIGATED LAND.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Center for Drainage Studies.
J. Gallichand, S. O. Prasher, R. S. Broughton, J. F. Metzger, and J. S. A. Brichieri-Colombi.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 397-405, June 1990. 6 fig, 5 tab, 16 ref.

Descriptors: *Construction costs, *Cost analysis, *Drainage engineering, *Drainage systems, *Economic aspects, Cropland, Drainage area, Egypt, Irrigation, Rice.

The economic feasibility of large-scale subsurface drainage projects in irrigated land is affected by construction costs. A study was conducted to evaluate the effect of two different types of subsurface drainage system layout on construction costs for a 1000 ha pilot area located in the Nile Delta of Egypt. The two types of layout studied were the conventional layout currently used in Egypt and a modified layout that was developed for reducing water losses from rice fields. When compared to the conventional layout, the modified layout resulted in a reduction of 6.74% in construction costs ($714,464 versus $766,142). This cost reduction is explained by the need for lesser lengths of large diameter collector pipes with the modified layout, which results from the smaller drainage area of subsurface drainage systems (average 23.7 versus 30.8 ha). The cost of subsurface drainage can be minimized by reducing the area drained by each subsurface drainage system. (Author's abstract)
W91-00081

ESTIMATING GROUNDWATER RECHARGE USING A SURFACE WATERSHED MODELLING APPROACH.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W91-00160

ESTIMATING GROUNDWATER RECHARGE USING A SURFACE WATERSHED MODEL: SENSITIVITY ANALYSES.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W91-00161

OPTIMAL PLANNING AND OPERATION OF MULTIAQUIFER SYSTEM.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Earth Sciences.
H. Yazicigil.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 435-454, July/August 1990. 7 fig, 5 tab, 19 ref.

Descriptors: *Aquifer management, *Groundwater management, *Model studies, *Water resources management, Agricultural hydrology, Drawdown, Management planning, Optimization, Pumping, Saudi Arabia, Selective withdrawal, Simulation analysis.

Three groundwater management models were developed to determine the optimal planning and operating policies of a multiaquifer system in eastern Saudi Arabia for an eight-year planning period. The modeled system, which consisted of the Alat, Khobar, and Umm Er Radhuma aquifers, was represented by a three-dimensional simulation model included in linear and quadratic optimization models using response functions. Yearly optimal pumping policies were determined for 52 well fields under three management objectives that maximized agricultural water withdrawals and minimized total drawdowns, and pumping costs subject to constraints related to the system's response equations, demand requirements, drawdown limitations, and discharge bounds. Multiobjective analyses were conducted to develop tradeoff curves relating increased agricultural water production to drawdown, aquifer dewatering, and pumping costs. Modeling results show the agricultural water production could be increased by almost two and a half times without causing dewatering. Optimal pumping schedules differed, depending upon the type of objective function employed. The best option appears to be the one in which extensive water transport is allowed between municipal well fields. (Author's abstract)
W91-00179

GROUND-WATER-MANAGEMENT AREAS IN UNITED STATES.
Illinois State Water Survey Div., Champaign.
J. A. Bowman.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 484-502, July/August 1990. 9 tab, 11 ref, 2 append.

Descriptors: *Groundwater management, *Legal aspects, *Legislation, *State jurisdiction, *Water resources management, Groundwater quality, Irrigation, Regulations, Selective withdrawal.

Laws governing groundwater withdrawals have been adjusted to reflect the desire and need to prevent resource depletion and conflict among users. Courts today are inclined to regard groundwater more as a shared public resource that is subject to management and regulation than as private property with rights of unlimited use. Also, state legislatures are passing comprehensive groundwater management statutes to prevent depletion and conflict and to reduce historic reliance on the courts to settle groundwater disputes. This has been called a 'management doctrine' for groundwater. One example of the management doctrine is the use of groundwater management areas to regulate regional groundwater withdrawals when and where that is necessary. A nationwide survey was conducted to collect information about the nature and distribution of groundwater management area programs around the country. Results show that 27 states allow for formation of special management areas to address some type of groundwater quantity problem; some areas also address groundwater quality problems. One distinction of interest is that while most states place the responsibility of controlling management areas with some central state agency, several states have opted to leave that responsibility with the local groundwater users. The heavily irrigated states of Colorado, Kansas, Nebraska, and Texas stand out in this regard. (Author's abstract)
W91-00182

PRINCIPLES OF A GROUND-WATER STRATEGY.
Greeley-Polhemus Group, Inc., West Chester, PA.
For primary bibliographic entry see Field 6A.
W91-00183

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES. VOLUME I.
Papers presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. 485p. Edited by C. P. Gupta, Shakeel Ahmed, V. V. S. G. Rao, and M. T. Rajan.

Descriptors: *Developing countries, *Groundwater budget, *Groundwater management, *Workshops, Data acquisition, Geohydrology, Groundwater movement, Groundwater pollution, Path of pollutants, Water resources development.

This International Workshop (IGW-89) was organized to share the experiences and knowledge of experts from developed as well as developing countries. Some of the issues covered include identification of the state-of-the-art techniques for geohydrological parameter estimation, acquisition of data, analysis of flow in the unsaturated zone, studies of contaminant migration and augmentation of groundwater. All these are essential prerequisites for reliable estimation and rational management of this vital resource. Cost-effectiveness of these techniques is especially important for developing countries. (See W91-00216 thru W91-00266) (Lantz-PTT)
W91-00215

APPROPRIATE WELL DESIGN FOR DEVELOPING FRESH WATER AQUIFER IN A MIXED QUALITY AQUIFER SYSTEM.
Central Ground Water Board, Hyderabad (India).
For primary bibliographic entry see Field 8A.
W91-00221

GROUNDWATER RECHARGE ESTIMATION BY TRITIUM TRACER TECHNIQUE IN SATHUPALLY AREA, ANDHRA PRADESH, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00225

MANAGEMENT AND CONSERVATION OF GROUND WATER RESOURCE THROUGH POINT DILUTION TECHNIQUE USING RADIOTRACER - SOME CASE HISTORIES.
K. S. Pandey, and S. K. Sinha.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 143-153, 4 fig, 2 tab, 4 ref.

Descriptors: *Case studies, *Groundwater management, *Groundwater resources, *India, *Radioactive tracers, *Surface-groundwater relations, *Tracers, *Water conservation, Canals, Developing countries, Groundwater recharge, Infiltration, Seepage, Water loss.

Management and conservation of groundwater resources, using cost-effective techniques such as point dilution, has assumed a greater importance in light of the high cost of irrigation. Experiments adopting point dilution techniques using the radiotracer 131-I were conducted along the banks of the Ghaggar branch of the Sirhind Canal (Sangrur district-Punjab), Amloh minor at Haripur (Patiala district-Punjab) and a water-logged area near Baropal (Suratgarh-Rajasthan). The radiotracer technique is more economical with regard to cost and studies duplication when compared to other methods. This radiotracer technique is simple to use in deep canals with turbulence and fast moving water, whereas canals with heavy weed growth create adverse bottom conditions for the technique. The amount of seepage water loss was evaluated by computing the values of infiltration velocity, wetted perimeter, and hydraulic gradient. Seepage losses from irrigation water conveyance and distribution systems are the greatest contributers to groundwater recharge. Lining the components of the system is seen as essential to reduce water loss. (See also W91-00215) (Lantz-PTT)
W91-00229

ROLE OF GROUND WATER IN CONTROLLING ECOLOGY OF AREA: A CASE STUDY OF GHANA BIRD SANCTUARY - DISTRICT BHARATPUR, RAJASTHAN.
For primary bibliographic entry see Field 6G.
W91-00234

BOREHOLE GEOPHYSICAL LOGGING TECHNIQUES FOR DELINEATING FRACTURED ZONES AND CAVITIES IN HARD ROCK AREAS FOR HYDROFRACTURING: A CASE STUDY.
For primary bibliographic entry see Field 2F.
W91-00241

CONJUNCTIVE USE FOR IRRIGATION DEVELOPMENT IN ALLUVIAL REGIONS: PROBLEMS, PROSPECTS AND RESEARCH ISSUES.
Bihar Coll. of Engineering, Patna (India). Dept. of Civil Engineeering.
For primary bibliographic entry see Field 3F.
W91-00261

AQUIFERS OF THE WESTERN MOUNTAIN AREA.
For primary bibliographic entry see Field 2F.
W91-00304

SNAKE RIVER PLAIN REGIONAL AQUIFER SYSTEM STUDY.
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00306

GROUND-WATER FLOW SYSTEMS OF WESTERN UTAH.
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00307

PROBLEMS OF SEA WATER INTRUSION INTO AQUIFERS OF THE COASTAL DINARIC KARST.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00325

SOME METHODS OF HYDROGEOLOGIC EXPLORATION AND WATER REGULATION IN THE DINARIC KARST WITH SPECIAL REFERENCE TO THEIR APPLICATION IN EASTERN HERZEGOVINA.
Karst Water Research Inst., Trebinje (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00327

HYDROGEOLOGICAL FEATURES OF SOME NORTHERN DALMATIA LITTORAL KARST PARTS, LIKA AND CROATIAN LITTORAL.
Institute of Geology, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00329

HYDROGEOLOGIC FEATURES OF SOME KARST PARTS OF SLOVENIA.
Institute for Karst Research, Postojna (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00330

GEOHYDROLOGY AND REGIONAL GROUND-WATER FLOW OF THE COASTAL LOWLANDS AQUIFER SYSTEM IN PARTS OF LOUISIANA, MISSISSIPPI, ALABAMA, AND FLORIDA--A PRELIMINARY ANALYSIS.
Geological Survey, Baton Rouge, LA.
For primary bibliographic entry see Field 2F.
W91-00332

WATER RESOURCES OF THE WHITE EARTH INDIAN RESERVATION, NORTHWESTERN MINNESOTA.
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 5F.
W91-00341

AVAILABILITY AND HISTORICAL DEVELOPMENT OF GROUND-WATER RESOURCES OF LONG ISLAND, NEW YORK--AN INTRODUCTION.
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00345

GROUND WATER RECHARGE AND POLLUTION POTENTIAL OF DRY WELLS IN PIMA COUNTY, ARIZONA.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5B.
W91-00367

WATER WATER EVERYWHERE . . . HAVE YOU LOOKED.
BCI Geonetics, Inc., Laconia, NH.
For primary bibliographic entry see Field 2F.
W91-00412

GROUND WATER MANAGEMENT IN THE SOUTH PLATTE BASIN OF COLORADO.
Central Colorado Water Conservancy District, Greeley.
T. V. Cech.
Water Well Journal WWJOA9, Vol. 44, No. 6, p 52-54, June 1990.

Descriptors: *Colorado, *Groundwater irrigation, *Groundwater management, *Groundwater recharge, *Legislation, Artificial recharge, Groundwater depletion, Platte River Basin, Water Rights Determination Act, Water management.

The Water Rights Determination Act of 1969 has resulted in improved management of scarce water resources in the South Platte River Basin. This law brought irrigators who were pumping from the alluvial aquifer of a stream within the priority system of surface users. To meet the requirements of this law, which was amended in 1975 to apply to only underground water, junior diverters using tributary wells are required to replace the resulting depletions to the river so that no injury occurs to senior water rights. This is generally achieved by purchasing replacement water to be used by senior diverters, or through groundwater recharge. Of these two practices, recharge has proven to be an economical method for groundwater users to augment their irrigation flows. Approximately 50 recharge projects are presently located in the basin and are responsible for artificially recharging 384,000 acre-feet of groundwater. This particular example of groundwater management in the South Platte Basin shows that legislation sensitive to the interrelationship of surface water and alluvial groundwater can encourage the development of groundwater projects, that recharge is an economical way to meet some of the augmentation requirements of 1969 act, and that significant amounts of water can be recharged in northeastern Colorado as long as adequate amounts of water are available during spring and winter months. (Fleishman-PTT)
W91-00413

DYNAMIC OPTIMIZATION MODEL FOR IRRIGATION INVESTMENT AND MANAGEMENT UNDER LIMITED DRAINAGE CONDITIONS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3F.
W91-00583

CAPILLARITY CORRECTION FOR FREE SURFACE FLOW REVISITED.
Cornell Univ., Ithaca, NY.
J. Y. Parlange, W. Brutsaert, J. P. Fink, and A. I. El-Kadi.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1691-1692, July 1990. 2 ref.

Descriptors: *Capillarity, *Drawdown, *Groundwater movement, *Mathematical analysis, *Unconfined aquifers, *Water table decline, Diffusion equation, Flow models.

The usual treatment of the initial response of the water table to a sudden drawdown involves a discontinuity at the outflow end of the aquifer. In the description of this problem by means of the diffusion equation of Boussinesq, this discontinuity is damped rapidly and presents no special difficulties. However, when a capillary correction, or similar source term, is applied to this equation, the additional term may exhibit singular behavior. A procedure is presented to deal with this behavior by allowing a discontinuous part for $t < o$. The resulting solution is quite acceptable physically in the case of sudden drawdown. (Author's abstract)
W91-00614

GROUNDWATER RECHARGE WITH RECLAIMED WATER IN CALIFORNIA.
Camp, Dresser and McKee, Inc., Clearwater, FL.
J. Crook, T. Asano, and M. Nellor.
Water Environment & Technology WAETEJ, Vol. 2, No. 8, p 42-49, August 1990. 4 tab, 4 ref.

Descriptors: *Artificial recharge, *California, *Groundwater, *Groundwater management, *Groundwater recharge, *Reclaimed water, *Water reuse, Groundwater depletion, Groundwater potential, Groundwater quality, Groundwater resources, Injection wells, Land disposal, Permits, Regulations.

Groundwater recharge with reclaimed water represents a large potential use of reclaimed water in California; however, there are few planned recharge projects in the state, partly because of economic considerations and continuing health concerns. This situation, coupled with the knowledge that unplanned or incidental recharge with wastewater is widespread and relatively uncontrolled, suggested that it was essential to undertake a comprehensive review of existing regulations and establish statewide policies and guidelines for planning and implementing new projects for groundwater recharge. Recharging groundwater with reclaimed water has several purposes: to prevent saltwater intrusion into fresh water aquifers, to store the reclaimed water for future use, to control or prevent ground subsidence, and to augment nonpotable or potable groundwater aquifers. Proposed state groundwater recharge guidelines include principles, permitting procedures, and criteria for groundwater recharge. The criteria for surface spreading and injection of reclaimed water will address treatment processes, treatment reliability, water quality, monitoring, dilution, time underground, distance to withdrawal, and operational procedures. It is anticipated that criteria for groundwater recharge will be somewhat flexible and take into consideration site-specific conditions such as percolation rate and depth to groundwater. (Korn-PTT)
W91-00800

WATER BANKING THROUGH ARTIFICIAL RECHARGE, LAS VEGAS VALLEY, CLARK COUNTY, NEVADA.
Las Vegas Valley Water District, NV.
K. Brothers, and T. Katzer.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 77-103, July 1990. 17 fig, 8 tab, 15 ref.

Descriptors: *Artificial recharge, *Groundwater availability, *Groundwater management, *Groundwater recharge, *Nevada, *Water resources management, Aquifer characteristics, Calcite, Colorado River, Groundwater chemistry, Groundwater quality, Model studies, Production wells, Pumpage, Water demand.

Artificially recharging the Las Vegas Valley groundwater system is one water resource management option available to the Las Vegas Valley Water District (District) to help meet increasing summer peak water demands. At the present time (1988) the water supply for Las Vegas Valley is made up of ca. 75% Colorado River water and ca. 25% groundwater, which is used primarily in the summer to meet peak demands. The District is investigating the feasibility of increasing the importation of treated Colorado River water into the valley during winter months, banking the water by artificially recharging the groundwater system, and subsequently withdrawing this water to meet summer peak demands and future needs. There were two major concerns regarding the feasibility of artificially recharging treated Colorado River water by deep aquifer injection. The first was the potential for calcite precipitation resulting from native groundwater and aquifer sediments mixing with treated Colorado River water which could reduce the aquifer permeability. The second was the long-term effects on well performance and production longevity by injecting through production wells. Although previous laboratory studies predicted that calcite precipitation would occur, a small-scale artificial recharge pilot study, conducted by the District in 1987, showed insignificant calcite precipitation. A larger scale demonstration project, initiated in February 1988, injected a total of 1153 acre-feet of treated Colorado River water into the principal groundwater system through two existing production wells. Injection was completed in late April and recovery of the native groundwater and Colorado River water mixture continued throughout the summer and fall. Recharge was accomplished by injection through the existing pump columns with minimal retrofitting of the existing wells and no detrimental effects to the pumps or well production rates have been determined. Water quality analyses and geochemical modeling indicate very little, if any, calcite precipitated during recharge and recovery. (Author's abstract)
W91-00880

4C. Effects On Water Of Man's Non-Water Activities

INPUT AND DEPLETION OF WOODY DEBRIS IN ALASKA STREAMS AND IMPLICATIONS FOR STREAMSIDE MANAGEMENT.
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
M. L. Murphy, and K. V. Koski.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 427-436, Fall 1989. 7 fig, 8 tab, 21 ref.

Descriptors: *Forest watersheds, *Logging, *Streams, *Water quality, *Watershed management, *Woody debris, Alaska, Aquatic habitats, Detritus.

Natural rates of input and depletion of large woody debris (LWD) in southeast Alaska streams were studied to provide a basis for managing streamside zones to maintain LWD for fish habitat after timber harvest. Debris was inventoried in a variety of stream types in undisturbed old-growth forest; 252 pieces of LWD were dated from the age of trees growing on them. Longevity of LWD was directly related to bole diameter: small LWD (10-30 cm diameter) was less than 110 years old, whereas large LWD (>60 cm diameter) was up to 226 years old. Assuming equilibrium between input and depletion of LWD in streams in old-growth forests and exponential decay of LWD, input and depletion rates were calculated from mean age of LWD. Input and depletion rates were inversely

proportional to LWD diameter and ranged from 1%/yr for large LWD in all stream types to 3%/yr for small LWD in large, high-energy, bedrock-controlled streams. A model of changes in LWD after timber harvest (which accounted for depletion of LWD and input from second-growth forest) indicated that 90 years after clear-cut logging without a stream-side buffer strip, LWD would be reduced by 70% and recovery to prelogging levels would take more than 250 years. Because nearly all LWD is derived from within 30 m of the stream, the use of a 30-m wide, unlogged buffer strip along both sides of the stream during timber harvest should maintain LWD. (Author's abstract)
W91-00011

EVALUATION OF TROUT PASSAGE THROUGH SIX HIGHWAY CULVERTS IN MONTANA.
Montana Cooperative Fishery Research Unit, Bozeman.
For primary bibliographic entry see Field 8I.
W91-00012

SALMON OF THE RIVER SIMOJOKI: RESEARCH AND MANAGEMENT (SIMOJOEN LOHI TUTKIMUKSEN JA HOIDON KOHTEENA).
Finnish Game and Fisheries Research Inst., Helsinki.
For primary bibliographic entry see Field 8I.
W91-00016

POTENTIAL COASTAL IMPACTS OF CONTEMPORARY CHANGING CLIMATE ON SOUTH ASIAN SEAS STATES.
Woods Hole Oceanographic Institution, MA. Coastal Research Center.
F. J. Gable, and D. G. Aubrey.
Environmental Management EMNGDC, Vol. 14, No. 1, p 33-46, January/February 1990. 4 fig, 96 ref.

Descriptors: *Asia, *Climatic changes, *Coasts, *Developing countries, *Future planning, *Global warming, *Sea level, Environmental effects, Marine climates, Ocean circulation, Precipitation, Research priorities, Storms.

The threat of man-induced global change on the nations of the South Asian seas region varies from place to place because of differences in exposure to monsoons and storms, differences in local tectonics and subsidence, and variations in air and sea climates. Because several nations are involved, some having subsistence budgets, and given the cost of deriving independently a comprehensive response to global change, the similarities and differences between national settings must be identified soon. These comparisons will form the basis for local response strategies; the similarities provide a basis for responses similar to that of other nations and the differences provide for local adaptation. That climate change on the South Asian coastal region will have an impact is certain; its economics, environment, and coastal land uses are dominated to a certain extent by this marine influence. The extent of these impacts, however, is uncertain. Accompanying global change will be changes in sea level, differences in storm climate, and altered precipitation patterns; science cannot define today what pattern these changes will take. Because global change is inevitable, although its magnitude, timing, and geographic distribution are unknown, the South Asian seas region should begin the appropriate research and planning studies to set forth a reasoned response to global change, for implementation when scientific evidence for global change is more quantitative. (Author's abstract)
W91-00027

ALGORITHM FOR ROUTING UNSTEADY FLOWS IN URBAN DRAINAGE NETWORKS.
Gutteridge, Haskins and Davey Pty Ltd., Sydney (Australia).
J. E. Ball.
Journal of Hydraulic Research JHYRAF, Vol. 23, No. 4, p 327-341, 1985. fig 9, 1 tab, 16 ref.

Descriptors: *Drainage patterns, *Hydraulics, *Model studies, *Routing, *Unsteady flow, *Urban drainage, *Urban hydrology, Algorithms, Channel flow, Finite difference methods, Hydrographs, Mathematical studies, St Venant equation.

The routing of hydrographs through a network is an important aspect of the design and analysis of urban drainage networks due to the flow of urban drainage networks being typically unsteady. The use of numerical solution of the Saint Venant equations to determine the propagation of unsteady flows through pipes has been validated by many researchers during the previous two decades. Among the many numerical techniques which have been developed for the analysis of unsteady flows in open channels is the four-point implicit finite difference scheme, commonly referred to as the Amein scheme. Use of this scheme requires the solution of the equation: C x delta v = -R, where C is a large sparse n x n matrix and delta v and R are n x 1 column vectors. The proposed algorithm uses the properties of the drainage network to develop an efficient algorithm for the solution of C x delta v = -R. This algorithm is based upon partitioning and decomposing the coefficient matrix C. As an additional advantage, the proposed solution algorithm enables the determination of the water surface level within a manhole, and the possibility of surcharge at a manhole. A sample urban drainage network is analyzed showing the use of the proposed solution algorithm. (Author's abstract)
W91-00031

STREAM-CHANNEL INCISION FOLLOWING DRAINAGE-BASIN URBANIZATION.
King County Basin Planning, Seattle, WA.
D. B. Booth.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 407-417, June 1990. 9 fig, 43 ref.

Descriptors: *Channel erosion, *Channel morphology, *Geomorphology, *Model studies, *Urban drainage, *Urban runoff, *Urbanization, Bank erosion, Channel flow, Erosion, Flood discharge, Rehabilitation, Runoff, Sediment transport, Storm runoff, Urban planning, Washington.

Urbanization of a drainage basin results in pervasive hydrologic changes that in turn initiate long-term changes in stream channels. Increases in peak discharges and in durations of high flows result in either quasi-equilibrium channel expansion, where cross-section area increases in near-proportion to the discharge increase, or catastrophic channel incision, where changes occur far out of proportion to the discharge increases that initiated them. Field data and hydrologic modeling of rapidly urbanizing basins in King County, Washington, defined conditions of flow, topography, geology, and channel roughness that identify streams susceptible to incision. Channel slope and geologic material are particularly critical; thus simple map overlays, nearly irrespective of contributing drainage area, provide a valuable planning tool for identification of susceptible terrain. Where such conditions exist, basal shear stress provides a quantifiable parameter for predicting likely problems, although knickpoints are typical in such settings and confound simple calculation of sediment-transport rates. Where urbanization proceeds in such areas, effective mitigation of the incision hazards requires a degree of stormwater control far in excess of standards typically applied to present development activity. (Author's abstract)
W91-00082

STORMFLOW AND SEDIMENT LOSS FROM INTENSIVELY MANAGED FOREST WATERSHEDS IN EAST TEXAS.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
W. H. Blackburn, R. W. Knight, J. C. Wood, and H. A. Pearson.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 465-477, June 1990. 4 fig, 5 tab, 25 ref.

Descriptors: *Clear-cutting, *Flood peak, *Forest management, *Forest watersheds, *Rainfall-runoff relationships, *Sediment discharge, *Soil erosion, *Streamflow, Conservation, Grazing, Livestock, Texas.

Five small (4 ha) forested watersheds in East Texas were instrumented in December 1980 to determine the effect of forest harvesting, mechanical site preparation, and livestock grazing on stormflow, peak discharge rate, and sediment loss. After three pretreatment years, four of the watersheds were treated as follows: (1) clearcutting followed by roller chopping; (2) clearcutting following by shearing and windrowing; (3) clearcutting following by shearing, windrowing, and continuous grazing; and (4) clearcutting followed by shearing, windrowing, and rotational grazing. Clearcut harvesting and all site preparation treatments significantly increased stormflow, peak discharge, and sediment losses over the undisturbed condition. Roller chopping and shearing/windrowing had little impact on sediment loss from these watersheds and appears to be a sound forest conservation practice for gently sloping watersheds (< 8%). As applied, livestock grazing had minimal impact on stormflow and peak discharge. The moderately stocked continuously grazed treatment had little impact on sediment loss, but the high stocking density of the rotational grazing treatment increased sediment losses over the undisturbed condition. Sediment losses from these intensively managed forest watersheds, even though significantly greater than from undisturbed conditions, were within the range of sediment losses from undisturbed watersheds in the Southeast, below the range of losses from mechanically prepared watersheds elsewhere, and well below potential losses from pasture and cropland. (Author's abstract)
W91-00087

FISHES OF BULLITT COUNTY, KENTUCKY.
Clemson Univ., SC. Dept. of Biological Sciences.
D. J. Durbin, and W. D. Pearson.
Transactions of the Kentucky Academy of Science TKASAT, Vol. 51, No. 12, p 6-13, March 1990. 1 fig, 3 tab, 25 ref.

Descriptors: *Fish populations, *Kentucky, *Land use, *Stream fisheries, Environmental effects, Population dynamics, Species composition, Species diversity, Surveys.

Bullitt County, Kentucky has undergone substantial changes in human population and land use over the past few decades. The 1980 census reported and increases of 4.5 times the number of people living in the area since the 1940 census. As the human population rose dramatically between 1960 and 1980, some the county's farmland was converted to residential uses; in addition, the number of industrial plants rose from 2 in 1950 to about 20 in 1983. To study the impacts of land use changes, 60 collections of fishes were made from 35 sites on 24 streams in Bullitt County between June and November, 1986. A total of 7,707 specimens, representing 58 species and 14 families, was collected. From these samples, as well as records from several previous surveys, a list for the county was compiled containing 78 species. The 1986 survey was then compared to a similar, but smaller, study made in 1950 to determine whether changes in human activities and land use in the interim had affected fish populations. No overall effect was indicated, but some streams did show signs of degradation as a result of dredging, channelization, pollution, removal of riparian growth and highway construction. One species, Lampetra aepyptera (brook lamprey), may have been extirpated since 1950. (Mertz-PTT)
W91-00108

POSTTREATMENT EFFECTS OF FOREST FERTILIZATION ON THE PREDOMINANT BENTHIC COMMUNITY OF A HEADWATER STREAM IN EASTERN KENTUCKY.
Southern Illinois Univ., Carbondale. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-00109

SIMULATION OF LAND USE CHANGES AND IMPACTS ON THE WATER BALANCE: A CASE STUDY FOR BELGIUM.
Institut Royal Meteorologique de Belgique, Brussels.
F. Bultot, G. L. Dupriez, and D. Gellens.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 327-348, May 1990. 13 fig, 24 ref. Commission of the European Communities Grant CLI-104B(RS).

Descriptors: *Belgium, *Hydrologic models, *Land management, *Land use, *Model studies, *Water resources management, *Watershed management, Coniferous forests, Evapotranspiration, Floods, Forest hydrology, Forest watersheds, Pastures, Stream discharge, Streamflow, Vegetation effects.

Those responsible for land management policies need to know to what extent land surface management can be beneficial or damaging to water resources. The impacts of assumed land use changes in the Houille catchment in Belgium have been simulated by means of a conceptual hydrological model, developed at the Royal Meteorological Institute of Belgium. The largest difference in impacts appears between basin-wide coverage by coniferous forests and pastures. The mean annual effective evapotranspiration is a maximum for 100% coniferous forests (552 mm/year) and a minimum for pastures (477 mm/year), while the mean annual streamflow is a minimum for coniferous forests (556 mm/year) and a maximum for pastures (631 mm/year). As compared with the pastures cover, the coniferous forests cover also demonstrates more frequent low-flow days (+14) and fewer flood days (-10); the discharges associated with extreme flood and low-flow conditions are however almost unaffected. Intermediate results are found for the other vegetation types. The assessment of the impact of limited or complex changes of vegetation may be estimated by a simple proportionality relation using the reference values provided by consideration of extreme hypothetical situations. The enlargement of impervious areas clearly modifies the streamflow regime in the basin by inducing more floods as well as longer low-flow stages. (Author's abstract)
W91-00162

SEDIMENT AND THE ENVIRONMENT.
For primary bibliographic entry see Field 2J.
W91-00280

GEOMORPHIC DESIGN AND MANAGEMENT OF DISTURBED LANDS.
Denver Univ., CO. Dept. of Geology and Geography.
T. J. Toy, and R. F. Hadley.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 145-153, 1 fig, 1 tab, 25 ref.

Descriptors: *Design criteria, *Environmental impact, *Erosion control, *Geomorphology, *Land management, *Land reclamation, *Land use, *Slopes, Channels, Drainage basins, Environmental control, Land resources, Landscaping, Project planning.

Human activities result in a wide variety of land disturbances. The contribution of geomorphology in the design and management of disturbed lands is discussed. Regardless of the type of disturbance, it is proposed that each type can be evaluated in terms of three factors: (1) areal extent, (2) intensity, and (3) duration. The goal in design of a landscape for a disturbed area is to mitigate environmental impacts and re-establish dynamic equilibrium within the geomorphic system. The design of the landscape involves three phases: (1) analysis of existing environmental conditions, (2) formulation of a reclamation program, and (3) program implementation. It is in the formulation of the reclamation program that the fundamental principles of geomorphology find direct application. Climate, geologic structure and lithology, and relief are regarded as the variables most influential in determining the morphology of drainage basins. There is a tradeoff in the design of hillslopes, such that length increases, base increases, and height decreases as gradient decreases for a given volume of material graded. The design of channels for disturbed lands should rest upon the expected hydrologic properties of the reclaimed surface rather than the properties of the natural, predisturbance surface. Post-reclamation management includes site monitoring, remedial actions to repair site deterioration, and decisions to minimize future deterioration. (See also W91-00280) (MacKeen-PTT)
W91-00296

LONG AND SHORT-TERM EPISODIC STORAGE AND REMOVAL OF SEDIMENT IN WATERSHEDS OF SOUTHWESTERN WISCONSIN AND NORTHWESTERN ILLINOIS.
Wisconsin Univ.-Madison. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W91-00297

HILLSLOPE AND CHANNEL SEDIMENT DELIVERY AND IMPACTS OF SOIL EROSION ON WATER RESOURCES.
East Carolina Univ., Greenville, NC. Dept. of Geography and Planning.
For primary bibliographic entry see Field 2J.
W91-00300

PHYSICAL HABITAT SIMULATION AND SEDIMENTATION.
National Ecology Center, Fort Collins, CO.
R. T. Milhous.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 211-218, 2 fig, 1 tab, 18 ref.

Descriptors: *Channel flow, *Flow control, *Instream flow, *Model studies, *Sedimentation, *Simulation analysis, Channel maintenance, Channel morphology, Channel stability, Flushing flow, Habitats, Mathematical models, Sedimentation rates, Stream banks, Streamflow, Watershed management.

Stream channels provide habitat for aquatic species and for animals that use the banks of the stream. Two sedimentation factors are important for maintenance of desirable habitat conditions: (1) maintain desirable channel shape, and (2) maintain desirable substrate by flushing fines through the system. Flushing flow methodology is reviewed, with the conclusion that current techniques are not sufficiently developed for application of any specific analytical channel maintenance methodology to instream flow management, but are closer to providing a quantitative flushing flow methodology. Approaches to selecting a channel maintenance flow based on the simple hydraulic geometry relation will fail if there is any significant change in either sediment load or streamflow. The more complex approaches based on width changes give uncertain results and should be investigated further. Flushing flows can be determined based on considerations of physical habitats and physical processes. (See also W91-00280) (MacKeen-PTT)
W91-00303

EFFECTS OF SUBURBANIZATION UPON SNOWMELT RUNOFF.
Trent Univ., Peterborough (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-00408

HYDROLOGIC AND CHEMICAL-QUALITY DATA FROM FOUR RURAL BASINS IN GUILFORD COUNTY, NORTH CAROLINA, 1985-88.
Geological Survey, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W91-00433

HYDROLOGIC AND WATER-QUALITY DATA FOR STREAMS AND IMPOUNDMENTS IN THE COTEAU DES PRAIRIES--UPPER MINNESOTA RIVER BASIN, 1979-84.
Geological Survey, St. Paul, MN.
For primary bibliographic entry see Field 2E.
W91-00434

HYDROLOGICAL EFFECTS OF CATCHMENT CHARACTERISTICS AND LAND USE CHANGES DETERMINED BY SATELLITE IMAGERY AND GIS.
Ruhr Univ., Bochum (Germany, F.R.). Inst. for Hydrology, Water Resources and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W91-00472

LOGGING EFFECTS ON STREAMFLOW: STORM RUNOFF AT CASPAR CREEK IN NORTHWESTERN CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
K. A. Wright, K. H. Sendek, R. M. Rice, and R. B. Thomas.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1657-1667, July 1990. 9 fig, 4 tab, 36 ref.

Descriptors: *Environmental effects, *Land use, *Logging, *Rainfall-runoff relationships, *Road construction, *Storm runoff, *Streamflow, California, Caspar Creek, Flow profiles, Forest watersheds, Hydrographs, Infiltration, Storage seepage.

The effects of road building and tractor harvesting on storm runoff were assessed for a small (424 ha) coastal watershed on Caspar Creek in northern California. Road building alone did not significantly affect the storm runoff. After road building and logging, lag time was decreased approximately 1.5 hr, and the very small storm volumes (less than 1209 cu m) and storm peaks (less than 566 L/s) were increased by about 132% and 111%, respectively. Storm volumes and peaks of large storms (occurring less frequently than eight times a year) were not significantly increased by either roads or logging, even though more than 15% of the watershed was compacted in roads, skid trails, and landings. Although a decrease in lag time showed that the average storm hydrograph was shifted forward in time, only the small storm hydrographs were changed in shape. It is speculated that the rate of delivery of water to the stream channel during large channel-forming flows was governed by infiltration and subsurface flow rates on the 85% of the watershed that was unaffected by roads, landings, or skid trails. It is concluded that, in a rain-dominated hydrologic environment, logging and forest road construction (as carried out in this study) are not likely to change the flow regime of a stream adversely. (See also W91-00611) (Author's abstract)
W91-00610

LOGGING EFFECTS ON STREAMFLOW: WATER YIELD AND SUMMER LOW FLOWS AT CASPAR CREEK IN NORTHWESTERN CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
For primary bibliographic entry see Field 3B.
W91-00611

PATTERNS OF FISH SPAWNING IN HUDSON RIVER TRIBUTARIES: RESPONSE TO AN URBAN GRADIENT.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
For primary bibliographic entry see Field 8I.
W91-00617

PILOT STUDIES FOR DESIGNS OF SURVEYS OF HUMAN DISTURBANCE OF INTERTIDAL HABITATS IN NEW SOUTH WALES.
Sydney Univ. (Australia). Inst. of Marine Ecology.
A. J. Underwood, and S. J. Kennelly.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 1, p 165-173, 1990. 3 tab, 28 ref.

Descriptors: *Australia, *Ecosystems, *Environmental impact, *Experimental design, *Human population, *Littoral environment, *New South Wales, *Recreational effects, *Surveys, Recreation facilities, Spatial distribution, Variability, Weather.

Data are presented from pilot studies as the first step in the design of large-scale surveys of the effects of human recreational activities on intertidal habitats in New South Wales. People visiting the seashore were counted and interviewed. Numbers of organisms removed for food or bait were determined, as were the numbers of fisherman and scavengers frequenting the shore. Data from pilot studies using these methods assessed the various effects of human recreation during school terms or holidays, on weekdays or weekends and on sunny or overcast days. Pilot sampling at different locations provided estimates of the variability from place to place within 30 km. Sampling was in a fully orthogonal design which allowed tests of various factors and their interactions. More people affected the shore during school holidays than during term-time, but there were no differences between weekends and weekdays. There were significant effects due to weather, with more potential impact occurring on sunny than on overcast days. There were also substantial differences in effects at different places. Other potential sources which should be considered in designing surveys of the effects of human recreation include variability due to time of day, the state of the tide, prevailing weather and various spatial and temporal scales. Such pilot sampling enables the efficient design of the large-scale, long-term surveys that are a necessary prerequisite to determining the magnitude and effects of human disturbances and their eventual management. (Author's abstract)
W91-00685

LEAD POISONING IN MAGPIE GEESE ANSERANUS SEMIPALMATA FROM INGESTED LEAD PELLET AT BOOL LAGOON GAME RESERVE (SOUTH AUSTRALIA).
Australian National Parks and Wildlife Service, Berri.
For primary bibliographic entry see Field 5C.
W91-00687

SEASONAL, HYDROLOGICAL, AND LAND MANAGEMENT FACTORS CONTROLLING DISSOLVED ORGANIC CARBON CONCENTRATIONS IN THE LOCH FLEET CATCHMENTS, SOUTHWEST SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 2H.
W91-00862

EVALUATION AND PREDICTION OF POSSIBLE MAN-INDUCED CHANGES IN THE HYDROLOGICAL CYCLE.
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
L. S. Kuchment.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 53-61, 3 fig, 7 ref.

Descriptors: *Climates, *Environmental effects, *Global warming, *Greenhouse effect, *Hydrologic cycle, *Land use, *Model studies, *Transpiration, Atmospheric carbon dioxide, Carbon dioxide, Catchment areas, Deforestation, Hydrologic models, Land development, Physical models, Reforestation, Rivers, Runoff, Watersheds.

Some man-induced changes in the hydrological cycle, particularly in river runoff, occur gradually over a long period of time and manifest themselves differently under various hydrometeorological conditions. This causes considerable difficulties in their detection on the basis of historic data analysis. Physically-based models of the hydrological cycle, taking into account man-induced changes in catchment characteristics, were used to identify man-induced alterations of water balance components and to predict their future changes, resulting from human activity and climate variability. Estimation of possible runoff changes resulting from predicted variations in temperature and precipitation, as well as calculations of transpiration dynamics caused by the changes in atmospheric carbon dioxide content were obtained. Numerical experiments provide an estimation of the impact of land ploughing, afforestation/deforestation, groundwater development and other types of human activity on watershed parameters. Physically based models offer the possibility of predicting changes in water balance components for planning land-use in the river basin and for runoff control on the watershed. (See also W91-00961) (Author's abstract)
W91-00967

USE OF KINEMATIC WAVE METHOD TO ASSESS EFFECTS OF URBAN DEVELOPMENT ON FLOOD PEAK CHANGES.
Nanyang Technological Inst., Singapore. School of Civil and Structural Engineering.
T. S. W. Wong, and C. N. Chen.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 93-102. 5 fig, 1 tab, 13 ref.

Descriptors: *Catchment areas, *Flood peak, *Kinematic wave theory, *Mathematical models, *Model studies, *Urban drainage, *Urban hydrology, *Urbanization, Soil water infiltration, Storm runoff, Storm sewers, Storm water.

Kinematic wave method was used to assess the effects of urban development on flood peak changes for an idealized overland catchment and for a range of rectangular drainage basins comprising two identical overland catchments and a drainage channel. The assessment on the overland catchment shows that the change in surface roughness as a result of urbanization causes the greatest increase in flood peak as compared to the changes in soil infiltration and depression storage. The method was applied to a range of idealized rectangular drainage basins of constant area of 1 sq km. For the drainage basin, the degree of urbanization is expressed in terms of the percentage of area made impervious and the percentage of area sewered. The effect of urbanization on the change of flood peaks is expressed in isopleth lines, which are lines of equal ratio of flood peak after and before urbanization. The basin shape has a significant impact on the isopleth line pattern. (See also W91-00961) (Author's abstract)
W91-00971

4D. Watershed Protection

SOIL EROSION IN THE YELLOW RIVER BASIN AND ITS IMPACTS ON RESERVOIR SEDIMENTATION AND THE LOWER YELLOW RIVER.
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China). Dept. of Sedimentation Engineering.
For primary bibliographic entry see Field 2J.
W91-00294

WATER QUALITY AND PAM INTERACTIONS IN REDUCING SURFACE SEALING.
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
I. Shainberg, D. N. Warrington, and P. Rengsamy.
Soil Science SOSCAK, Vol. 149, No. 5, p 301-307, May 1990. 3 fig, 2 tab, 15 ref.

Descriptors: *Erosion, *Erosion control, *Infiltration, *Rainstorms, *Runoff, *Soil chemistry, Aggregates, Bonding, Electrolytes, Polyacrylamides, Soil types.

Seals formed at the soil surface during rainstorms reduce penetration and cause runoff and erosion. Surface application of an anionic polyacrylamide (PAM) was tested at rates of 10, 20 and 40 kg/ha for its effect on the infiltration rate (IR) of two soils, a loess (Calcic Haploxeralf) and a grumusol ((Typic Chromoxerert), during simulated rainstorms. The interaction between PAM and electrolyte concentration was also investigated at the soil surface under a simulated rainfall of distilled water or tap water and by spreading gypsum. Electrolytes in the soil solutions that flocculated the soil clay enhanced the beneficial effect of the polymer on aggregate stability and greatly reduced water losses. Complete drying of the polymer-soil surfaces improved the binding action of the polymer. Treatments with PAM under optimal conditions increased the final IR of the loess from 2.0 to 23.5 mm/hr and the rain intake of an 80 mm rainstorm from 12.3 to 64.2 mm. PAM treatment of the grumusol increased the final IR from 3.0 in the control to 20.5 mm/hr and the rain intake from 21.3 to 62.3 mm. As soils from semiarid regions are unstable, form crusts, and produce much runoff (approximately 80%) during rainstorms, the use of PAM to reduce runoff is a viable possibility. (Author's abstract)
W91-00791

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

SUMMERTIME SAMPLING.
Southern Illinois Univ. at Edwardsville. Environmental Resources Training Center.
D. Anderson, and D. Bennett.
Water Engineering and Management WENMD2, Vol. 137, No. 6, p 40-41, June 1990.

Descriptors: *Bacterial analysis, *Pollutant identification, *Summer, *Water sampling, *Water treatment, Bacteria, Bacterial growth, Laboratory methods, Seasonal variation, Water analysis.

During warm temperatures, excessive noncoliform bacteria growth--after sample collection and before the sample is analyzed--does not indicate an actual problem with such noncoliform bacteria in drinking water. The problem is faulty sampling procedures for the given conditions of summer. The special conditions of summer are very favorable for excessive bacteria growth, especially for surface water supplies. To prevent bacteriological contamination of water samples in warm weather the following procedures are recommended: the service line and nearby hydrants should be flushed; the sample should be collected without changing water pressure; samples should be transported directly and packed in ice; samplers should be sure to wash their hands with soap and water before sampling and take care to select the proper type of sampling tap, preferably a smooth-nosed tap that doesn't leak and that does not have an aerator, sample should not be taken from an outside sill-cock since these are threaded and usually near the ground where they can be contaminated easily. (Mertz-PTT)
W91-00111

REPRODUCTIVE STRATEGY OF DAPHNIA MAGNA AFFECTS THE SENSITIVITY OF ITS PROGENY IN ACUTE TOXICITY TESTS.
Ministry of Transport and Public Works, Lelystad (Netherlands). Lab. for Ecotoxicology.
L. Enserink, W. Luttmer, and H. Maas-Diepeveen.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 15-25, July 1990. 8 fig, 18 ref.

Descriptors: *Acute toxicity, *Adaptation, *Bioindicators, *Cadmium, *Chromium, *Daphnia, *Heavy metals, *Water pollution effects, Chlorophyta, Food habits, Laboratory methods, Reproducibility, Toxicology, Trace metals.

Maternal nutrition in Daphnia magna affects the body size of the young and the sensitivity of the brood for acute exposure to Cd, but not to Cr(VI). This phenomenon may contribute to inter-laboratory as well as intra-laboratory variation in test results, because Daphnia culture techniques are not yet standardized in a sufficient way. In one set of

trials four food ration levels of the green alga Chlorella pyrenoidosa were given to a cohort of adult D. magna. After eight days brood size and the size of young became adapted to the new food ration level. At low levels, small broods were produced which consisted of large neonates, whereas at high food levels many tiny young were born. In acute toxicity tests with Cd the sensitivity of the neonates appeared to be connected with their body size. The smallest young were three times more sensitive than the largest neonates, comparing the 48-h LC50. No difference in sensitivity occurred during acute exposure to Cr. (Author's abstract)
W91-00192

IN VITRO INHIBITION OF ACETYLCHOLINESTERASE FROM FOUR MARINE SPECIES BY ORGANOPHOSPHATES AND CARBAMATES.
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes. Lab. of Biochemistry.
F. Galgani, and G. Bocquene.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 243-249, August 1990. 2 fig, 1 tab, 10 ref.

Descriptors: *Bioassay, *Carbamate pesticides, *Enzymes, *Organophosphorus pesticides, *Pollutant identification, *Water pollution effects, Acetylcholinesterase, Animal metabolism, Muscle, Bioindicators, Fish, Fish physiology, Marine animals, Marine pollution, Mussels, Organophosphorus compounds, Shrimp.

Because of the sensitivity of acetylcholinesterase (ACE) to carbamates and organophosphates, the enzyme has been used as a biochemical indicator of pollution by these pesticides. A study was conducted to investigate the sensitivity of various marine animals to both organophosphates and carbamates. The study was conducted by assessing the in vitro effect of five organophosphates and three carbamates on ACE activity from the muscle of the shrimp Palaemon serratus, the fishes Scomber scomber and Pleuronectes platessa, and from the whole mussels Mytilus edulis. ACE from whole mussel was less sensitive to organophosphates than the enzyme from P. serratus and the fishes. For all organophosphates studied, sensitivity was highest for P. platessa, with its ACE being inhibited by as little as a 1 ppb concentration. With carbamates, the fish were found to be more sensitive having detection levels less than 10 micrograms/L in both species. Of all species studied, P. platessa appears to be the most sensitive for the monitoring of organophosphate and carbamate pollutant effects. (Hoskin-PTT)
W91-00206

HEAVY METAL CONTAMINATION IN THE RIVER TOAD, BUFO JUXTASPER (INGER), NEAR A COPPER MINE IN EAST MALAYSIA.
National Univ. of Malaysia, Kota Kinabalu. Faculty of Science and Natural Resources.
For primary bibliographic entry see Field 5B.
W91-00209

SELECTED QUALITY ASSURANCE DATA FOR WATER SAMPLES COLLECTED BY THE U.S. GEOLOGICAL SURVEY, IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO, 1980 TO 1988.
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 7B.
W91-00334

PROPOSAL TO USE CHLORINE-36 FOR MONITORING THE MOVEMENT OF RADIONUCLIDES FROM NUCLEAR EXPLOSIONS.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
F. M. Phillips, S. N. Davis, and P. Kubik.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 106-113, Summer 1990. 2 fig, 5 tab, 20 ref. NSF Grant PHY-8818281.

Descriptors: *Chlorine radioisotopes, *Groundwater pollution, *Monitoring, *Nuclear explosions, *Path of pollutants, *Radioactive tracers, *Tracers, Fate of pollutants, Groundwater movement, Groundwater transport, New Mexico, Radioactive wastes, Soil contamination.

Chlorine-36 has been produced in large amounts by hundreds of nuclear explosions on the Nevada Test Site as well as 12 off-site explosions at eight locations in five states. Continued monitoring of the redistribution of radionuclides by subsurface water is of concern in most of the areas affected by the detonations. Chlorine-36 has the following advantages as a built-in tracer for this redistribution: its mobility is equal to or greater than water, its long half-life assures its continued usefulness over long periods, collection and storage of samples is simple, it is not subject to vapor transport at ordinary temperatures, its natural background is very low, and it does not form insoluble precipitates. Chlorine-36 from the Gnome event near Carlsbad, New Mexico, illustrated how chlorine-36 can be used to help study the redistribution of radionuclides in the soil profile. Chlorine-36 is also potentially useful as a tracer to study movement of contaminants around large nuclear reactor complexes and near repositories for radioactive waste. (Author's abstract)
W91-00366

SOIL-GAS SURVEYING FOR SUBSURFACE GASOLINE CONTAMINATION USING TOTAL ORGANIC VAPOR DETECTION INSTRUMENTS: PART I. THEORY AND LABORATORY EXPERIMENTATION.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
G. A. Robbins, B. G. Deyo, M. R. Temple, J. D. Stuart, and M. J. Lacy.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 122-131, Summer 1990. 15 fig, 18 ref. EPA Grant No. CR-814542-01.

Descriptors: *Gasoline, *Groundwater pollution, *Measuring instruments, *Petroleum products, *Pollutant identification, *Soil analysis, *Soil gases, Analytical techniques, Chemical analysis, Laboratory methods, Monitoring, Permeability, Subsurface water, Volatile organic compounds.

Soil-gas surveying has become an effective means to screen for subsurface gasoline contamination. Most reported studies have described the use of gas chromatographs in conducting surveys. In contrast, few published studies have described the use of total organic vapor detection (TOV) instruments in conducting surveys, despite their common use. Factors influencing the response of TOV detection instruments used in soil-gas surveying for subsurface gasoline leakage were investigated through performing theoretical assessments and laboratory experiments. Theoretical assessments indicate that TOV measurements will depend on response conditions and the relative concentration of constituents in soil gas, in addition to absolute constituent levels. Laboratory tests conducted using flame ionization, photoionization and explosimeter devices indicated that conditions influencing their responses included instrument flow rate and soil-air permeability when performing direct-probe sampling; the linear range of the instrument; the multicomponent nature of gasoline vapors; and levels of oxygen, nitrogen, carbon dioxide and relative humidity in soil air. If an instrument's response to these conditions is not taken into account, survey results may be misleading. To circumvent adverse instrument responses, a serial dilution technique was used. (Author's abstract)
W91-00368

MEASUREMENT OF BIODEGRADABLE ORGANIC MATTER AND BACTERIAL GROWTH POTENTIAL IN DRINKING WATER.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-00381

DETECTING THE BIOLOGICAL EFFECTS OF DEEP-SEA WASTE DISPOSAL.
Woods Hole Oceanographic Institution, MA.
J. J. Stegeman.
Oceanus OCEAAK, Vol. 33, No. 2, p 54-61, Summer 1990. 4 fig.

Descriptors: *Bioindicators, *Marine environment, *Marine pollution, *Path of pollutants, *Water pollution effects, Animal metabolism, Bioassay, Biochemical tests, Chlorinated hydrocarbons, Cytochromes, Fish physiology, Liver, Marine animals, Monitoring, Newfoundland, Polycyclic aromatic hydrocarbons.

Biomarkers, certain biochemical changes that signal an organism's first response to chemical pollutants, can be used to assess the biological exposure and effects of pollutants more specifically and inexpensively than other methods. Using biomarkers to investigate the deep-sea environment could provide the essential background information for monitoring the effects of wastes that are disposed of in the deep ocean. The induction of cytochrome P450 is know be a well-characterized effect of many polycyclic aromatic hydrocarbons (PAHs) and chlorinated aromatic hydrocarbons (CAHs) such as dioxins and benzofurans. A widely-distributed deep sea species, the rattail fish (Coryphaenoides armatus), was chosen to study the ability to detect deep-sea environmental contamination. Two sites about 1600 km apart in the North Atlantic were studied: Hudson Canyon off the eastern United States and Carson Canyon off Newfoundland. High levels of cytochrome P450E were found in the southern group's livers, but very low levels in the northern group's livers. Polychlorinated biphenyl levels correlated with cytochrome P450E levels. The induction indicates that CAHs or other chemicals are present at levels high enough to cause this biochemical effect in animals far removed from known point-sources of the chemicals. In another collection of rattail fish near a deep-water (2500 m) dumpsite off the U.S. eastern seaboard, high levels of cytochrome P450E induction were also detected. In the future, biomarkers such as cytochrome P450E could supplant analytical chemistry as a first screen for the presence of many chemical contaminants such as PAHs and CAHs. Thus biomarkers could become a key component in any system to monitor disposal sites for chemically-induced biological change. (Hoskin-PTT)
W91-00386

DETERMINATION OF GOLD AT FEMTOMOLAR LEVELS IN NATURAL WATERS BY FLOW INJECTION INDUCTIVELY COUPLED PLASMA QUADRUPOLE MASS SPECTROMETRY.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
For primary bibliographic entry see Field 2K.
W91-00388

DETERMINATION OF CHLOROANILINE TRACES IN ENVIRONMENTAL WATERS BY SELECTIVE EXTRACTION WITH TWO TRAPS IN TANDEM AND LIQUID CHROMATOGRAPHY.
Rome Univ. (Italy). Dipt. di Chimica.
A. Di Corcia, and R. Samperi.
Analytical Chemistry ANCHAM, Vol. 62, No. 14, p 1490-1494, July 15, 1990. 1 fig, 5 tab, 17 ref.

Descriptors: *Analytical methods, *Chemical analysis, *Chlorinated hydrocarbons, *Chromatography, *High performance liquid chromatography, *Pollutant identification, *Water analysis, Adsorbents, Cation exchange, Chloranilines, Detection limits, Laboratory methods, Water quality monitoring.

Selective liquid-solid extraction from environmental waters of 14 chloroanilines was achieved using a two-trap tandem system, one containing a nonspecific absorbing material, such as graphitized carbon black (Carbopack B), and the other one filled with a resin-based strong cation exchanger. After percolation of water samples through the Carbopack column (extraction cartridge) the two traps were connected in series, acetonitrile acidi-

fied with HCl (10 mmol/L) was allowed to flow along them, and chloroanilines displaced from the extraction cartridge were selectively readsorbed via hydrogen bonding on the strong acid exchanger column (isolation cartridge). After this column was washed, the analytes were eluted from the isolation cartridge with 1 ml of aqueous acetonitrile KOH (0.1 mol/L) solution. After suitable neutralization, 0.2 ml of this solution was directly injected into the liquid chromatographic apparatus, which was operated isocratically in the reverse-phase mode with UV detection at 240 nm. The analytical recoveries of the 14 chloroanilines were higher than 88%. The limits of detection of the analytes considered were well below 0.1 microg/L. The effectiveness in terms of recovery and selectivity of the two traps in a series was superior compared with the cartridges used individually, or with a third cartridge which contained a chemically bonded siliceous material. (Author's abstract)
W91-00389

AUTOMATED HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY FOR THE DETERMINATION OF PESTICIDES IN WATER USING SOLID PHASE EXTRACTION.
Brock Univ., St. Catharines (Ontario). Dept. of Chemistry.
C. H. Marvin, I. D. Brindle, C. D. Hall, and M. Chiba.
Analytical Chemistry ANCHAM, Vol. 62, No. 14, p 1495-1498, July 15, 1990. 4 fig, 2 tab, 10 ref.

Descriptors: *Analytical methods, *Chemical analysis, *Chromatography, *High performance liquid chromatography, *Pesticides, *Pollutant identification, *Water analysis, Adsorbents, Automation, Detection limits, Laboratory methods, Water quality monitoring.

An automated solid phase extraction/high performance liquid chromatography (SPE/HPLC) method has been developed to determine trace concentrations of Propoxur, Carbofuran, Carbaryl, Propham, Captan, Chloropropham, Barban, and Butylate in water. One hundred ml of sample is passed through a disposable SPE cartridge packed with 90 microm sorbent at 10 ml/min. The concentrated analytes are eluted from the cartridge with acetonitrile. The resulting eluate is blown down under nitrogen, made up in water, and injected into the HPLC. The analytes are separated on a 25 cm C(8) analytical column and determined by UV absorption at 220 nm. The total time for the analysis is 90 min and the lowest detectable concentrations are in the range of 0.02-0.92 microg/L for the eight pesticides. Recoveries for the eight pesticides ranged from 84-93%. The procedure is totally automated and can analyze 30 samples consecutively and unattended. (Author's abstract)
W91-00390

PERFORMANCE EVALUATION MATERIALS FOR THE ANALYSIS OF VOLATILE ORGANIC CONTAMINANTS IN SOIL: A PRELIMINARY ASSESSMENT.
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV.
T. E. Lewis, B. A. Deason, C. L. Gerlach, and D. W. Bottrell.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 5, p 505-531, July 1990. 4 fig, 7 tab, 24 ref. EPA Contract 68-03-3249.

Descriptors: *Analytical methods, *Chemical analysis, *Pollutant identification, *Soil analysis, *Volatile organic compounds, Gas chromatography, Mass spectrometry, Performance evaluation, Quality control, Sample preparation, Soil contamination, Stability analysis, Static headspace.

The performance of an analytical method may vary significantly as a result of the diverse nature of sample matrices. During an evaluation of field portable gas chromatographs (GC), site-specific performance evaluation materials (PEM) were prepared and used as quality control samples. Clean soils from two contaminated sites were spiked with various volatile organic compounds. The PEM were shipped to the field via air carrier and analyzed by GC. The PEM samples were also shipped back to the laboratory and analyzed as double blind samples on a GC and a GC/mass spectrometer. PEM samples which were held in the laboratory without being shipped were also analyzed. GC analyses with a static headspace method revealed highly variable recoveries for both shipped and unshipped PEM. An operationally defined headspace calibration was used to quantitate the amount of analyte remaining in the soil at various holding times and under various shipping scenarios. Several factors were critical in the preparation and long term integrity of soil volatile PEM: moisture status of the soil, sample aging, chemical characteristics of the spiked analytes, storage container, and spiking solution. (Author's abstract)
W91-00393

CURRENT STATUS OF DISINFECTANT RESIDUAL MEASUREMENT METHODS FOR FREE AND COMBINED CHLORIDE AND OXYCHLORINE SPECIES.
Miami Univ., Oxford, OH. Dept. of Chemistry.
G. Gordon, G. E. Pacey, and W. J. Cooper.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 29-45, 1 fig, 27 ref.

Descriptors: *Chemical analysis, *Chlorides, *Chlorination, *Data acquisition, *Pollutant identification, *Residual chlorine, *Water analysis, Amperometry, Chloramines, Disinfection, Laboratory methods, Syringaldazine, Water treatment.

A detailed report was written for the American Water Works Association Research Foundation, which reviews and summarizes all disinfectant residual measurement techniques currently available for free chlorine (along with the various chloramines), combined chlorine, chlorite ion, chlorine dioxide, and chlorate ions. A common problem with chemical methods for determination of disinfection species is that there is no ideal or referee method that can be used to check the accuracy of the new ones being developed and tested. The ideal method for determination of chlorine would accurately measure free aqueous chlorine (Cl2 + HOCl) in all types of water samples. Even though HOCl is the disinfecting species that appears to be most effective, almost all methods determine both species simultaneously. The ideal method should work equally well for all water samples. There is a great need for extremely selective analytical methods capable of determining not only chlorine but the individual chloramines and other oxychlorinated species. In general, because the molar absorptivities are quite low for chlorine and chloramine species, current methods are not considered useful in routine monitoring of chlorine residuals. It is possible that additional methods using permeable membranes, such as gas diffusion flow-injection analysis, could be developed for simultaneous determination of chlorine species in aqueous solution. Amperometric titration techniques will probably remain the laboratory standard used as the basis for comparisons of accuracy. The FACTS test, which uses syringaldazine, appears to be very useful for determination of free chlorine in the presence of relatively high concentrations of combined inorganic chlorine. A severe drawback of the FACTS test procedure is the insolubility of the syringaldazine in either 2-propanol or water. Both fluorescence and chemiluminescence methods show promise for specific determination of free chlorine at very low concentrations. Neither the iodometric or amperometric methods are recommended because they are unreliable. (See also W91-00476) (Lantz-PTT)
W91-00479

EVALUATION OF PROTOCOL FOR PREPARING DRINKING WATER SAMPLES FOR AMES MUTAGENICITY TESTING.
California Dept. of Health Services, Berkeley.
Y. Y. Wang, C. P. Flessel, K. I. Chang, D. A. Hollander, and P. J. Marsden.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 261-277, 29 ref.

Descriptors: *Ames test, *Chlorination, *Disinfection, *Drinking water, *Laboratory methods, *Mutagens, *Sample preparation, *Water analysis, *Water quality control, California, Water sampling.

Studies on the isolation and quantitation of the semivolatile and nonvolatile residue organics have been difficult to compare because suitable sample preparation and measurement procedures have not been validated and standardized. A protocol detailing the preparation of drinking water samples for Ames mutagenicity testing was published under the sponsorship of the EPA. A modification of the consensus EPA protocol was used for preparing drinking water samples collected from 5 different northern California sites. These sites delivered samples from both surface-water and groundwater, and all were chlorinated. Improvements were made by adjusting the pH to 2 before column extraction. Acidifying the water samples increased the yield of organic residues and mutagenic responses. The precision of the modified method, based on a single comparison of two identical aliquots of drinking water processed simultaneously, was approximately 14%. Temporal variation in mutagenicity of samples from a single collection site ranged from 2 to 46%. Recovery of a spiked standard was also higher at pH 2. Based on experiments with a water-soluble mutagen, 4-NBA, the recovery efficiency ranged from 75-91%. Further work is required to establish the accuracy of the modified method for the recovery of other soluble mutagens. (See also W91-00476) (Lantz-PTT)
W91-00496

MEASUREMENT OF CHLORINE RESIDUALS IN CHLORINATED COOLING WATERS: EFFECT OF ORGANIC NITROGEN.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00517

TRIHALOMETHANE FORMATION POTENTIAL AND ORGANIC CONTENT: A NEW ANALYTICAL APPROACH.
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
For primary bibliographic entry see Field 5F.
W91-00524

IDENTIFICATION OF ORGANIC N-CHLORAMINES IN WASTEWATER.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
E. Choshen, J. D. Johnson, F. E. Scully, J. A. Jersey, and J. T. Jewell.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. V 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, TN, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, MI. 1989. p 751-761, 5 fig, 1 tab, 29 ref. National Science Foundation Grant ECE-8415255, Electric Power Research Institute Grant Number RP2300-7.

Descriptors: *Chloramines, *Chlorination, *Laboratory methods, *Organic compounds, *Pollutant identification, *Water pollution control, Amino acids, Chemical analysis, Gas chromatography, High performance liquid chromatography, Mass spectrometry, Wastewater, Water quality.

Free amino compounds are known to occur in sewage. During chlorination of water, amino compounds are converted rapidly and quantitatively to their N-chloro derivatives. Therefore a discussion of nitrogenous organic compounds in chlorinated wastewater must be directed to organic N-chloramines and N-chloramino acids rather than to free amino compounds. Organic N-chloramines have

widely ranging stabilities, with half lives ranging from minutes to weeks. Because they are thermally labile or readily undergo decomposition when concentrated or isolated from solution, organic chloramines are not likely to withstand the harsh conditions of concentration, gas chromatographic separation, and mass spectrometric identification conventionally used to identify trace organics. A combination of separation and detection techniques (high performance liquid chromatography and gas chromatography/mass spectrometry) has resulted in a method for confirmed identification of individual N-chloramines in water. The use of this method has enabled the first confirmed identification of N-chloro compounds in wastewater. Breakpoint chlorination resulted in a significant decrease in the number of detected products over chlorination to the chloramine maximum. The procedure reported here can be applied to various waters and wastewaters. It can be used for future qualitative studies of N-chloro compounds and a better understanding of the chemistry of organic N-chloramines. (See also W91-00476) (Lantz-PTT)
W91-00533

CHLORINE AND MONOCHLORAMINE MEASUREMENTS USING A PULSED SILVER IODIDE ELECTRODE.
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
T. N. Morrison, and C. O. Huber.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 795-799, 1 fig, 1 tab, 5 ref.

Descriptors: *Chlorination, *Chlorine, *Electrodes, *Measuring instruments, *Pollutant identification, *Water quality control, *Water treatment, Chemical reactions, Chlorinated hydrocarbons, Hydrogen ion concentration.

Protection from infectious diseases dictates chlorination, yet the toxic and mutagenic effects of chlorinated organics produced in natural water requires the use of minimal concentrations of residual active chlorine. In most potable water, surface water, or wastewater samples, the most important chlorine species typically use reduction of the chlorine by a standardized reductant, often with iodide as an intermediate or catalytic reducing agent. The work reported here presents an analytical measurement based on direct reduction rates by iodide at the electrode surface. Selectivity is based on pH effects on the relative rates of hypochlorous vs. monochloramine reduction. Measurement of the rate constant for the formation of monochloramine at realistically low concentrations and ionic strengths is demonstrated. Selectivity for hypochlorous acid over monochloramine was obtained by controlling the pH. The forward rate constant for the monochloramine-iodide reaction is smaller than for the hypochlorous acid-iodide reaction. At pH $>$ 5 no measurable current is observed for monochloramine, while below pH 3 the current due to monochloramine is equivalent to the current for hypochlorous acid. The sensitivity for hypochlorous acid is invariant from pH 2.5 to 5.5. This facilitates the subtraction of the hypochlorous acid component for a mixture by measuring first at pH 5.5 and then at pH 3. Selected conditions and analytical characteristics of flow injection concentration measurements showed linear response. Analytical measurements were obtained by operators with a range of technical background in order to evaluate the dependence of precision on operator expertise. (See also W91-00476) (Lantz-PTT)
W91-00536

CHLORAMINE INTERFERENCE IN THE MEASUREMENT OF FREE CHLORINE BY THE AMPEROMETRIC MEMBRANE ELECTRODE.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W91-00537

AUTOMATED PRECONCENTRATION OF TRACE METALS FROM SEAWATER AND FRESHWATER.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
For primary bibliographic entry see Field 7B.
W91-00615

AUTOMATED DETERMINATION OF SILICA IN SURFACE AND GROUND WATER (DIE OUTOMATIESE BEPALING VAN SILIKA IN OPPERVLAK EN GRONDWATER).
Pretoria Univ. (South Africa). Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W91-00638

SYNCHRONOUS FLUORESCENCE SPECTROSCOPY OF DISSOLVED ORGANIC MATTER IN SURFACE WATERS: APPLICATION TO AIRBORNE REMOTE SENSING.
Cornell Univ., Ithaca, NY. Cornell Lab. for Environmental Applications of Remote Sensing.
A. Vodacek.
Remote Sensing of the Environment RSEEA7, Vol. 30, No. 3, p 239-247, Dec 1990. 3 fig, 26 ref.

Descriptors: *Dissolved solids, *Fluorescence, *Lakes, *Remote sensing, *Spectroscopy, *Surface water, *Water analysis, Analytical methods, Data interpretation, Lignin, Michigan, New York, Regression analysis, Spectral analysis, Wavelengths, Wisconsin.

Synchronous fluorescence spectroscopy of dissolved organic matter (DOM) in surface waters was investigated as a method of inferring DOM composition. The synchronous fluorescence technique, which has been previously shown to provide structural information for polycyclic hydrocarbons, including crude oils, has been extended to DOM as a method for 'fingerprinting' humic substance (HS) types. Fluorescence emission and synchronous fluorescence data were collected for 21 lake water samples, 10 from lakes in the Adirondack Mountains of New York and 11 from lakes in northern Michigan and northern Wisconsin. The lake sample synchronous spectra, which are compared with synchronous spectra of lignin and data derived from the literature of other model compounds, provide new insights into the structure of surface water DOM. Further support for this approach is provided by a comparison between the multiple linear regression result found when relating measured pH to fluorescence emission data (R squared = 0.75) and that found when relating the measured pH to synchronous fluorescence data (R squared = 0.90.). Adapting the synchronous fluorescence spectral technique to a remote sensing context is discussed in terms of using the method for choosing optimal excitation wavelengths for a multiple-wavelength lidar. A lidar with a limited number of excitation wavelengths may be sufficient if key excitation-emission pairs can be identified for a particular application. For example, a lidar that could excite sequentially at 286 nm, 350 nm, and 387 nm, and measure the three respective emission spectra with an array spectrograph could provide similar data to that obtained from the synchronous spectra in this study. (Author's abstract)
W91-00639

USE OF EXTANT POPULATIONS OF SCALED CHRYSOPHYTES FOR THE INFERENCE OF LAKEWATER PH.
Connecticut Coll., New London. Dept. of Botany.
P. A. Siver, and J. S. Hamer.
Canadian Journal of Fisheries and 'Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1339-1347, July 1990. 2 fig, 3 tab, 41 ref. U.S. Department of the Interior Grant 14-08-0001-G1412-04.

Descriptors: *Acid lakes, *Acid rain, *Bioindicators, *Chrysophyta, *Connecticut, *Limnology, *Model studies, *Paleolimnology, Cluster analysis, Hydrogen ion concentration, Long-term studies, Monitoring, Regression analysis, Statistics.

Abundance of living populations of scaled chrysophytes were used to develop multiple regression models for inferring lakewater pH. Until now, all such inference models had been prepared with surface sediment remains and used to reconstruct historical (down-core) changes. Highly significant models can be prepared from living populations of scaled-chrysophytes that could be valuable for monitoring chronic, episodic and/or long-term changes in lakewater pH. Average weighted-mean pH and a cluster analysis technique were used to divide 33 taxa found in 26 Connecticut lakes into groups according to their distribution along a pH gradient. Two calculations of average weighted-mean pH were made: one based on data from this study and another based on literature records. Inference models were developed using a single sample from each lake as well as for multiple samples collected throughout the year. The best model based on a single discrete sample yielded and R-squared of 0.58 ($p<0.05$); multiple samples from each lake yielded significantly higher R-squared values (between 0.75 and 0.83). Scaled chrysophytes appear to be very valuable assemblage of indicator organisms for the long-term monitoring of lakes. (Author's abstract)
W91-00658

ARSENATE SENSITIVITY IN MARINE PERIPHYTON COMMUNITIES ESTABLISHED UNDER VARIOUS NUTRIENT REGIMES.
Goeteborg Univ. (Sweden). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-00700

USING SEABIRDS TO MONITOR MERCURY IN MARINE ENVIRONMENTS: THE VALIDITY OF CONVERSION RATIOS FOR TISSUE COMPARISONS.
Glasgow Univ. (Scotland). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W91-00704

RAPID METHOD FOR ASSESSING GROWTH RATES OF CORAL IN RELATION TO WATER POLLUTION.
Glasgow Univ. (Scotland). Dept. of Zoology.
P. S. Davies.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 346-348, July 1990. 2 tab, 20 ref.

Descriptors: *Animal growth, *Bioassay, *Bioindicators, *Corals, *Water pollution effects, Animal metabolism, Buoyant weighing, Nitrates, Nitrites, Phosphates.

The rates of growth of small pieces (nubbins) of the branching coral (Porites porites) and of cores taken from the massive coral (Montastrea annularis) were measured on a gradient of eutrophication in Barbados. Growth rate was determined using the buoyant weighing technique. This technique enabled growth to be measured after only three days in Porites and seven days in Montastrea. P. porites showed no difference in growth rate associated with elevated nitrite/nitrate or phosphate levels, while the growth of M. annularis was significantly reduced. These preliminary experiments suggest that the buoyant weighing technique is suitable for further development as a bioassay for coral reefs subjected to environmental pollution, although the coral species used may have to be chosen with care. (Author's abstract)
W91-00705

EVALUATING THE PROBABILITY OF VIOLATING DISSOLVED OXYGEN STANDARD.
Wyoming Water Research Center, Laramie.
For primary bibliographic entry see Field 5G.
W91-00715

COMPARATIVE STUDY OF TOXIC LEAD EFFECT ON GILL AND HEMOGLOBIN OF TILAPIA FISH.
Instituto Politecnico Nacional, Mexico City. Dept. de Farmacologia y Toxicolgia.
L. M. Tabche, C. M. Martinez, and E. Sanchez-Hidalgo.
Journal of Applied Toxicology JJATDK, Vol. 10,

No. 3, p 193-195, June 1990. 3 fig, 27 ref.

Descriptors: *Bioassay, *Lead, *Pollutant identification, *Toxicity, *Water pollution effects, Bioindicators, Comparison studies, Gills, Hemoglobin, Membranes, Tilapia.

A study was designed to determine the 72-hr LC50 of lead for tilapia fish (Oreochromis hornorum) as well as the effect of exposure to sublethal lead concentrations (15, 23, 39, and 47% of the LC50) on gill tissue lysosomal membranes of the fish and the hemoglobin concentration in the blood. The LC50 was 202 mg Pb(2+)/L. Exposure to sublethal lead concentrations for 72 hr showed significant increases in the lability of gill lysosomal membranes, measured by the release of acid phosphatase. Changes in membrane lability and in hemoglobin concentration depended on the amount of lead used during the exposure. Membrane lability is concluded to be an adequate parameter to assay for monitoring lead contamination in water because it is more sensitive than the hemoglobin concentration in blood. (Author's abstract)
W91-00722

DETERMINATION OF WARFARIN IN DRINKING WATER BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY AFTER SOLID-PHASE EXTRACTION.
Gacell Labs. A.B., Malmo (Sweden). Analytical and Quality Development Dept.
J. Dalbacke, I. Dahlquist, and C. Persson.
Journal of Chromatography JOCRAM, Vol. 507, p 381-387, May 1990. 2 fig, 2 tab, 10 ref.

Descriptors: *High performance liquid chromatography, *Pesticides, *Pollutant identification, *Rodenticides, *Warfarin, *Water analysis, Drinking water, Performance evaluation, Standards.

Warfarin (4-hydroxy-3-(3-oxo-1-phenylbutyl)coumarin) is used both as an anticoagulant in man and as a rodenticide. According to EEC guidelines, the concentration of warfarin in drinking water must not exceed 0.1 ppb (0.1 micrograms/L). A method was therefore developed for the determination of 0.1 microgram/L of the warfarin in drinking water. A 1000-ml volume of drinking water was aspirated through a solid-phase extraction column and warfarin was eluted to 1.0 ml. The eluate was analyzed using reversed-phase high-performance liquid chromatography with UV detection. The detection limit was 0.02 microgram/L. Recoveries exceeding 90% were obtained from tap water spiked with warfarin. (Author's abstract)
W91-00723

DETERMINATION OF FUNGISTATIC QUATERNARY AMMONIUM COMPOUNDS IN BEVERAGES AND WATER SAMPLES BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY.
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Elintarvikelaboratorio.
T. Suortti, and H. Sirvio.
Journal of Chromatography JOCRAM, Vol. 507, p 421-425, May 1990. 1 fig, 1 tab, 4 ref.

Descriptors: *Food analysis, *Fungicides, *High performance liquid chromatography, *Pollutant identification, *Water analysis, Performance evaluation, Quaternary ammonium compounds.

Fungistatic and fungicidal quaternary alkylammonium compounds are used widely to prevent staining of timber and may be applied to restrict growth of fungi in barley. Although these compounds show only low toxicity, sensitive methods are required for their determination as trace contaminants in food products and water. Problems arise in their analysis because they are of low volatility, do not carry a chromophore, and are difficult to derivatize. The present study aimed to develop a method of determining quaternary alkylamines at the microgram/ml level. An anomalous effect was observed of the concentration of ion-pairing agent on C18 and CN columns. Normally, an ion-pairing effect would induce an increase in retention, but with benzene sulfonic acid the opposite effect was seen. Thus, the concentration in the aqueous effluent of either didecyldimethylammonium (DE) or dodecyltrimethylammonium (DO) decreased as the concentration of benzene sulfonic acid and methanol employed increased. Using this phenomenon in high-performance liquid chromatography enabled the recovery of quaternary alkylammonium compounds at the 70% level from beer spiked at the 25 mg/L, 64% from wort, and 68% from water spiked at the 50 mg/L. (Rochester-PTT)
W91-00724

DETERMINATION OF BORATE AT TRACE LEVELS IN ENVIRONMENTAL SAMPLES BY ION-EXCLUSION CHROMATOGRAPHY.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
H. C. Mehra, K. D. Huysmans, and W. T. Frankenberger.
Journal of Chromatography JOCRAM, Vol. 508, No. 1, p 265-270, May 25, 1990. 2 fig, 2 tab, 10 ref.

Descriptors: *Borates, *High performance liquid chromatography, *Phytotoxicity, *Pollutant identification, *Water analysis, Boron, Colorimetry, Comparison studies, Performance evaluation, Soil chemistry, Water chemistry.

Boron can be toxic to higher plants when present in the soil solution (0.5-5.0 microgram/ml) not much greater than trace amounts needed for normal growth. Boron toxicities are more prevalent than boron deficiencies among crops grown on saline soils. Boron in drinking water in many regions of the world has been reported to be 100 microgram/L or less. Ion-exclusion chromatography was employed for the determination of borate in soils, sediments, and water samples using D-sorbitol in the mobile phase. This method also has applications in the determination of bicarbonate. Two ion-exclusion columns were evaluated for their efficiencies in separation of borate. This ion-exclusion chromatography technique enables separation, detection, and quantification of borate from various matrices obtained from several experimental problem sites. Results obtained by ion-exclusion chromatography were close to those obtained by the colorimetric azomethine-H procedure in determination of borate in soil, sediment, and lake water samples. (Rochester-PTT)
W91-00725

DETERMINATION OF RESIN AND FATTY ACIDS IN PULP AND PAPER MILL EFFLUENTS AND WHITE WATERS BY GAS-LIQUID CHROMATOGRAPHY.
Ukrainskii Nauchno-Issledovatel'skii Inst. Tselliuloznoii Bumazhno Promyshlennosti, Kiev (USSR).
O. Kalchenko, and W. P. Svitelsky.
Journal of Chromatography JOCRAM, Vol. 509, No. 1, p 65-68, June 15, 1990. 2 fig, 1 tab, 5 ref.

Descriptors: *Gas liquid chromatography, *Organic compounds, *Pollutant identification, *Pulp wastes, *Wastewater analysis, Performance evaluation, Qualitative analysis, White water.

Studies on the composition of organic compounds accumulating in white waters from the pulp and paper industry can contribute to their efficient removal and lower discharge loads. Gas-liquid chromatography (GLC) has been used successfully for monitoring organic components. The compositions of organic components extracted with chloroform-diethyl ether from white waters from thermomechanical pulping of spruce, the filtrate of a bleached kraft pulp suspension (pine), and effluents from a board mill and waste paper recycling plant (1:1) were investigated. Organic substances (phenols, aromatic acids, aliphatic acids, and resin acids) were determined by an internal standard procedure (methyl stearate standard). Qualitative analysis was performed by comparing the elution times of substances on the chromatograms with those of standard substances. (Rochester-PTT)
W91-00726

SIMPLE DEVICE FOR THE DETERMINATION OF VOLATILE CHLORINATED HYDROCARBONS IN WATER BY GAS CHROMATOGRAPHY.
Vyzkumny Ustav Vodohospodarsky, Prague (Czechoslovakia).
B. Uchytil, and J. Munich.
Journal of Chromatography JOCRAM, Vol. 509, No. 1, p 111-113, June 15, 1990. 2 fig, 4 ref.

Descriptors: *Chlorinated hydrocarbons, *Gas chromatography, *Pollutant identification, *Trace levels, *Water analysis, Benzene, Headspace method, Microcartridges, Toluene.

In trace analysis, methods for concentrating analyte compounds from the sample are often needed. The dynamic headspace method is suitable, but requires a special accessory (a furnace with a control unit for thermal desorption of analytes). A simple device was designed for collecting analyte compounds in a preconcentration microcartridge, which can be inserted into the injector of any gas chromatograph with a sufficiently wide injector, without interruption of the gas flow. The method was applied to the determination of volatile chlorinated hydrocarbons in water. The analyte compounds were isolated from a 50-ml water sample by the dynamic headspace method by concentration on the microcartridge and inserted into the injector of the gas chromatograph. The minimum concentration of chloroform, 1,2-dichloroethane, perchloroethylene and trichloroethylene that can be determined is 0.2 micrograms/L; of chlorobenzene, 1,2-, and 1,4-dichlorobenzene 0. micrograms/L; and of benzene and toluene 0.05 micrograms/L. (Rochester-PTT)
W91-00727

SIMULTANEOUS DETERMINATION OF NITRITES, NITRATES AND AMINES BY ION-INTERACTION REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY.
Turin Univ. (Italy). Dipt. di Chimica Analitica.
M. C. Gennaro, and P. L. Bertolo.
Journal of Chromatography JOCRAM, Vol. 509, No. 1, p 147-156, June 15, 1990. 5 fig, 4 tab, 8 ref.

Descriptors: *High performance liquid chromatography, *Nitrogen compounds, *Pollutant identification, Amines, Nitrates, Performance evaluation.

The conditions for the simultaneous separation of aliphatic and aromatic amines, nitrites, and nitrates by ion-interaction reversed-phase high-performance liquid chromatography (HPLC) were optimized. The mechanism that governs retention in this HPLC technique was considered and it was concluded that the alkyl chain length of the ion-interaction reagent has the greatest influence on retention. Sensitivity of the order of 0.10 ppm for nitrites and nitrates can be obtained with octylamine orthophosphate as eluent at 210 nm. Amounts of 0.20 ppm of nitrates and 0.50 ppm of 1,4-phenylenediamine can be identified easily and determined in matrices as complex as sea water. (Author's abstract)
W91-00728

DISTRIBUTION AND CORRELATION OF ELEMENTS IN WATERS, SUSPENSIONS, SEDIMENTS, AND MARINE ORGANISMS FROM THE BLACK SEA.
Bulgarian Academy of Sciences, Varna. Inst. of Oceanography.
G. Andreev, and V. Simeonov.
Toxicological and Environmental Chemistry TXECBP, Vol. 28, No. 1, p 1-9, 1990. 5 fig, 8 tab, 6 ref.

Descriptors: *Black Sea, *Indicators, *Marine environment, *Path of pollutants, *Water pollution effects, *Water pollution sources, Bottom sampling, Correlation analysis, Inorganic compounds, Marine life, Monitoring, Statistical analysis, Suspended sediments.

The simultaneous study of the distribution of chemical components in various marine environment samples allows a more effective evaluation of the complex ecological equilibrium. For this reason, the distribution of several ecologically important elements in Black Sea waters, suspensions,

sediments, and marine organisms (Mytilus gallprovincialis and Gobin niger) was studied using five sampling profiles. The stations were located at different distances from an anthropogenic source. A correlation analysis was carried out that showed a significant relationship between the elements in consideration both within and between the marine phases. The correlated analysis also indicated a higher correlation among the natural process of elemental accumulation: from waters and suspended material to the thin surface layer and, then, to sediments and living organisms. The correlation analysis also showed the significance of the sediments for metal accumulation in bottom-dwelling marine organisms. The investigation also determined that the best way to study anthropogenic effects in a sea region is to use mainly organisms and sediments as pollution indicators. Both types of samples show the steady trends in the element distribution quite satisfactorily. Water samples and suspended matter are more unstable with respect to distribution effects and undergo more short-term fluctuations. (Korn-PTT)
W91-00797

ENVIRONMENTAL RUSSIAN ROULETTE: COMPLIANCE AT OR NEAR THE DETECTION LEVEL.
Nixon, Hargrave, Devans and Doyle, Rochester, NY.
For primary bibliographic entry see Field 5G.
W91-00802

DISTRIBUTION AND TRANSPORT OF SEDIMENT-BOUND METAL CONTAMINANTS IN THE RIO GRANDE DE TARCOLES, COSTA RICA (CENTRAL AMERICA).
Geological Survey, Menlo Park, CA.
C. C. Fuller, J. A. Davis, D. J. Cain, P. J. Lamothe, and T. L. Fries.
Water Research WATRAG, Vol. 24, No. 7, p 805-812, July 1990. 7 fig, 3 tab, 21 ref.

Descriptors: *Chromium, *Costa Rica, *Heavy metals, *Lead, *Path of pollutants, *Sediment contamination, *Water pollution sources, *Zinc, River beds, River sediments, Sediment analysis, Sediment transport.

A reconnaissance survey of the extent of metal contamination in the Rio Grande de Tarcoles river system of Costa Rica indicated high levels of chromium (Cr) in the fine-grained bed sediments (< 60 micro m) of tributaries downstream from leather tanneries (50-83 times Cr background or 3000-5000 micro g/g). In the main channel of the river downstream of the Sane Jose urban area Cr contamination in sediments was 4-6 times background and remained relatively constant over 50 km to the mouth of the river. Sediments from a mangrove swamp at the river mouth had Cr levels 2-3 times above background. Similar patterns of dilution were observed for lead (Pb) and Zinc (Zn) sediment contamination although the contamination levels were lower. The high affinity of Cr towards particulate phases, probably as Cr(III), allows the use of Cr contamination levels for delineating regions of deposition of fine-grained sediments and dilution of particle associated contaminants during transport and deposition. (Author's abstract)
W91-00804

MICROBIAL SENSOR FOR BOD.
Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Molekularbiologie.
K. Riedel, K. P. Lange, H. J. Stein, M. Kuhn, and P. Ott.
Water Research WATRAG, Vol. 24, No. 7, p 883-887, July 1990. 8 fig, 4 tab, 12 ref.

Descriptors: *Biochemical oxygen demand, *Instrumentation, *Pollutant identification, *Sensors, *Water analysis, Biodegradation, Electrodes, Experimental design, Microbial degradation, Microorganisms, Wastewater.

Biochemical oxygen demand (BOD) is a widely used parameter for the determination of biodegradable organic compounds in wastewater. The conventional BOD test takes 5 days and is thus unsuitable for process control. A more rapid estimation of BOD is possible by using a microbial sensor containing whole cells immobilized on an oxygen electrode. Most BOD sensors use the stationary state measurement and show a response time of 15-29 min, but it is possible to use the dynamic or kinetic mode (differential current time curve method) for the determination of BOD with microbial sensors. These sensors measure the respiration acceleration rate by the change in electric current and allow a response time of less than 1 min. A microbial amperometric sensor to determine the biochemical oxygen demand was developed using Trichosporon cutaneum cells immobilized in polyvinylalcohol. This sensor measured BOD with a very short response time (<30 s), an operation stability of 48 days and a serial coefficient of variation of 3.3% when a sample solution containing 22 mg/L BOD was used. A linear range of up to 100 mg/L BOD was obtained using a glucose/glutamic acid standard. The sensitivity and specificity was increased by incubating the BOD sensor with the respective wastewater. Comparable results were obtained for BOD values estimated by the biosensor and those determined by the 5-day method. (Korn-PTT)
W91-00812

SIMPLE CONTINUOUS-FLOW TOXICITY TEST SYSTEM FOR MICROSCOPIC LIFE STAGES OF AQUATIC ORGANISMS.
California Univ., Santa Cruz. Inst. of Marine Sciences.
M. M. Singer, D. L. Smalheer, and R. S. Tjeerdema.
Water Research WATRAG, Vol. 24, No. 7, p 899-903, July 1990. 4 fig, 1 tab, 11 ref.

Descriptors: *Bioassay, *Testing procedures, *Toxicity, Biochemical oxygen demand, Instrumentation, Microorganisms, Organic compounds, Volatile organic compounds.

A flow-through toxicity testing system utilizing a new exposure chamber designed for microscopic organisms was developed. Typically, flow-through testing is conducted with either a serial or proportional diluting system. While generally relying on gravity to drive water flow, as different amounts of toxicant and diluent are combined in glass or plexiglass mixing cells, they are almost always open to the surrounding atmosphere. In contrast, the system described here is based on a simple exposure design utilizing premixed stocks representing each exposure concentration. While the system is entirely closed to the surrounding atmosphere, for testing of volatile organic mixtures in addition to nonvolatile inorganic toxicants, the delivery manifold may be aerated for toxicants of low volatility and high biochemical oxygen demand (BOD). The system incorporates flexible Teflon gas sampling bags for stock preparation and storage (thus avoiding the need for a headspace), and digital unified-drive peristaltic pumps for controlled toxicant delivery. To reduce surface partitioning of toxicants, all system components are constructed of chemically inert materials (Teflon, glass, and silicone). (Author's abstract)
W91-00814

SEQUENTIAL INOCULATION AS AN ADJUNCT IN ENTERIC VIRUS PLAQUE ENUMERATION.
Environmental Protection Agency, Cincinnati, OH.
W. H. Benton, and C. J. Hurst.
Water Research WATRAG, Vol. 24, No. 7, p 905-909, July 1990. 4 tab, 7 ref.

Descriptors: *Culturing techniques, *Laboratory methods, *Pollutant identification, *Viruses, Data acquisition, Enteroviruses, Experimental design, Iododeoxyuridine.

Monitoring enteric viruses present in source waters and drinking water involves physically concentrating viruses from the water sample into a smaller and more manageable volume. Efficient enumeration of the concentrated viruses is the crucial second step, where perhaps the utmost consideration is selection and use of host cell lines that are most sensitive for supporting replication of those viruses present in the sample. The potential utility of sequentially inoculating a virus sample onto two different cultures of similar vs. dissimilar cell lines was evaluated in conjunction with IDU (5-iodo-2-deoxyuridine) treatment of the cells as a potential adjunct in viral plaque formation assays. This evaluation was done using laboratory grown human echovirus 7, human enterovirus 69 and human poliovirus 1, plus an environmental concentrate derived from sewage that contained indigenous untyped enterovirus. The cell lines employed were BGM, RD, L-132, and HEL-299. Sequential inoculation generally yielded higher viral assay titers when compared with the more traditional method of simply introducing viral inoculum onto a culture of the first (initial) cell line and then completing the assay without removing that inoculum. When a permissive cell line (BGM or RD) was used for both the initial and final cultures in a sequential inoculation technique, the total plaque count titer from both the initial plus final cultures represented an average 35% improvement over the traditional method. (Author's abstract)
W91-00815

BIOMONITORING OF CHEMICALS ON TROPICAL ECOSYSTEMS.
Universitaet des Saarlandes, Saarbruecken (Germany, F.R.). Inst. fuer Biogeographie.
For primary bibliographic entry see Field 5B.
W91-00823

DETECTION OF VIBRIO CHOLERAE O1 IN THE AQUATIC ENVIRONMENT BY FLUORESCENT-MONOCLONAL ANTIBODY AND CULTURE METHODS.
International Centre for Diarrheal Disease Research, Dacca (Bangladesh).
A. Huq, R. R. Colwell, R. Rahman, A. Ali, and M. A. R. Chowdhury.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2370-2373, August 1990. 1 fig, 1 tab, 17 ref. A.I.D. Grant DPE-5542-G-55-4060-00, NSF Grant BSR-88-06509, EPA Agreement CR 81-2246-02-3.

Descriptors: *Human diseases, *Pathogenic bacteria, *Pollutant identification, *Vibrio, Analytical methods, Bangladesh, Culturing techniques, Fluorescent antibody technique, Plankton, Ponds, Public health, Rivers, Water quality monitoring.

Vibrio cholerae O1 is recognized as the etiological agent of pandemic Asiatic cholera. Vibrio cholerae O1 in plankton samples collected from ponds and rivers between February 1987 and January 1990 in Matlab, Bangladesh, was detected by the fluorescent-monoclonal antibody (FA) technique. Samples were collected at sites which were monitored fortnightly (fixed sites) as well as at sites that were part of a case-control study. FA results were compared with those obtained by conventional culture methods (CM). A total of 876 samples were collected; V. cholerae O1 was detected in 563 samples (64.3%) by the FA method and in 3 samples (0.34%) by CM. Of the fixed-site plankton samples, 439 (63.6%) were positive by FA and none were positive by CM. Of the 93 case sites sampled on the day after the occurrence of a case of cholera, 73 (78.5%) were positive for V. cholerae O1 by FA and 3 (3.2%) were positive by CM. In comparison, of the 93 first-day sample collections at control sites at the time a case of cholera occurred, only 51 (54.8%) were positive by FA and none were positive by CM. From the data, it is concluded that V. cholerae O1 is present throughout the year in the ponds and rivers of Bangladesh that were examined in this study and that V. cholerae can be detected by FA but not always by CM. The FA procedure was found to be very useful in detecting V. cholerae in plankton, with which it was associated and often occurred in large numbers in the nonculturable stage. Thus, studies investigating the significance of the role of environmental factors in the epidemiology of cholera can be performed effectively by using FA. (Author's abstract)
W91-00828

USE OF MEMBRANE EXTRACTION DISKS FOR ON-LINE TRACE ENRICHMENT OF ORGANIC COMPOUNDS FROM AQUEOUS SAMPLES.
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
E. R. Brouwer, H. Lingeman, and U. A. T. Brinkman.
Chromatographia CHRGB7, Vol. 29, No. 9/1, p 415-418, May 1990. 3 fig, 1 tab, 8 ref.

Descriptors: *Analytical techniques, *Herbicides, *Organic compounds, *Pollutant identification, *Water analysis, Atrazine, Chromatography, Detection limits, Liquid chromatography, Membrane extraction disks, Pesticides, Preconcentration, Simazine, Trace levels, Trichlorophenol.

Membrane extraction disks have been recently introduced for the solid-phase extraction of organic compounds from aqueous samples. The material consists of alkyl-modified silica particles enmeshed in an inert PTFE matrix. Aqueous samples containing polar pesticides and herbicides are preconcentrated on-line from acidic solutions on membrane extraction disks containing immobilized octadecyl-modified silica and analyzed with an isocratic liquid chromatography system using PLRP-S as the stationary phase and aqueous acetonitrile mixtures (pH 3) as the eluant. The recoveries for atrazine, simazine, and 2,3,4-trichlorophenol from tap water at the 50 ppb level were 84, 81, and 89%, respectively. The calibration curves for the three components were linear over at least two orders of magnitude (1 to 100 ppb). For 10 ml samples, the detection limits of the analytes atrazine, simazine, and 2,3,4-trichlorophenol in tap water are 0.1-1.0 ppb. (Author's abstract)
W91-00839

MICROBIOLOGICAL INVESTIGATIONS INTO AN OUTBREAK OF PONTIAC FEVER DUE TO LEGIONELLA MICDADEI ASSOCIATED WITH USE OF A WHIRLPOOL.
Department of Laboratory Medicine, Ruchill Hospital, Glascow G20 9NB.
R. J. Fallon, and T. J. Rowbotham.
Journal of Clinical Pathology JCPAAK, Vol. 43, No. 6, p 479-483, 1990. 2 tab, 18 ref.

Descriptors: *Culturing techniques, *Legionella, *Microbiological studies, *Pollutant identification, Amebas, Epidemiology, Human diseases, Immunofluorescence, Lochgoilhead, Recreation facilities, Scotland, Water pollution, Whirlpool baths.

In the investigation of a large outbreak of non-pneumonic legionellosis at a leisure complex in Lochgoilhead, Scotland, all direct cultures of environmental samples were initially negative for legionellae. Legionellae readily infect appropriate protozoa under suitable conditions, and following immunofluorescence to select specimens for special study, Legionella micdadei was isolated from whirlpool water via co-cultivation with Acanthamoeba polyphaga. L. micdadei was also isolated, along with host amoebae, from the whirlpool filter. The use of amebas in the isolation of legionellae from environmental (and other) sources can be of great value, especially if specimens shown by indirect immunofluorescence to contain legionellae fail to yield legionellae on routine culture. (Author's abstract)
W91-00840

CHEMICAL CHARACTERIZATION OF ACID PRECIPITATION IN ALBANY, NEW YORK.
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
H. A. Khwaja, and L. Husain.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1869-1882, July 1990. 9 fig, 8 tab, 53 ref.

Descriptors: *Acid rain, *Air pollution, *Air pollution sources, *Chemical composition, *Chemistry of precipitation, *Hydrogen ion concentration, *Path of pollutants, *Sulfates, Ammonium, Calcium, Chemical analysis, Chlorides, Deposition, Magnesium, Nitrites, Precipitation, Seasonal variation, Sodium.

The chemical composition of precipitation in Albany, NY from July 1986 to December 1988 has been studied. Mean volume-weighted concentrations (microequivalents/liter) were: acidity, 104.0; alkalinity, -63.7; SO4(2-), 52.8; NO3(-), 29.8; Cl(-), 5.6; F(-),0.50; NH4(+), 19.3; Ca(2+), 6.5; Mg(2+), 2.8; Na(+), 3.5; and K(+), 1.4. Mean pH was 4.2. Seasonal patterns were pronounced for most species. Concentrations of H(+), SO4(2-), NO3(-), NH4(+) and Ca (2+) peaked in the summer and spring. Deposition was related to rainfall amount by a power law relationship in which the exponent of the equation was approximately 0.6. Wet SO4(2-) deposition was 2.35 kiloequivalents/hectare over a 30-month period. The SO4(2-) and NO3(-) deposition rates observed at Albany indicate that transport from midwestern sources have a major influence at this site. On the average, free H(+) ion concentrations determined the pH measurements accounted for 51% of the measured total acidity. There were unknown species, most likely organic acids, that could contribute to the acidity. Correlation and regression analysis revealed four common factors which are related to fossil-fuel combustion, sea spray, cement factory and biomass burning. (Author's abstract)
W91-00850

TRACE METAL WET DEPOSITION IN SWEDEN: INSIGHT GAINED FROM DAILY WET ONLY COLLECTION.
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
For primary bibliographic entry see Field 5B.
W91-00853

RELEASE OF HEAVY METALS FROM SNOWPACKS ON THE JAPAN SEA SIDE OF JAPAN.
Kanazawa Univ. (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W91-00858

FURTHER DISCUSSION ON THE INTERCOMPARISON OF THE TRACE METAL CONCENTRATIONS AND PARTICLE SIZE OF FLUVIAL SEDIMENT RECOVERED FROM TWO CENTRIFUGE SYSTEMS.
Geneva Univ. (Switzerland). Inst. F.-A. Forel.
S. Santiago, R. L. Thomas, J. L. Loizeau, P. Y. Favarger, and J. P. Vernet.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 283-287, July/September 1990. 1 fig, 2 tab, 5 ref.

Descriptors: *Analytical methods, *Analytical techniques, *Centrifugation, *Data acquisition, *Pollutant identification, *Trace metals, Barium, Beryllium, Boron, Calcium, Chromium, Cobalt, Copper, Heavy metals, Iron, Lead, Magnesium, Manganese, Nickel, Phosphorus, Sediment recovery, Sodium, Strontium, Switzerland, Vanadium, Zinc.

A single large volume water sample taken at the mouth of the Upper Rhone River on Lake Geneva was processed directly in parallel through two continuous flow centrifuges, a Westphalia and an Alfa-Laval. Sediment was recovered from the Westphalia, and separately from the bowl and brass core of the Alfa-Laval. The three sediment samples were analyzed for particle size and the following elements: Zn, Cu, Mn, Cr, P, Co, B, V, Be, Sr, Na, Pb, Ni, Ba, Fe, Ca, and Mg. Results indicate that the particle size recovery of both machines is similar when sediment from the brass core and bowl of the Alfa-Laval are combined, and that the recovery for all elements other than Cu, V, B, and Pb are the same when the particle size differences are taken into account. Sediment from the Alfa-Laval brass core is clearly contaminated by Cu and B and is also elevated in V and Pb but not to a significant extent. The sediment recovered from the bowl of the Alfa-Laval is contaminated only with Cu, with a 10 ppm increase over the 52 ppm recovered in the Westphalia sediment. Operating procedures involve the discarding of the brass core sediment and the mixing of the Alfa-Laval bowl sediment with that form the Westphalia. The consequent increase in Cu is estimated at less than 5 ppm or within the confidence level of the analysis. These procedures are recommended to all operators of non-modified Alfa-Laval units. (Author's abstract)
W91-00866

F-SPECIFIC RNA BACTERIOPHAGES AND SENSITIVE HOST STRAINS IN FAECES AND WASTEWATER OF HUMAN AND ANIMAL ORIGIN.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
A. H. Havelaar, W. M. Pot-Hogeboom, K. Furuse, R. Pot, and M. P. Hormann.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 1, p 30-37, July 1990. 1 fig, 5 tab, 15 ref.

Descriptors: *Bacteriophage, *Bioindicators, *Escherichia coli, *Feces, *Pollutant identification, *Wastewater, *Wastewater pollution, *Water pollution sources, Antibiotics, Barn wastes, Cattle, Fecal coliforms, Human pathogens, Laboratory methods, Municipal wastewater.

Bacteriophages are potential model viruses in water quality studies. Feces of humans, pigs, cattle and chickens were investigated for the presence of somatic coliphages. F-specific bacteriophages and Escherichia coli strains sensitive to infection by F-specific phages. Attention was given to the possible effect of age and use of antibiotics on the prevalence of the FRNA phages and sensitive E. coli strains. Somatic coliphages were often detected in high numbers in all types of feces. In contrast FRNA phages were rarely detected in feces from humans and cattle but more often in feces from pigs and adult chickens. Samples from young chickens (with or without antibiotics)were consistently positive for FRNA phages (up to 3 million plaque forming units (pfu)/g). F-specific RNA phages were found in substantial numbers (> 1000 pfu/ml) in a variety of wastewaters: domestic, hospital, slaughterhouses and occasionally in 'grey water'. Their origin in wastewater was not clear. Strains from feces usually belonged to serogroups I and IV. These types were also found in wastewater, as were group II and III strains. Serogroup II phages were abundant in wastewater of human origin but rare in feces. E. coli strains sensitive to infection by F-specific phages were common in feces (overall 290/1081: 27%). No strains with fully derepressed F-pilus synthesis were detected among the sensitive strains. It is concluded that the occurrence of F-specific RNA bacteriophages in water points to sewage pollution rather than fecal pollution; the mechanism of replication of these organisms in wastewater is not understood. (Author's abstract)
W91-00872

SAMPLING AND MONITORING OF REMEDIAL-ACTION SITES.
Weston (Roy F.), Inc., West Chester, PA.
T. P. McVeigh.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 12.2-12.34, 8 fig, 6 tab.

Descriptors: *Hazardous waste disposal, *Monitoring, *Sampling, *Site remediation, *Waste disposal, Assessments, Data collections, Data management, On-site investigations.

Sampling and monitoring at remedial-action sites are part of the Remedial Investigation and Feasibility Study process described in the National Oil and Hazardous Substance Contingency Plan. Data collection and site characterization are the primary elements of the remedial investigation. Additional activities are the primary elements of the remedial investigation. Additional activities include data management, bench and/or pilot studies, and site-investigation reports. Prior to any sampling or monitoring activities at a remedial-action site, a preliminary assessment is performed. The assessment usually consists of the following four elements: collection of existing data, identification of site characteristics and pollutant pathways, evaluation of potential hazards, and identification of data requirements for site assessment and remedial

action. The information from these activities will be used in the development of the sampling, health and safety, and quality-assurance plans for the site. Sampling at remedial-action sites requires the development of three plans before the actual site activities begin: sampling, health and safety, and quality-assurance plans. The sampling program begins with the monitoring of ambient conditions during the preliminary site assessment and ends with the validation of analytical data by the laboratory. Sampling is conducted to determine hazardous-waste sources, and to monitor soils and sediments, groundwater, surface waters, and air quality. Two procedures are recommended to accomplish effective management of environmental-monitoring data: institution of a document-control system for files and reports, and the use of automated data processing for analytical data. Remedial actions are then designed to control, contain, treat or remove contaminants from uncontrolled hazardous-waste sites. Remedial actions are divided into surface controls, groundwater controls, leachate controls, direct-treatment methods, gas-migration controls, techniques for contaminated water and sewer line, and methods for contaminated-sediment removal. (See also W91-00900) (White-Reimer-PTT)
W91-00955

SAMPLING AND ANALYSIS OF HAZARDOUS WASTES.
Environmental Monitoring Systems Lab., Research Triangle Park, NC.
L. D. Johnson, and R. H. James.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 13.3-13.44, 10 fig, 12 tab, 47 ref.

Descriptors: *Chemical analysis, *Hazardous materials, *Hazardous wastes, *Sampling, *Testing procedures, Analytical techniques, Documentation, Quality control, Regulations, Sample analysis.

An overview and guide to the field of sampling and analysis of hazardous waste and related products is presented. Topics covered include techniques for: (1) sampling hazardous waste; (2) sampling waste-combustion products; (3) sampling solid and liquid effluents from combustors and control devices; (4) sample containers, shipping, and storage; (5) quality control and quality assurance; and (6) safety. Methods of measuring and defining toxic and hazardous emissions in the environment have been developed. For most samples, the analyst should employ proven analytical techniques that are selective and sensitive. The most universal methods for trace analysis are gas chromatography, liquid chromatography, mass spectrometry, and a combination of these techniques. The integrity of the analytical data is highly dependent on the sample submitted for instrumental analysis. While most instrumental 'finishes' yield final data that are of known quality when standard solutions are analyzed, many areas of sample handling prior to analysis are more variable and matrix-dependent and are critical to the accuracy of the resulting data. Test procedures, or supporting documentation, for the analysis of hazardous wastes is required in each of four major areas: waste characteristics, proximate analyses, survey analyses, and directed analysis. Analytical measurements should be documented to provide easy access to information that will support all claims for the results. Laboratory records should be retained in a permanent file for a length of time set by the government or necessary to fulfill other legal requirements. Quality assurance is the highest priority with respect to the analysis of environmental samples. Therefore the quality assurance program must contain procedures that cover program management and personnel responsibilities, facilities and equipment, data generation and processing, data-quality assessment, and corrective actions. (See also W91-00900) (White-Reimer-PTT)
W91-00958

5B. Sources Of Pollution

EMPIRICAL MODELS FOR PREDICTING WATER QUALITY, AS APPLIED TO DATA ON LAKES OF POLAND.
Polish Academy of Sciences, Warsaw. Zaklad Paleobiologii.
For primary bibliographic entry see Field 2H.
W91-00001

NUMERICAL MODEL OF PHOSPHORUS EXCHANGE BETWEEN THE SEDIMENTS AND THE NEAR-BOTTOM WATER IN A LAKE.
Warsaw Univ. (Poland). Lab. of Medical Physics.
For primary bibliographic entry see Field 2H.
W91-00002

METHODS FOR IMPROVING THE EFFICIENCY OF CALIBRATION OF A MODEL OF PHOSPHORUS CYCLING IN A LAKE ECOSYSTEM.
Politechnika Warszawska (Poland). Inst. of Environmental Engineering.
For primary bibliographic entry see Field 2H.
W91-00004

GEOCHEMICAL STUDY OF SEDIMENT CONTAMINATION IN NEW BEDFORD HARBOR, MASSACHUSETTS.
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
R. J. Pruell, C. B. Norwood, R. D. Brown, W. S. Boothman, and P. F. Rogerson.
Marine Environmental Research MERSDW, Vol. 29, No. 2, p 77-101, 1990. 4 fig, 6 tab, 43 ref.

Descriptors: *Estuarine sediments, *Geochemistry, *Industrial wastes, *Marine pollution, *Massachusetts, *Path of pollutants, *Polychlorinated biphenyls, *Sediment contamination, *Water pollution sources, Chemical analysis, Combined sewer overflows, Environmental gradient, Sludge disposal, Trace metals, Urban runoff.

Chemical analyses of sediment samples collected along a transect in New Bedford Harbor revealed a gradient of increasing concentrations of polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polycyclic aromatic hydrocarbons (PAHs) and several trace metals from the southern to the northern areas of the estuary. Although the concentrations of contaminants generally increased with distance north in the estuary for all classes of compounds, differences were observed between the trends for many of the compounds. These differences are probably due to both the sources and differential environmental behaviors of the compounds in the estuary. The primary sources of PCBs, PCDFs, and trace metals appear to be industrial discharges either directly into the estuary or through combined sewer overflows. Additional inputs of PCDFs may have also impacted the lower portions of the harbor. These inputs may be from the combustion of sewage sludge containing high concentrations of PCBs at the New Bedford Harbor Municipal Wastewater Treatment Plant. The major inputs of PAHs and PCDDs are probably from urban runoff entering the harbor through combined sewer overflows and storm drains. (Stoehr-PTT)
W91-00043

EFFECTS OF DRILL CUTTINGS ON A MODEL MARINE SEDIMENT SYSTEM.
Heinz and Co. Ltd., Hayes (England). Microbiology Dept.
For primary bibliographic entry see Field 5C.
W91-00044

CASCADING WATER: A THREAT TO GROUND WATER QUALITY.
G. L. Hix.
Water Well Journal WWJOA9, Vol. 44, No. 4, p 40-41, April 1990.

Descriptors: *Cascading water, *Groundwater pollution, *Groundwater quality, *Water pollution sources, *Well casings, *Well seepage, Groundwater recharge, Grouting, Perched water, Water table, Well water.

Cascading water or ground water that is entering some older water wells and flowing down into the well casing is a problem that concerns ground water quality regulators, well owners, and drillers wherever it occurs. Often, this cascading water is of lesser quality than that present in the lower part of the well. How much poorer the quality of this returning water depends on the source of that water and the type of contamination it carries with it. Water quality deterioration is a primary concern but deterioration of the well itself is also a problem. One method to solve this water problem is to cut off the source of the recharge water. If this is impractical, it is sometimes possible to intercept this water with new wells or by installing cut-off walls made of bentonite slurry or other grout materials. Sometimes the well itself can be modified to shut out the water, but this does not entirely solve the problem. The return water is now just perched outside the well where it will eventually find its way to the water table. Attempts have been made to inject grout outward through the well casing perforations using inflatable packers to seal off part of the well. This method works only if the grout doesn't find channels outside the well casing that short circuit and divert it back inside the well above or below the packers. Another method tried is to line the well with a smaller diameter casing and grouting the annular space. Again, this procedure seals out the water and prevents it from entering the well. It will not remove the perched water nor solve the problem completely. Eliminating cascading water altogether may not be possible in most areas, but controlling the extent of the damage to wells, pumps, and groundwater quality is. (Medina-PTT)
W91-00053

THREE-DIMENSIONAL SCALE MODEL OF GROUND-WATER SOLUTE TRANSPORT.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Div. of Engineering Fundamentals.
S. S. Crider, B. L. Sill, and D. E. Gordon.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 816-834, June 1990. 14 fig, 4 tab, 23 ref. Department of Energy Contract No. DE-AC09-76Sr00001.

Descriptors: *Hydraulic models, *Hydrologic models, *Model studies, *Path of pollutants, *Solute transport, Groundwater movement, Groundwater pollution, Savannah River Plant, South Carolina, Waste disposal.

A three-dimensional scale model was designed and built to simulate groundwater solute transport at the Savannah River Site in east-central South Carolina. The site is 0.75 sq km in surface area, and averages 35 m in depth. Liquid wastes have been continuously disposed of on the site for about 30 yr. The model was built to an undistorted geometric length scale of 1/500. Model materials of sand, cement, and water, blended in varying proportions to achieve different hydraulic conductivities and effective porosities, allowed simulation of four geologic formations in the prototype. The organic dye Rhodamine 6G was used to represent the prototype solute, tritium. Using scaling laws developed for advection, dispersion, chemical interaction, and making adjustments for the radioactive decay of the tritium, the model plume favorably compared with the carefully mapped plume at the prototype. Capillary forces were not scaled. The model included more than 125 simulated wells in two formations. A peristaltic pump was used to discharge source dye into the model, a fluorometer was used to measure fluorescence of the dye, and the concentration of dye (solute) was calculated. The concentrations were modified to account for the radioactive decay of the solute (tritium), and the data used to plot isoconcentration lines. Comparison of model predictions to prototype benchmarks are generally favorable; some problems are attributable to the inability of the model to simulate flow through the unsaturated zone. More

widespread use of scale models in groundwater research is cautiously recommended. (Author's abstract)
W91-00064

LONGITUDINAL AND SEASONAL WATER CHEMISTRY VARIATIONS IN A NORTHERN APPALACHIAN STREAM.
Marian Coll., Indianapolis, IN. Dept. of Biology.
For primary bibliographic entry see Field 2K.
W91-00089

THEORY OF SUBSURFACE WATER-BORNE SOLUTE TRANSPORT.
Australian Nuclear Science and Technology Organisation, Sutherland. Environmental Science Div.
G. Pantelis.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 24-28, March 1990. 9 ref, append.

Descriptors: *Advection, *Convection, *Dispersion, *Groundwater movement, *Mathematical models, *Model studies, *Path of pollutants, *Saturated flow, *Unsaturated flow, Groundwater, Mathematical equations, Parabolic equations, Soil water, Specific discharge.

The many computer codes currently available for simulating subsurface waterborne pollutant transport are usually based on some finite difference or finite element approximation of the equations which describe the transport mechanisms at the representative elementary volume (REV) level. When the transport equations at the REV level are applied to spatial and time scales which differ greatly from those associated with the REV, some averaging or asymptotic procedure may be necessary to reveal a new set of properties for the mathematical formulation. The equations for the water mass balance and the waterborne solute transport in a regional unconfined aquifer are used to determine a three-dimensional specific discharge field. The aquifer is treated as a coupled saturated-unsaturated system with a time varying water table height. The REV-level approach results in excessive computations and numerical inaccuracies at the regional scale, and modifications based upon scale are required. The associated convection-dispersion equation indicates that vertical advection must be included although it is numerically much smaller than the horizontal advection on the local scale. On the regional scale transverse dispersion is dominant in regions of high moisture content, whereas longitudinal dispersion is negligible everywhere. The asymptotic theory presented indicates that if longitudinal dispersion is to be a meaningful quantity in regional aquifer simulations it is necessary to have a high degree of accuracy in the water matric pressure head and specific discharge. (Tappert-PTT)
W91-00119

NUMERICAL MODEL FOR AREAL MIGRATION OF WATER AND LIGHT HYDROCARBON IN UNCONFINED AQUIFERS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
J. J. Kaluarachchi, J. C. Parker, and R. J. Lenhard.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 29-40, March 1990. 16 fig, 1 tab, 24 ref. American Petroleum Institute Modeling Task Force Contract WM-5-324-7.

Descriptors: *Finite element method, *Hydrocarbons, *Mathematical models, *Model studies, *Multiphase flow, *Path of pollutants, Galerkin method, Mass balance, Mathematical analysis, Mathematical equations, Numerical analysis, Recovery wells, Seepage, Spills, Unconfined aquifers.

A finite element model has been developed to simulate the simultaneous flow of water and light hydrocarbons in an unconfined aquifer, for analysis of hydrocarbons spreading from subsurface leaks or spills and for use in the design of free product recovery systems. Vertically integrated governing equations for water and oil flow are employed which assume local vertical equilibrium and negligible gas pressure gradients. Multiple water and free product recovery wells are handled as internal type-1 boundary conditions by stipulating air-oil table elevation and free product height, with corrections to convert grid averaged nodal heads to actual well bore fluid levels. An automatic updating scheme for well bore correction factors is introduced which ensures consistency of well flux calculations with the global mass balance. Areal model predictions are compared with two dimensional vertical cartesian and radial simulations, with multiphase seepage faces for hypothetical trench and well free product recovery systems. The results indicate that the assumption of vertical equilibrium and lack of explicit treatment of seepage faces in the areal model produce minor loss in accuracy while conferring a major reduction in computational effort. Simulations of various spill spreading and free product recovery scenarios with multiple pumping wells are investigated to demonstrate the model capabilities. (Author's abstract)
W91-00120

TIME SERIES ANALYSIS OF UNEQUALLY SPACED OBSERVATIONS-WITH APPLICATIONS TO COPPER CONTAMINATION OF THE RIVER GAULA IN CENTRAL NORWAY.
Norsk Regnesentral, Oslo.
M. Aldrin, E. Damsleth, and H. V. Saebo.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 227-243, November 1989. 8 fig, 4 tab, 7 ref.

Descriptors: *Copper, *Gaula River, *Monitoring, *Norway, *Path of pollutants, *Time series analysis, *Water pollution sources, Data interpretation, Mathematical analysis, Sampling, Statistical analysis, Statistics.

The upper reaches of the Gaula River in central Norway are heavily contaminated by toxic metals, particularly copper, due to mines located along the headwaters. A monitoring program for the river was established in early 1986, and the concentration of Cu, among other variables, has been measured. Goals of the investigation included: (1) to estimate the various statistical characteristics for concentrations and loadings of heavy metals along the river; and (2) to quantify the effect of the contamination from the copper mines both locally and further downstream. There was a fairly strong temporal component in the Cu measurements, which called for a time series model. The irregular pattern of the observation times, however, made the usual models infeasible as they assumed equispaced observations. A simple dynamic linear model (DLM) was used which gave a satisfactory description of the Cu concentration series. The model was fitted to the data using a Kalman filter technique, which handled the irregularly spaced observations without problems. The model has been utilized to: interpolate non-observed values; estimate the net loading; and simulate alternative patterns for the Cu series (observed values and the runoff) in order to obtain estimates of the extreme values and the probability that the concentration has exceeded a certain limit. (Author's abstract)
W91-00128

EVALUATION OF PHOSPHORUS LOADS FROM ONTARIO MUNICIPAL WASTEWATER TREATMENT PLANTS.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
For primary bibliographic entry see Field 5D.
W91-00132

STATUS OF THE NIAGARA RIVER POINT SOURCE DISCHARGE INFORMATION: SAMPLING DESIGN AND ESTIMATION OF LOADING.
National Water Research Inst., Burlington (Ontario).
A. H. El-Shaarawi, and D. J. Williams.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 331-341, November 1989. 6 tab, 4 ref.

Descriptors: *Industrial wastewater, *Monitoring, *Niagara River, *Pollution load, *Sampling, *Statistical analysis, *Statistical methods, Canada, Mathematical studies, Path of pollutants, Wastewater analysis, Wastewater pollution.

Toxic pollutants are discharged to the Niagara River from a number of municipal and industrial point sources. A reliable estimate of the load must satisfy several requirements, including the absence of systematic error (bias), a high level of precision, and some estimate of the uncertainty surrounding the load estimate generated from the data. Both bias and low precision can result from using a bad sampling design and/or an inadequate method of estimation. The effects of biases can be reduced at the design stage prior to data collection or at the data analysis stage. From a management perspective, compliance cannot be effectively monitored if sources of bias in the data are not removed. An evaluation of recently published point source discharge data from the Niagara River suggests that mean values based upon single point in time sampling are not comparable with median values based upon monthly facility data, and that monthly facility data tend to underestimate the actual load. The application of matrix techniques such as the Balanced Incomplete Block Design to develop sampling plans can be useful in allocating restricted resources to provide the best estimate of pollutant load. (Tappert-PTT)
W91-00134

INFERENCES ABOUT POINT SOURCE LOADING FROM UPSTREAM/DOWNSTREAM RIVER MONITORING DATA.
International Joint Commission-United States and Canada, Windsor (Ontario).
D. M. Dolan, and A. H. El-Shaarawi.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 343-357, November 1989. 5 fig, 11 tab, 12 ref.

Descriptors: *Industrial wastewater, *Monitoring, *Path of pollutants, *Pollution load, *Statistical analysis, *Water pollution sources, *Water quality, Canada, Sampling, Statistical methods, Wastewater pollution, Water quality management.

Active sources of contaminants in the Great Lakes are primary targets for remedial actions by water quality managers. Most Areas of Concern in the Great Lakes Region such as the Niagara and Detroit Rivers contain a myriad of point and non-point sources. These are difficult and expensive to monitor and often present unique analytical problems subject to analytical error. The Niagara River Toxics Committee and the Upper Great Lakes Connecting Channels Study Modeling Committee designed programs to indirectly monitor these sources by upstream/downstream sampling at the head and mouth of the rivers. Paired samples are collected by staggering the time of collection based upon travel time of the receiving water. Objectives of the monitoring were to determine trends in contaminant concentrations over time, compare concentrations to criteria and report exceedences, and estimate relative differences between the head and mouth of the river. Upstream/downstream samples were paired to obtain differential loadings wherever possible, but when some results were reported as below the detection limit, a maximum likelihood estimate was used. The resulting differential loading, adjusted for non-point sources, is the total point source load to the river minus any losses due to volatilization, settling or degradation. (Tappert-PTT)
W91-00135

STATISTICAL ZONATION OF SEDIMENT SAMPLES USING RATIO MATCHING AND CLUSTER ANALYSIS.
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
For primary bibliographic entry see Field 2J.
W91-00137

ROBUST GRAPHICAL METHODS FOR DIAGNOSING TREND IN IRREGULARLY SPACED WATER QUALITY TIME SERIES.
Ontario Ministry of the Environment, Toronto.

Water Resources Branch.
B. A. Bodo.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 407-428, November 1989. 7 fig, 31 ref.

Descriptors: *Data interpretation, *Graphical analysis, *Graphical methods, *Time series analysis, *Water quality, *Water quality trends, Forecasting, Mathematical analysis, Monitoring, Regression analysis, Water pollution sources.

Although point source pollution monitoring may be concerned with directly characterizing the properties of an effluent stream, it is frequently necessary to assess the impacts of point sources in receptor media. Graphical methods can enhance reliability in the assessment of data from river quality data series, both as diagnostic tools and as visual corroborative evidence when assumptions required for formal statistical tests are not met. Robust, graphically oriented trend diagnostic procedures can be applied to data series characterized by nonnormal populations, uneven time spacing, nonmonotonic trends and other factors which can create serious problems for standard parametric time series methods. Cleveland's robust locally weighted regression (RLWR) developed for investigating nonlinearity in x-y scatterplots was adapted as a robust/resistant smoothing filter for the analysis of irregular time series of quantitative observations. Low powered RLWR trend lines revealed temporally local phenomena, such as abrupt jumps (often associated with point source impacts) and periodicities, while higher powered RLWR yielded smooth lines characterizing medium and longer term trends. Simple variants of Tukey smoothing concepts were developed for series with censored observations. Applications to Ontario river quality series reveal that graphical evidence is frequently sufficient to obviate the need for formal trend testing. The methods are generally applicable to most time series. (Tappert-PTT)
W91-00138

DEVELOPMENT OF A SOFTWARE PACKAGE FOR TREND DETECTION IN TEMPORAL SERIES: APPLICATION TO WATER AND INDUSTRIAL EFFLUENT QUALITY DATA FOR THE ST. LAWRENCE RIVER.
INRS-Eau, Sainte-Foy (Quebec).
D. Cluis, C. Langlois, R. van Coillie, and C. Laberge.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 429-441, November 1989. 4 fig, 6 tab, 16 ref.

Descriptors: *Computer models, *Computer programs, *Evaluation, *Monitoring, *Statistical analysis, *Water quality, Fortran, Industrial wastewater, Markov process, Pollution load, Statistical methods, Water analysis, Water quality management, Water sampling.

Follow-up environmental studies are an essential step in the objective assessment of the efficiency of any sanitation program. Despite the considerable amount of effort and resources involved in monitoring water quality, water quality assessment and environmental follow-up are sometimes carried out with simple statistics, the main reason being the lack of appropriate statistical methods adapted to the nature of sampled water quality data. A survey of the classical methods used for trend detection, including the most recent non-parametric techniques, reveal many problems with statistical analysis due to the structure of the sampled data and the possible types of trends occurring. Water quality data are rarely normally distributed or temporally independent. The sampling frequency, widely asymmetric distributions, seasonal variances, and characteristics of data reporting (such as detection limits) reduce the effectiveness of standard techniques for trend detection. A new set of non-parametric tests now exist that are better suited to the real structure of water quality data. Coupled with retrospective graphical techniques as preliminary analytical tools, an interactive user-friendly software package written in Fortran has been developed for microcomputers making use of these latest adapted techniques. The software was applied to phenol loadings discharged from two Montreal refineries, and dissolved nitrogen concentrations in the St. Lawrence River. The software should be updated as improved trend detection techniques appear in the literature. (Tappert-PTT)
W91-00139

CRUDE OIL AND HYDROCARBON-DEGRADING STRAINS OF RHODOCOCCUS RHODOCHROUS ISOLATED FROM SOIL AND MARINE ENVIRONMENTS IN KUWAIT.
Kuwait Univ., Safat. Dept. of Botany and Microbiology.
N. A. Sorkhoh, M. A. Ghannoum, A. S. Ibrahim, R. J. Stretton, and S. S. Radwan.
Environmental Pollution ENPOEK, Vol. 65, No. 1, p 1-17, 1990. 5 fig, 5 tab, 26 ref. Kuwait University, Research Council, grant no. S0033; Kuwait Foundation for the Advancement of Science, grant no. 87-01-04.

Descriptors: *Biodegradation, *Environmental engineering, *Fate of pollutants, *Hydrocarbons, *Kuwait, *Marine bacteria, *Oil pollution, *Soil bacteria, Biological treatment, Environmental effects, Fungi, Marine environment, Marine pollution, Oil industry.

The oil industry and various related processes pose a constant threat to the marine environment as a consequence of the huge influx of petroleum hydrocarbons into this ecosystem. The northwestern region of the oil-producing Persian Gulf is heavily polluted. Soil and marine samples collected from different localities in Kuwait were screened for microorganisms capable of oil degradation. Both fungi and bacteria were isolated. The fungal flora consisted of Aspergillus terreus, A. sulphureus, Mucor globosus, Fusarium sp. and Penicillium citrinum. Mucor globosus was the most active oil degrading fungus isolated. Bacterial isolates included Bacillus spp., Enterobacteriaceae, Pseudomonas spp., Nocardia spp., Streptomyces spp., and Rhodococcus spp. Among these, Rhodococcus strains were the most efficient in oil degradation and, relatively, the most abundant. Bacterial and fungal isolates differed in their ability to degrade crude oil, with Rhodococcus isolates being more active than fungi in n-alkane biodegradation, particularly in the case of R. rhodochrous. In addition to medium chain n-alkanes, fungi utilized one or more of the aromatic hydrocarbons studied, while the bacteria failed to do so. R. rhodochrous KUCC 8801 was shown by gas liquid chromatography and post-growth studies to be more efficient in oil degradation than isolates known to be active oil degraders. (Author's abstract)
W91-00144

ACID PRECURSOR CONCENTRATIONS ABOVE THE NORTHEASTERN UNITED STATES DURING SUMMER 1987: THREE CASE STUDIES.
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
J. F. Boatman, N. Laulainen, J. Ray, C. Van Valin, and L. Gunter.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 95, No. 8, p 11,831-11,845, July 20, 1990. 10 fig, 2 tab, 40 ref.

Descriptors: *Acid rain, *Air pollution, *Atmospheric chemistry, *Path of pollutants, *Trace levels, *Water pollution sources, Aircraft, Data collections, Hydrogen peroxide, Nitrogen oxides, Ozone, Sulfur dioxide.

Two aircraft measured the spatial distribution of selected acid trace species (SO2, H2O2, O3, and NOy) above the northeastern United States during summer. The aircraft flew together on three missions between Columbus, Ohio and Saranac Lake, New York. The sulfur dioxide concentration averaged 1-2 ppbv within the planetary boundary layer (pbl) and <1 ppbv in the free troposphere. Superimposed on this background concentration were surface source regions with elevated concentrations as high as 14 ppbv. The hydrogen peroxide concentration averaged 2-4 ppbv, with the highest values found above the top of the pbl. The H2O2 pattern increased in both size and intensity above the top of the pbl during the afternoon, possibly due to photochemical production and advection. The ozone concentration varied between 30 and 110 ppbv. The concentration of O3 increased by as much as 30 ppbv during the day. Nitrogen oxide concentrations were in the range <1-8 ppbv. The pattern of SO2 and NO concentrations remained substantially the same during the daytime hours. The O3 and NOy concentrations were linked to surface emissions and photochemical processes. The ratio between H2O2 and SO2 was >1, except in the lower pbl and near surface SO2 source regions. It was found that it was feasible to collect pollutant data using multiple aircraft in repeated flights over long distances, and that this technique is in fact necessary to capture the vertical patterns of pollutants. (Fish-PTT)
W91-00148

USING ISOTOPE FRACTIONATION OF NITRATE-NITROGEN AND NITRATE-OXYGEN FOR EVALUATION OF MICROBIAL DENITRIFICATION IN A SANDY AQUIFER.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
J. Bottcher, O. Strebel, S. Voerkelius, and H. L. Schmidt.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 413-424, May 1990. 5 fig, 1 tab, 15 ref. Deutsche Forschungsgemeinschaft.

Descriptors: *Biotransformation, *Denitrification, *Fate of pollutants, *Isotope fractionation, *Isotope studies, *Nitrates, *Nonpoint pollution sources, *Oxygen isotopes, *Sand aquifers, Coniferous forests, Enrichment, Germany, Groundwater flow, Groundwater recharge, Land use, Monitoring wells, Water sampling.

The nitrate input into the groundwater from forest and agricultural land in the Fuhrberger Feld catchment area in West Germany is virtually completely degraded by microbial denitrification in the aquifer. Five multilevel groundwater sampling wells show characteristic depth functions of nitrate, proving the denitrification process. A series of 10 samples of 'arable land groundwater' was taken from different depths at these multilevel wells and isotope ratios of N15/N14 and O18/O16 in the nitrate were measured. The sampling was based on the two-dimensional vertical-plane groundwater flownet and on the knowledge of the land use upgradient of the multilevel wells. High nitrate concentrations are associated with low delta N15 and low delta O18 values, and vice versa. The delta N15/delta O18 ratio indicates a linear increase with a slope of 1:2.1. The microbial denitrification accords with a Rayleigh process with calculated enrichment factors of -15.9 ppt for N15 and -8.0 ppt for O18. Three samples taken from groundwater recharged under coniferous forest show deviating characteristics: low nitrate concentrations with low delta N15 values but very high delta O18 values. Using the enrichment factors for N15 and O18, an attempt was made to ascertain the significance of denitrification in specific depth sections at two other multilevel wells. In two cases quantitative assessments on the degree of nitrate concentration decrease owing to denitrification were possible. However, in other cases the specific nitrate isotope fractionation was masked by the variability of nitrate concentration and of nitrate isotope ratios in the corresponding groundwater recharge preventing definite interpretations. (Author's abstract)
W91-00166

INFLUENCE OF PH, TEMPERATURE AND SEDIMENT TYPE ON THE TOXICITY, ACCUMULATION AND DEGRADATION OF PARATHION IN AQUATIC SYSTEMS.
Ohio State Univ., Columbus. Dept. of Zoology.
M. J. Lydy, T. W. Lohner, and S. W. Fisher.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 27-44, July 1990. 2 fig, 7 tab, 35 ref.

Descriptors: *Acute toxicity, *Fate of pollutants, *Midges, *Parathion, *Path of pollutants, *Water pollution effects, Animal metabolism, Bioavailability, Chemical degradation, Hydrogen ion concen-

tration, Insecticides, Laboratory methods, Sediments, Temperature effects.

Parathion is a widely-used insecticide which is believed not to persist in the environment. However, its detection in ground water supplies has raised doubt as to whether it is ephemeral. The effects of pH, temperature, and sediment on the toxicity and aquatic fate of parathion were investigated. Acute toxicity tests, accumulation and metabolism studies were conducted with midge larvae, Chironomus riparius, at pH values 4, 6, and 8 in water held at 10, 20, and 30 degrees, with and without sediment. Abiotic tests were also performed to determine the fate of parathion under various substrate conditions. Without exception, temperature was the most influential parameter tested. It altered both the toxicity and metabolism of parathion, at times increasing toxicity as much as 100-fold when the temperature increased from 10 C to 30 C. Sediment also influenced parathion toxicity and degradation, although to a lesser extent than temperature. Changes in pH had little influence on parathion toxicity or degradation. The results of these studies further emphasize the importance of abiotic factors on the environmental fate of xenobiotics. (Author's abstract)
W91-00193

BIOACCUMULATION OF KEPONE BY GRASS SHRIMP (PALAEMONETES PUGIO): IMPORTANCE OF DIETARY ACCUMULATION AND FOOD RATION.
Maryland Univ., Queenstown. Wye Research and Education Center.
D. J. Fisher, and J. R. Clark.
Aquatic Toxicology AQTCDG, Vol. 17, No. 2, p 167-186, August 1990. 4 fig, 4 tab, 31 ref.

Descriptors: *Bioaccumulation, *Biological magnification, *Fate of pollutants, *Insecticides, *Organochlorine pesticides, *Path of pollutants, *Shrimp, Animal metabolism, Bioavailability, Estuarine environment, Feeding rates, Food chains.

The relative extent of Kepone chloralscone uptake from food (dietary accumulation) and water (bioconcentration) by grass shrimp (Palaemonetes pugio) was evaluated quantitatively at food rations of 4% and 8% of the average weight of the shrimp. C14-Kepone was utilized to determine bioconcentration and dietary accumulation separately, while C14-Kepone-contaminated food (grass shrimp) and unlabeled Kepone in water were used to determine accumulation from both sources simultaneously. Grass shrimp and their food were exposed to the same aqueous Kepone concentration (0.04 micrograms/L). A first-order pharmacokinetic equation was used to model Kepone accumulation kinetics during the 16-day uptake and 21-day clearance phases. A doubling of contaminated food ration caused a significant (alpha = 0.05) increase in the whole-body Kepone concentration in the shrimp. Shrimp fed either a 4% or 8% ration of uncontaminated food and exposed to 0.04 micrograms/L Kepone in water bioconcentrated Kepone equally. When shrimp were exposed to contaminated water and food, Kepone accumulation from each source was additive. Food ration, however, was very important in determining final Kepone body burdens. The dietary source of Kepone represented approximately 24% and 33% of the total body burden accumulated by shrimp fed 4% and 8% food rations, respectively, but assimilation efficiencies of Kepone from the food source were low. The laboratory results suggest that dietary accumulation of Kepone by grass shrimp may play an important role in determining final Kepone body burdens in feral organisms, especially during periods of high food consumption. (Author's abstract)
W91-00201

POTENTIAL FOR AGRICULTURAL PESTICIDE RUNOFF TO A PUGET SOUND ESTUARY: PADILLA BAY, WASHINGTON.
Western Washington Univ., Bellingham. Inst. for Watershed Studies.
J. R. Mayer, and N. R. Elkins.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 215-222, August 1990. fig 1, tab 2, 14 ref.

Descriptors: *Estuarine environment, *Nonpoint pollution sources, *Path of pollutants, *Pesticides, *Washington, Agricultural runoff, Chemical analysis, Estuarine sediments, Halogenated pesticides, Herbicides, Puget Sound, Sediment analysis, Sediment contamination.

Padilla Bay, an estuary of Puget Sound, possesses one of the three most extensive eelgrass communities in the Pacific Northwest. Recently, the potential for pesticide contamination of Padilla Bay has received attention due to the intensively managed agricultural areas immediately to the east of the Bay. The purposes of this 2 year investigation were: (1) to identify and quantify pesticide runoff in this agricultural environment; and, (2) to assess the ecological significance of pesticide runoff to Padilla Bay given the knowledge that fourteen pesticides are applied each summer at known rates. Four sampling expeditions were carried out; the first and third were during the springs of 1987 and 1988 and were before any pesticide applications for those years, while the second and fourth were during the summers of 1987 and 1988, after pesticide applications were completed. The results show that no ecologically significant levels of any of the fourteen pesticides studied were found in the water or sediments associated with Padilla Bay sloughs or the Bay itself during this investigation. The very low levels of dicamba and 2,4-D found in some water and sediment samples supports the view that they are subject to runoff following significant rain events. (Hoskin-PTT)
W91-00204

HEAVY METAL CONTAMINATION IN THE RIVER TOAD, BUFO JUXTASPER (INGER), NEAR A COPPER MINE IN EAST MALAYSIA.
National Univ. of Malaysia, Kota Kinabalu. Faculty of Science and Natural Resources.
Y. H. Lee, and R. B. Stuebing.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 272-279, August 1990. 1 fig, 3 ref, 14 ref.

Descriptors: *Bioindicators, *Heavy metals, *Malaysia, *Mine wastes, *Path of pollutants, *Toads, Bioaccumulation, Bioassay, Chromium, Cobalt, Copper, Embryonic growth stage, Lead, Liver, Manganese, Mine drainage, Regression analysis, Silver, Trace metals, Zinc.

An open pit copper mine situated in the Northwest of Sabah, East Malaysia has been known to pollute its surroundings, especially with discharges involving heavy metals. As amphibians live both on land and in water, a study on the heavy metal content of these animals will enable a more extensive evaluation of the degree of contamination by heavy metals. Toads (Bufo juxtasper) were collected from four different sites, with only one location directly affected by mine effluent discharge. The liver Cu content of toads collected from all sampling sites appears to be extremely variable and abnormally high (range: 4-1020 ppm). The Cd and Ni content of toad livers from the effluent-affected site were significantly higher compared to all three non-polluted sites. Cu content was also significantly greater for the polluted site compared to two of the control sites. Pb and Zn were significantly higher at the polluted site over one of the control sites. No significant difference was observed between the contents of Ag, Co, Cr and Mn in the liver of B. juxtasper collected from the polluted and control sites. There was a negative correlation between Pb content and liver size, indicating accumulation of Pb in the larval phase of B. juxtasper but such accumulation declined relative to body weight when the toad entered the adult phase. (Hoskin-PTT)
W91-00209

COMPARATIVE TOXICITY OF AN EFFLUENT FROM A CHLOR-ALKALI INDUSTRY AND HGCL2.
Berhampur Univ. (India). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-00210

BIOACCUMULATION OF MERCURY AND ITS EFFECT ON PROTEIN METABOLISM OF THE WATER HYACINTH WEEVIL NEOCHETINA EICHHORNAE (WARNER).
Indian Inst. of Chemical Technology, Hyderabad. Biology Group.
For primary bibliographic entry see Field 5C.
W91-00212

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES. VOLUME I.
For primary bibliographic entry see Field 4B.
W91-00215

ENVIRONMENTAL ISOTOPE-AIDED STUDIES ON WATER RESOURCES IN THE REGION OF CHEJU ISLAND.
Korea Advanced Energy Research Inst., Daeduk (Republic of Korea).
For primary bibliographic entry see Field 2F.
W91-00224

ESTIMATION OF RECHARGE AND POLLUTANT TRANSFER TO GROUNDWATER BY MODELLING OF UNSATURATED ZONE.
Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 2F.
W91-00259

SEDIMENT AND THE ENVIRONMENT.
For primary bibliographic entry see Field 2J.
W91-00280

NITROGEN AND PHOSPHORUS IN ERODED SEDIMENT FROM CORN AND SOYBEAN TILLAGE SYSTEMS.
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
G. F. McIsaac, M. C. Hirschi, and J. K. Mitchell.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 3-10, 2 fig, 2 tab, 18 ref.

Descriptors: *Agricultural runoff, *Erosion, *Nonpoint pollution sources, *Runoff, *Soil erosion, *Tillage, *Water pollution sources, Agriculture, Contour terracing, Corn, Cropland, Illinois, Nitrogen, Phosphorus, Sediment analysis, Sediment chemistry, Simulated rainfall, Soybeans.

Midwestern U.S. cropland soils have been eroding at rates believed to be damaging to the productivity of the soils. Runoff, soil loss and sediment bound total Kjeldahl nitrogen (TKN) and Bray P-1 phosphorus losses from simulated rainfall were measured from five alternative corn and soybean tillage systems. Runoff and soil losses were influenced by contouring and tillage treatment. TKN concentration in the sediment was not greatly affected by tillage treatment and the average TKN enrichment ratio was 1.15. Bray P-1 concentration in the soil and eroded sediment was significantly reduced by inversion plowing, and concentrations in the eroded sediment tended to decrease as soil loss increased. Bray P-1 enrichment ratios ranged from 1.7 to 4.5, and variations were not well correlated with soil loss. (See also W91-00280) (Author's abstract)
W91-00281

ROLE OF SEDIMENT IN METOLACHLOR TRANSPORT FROM AGRICULTURAL FIELDS.
Trent Univ., Peterborough (Ontario). Dept. of Geography.
J. M. Buttle.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p. 11-18, 3 fig, 3 tab, 8 ref.

Descriptors: *Agricultural runoff, *Fate of pollutants, *Herbicides, *Nonpoint pollution sources, *Path of pollutants, *Sediments, *Water pollution sources, Agricultural chemicals, Canada, Metolachlor, Ontario, Peterborough, Rainfall, Water table.

The increased use of herbicides in agricultural activities has heightened public concern over their potential to contaminate surface and subsurface waters. A two year investigation of the hydrological pathways of metolachlor transport from application site to receiving water bodies was undertaken using a corn field located 15 km south of Peterborough, Ontario, Canada. Examination of metolachlor concentrations and loads in the dissolved and suspended phases in runoff water revealed that sediment can be an important transport vector in the movement of relatively soluble herbicides from site of application. The proportion of total metolachlor yield carried on sediment ranged from 9 to 70% for natural rainstorms on experimental plots. Near-stream water table conditions appeared to determine whether field exports of metolachlor and sediment enter adjacent streams or are deposited in footslope areas. (See also W91-00280) (MacKeen-PTT)
W91-00282

TRANSPORT OF MINE TAILINGS AS SUSPENDED SEDIMENT IN THE BELLE FOURCHE RIVER, WEST-CENTRAL SOUTH DAKOTA, USA.
Geological Survey, Indianapolis, IN. Water Resources Div.
D. C. Marron.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p. 19-26, 3 fig, 8 ref.

Descriptors: *Arsenic, *Mine wastes, *Path of pollutants, *Sediment contamination, *Sediment transport, *Suspended sediments, Alluvium, Belle Fourche River, Flood plains, Gold mining, River sediments, South Dakota, Whitehead Creek.

Millions of tons of mine tailings that were discharged into Whitehead Creek in South Dakota between the late 1800's and 1978 were transported through the Belle Fourche River or deposited on its flood plain. Arsenic concentrations in overbank deposits along the Belle Fourche River record the dilution of transported mine tailings by uncontaminated alluvium during overbank flow. Arsenic concentrations decrease in a downstream direction and are smallest in sediments that were deposited by the highest streamflow. Background and pre-1978 suspended sediment data collected at gauging stations on the Belle Fourche River also indicate increasing dilution of mine tailings by uncontaminated alluvium with increasing distance downstream and at higher streamflow. Calculations of pre-1978 mine tailings transport at two gauging stations along the Belle Fourche River illustrate the capacity of the Belle Fourche River to transport a large, fine-grained sediment load, and the ability of flood plains to store large amounts of fine-grained sediment. (See also W91-00280) (Author's abstract)
W91-00283

SEDIMENT-ASSOCIATED TRANSPORT AND REDISTRIBUTION OF CHERNOBYL FALLOUT RADIONUCLIDES.
Exeter Univ. (England). Dept. of Geography.
D. E. Walling, J. S. Rowan, and S. B. Bradley.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p. 37-45, 3 fig, 2 tab, 6 ref.

Descriptors: *Fallout, *Path of pollutants, *Sediment contamination, *Sediment transport, *Water pollution sources, Cesium radioisotopes, Chernobyl, England, Flood plain sediments, Radionuclides, River Severn, Sediment analysis, Suspended sediments, Wales.

Fallout of Chernobyl-derived radionuclides over the UK evidenced marked spatial variation. Relatively high levels were recorded in central Wales, but they declined rapidly to the east. As a result the headwaters of the River Severn received significant inputs of fallout, whereas only low levels were recorded over the middle and lower reaches. Measurements of the cesium-137 content of suspended sediment transported by the River Severn and of channel and floodplain sediments collected from various locations within the basin have been used to assess the importance of fluvial transport and redistribution of Chernobyl-derived radionuclides. High concentrations of cesium-137 (up to 1450 mBq/g) were recorded in suspended sediment collected from the lower reaches of the river shortly after the Chernobyl incident and substantial accumulations of Chernobyl-derived radionuclides have been detected in floodplain and channel sediments collected from areas which received only low levels of fallout directly. (See also W91-00280) (Author's abstract)
W91-00285

METAL DISPERSAL IN THE FLUVIAL SYSTEM OF THE RIVER GEUL: THE ROLE OF DISCHARGE, DISTANCE TO THE SOURCE, AND FLOODPLAIN GEOMETRY.
Utrecht Rijksuniversiteit (Netherlands). Dept. of Geography.
H. Leenaers, and M. C. Rang.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 47-55, 5 fig, 4 tab, 19 ref.

Descriptors: *Heavy metals, *Mine wastes, *Path of pollutants, *River sediments, *Sediment contamination, *Sediment transport, *Water pollution sources, Cadmium, Flood plain sediments, Flood plains, Geul River, Lead, Suspended sediments, The Netherlands, Zinc.

Due to mining activities in the past, the floodplains of the River Geul in the Netherlands are severely polluted with heavy metals, especially lead, zinc and cadmium. In the present situation, two active sources of heavy metals were recognized. Older floodplain sediments, which have been contaminated by the disposal of solid waste, are reworked and continue to function as a major source of heavy metals during floods. Erosion and leaching of spoil heaps that are still present along the channel and on the river banks are additional sources of heavy metals. As a result of an increased activity of these sources during flood events, for at-a-station measurements only a weak negative relation was found between river discharge and metal concentration of suspended sediments. However, downstream observations reveal an exponential decay of metal concentrations that is due to dilution with relatively clean bed, bank and hillslope material. Moreover, differences in geochemical mobility and specific density may cause metal-specific decay rates during low flow conditions. During flood events suspended sediments are deposited in the floodplain area. Local floodplain characteristics such as inundation frequency and geomorphology reflect a spatial pattern of soil pollution that consists of local deviations from the general, exponential decay pattern. (See also W91-00280) (Author's abstract)
W91-00286

CROPPING SYSTEMS EFFECTS ON RUNOFF, EROSION, WATER QUALITY, AND PROPERTIES OF A SAVANNA SOIL AT ILORIN, NIGERIA.
Ohio State Univ., Columbus. Dept. of Agronomy.
R. Lal.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 67-74, 1 fig, 8 tab, 19 ref.

Descriptors: *Agricultural runoff, *Erosion, *Nonpoint pollution sources, *Runoff, *Soil erosion, *Tillage, *Water pollution sources, Africa, Crop yield, Cropping, Farm management, Ilorin, Nigeria, Savannas, Soil compaction, Soil properties, Tropical regions.

Soil erosion and land degradation are severe problems in some ecological regions of tropical Africa. The effects of five cropping systems and tillage methods on runoff, erosion and soil properties were investigated for a savanna soil on field runoff plots from 1983-1985. Treatments consisted of traditional farming, no-till, plow-till, alley cropping and bush fallow control. The mean annual runoff for 1983 and 1984 was trace amounts for bush fallow, 38 and 44 mm for traditional farming, 29 and 11 mm for no-till, 36 and 61 mm for plow-till, and 77 and 39 mm for alley cropping treatments. Annual soil erosion for 1983 and 1984 was trace amounts for bush fallow, 779 and 1139 kg/ha for traditional farming, 319 and 133 kg/ha for no-till, 984 and 3318 kg/ha for plow-till, and 1520 and 172 kg/ha for alley cropping. Soil physical and hydrological properties and crop yields were satisfactory in the traditional farming system. Vehicular traffic caused soil compaction in other treatments. Among cropped plots, runoff and erosion were less in no-till compared with other treatments. (See also W91-00280) (Author's abstract)
W91-00288

SOIL EROSION AND FLOODPLAIN SOIL POLLUTION; RELATED PROBLEMS IN THE GEOGRAPHICAL CONTEXT OF A RIVER BASIN.
Utrecht Rijksuniversiteit (Netherlands). Dept. of Geography.
H. Leenaers, and C. J. Schouten.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 75-83, 3 fig, 5 tab, 26 ref.

Descriptors: *Erosion, *Nonpoint pollution sources, *Soil erosion, *Surface runoff, *Urbanization, Agriculture, Bank erosion, Flash floods, Flood peak, Flood plain sediments, Floods, Heavy metals, Limburg, Mine wastes, River Geul, River basins, Sediment contamination, The Netherlands.

In the Netherlands, as in other parts of western Europe, a slow process of land use changes began in the 1950s. Due to an increase of the urban area and sealed roads, as well as a scale enlargement and modernization in agricultural practice, the infiltration capacity of the physical environment has decreased. In the hill country of the province of Limburg this process has contributed to an increase in surface runoff, causing severe problems of water damage in urban areas and soil erosion on agricultural cropland. The discharge of the River Geul, with a catchment area of 350 sq km, heavily depends on rainfall. The increasing amount of surface runoff is reflected in a flashier discharge regime, i.e. under similar rainfall conditions a higher peak discharge is produced in the present situation as compared to the situation in the 1950s. Because of mining activities in the past, the alluvial deposits in the Geul valley are severely polluted with heavy metals (lead, zinc and cadmium). During floods, the contaminated streambank deposits are eroded and therefore continue to act as a source of heavy metals. This process of sediment reworking has intensified since the 1950s, as can be derived from an increase of the rate of channel migration and the frequency and magnitude of floods. As a result, the area that is regularly flooded has grown and contaminated sediments are deposited in the floodplains at high rates. (See also W91-00280) (Author's abstract)
W91-00289

FLOCCULATION OF SUSPENDED SOLIDS IN SOUTHERN ONTARIO RIVERS.
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W91-00291

PLACER MINING OPERATIONS AND MODIFICATIONS OF THE PHYSICAL CHEMICAL NATURE OF THE WATERS OF THE RIO KAKA DRAINAGE BASIN (ANDES, BOLIVIA).
Office de la Recherche Scientifique et Technique

Outre-Mer, La Paz (Bolivia).
J. L. Guyot, and G. Herail.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 115-121, 6 fig, 2 tab, 6 ref.

Descriptors: *Mine wastes, *Suspended load, *Suspended solids, *Water pollution sources, *Water quality, Andes, Bolivia, Challana River, Consata-Mapiri River, Dissolved solids, Gold mining, Kaka River, River sediments, Tipuani River.

The influence of the exploitation of gold placers in the Bolivian Andes on water quality was examined. Three rivers were studied: the lightly exploited Challana River, the Tipuani River, where exploitation is intense in low water, and the Consata-Mapiri River, where extraction takes place on terraces and effluents are not poured directly into the river. In low water periods, when mining activity was maximal, suspended load increased strongly, up to 130 times the natural value observed in the Challana River. In a low water period, the yields to the Kaka River from the Tipuani River were 8.4% of the discharge, 4.4% of the total dissolved solids (TDS), but 77.8% of the total suspended solids (TSS). The Challana River supplied 12.0% of the discharge, 6.3% of the TDS and 0.8% of the TSS to the Kaka River. The increase in TSS was still noticeable at the foot of the Andes, 200 km downstream. On the other hand, no influence of mining activity on TDS was observed. (See also W91-00280) (MacKeen-PTT)
W91-00293

MODELLING AGRICULTURAL RUNOFF: OVERVIEW.
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
J. Marsalek.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 201-209, 1 tab, 19 ref.

Descriptors: *Agricultural runoff, *Computer models, *Model studies, *Nonpoint pollution sources, *Water pollution sources, Agricultural chemicals, Hydrologic models, Management planning, Planning, Reviews, Sediment yield, Watershed management.

Approaches to the modelling of agricultural runoff pollution are reviewed, and refinements of the modelling process and of existing models are proposed. According to the modelling objectives, three distinctive types of modelling are recognized: screening, planning, and design modelling. Model selection depends upon the accuracy requirements of the analysis, characteristics of the system and contaminants studied, and available data and resources. The modelling process consists of three phases comprising preparation of input data, model validation or testing, and the analysis of alternatives. A list of representative agricultural runoff models includes relatively simple screening models, which do not simulate hydrological processes but produce sediment yields and or chemical loads, and planning and design models which typically simulate basin hydrology, sediment yields and some agricultural chemical loads. Suggestions for model improvement include improved documentation, wider use of geographical information systems, and refinement of models to better reflect end-user requirements. (See also W91-00280) (MacKeen-PTT)
W91-00302

TRITIUM CONCENTRATIONS IN FLOW FROM SELECTED SPRINGS THAT DISCHARGE TO THE SNAKE RIVER, TWIN FALLS-HAGERMAN AREA, IDAHO.
Geological Survey, Idaho Falls, ID. Water Resources Div.
L. J. Mann.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4156, September 1989. 20p, 2 fig, 3 tab, 15 ref.

Descriptors: *Idaho, *Path of pollutants, *Radioactive wastes, *Snake River, *Springs, *Tritium, Aquifers, Detection limits, Hazard assessment, Water quality standards.

Concern has been expressed that some of the approximately 30,900 curies of tritium disposed to the Snake River Plain aquifer from 1952 to 1988 at the INEL (Idaho National Engineering Laboratory) has migrated to springs that discharge to the Snake River in the Twin Falls-Hagerman area. To document tritium concentrations in springflow, 17 springs were sampled in November 1988 and 19 springs were sampled in March 1989. Analyses showed that the tritium concentrations were less than the minimum detectable concentration of about 0.5 pCi/mL (picocuries per milliliter) in November 1988 and less than the minimum detectable concentration of about 0.2 pCi/mL in March 1989; the minimum detectable concentration was smaller in March 1989 owing to a longer counting time in the liquid scintillation system. For comparison, the maximum contaminant level of tritium in drinking water as established by the Environmental Protection Agency. is 20 pCi/mL. Samples analyzed by the EPA indicate there has been a subtle decrease in tritium concentrations in the Snake River near Buhl since the 1970's owing to the radioactive decay of tritium that was produced by atmospheric testing of nuclear weapons in the 1950's and 1960's. In 1974-79, the concentrations were less than 0.3 +/-0.2 pCi/mL in 3 of 20 samples, whereas, in 1983-88, 17 of 23 samples contained less than 0.3 +/-0.2 pCi/mL. On the basis of these findings, aqueous waste disposal of tritium at the INEL has had no measurable effect on tritium concentrations in the springflow discharging from the Snake River Plain aquifer and in the Snake River near Buhl. This conclusion is supported by the distribution of tritium in the Snake River Plain aquifer. (Author's abstract)
W91-00336

HYDROGEOLOGY AND GROUND-WATER-QUALITY CONDITIONS AT THE GEARY COUNTY LANDFILL, NORTHEAST KANSAS, 1988.
Geological Survey, Lawrence, KS. Water Resources Div.
N. C. Myers, and P. R. Bigsby.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4114, 1989. 41p, 20 fig, 9 tab, 28 ref.

Descriptors: *Geohydrology, *Groundwater quality, *Kansas, *Landfills, *Path of pollutants, *Water pollution sources, Calcium bicarbonate, Groundwater movement, Leachates, Organic pollutants, Trace elements, Water quality standards.

Chemical analyses of water from monitoring wells installed at locations upgradient and downgradient from the landfill indicate the presence of calcium bicarbonate, sodium chloride, and mixed calcium bicarbonate sodium chloride water types. For the dominant calcium bicarbonate water type, inorganic and organic constituents indicate the presence of reducing conditions in the landfill, and increased concentrations of calcium, magnesium, sodium, bicarbonate, sulfate, chloride, ammonia, iron, manganese, and other trace elements downgradient within a leachate plume that extends northeasterly away from the landfill. The orientation of the long axis of the leachate plume does not coincide with the direction of groundwater flow, based on measurements of water-level altitude, possibly due to the effect of abundant rainfall and high river stages at other times of the year or preferential flow in very transmissive zones, and thus may indicate the dominant direction of groundwater flow. None of the organic-constituent or inorganic-constituent concentrations exceeded primary drinking water standards, but iron and manganese concentrations exceeded secondary drinking water standards. Concentrations of benzene, vinyl chloride, and 1,2-trans-dichloroethene exceeded Kansas notification levels. (Author's abstract)
W91-00338

STORM RUNOFF AND ITS EFFECTS ON THE WATER QUALITY AND BOTTOM-MATERIAL QUALITY OF CEDAR CREEK, WEST-CENTRAL ILLINOIS, 1985-6.
Geological Survey, Urbana, IL. Water Resources Div.
W. O. Freeman, A. R. Schmidt, and R. D. McFarlane.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4088, October 1989.

Descriptors: *Bottom sediments, *Illinois, *Path of pollutants, *Storm runoff, *Streams, *Urban hydrology, *Urban runoff, *Water pollution sources, *Water quality, Combined sewer overflows, Galesburg, Heavy metals, Oxygen demand, Pollution load, Storm sewers, Wastewater facilities, Water quality data, Water quality standards.

Storm-related constituent loads to a 26.2-mile reach of Cedar creek, which flows through Galesburg, IL, were estimated from measurements made at 49 combined sewers, 7 storm sewers, a wastewater-treatment facility, 3 tributaries, and 5 stream sites along the creek. Sediment oxygen demands and concentrations of sediment constituents were determined at 45 locations in the creek and tributaries. Water-quality samples from the creek indicated that concentrations of copper, lead, cadmium, zinc, iron, and oxygen-demanding wastes exceeded the state effluent standards. Odors and the amount of floating material may also have exceeded the state standards, as did storm-sewer discharge concentrations of lead, iron, and dissolved solids. Sediment concentrations of mercury, lead, chromium, cadmium, and zinc were extremely high compared to mean background concentrations for Illinois. Sediment oxygen demands ranged from 0.4 to 9.1 g/sq m/day. Agricultural runoff contributes a substantial amount of suspended solids and oxygen-demanding materials, but these sources are mostly downstream from the areas of bottom material having high sediment oxygen demands. Bottom-material samples and the locations of the subreaches with high sediment oxygen demands indicate that runoff from the ongoing highway construction did not contribute substantial amounts of metals or oxygen-demanding sediments. The locations of the majority of these sites indicated that major sources of constituents are runoff from combined sewers and storm sewers and effluent from the Galesburg wastewater-treatment facility. A sludge-application field located just upstream from the wastewater-treatment facility also is a possible source of oxygen-demanding materials. Runoff from combined sewers is a major source of cadmium, copper, lead, and zinc. The wastewater-treatment-facility effluent and runoff from the storm sewers are major sources of mercury and chromium, respectively, in streamflow and bottom materials. Mercury from the wastewater-treatment facility is most likely in the dissolved phase because suspended-solids concentrations are very low compared to other sources of runoff. (Author's abstract)
W91-00339

HYDROGEOLOGY AND SIMULATION OF GROUND-WATER FLOW AT SUPERFUND-SITE WELLS G AND H, WOBURN, MASSACHUSETTS.
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00340

WHAT IS A LEACHER.
Biospherics, Inc., Beltsville, MD. Ground Water and Environmental Programs.
S. Cohen.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 72-73,75, Summer 1990. 6 ref.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Leaching, *Mathematical models, *Nonpoint pollution sources, *Path of pollutants, *Pesticide drift, *Pesticides, Agricultural chemicals, Hydrolysis, Photolysis, Solubility coefficient, Toxicity.

The term 'leacher' has been used to describe certain pesticides for at least a decade. Often, the term is used without any definition or with a proposed definition. However, regulatory, data requirement, and user-based decisions about particular pesticides are frequently made based on this label. The various approaches that have been developed to determine the degree of leaching of a pesticide are discussed. One approach is the use of a static threshold based on various leaching criteria for the pesticide, including water solubility (>30 ppm), soil/water distribution coefficient (<5 and usually <1 or 2), Henry's Law constant (<0.01 atm-cu m/mol), speciation (negatively charged at ambient pH), hydrolysis half-life (>25 wks), photolysis half-life (>1 wk) and soil half-life (>2-3). Another approach is the use of simple screening models or indices for ranking leaching potential of pesticides. These are simple, useful algorithms that integrate pesticides and hydraulic factors. These are best used for ranking and setting priorities, rather than predicting concentrations. It is concluded that the best definition of a leacher is a pesticide that has sufficient mobility and persistence to migrate to groundwater, following normal use, at toxicologically significant concentrations. Expert judgement should be used to select the appropriate assessment method at a particular site with a particular pesticide. (Hoskin-PTT)
W91-00362

SUBSURFACE TRANSPORT OF INORGANIC AND ORGANIC SOLUTES FROM EXPERIMENTAL ROAD SPREADING OF OIL-FIELD BRINE.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
E. S. Bair, and R. K. Digel.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 94-105, Summer 1990. 9 fig, 2 tab, 22 ref.

Descriptors: *Brine disposal, *Deicers, *Groundwater movement, *Groundwater pollution, *Path of pollutants, *Surface-groundwater relations, *Wastewater disposal, Benzene, Calcium, Chlorides, Dust control, Lysimeters, Monitoring wells, Oil fields, Potassium, Sodium, Strontium.

A study designed to evaluate groundwater quality changes resulting from spreading oil-field brine on roads for ice and dust control was conducted using a gravel roadbed that received weekly applications of brine eight times during the winter phase and 11 times during the summer phase of the study. A network of 11 monitoring wells and five pressure-vacuum lysimeters was installed to obtain groundwater and soil water samples. Thirteen sets of water-quality samples were collected and analyzed for major ions, trace metals and volatile organic compounds. Two sets of samples were taken prior to brine spreading, four sets during winter-phase spreading, five sets during summer-phase spreading, and two sets during the interim between the winter and summer phases. A brine plume delineated by elevated specific-conductance values and elevated chloride concentrations developed downgradient of the roadbed during both the winter and summer phases. The brine plume caused chloride concentrations in ground water samples to exceed EPA public drinking-water standards by two-fold during the winter phase and five-fold during the summer phase. No other major ions, trace metals or volatile organic compounds exceeded the standards during the winter or summer phases. More than 99% dilution of the solutes in the brine occurred between the roadbed surface and the local ground water flow system. Further attenuation of calcium, sodium, potassium and strontium resulted from adsorption, whereas further attenuation of benzene resulted from volatilization and adsorption. (Author's abstract)
W91-00365

PROPOSAL TO USE CHLORINE-36 FOR MONITORING THE MOVEMENT OF RADIONUCLIDES FROM NUCLEAR EXPLOSIONS.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 5A.
W91-00366

GROUND WATER RECHARGE AND POLLUTION POTENTIAL OF DRY WELLS IN PIMA COUNTY, ARIZONA.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
L. G. Wilson, M. D. Osborn, K. L. Olson, S. M. Maida, and L. T. Katz.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 114-121, Summer 1990. 3 fig, 2 tab, 26 ref.

Descriptors: *Arizona, *Disposal wells, *Dry wells, *Groundwater pollution, *Path of pollutants, *Urban runoff, *Water pollution sources, Benzenes, Chromium, Drinking water, Groundwater movement, Groundwater transport, Heavy metals, Lead, Manganese, Municipal wastes, Nickel, Pesticides, Sediment analysis, Sediment contamination, Toluene, Trace metals, Vadose zone, Volatile organic compounds, Zinc.

Urbanization of the city of Tucson and Pima County, Arizona, has increased the rate and volume of urban runoff. Dry wells are used to dispose of urban runoff is the vadose zone to comply with local detention/retention ordinances. A study was made to estimate the potential for dry-well drainage of urban runoff to recharge and pollute ground water in Tucson, Arizona. Three candidate dry wells were selected for study. At each site samples of runoff, dry-well sediment, vadose-zone sediment, perched groundwater and groundwater were collected. Water content data from vadose-zone samples suggest that dry-well drainage has created a transmission zone for water movement at each site. Volatile organic compounds, while undetected in runoff samples, were present in dry-well sediment, perched groundwater at one site, and groundwater at two sites. The concentrations of volatile organics (toluene and ethylbenzene) in the water samples were less than the corresponding EPA human health criteria. Pesticides were detected only in runoff and dry-well sediment. Lead and chromium occurred in runoff samples at concentrations above drinking water standards. Nickel, chromium and zinc concentrations were elevated in vadose-zone samples at the commercial site. Of the metals, only manganese, detected at the residential site, exceeded Secondary Drinking Water Standards in groundwater. It is concluded that the three dry wells examined during this study are currently not a major source of groundwater pollution. (Author's abstract)
W91-00367

MODELING THE POTENTIAL EFFECT OF ADDITIVES ON ENHANCING THE SOLUBILITY OF AROMATIC SOLUTES CONTAINED IN GASOLINE.
Michigan Technological Univ., Houghton. Dept. of Civil and Environmental Engineering.
J. R. Mihelcic.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 132-137, Summer 1990. 3 fig, 2 tab, 20 ref.

Descriptors: *Computer models, *Hydrocarbons, *Path of pollutants, *Petroleum products, *Solubility, *Solute transport, Alcohols, Benzenes, Chemical analysis, Ethers, Groundwater pollution, Soil contamination, Toluene, Xylenes.

It is important to understand the transport and fate of aromatic hydrocarbons that may be released from underground storage tanks into soil-water systems, and particularly, potential transport enhancement of hazardous fuel constituents by the presence of a miscible or highly soluble fuel additive cosolvent. The potential effect of two common gasoline additives, ethanol and methyl tertiary-butyl ether (MTBE), on enhancing the solubility of the aromatic solutes benzene, toluene, ethylbenzene, o-, m-, and p-xylene, was examined using a computer model, ARSOL. Aqueous solute systems containing cosolvents ethanol and MTBE at 0, 0.1, 1, and 4.3 percent were modeled for both ethanol and MTBE systems. Five-percent and 10-percent ethanol systems were also modeled. Little solubility enhancement was predicted by modeling at cosolvent levels less than 1%. At cosolvent levels greater than 1%, predicted solute solubility increased curvilinearly with an increase in percent cosolvent; a 10 percent cosolvent system increased aromatic hydrocarbon solubility by approximately 100%. According to the model predictions, MTBE enhanced solute solubility more than ethanol, with enhancement by MTBE being approximately 10% greater than enhancement by ethanol at 4.3% cosolvent. Other concerns regarding gasoline additives are the observed reduction in partitioning of solutes to soils and sediments and the contamination of water supplies due to the high water solubility of the additives. (Author's abstract)
W91-00369

EFFECT OF HUMIC SUBSTANCES ON THE TOXICITY OF ALUMINUM TO ADULT RAINBOW TROUT, ONCORHYNCHUS MYKISS (WALBAUM).
Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
For primary bibliographic entry see Field 5C.
W91-00371

EFFECTS OF WASTES ON THE OCEAN: THE COASTAL EXAMPLE.
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-00385

BACTERIAL POLLUTION OF THE RIVER TIGRIS.
Mosul Univ. (Iraq). Dept. of Biology.
S. H. Khalaf.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 5, p 495-503, July 1990. 1 fig, 3 tab, 5 ref.

Descriptors: *Bacterial analysis, *Path of pollutants, *Tigris River, *Water pollution sources, Aerobic bacteria, Antibiotics, Coliforms, Iraq, Seasonal variation.

The Tigris River is one of the two main water sources in Iraq. It receives untreated domestic wastewater as well as the wastes of hospitals and factories. Two hundred and forty water samples were collected from the Tigris River and tested bacteriologically from the end of 1986 to the end of 1987. The mean total aerobic bacteria count was 9,700/ml while the mean total coliforms count was 10,500/100 ml, mean fecal coliform count was 4,800/100 ml, and mean fecal streptococci count was 1,400/100 ml. The counts of all types of bacteria were higher in the winter and spring than in autumn and summer months. A high level of resistance to antibiotics was observed at Station 2, which may be due to discharge of untreated hospital wastes in the area. (Author's abstract)
W91-00392

CORROSION AND WATER QUALITY.
Wisconsin Dept. of Natural Resources, Spooner. Northwest District.
D. W. Herrick.
Water Well Journal WWJOA9, Vol. 44, No. 6, p 40-42, June 1990. 5 fig.

Descriptors: *Corrosion, *Domestic water, *Drinking water, *Plumbing, *Water pollution sources, *Water quality, Copper, Flushing, Lead, Neutralization, Pipes.

Household water quality can be compromised by the dissolution of metal plumbing materials into the water they contain. The rate of corrosion varies according to the specific metal involved and the chemical make-up of the water. For example, copper is more reactive than stainless steel and soft

water is more corrosive than hard water. Of the metals used for plumbing fixtures, lead and copper pose the greatest health concern. High levels of copper in drinking water usually come from the pipe itself, whereas lead can come from several sources. However, the most common source of lead in drinking water is the lead/tin solder and lead fluxes used to join copper distribution plumbing. Factors determining the levels of lead and copper in water include: the age of the plumbing; the number and age of lead soldered joints and quality of workmanship of the joints; contact time with water; and length and diameter of the plumbing lines. The simplest precaution people can take to protect against high levels of copper or lead is to flush their water lines after six or more hours of non-use. Two to three minutes of flushing will usually eliminate stagnant water from the lines. Other steps homeowners can take is to avoid using water from the hot water tap for cooking or drinking purposes since hot water dissolves lead more readily, and by making the water supply less acidic by installing a neutralizing tank containing limestone chips or adding soda-ash with a chemical feed pump. (Fleishman-PTT)
W91-00411

ESTIMATES OF ION SOURCES IN DECIDUOUS AND CONIFEROUS THROUGHFALL.
Geological Survey, Reston, VA. Water Resources Div.
L. J. Puckett.
Atmospheric Environment ATENBP, Vol. 24A, No. 3, p 545-555, 1990. 1 fig, 5 tab, 36 ref.

Descriptors: *Acid rain, *Canopy, *Chemistry of precipitation, *Conifers, *Deciduous trees, *Throughfall, *Water pollution sources, Air pollution effects, Ecosystems, Ions, Leaching, Mathematical studies, Nitrates, Regression analysis, Sulfates, Sulfur dioxide.

One of the major questions concerning the chemistry of throughfall precipitation is the nature of the sources, and sinks of the ions that exhibit net changes relative to incident precipitation. Estimates of external and internal sources of ions in net throughfall depositions were derived for a deciduous and coniferous canopy by use of multiple regression. The external source component appears to be dominated by dry deposition of Ca(2+), SO4(2-) and NO3(-) during dormant and growing seasons for the two canopy types. Increases in the leaching rates of K(+) and Mg(2+) during the growing season reflect the presence of leaves in the deciduous canopy and increased physiological activity in both canopies. Internal leaching rates for SO4(2-) doubled during the growing season presumably caused by the increased physiological activity and uptake of SO2 through stomates. Net deposition of SO4(2-) in throughfall during the growing season appears highly dependent on stomatal uptake of SO2. Estimates of SO2 deposition velocities were 0.06 cm/s and 0.13 cm/s for the deciduous and coniferous canopies, respectively, during the dormant season, and 0.30 cm/s and 0.43 cm/s for the deciduous and coniferous canopies, respectively, during the growing season. For the ions of major interest with respect to ecosystem effects, namely H(+), NO3(-) and SO4(2-), precipitation inputs generally outweighed estimates of dry deposition input. However, net throughfall deposition of NO3(-) and SO4(2-) accounted for 20-47% and 34-50% respectively, of total deposition of those ions. Error estimates of ion sources were at least 50-100% and the method is subject to several assumptions and limitations. (Author's abstract)
W91-00415

RESEARCH ON AGRICHEMICALS IN WATER RESOURCES.
Geological Survey, Iowa City, IA.
M. R. Burkart, C. A. Onstad, and G. D. Bubenzer.
EOS EOSTAJ, Vol. 71, No. 29, p 980-981, 988, July 17, 1990. 2 fig, 19 ref.

Descriptors: *Agricultural chemicals, *Data requirements, *Groundwater pollution, *Network design, *Water pollution control, *Water pollution sources, *Water resources data, Administrative decisions, Agriculture, Alachlor, Atrazine, Carbofuran, Corn belt, Decision making, Insecticides, Land management, Land use, Nutrients, Pesticides, Water pollution, Water quality control, Water resources.

A plan to study the effects of agricultural systems on the occurrence of agricultural chemicals in the ground and surface waters is being formulated by the U.S. Department and the U.S. Geological Survey. This plan develops a protocol for collecting data, evaluating farming systems, and organizing research to determine the occurrence of agricultural chemicals in the environment. Initial research will focus on the herbicides atrazine and alachlor, the insecticide carbofuran, and the plant nutrient, nitrate. The midwestern United States cornbelt was selected as the geographic area to initiate this research activity. The combination of hydrologic boundaries and land use provides an opportunity to focus research on water quality in a distinct land-use region of the nation. The results of this work are expected to provide information needed to make decisions on land management policies and practices to improve water quality. The specific objectives of the plan are outlined. These include: (1) understanding fundamental natural processes and human input factors affecting the fate and transport of agrichemicals; (2) evaluation of farming systems to determine their effect on water quality; (3) development of new farming systems and components that protect, improve, or remediate water quality; (4) evaluation of spatial data to relate the occurrence of agricultural chemicals to human and environmental factors; (5) development and assessment of models and other decision aids that can be used to protect water quality; (6) transferring technology and information to education and technical assistance agencies; (7) development of laboratory and sampling methods to provide services to researchers; and (8) understanding the impact of agricultural chemicals and practices on other ecosystems. (Agostine-PTT)
W91-00417

STREAMFLOW AND WATER-QUALITY DATA FOR MEADOW RUN BASIN, FAYETTE COUNTY, PENNSYLVANIA, DECEMBER 1987 - NOVEMBER 1988.
Geological Survey, Harrisburg, PA.
K. M. Kostelnik, and E. C. Witt.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Rpt. 89-404, 1989. 30p, 4 fig, 14 tab, 16 ref. Prepared in cooperation with the U.S. Dept. of the Interior, Office of Surface Mining Reclamation and Enforcement and the PA Dept. of Environmental Resources, Bureau of Mining and Reclamation.

Descriptors: *Acid mine drainage, *Meadow Run Basin, *Pennsylvania, *Streamflow data, *Surface water data, *Water pollution sources, *Water quality, Coal mines, Conductance, Rainfall, Water analysis, Water temperature.

Streamflow and water quality data were collected throughout the Meadow Run basin, Fayette County, Pennsylvania, from December 7, 1987 through November 15, 1988, to determine the prevailing quality of surface water over a range of hydrologic conditions. This data will assist the Pennsylvania Department of Environmental Resources during its review of coal-mine permit applications. A water-quality station near the mouth of Meadow Run provided continuous-record of stream stage, pH, specific conductance, and water temperature. Monthly water quality samples collected at this station were analyzed for total and dissolved metals, nutrients, major cations and anions and suspended-sediment concentrations. Fourteen partial-record sites, located throughout the basin, were similarly sampled four times during the study. Streamflow and water quality data obtained at these sites during a winter base flow, a spring rainfall event, a summer rainfall event, and a low summer base flow also are presented. (Author's abstract)
W91-00431

HYDROLOGIC AND CHEMICAL-QUALITY DATA FROM FOUR RURAL BASINS IN GUILFORD COUNTY, NORTH CAROLINA, 1985-88.
Geological Survey, Raleigh, NC.
C. L. Hill.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-578, 1989. 105p, 7 fig, 35 tab, 15 ref. Prepared in cooperation with Guilford County Soil and Water Conservation District.

Descriptors: *Hydrologic data, *Land use, *Nonpoint pollution sources, *North Carolina, *Soil erosion, *Water chemistry, *Water pollution sources, *Water quality, Agricultural watersheds, Forest watersheds, Nitrates, Rural areas.

An investigation was begun in 1984 in Guilford County, North Carolina, to monitor water quality and soil erosion in basins with various land management practices. Hydrologic and chemical-quality data were collected from four rural drainage basins, including two agricultural basins (7.4 and 4.8 acres) cultivated in tobacco and small grains, a mixed rural land-use basin (665 acres) currently under standard land-management practices, and a forested control basin (44 acres) characterizing background conditions. Mean concentrations of total nitrite plus nitrate were 1.0 mg/L from the agricultural basin under standard land-management practices. This was nearly 10 times greater than concentrations from the forested basin. Records of streamflow discharge, chemical quality, groundwater levels, precipitation, and farming activities collected from October 1984 through September 1988 at one or more of the basins are also presented in this report. (Author's abstract)
W91-00433

HYDROLOGIC AND WATER-QUALITY DATA FOR STREAMS AND IMPOUNDMENTS IN THE COTEAU DES PRAIRIES--UPPER MINNESOTA RIVER BASIN, 1979-84.
Geological Survey, St. Paul, MN.
For primary bibliographic entry see Field 2E.
W91-00434

HYDROGEOLOGIC AND WATER-QUALITY DATA FROM WELL CLUSTERS NEAR THE WASTEWATER-TREATMENT PLANT, U.S. MARINE CORPS AIR STATION, CHERRY POINT, NORTH CAROLINA.
Geological Survey, Raleigh, NC.
L. C. Murray, and C. C. Daniel.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-615, 1990. 56p, 10 fig, 11 tab, 7 ref. Prepared in cooperation with the Department of the Navy, U.S. Marine Corps.

Descriptors: *Data collections, *Geohydrology, *Groundwater pollution, *Groundwater quality, *North Carolina, *Path of pollutants, *Wastewater lagoons, *Water pollution sources, *Wells, Military reservations, Observation wells, Priority pollutants, Wastewater facilities.

Hydrogeologic and groundwater quality data were collected near the wastewater-treatment plant and associated polishing lagoons at the Marine Corps Air Station, Cherry Point, North Carolina, in 1988. Between March and May 1988, two observation wells were installed upgradient and six wells were installed downgradient of the polishing lagoons and sampled for organic and inorganic U.S. Environmental Protection Agency priority pollutants. Placement of the well screens allowed sampling from both the upper and lower parts of the surficial aquifer. Natural gamma-ray geophysical logs were run in the four deepest wells. Lithologic logs were prepared from split-spoon samples collected during the drilling operations. Laboratory hydraulic conductivity tests were conducted on samples of fine-grained material recovered from the two confining units that separate the surficial aquifer and the drinking water supply aquifer; values ranged from 0.011 to 0.014 ft/day. 0.000004 to 0.000005 centimeters/sec). Static water levels were

recorded on April 25, 1988. Relatively low concentrations of purgeable organic compounds (up to 2.2 micrograms/L for dichlorodifluoromethane), acid and base/neutral extractable compounds (up to 58 micrograms/L for bis(2-ethylhexyl) phthalate), or pesticides (up to 0.03 micrograms/L for diazinon and methyl parathion) were detected in water samples collected from all of the wells. Trace metals were detected in concentrations above minimum detectable limits in all of the wells and were found to be higher in water samples collected from the downgradient wells (up to 320 micrograms/L for zinc) than in water samples from the upgradient wells. (Author's abstract)
W91-00438

HYDROLOGIC AND CHEMICAL DATA FROM SELECTED WELLS AND SPRINGS IN SOUTHERN ELMORE COUNTY, INCLUDING MOUNTAIN HOME AIR FORCE BASE, SOUTHWESTERN IDAHO, FALL 1989.
Geological Survey, Boise, ID.
D. J. Parliman, and H. W. Young.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 90-112, 1990. 35p, 4 fig, 6 tab, 5 ref. Prepared in cooperation with Department of the Air Force.

Descriptors: *Hydrologic data, *Idaho, *Path of pollutants, *Springs, *Water chemistry, *Water pollution sources, Bacterial analysis, Chemical analysis, Drinking water, Groundwater quality, Military reservations.

Hydrologic and chemical data were collected during September through November 1989 from 90 wells and 6 springs in southern Elmore County, southwestern Idaho. These data were collected to characterize the chemical quality of water in major water-yielding zones in areas near Mountain Home and Mountain Home Air Force Base. The data include well and spring locations, well-construction and water level information, and chemical analyses of water from each well and spring inventoried. Groundwater in the study area is generally suitable for most uses. In localized areas, water is highly mineralized, and pH, concentrations of dissolved sulfate, chloride, or nitrite plus nitrate and nitrogen exceed national public drinking-water limits. Fecal coliform and fecal streptococci bacteria were detected in separate water samples. One or more volatile organic compounds were detected in water samples from 15 wells, and the concentration of benzene exceeded the national public drinking-water limit in a water sample from one well. (Author's abstract)
W91-00440

MACROFAUNA DISTRIBUTIONS AND SEDIMENT ANALYSES FROM THE BRUNSWICK, GEORGIA OCEAN DREDGED MATERIAL DISPOSAL SITE AND ENVIRONS.
Georgia Univ., Savannah. Marine Extension Service.
For primary bibliographic entry see Field 5E.
W91-00444

SUPERFUND RECORD OF DECISION: FRENCH LIMITED, TX.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00447

FATE AND TRANSPORT OF PETROLEUM RELEASED FROM UNDERGROUND STORAGE TANKS.
University of Southern California, Los Angeles. E. Compton.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-188510/AS. Price codes: A03 in paper copy, A01 in microfiche. Report No. 600/9-89/030; Contract No. U-912990, 1988. 43p.

Descriptors: *Groundwater pollution, *Karst hydrology, *Literature review, *Path of pollutants, *Underground storage tanks, Drinking water, Fate of pollutants, Nonpoint pollution sources, Petroleum products, Water pollution prevention.

Because service stations having leaking hydrocarbon storage tanks are numerous and widespread, this type of contamination is considered a nonpoint source of pollution. The goal of this study was to determine the transport and ultimate fate of petroleum products within a region of karst geomorphology. Arkansas, Louisiana, New Mexico, Oklahoma, and Texas (the five states forming U.S. EPA Region VI) constituted the designated study area. With the exception of Louisiana, each state within the region has large karst aquifers. A complete literature review, including references that pertain to contaminant transport within karst aquifers and the remediation of hydrocarbon spills, was entailed. Five mechanisms control the fate of petroleum products in the subsurface: (1) vaporization, (2) solubility, (3) adsorption, (4) transformation, and (5) biodegradation. To determine the ultimate fate of petroleum products in karst terrain, these five processes need to be quantified for each specific case. Stricter standards must be imposed for regulating underground storage tanks that overlie karst. Rather than corrective actions, preventive measures (such as improved inventory control, leak detection, and upgraded tank specifications) are necessary to protect the quality of drinking water provided by carbonate aquifers. (Shidler-PTT)
W91-00452

SPATIAL ALLOCATION FACTOR PROCEDURES FOR THE 1980 NAPAP (NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM) EMISSIONS INVENTORY DOCUMENTATION.
Alliance Technologies Corp., Bedford, MA.
T. A. Beaulieu, and L. G. Modica.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-159479/AS. Price codes: A13 in paper copy, A01 in microfiche. Report No. EPA/DF/MT-89/02a; EPA/600/7-88/024a; Contract No. 68-02-4274, Tasks 1 and 4, December 1988. 284p, 6 fig, 5 tab, 7 ref, append.

Descriptors: *Acid rain, *Air pollution, *Computer programs, *Model studies, *National Acid Precipitation Assessment, *Spatial allocation, Data processing, Housing, Human population, Land use.

The development of spatial allocation factors to apportion NAPAP area source emissions from counties to individual grid cells for input to the Regional Acid Deposition (RADM) and Regional Oxidant (ROM) Models is documented. The development effort focused on creating a variety of spatial surrogates to allow the user maximum flexibility in assigning area source emissions to modeling grid cells. The surrogates are used to represent the sub-county distribution of area source emissions for each category. Fourteen surrogate indicators were developed for use with the NAPAP inventory based on housing, population, and land use data. Fortran programs were developed to generate the spatial factors. These programs are available on a companion magnetic tape. The user can specify processing options and grid definition by means of control option files accessed by the programs. Once the sub-county distribution of each surrogate is determined, area source emissions categories are matched to the most appropriate surrogate. The resultant Spatial Allocation Factor File is input to the Spatial Allocation Module of the Flexible Regional Emissions Data System. (Author's abstract)
W91-00453

WATER CHLORINATION: CHEMISTRY, ENVIRONMENTAL IMPACT AND HEALTH EFFECTS. VOLUME 6.
For primary bibliographic entry see Field 5F.
W91-00476

PRODUCTION OF ORGANIC CHEMICALS AND MUTAGENS DURING CHLOI INATION OF AMINO ACIDS IN WATER.
Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 5F.
W91-00485

FORMATION AND PROPERTIES OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE, A POTENT MUTAGEN IN CHLORINATED WATERS.
Abo Akademi, Turku (Finland). Lab. of Forest Products Chemistry.
B. Holmbom, L. Kronberg, P. Backlund, V. Langvik, and J. Hemming.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 125-135, 2 fig, 5 tab, 26 ref.

Descriptors: *Chlorination, *Pulp and paper industry, *Wastewater treatment, *Water treatment, Ames test, Bleaching wastes, Drinking water, Humic acids, Industrial wastewater, Mutagens.

In the late 1970s, chlorination stage liquors of wood pulp bleaching, and concentrations of chlorinated drinking waters were reported to be mutagenic in the Ames test. Since then, much research has been devoted to identifying the active mutagens formed during chlorination of lignin and humic substances. Numerous chlorinated mutagens have been identified in drinking waters as well as in wood pulp bleaching liquors. An extremely strong Ames mutagen was isolated from bleaching liquors by a multistep isolation procedure and its structure was determined to be 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX). This previously undescribed compound, coded MX was stated to be a major TA100 mutagen in wood pulp chlorination liquors. Results in this study verify that MX is a major mutagen, although a minor component, both in chlorination liquors from wood pulp bleaching and in chlorinated drinking waters. MX can contribute to more than half of the total mutagenicity. MX is also formed during chlorine dioxide treatment of humic material. With aerobic biological water treatment, MX decreases to below or close to its detection level. Lignin and lignin degradation products released from pulp mills can be precursors to the formation of mutagens in drinking water plants using surface waters polluted by pulp mills. (See also W91-00476) (Lantz-PTT)
W91-00486

IMPORTANCE OF GLUTATHIONE IN THE IN VITRO DETOXIFICATION OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE, AN IMPORTANT MUTAGENIC BY-PRODUCT OF WATER CHLORINATION.
Environmental Protection Agency, Cincinnati, OH.
J. R. Meier, R. B. Knohl, B. A. Merrick, and C. L. Smallwood.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 159-170, 6 fig, 3 tab, 10 ref.

Descriptors: *Chlorination, *Fate of pollutants, *Glutathione, *In vitro tests, *Water pollution sources, *Water treatment, Ames test, Liver, Mammals, Mutagens, Toxicity.

3-Chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) was originally isolated and identified in chlorination-stage effluents of wood pulp mills and was estimated to account for 30 to 50% of the mutagenicity of the chlorinated pulp effluent as determined in a Salmonella mutagenicity assay (Ames test). Experiments indicate that MX is a substrate for conjugation with glutathione (GSH) and that this reaction results in its inactivation as a mutagen. At the levels of GSH present in the mammalian liver, it appears likely that any MX reaching the liver would be readily conjugated and

excreted, either unchanged via the bile or after further conversion to a mercapturic acid via the urine. Other liver cystolic activities also may play a role in reducing the reactivity of MX. The detoxification of MX by the liver may explain the lack of genotoxic activity for mouse bone marrow in this experiment. Further investigation into possible organ-specific effects seems warranted before any conclusions are drawn about the in vivo genotoxic or carcinogenic potential of MX. (See also W91-00476) (Lantz-PTT)
W91-00489

CHLORINATION OF AQUATIC FULVIC ACID AND NATURAL WATERS: ADDITIONAL BY-PRODUCTS.
ENVIRON Corp., Washington, DC.
For primary bibliographic entry see Field 5F.
W91-00490

ORGANIC REACTIONS OF CHLORINE DIOXIDE IN DRINKING WATER-A MUTAGENIC ASSESSMENT.
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
For primary bibliographic entry see Field 5F.
W91-00494

ACUTE TOXICITY, SUBLETHAL EFFECTS, AND BIOCONCENTRATION OF CHLORINATION PRODUCTS, VIRUSES, AND BACTERIA IN EDIBLE SHELLFISH: A REVIEW.
South Carolina Univ., Columbia. School of Public Health.
For primary bibliographic entry see Field 5C.
W91-00515

MEASUREMENT OF CHLORINE RESIDUALS IN CHLORINATED COOLING WATERS: EFFECT OF ORGANIC NITROGEN.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
J. N. Jenson, C. LeCloirec, and J. D. Johnson.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 535-544, 2 fig, 4 tab, 14 ref. EPRI Grant No. RP2300-7.

Descriptors: *Biofouling, *Chlorination, *Chlorine, *Path of pollutants, *Pollutant identification, *Residual chlorine, *Water treatment, Cooling water, Disinfection, Fate of pollutants, Nitrogen.

The control of cooling water biofouling processes using minimum levels of chlorine depends on the ability to measure the disinfectant chemical forms produced when chlorine is added to natural water. Chlorine added to water reacts rapidly with many substrates to produce new products, only some of which are disinfectants. Problems arise when poor biofouling control agents interfere and measure as free chlorine. The standard methods for the measurement of free chlorine residuals have been designed to minimize interference from inorganic chloramines (mono-, and dichloramine). The objective of this study was to correlate the problem of false measurements of free chlorine residuals in powerplant cooling waters with water quality parameters. Specifically, cooling water break-point chlorinations were performed, and break-point curve morphologies were related to the nitrogenous fractions. Based on experimental data, the following conclusions can be made: (1) chlorine reacts with organic nitrogen when cooling waters are chlorinated; (2) there are no significant differences between the 30 min and 2 hr break-point curves for any sample; (3) there appears to be a stable oxidant residual at high chlorine doses; (4) all techniques are subject to interferences in the measurement of free chlorine; and (5) the electrode signal decays with some samples chlorinated past the break-point. This decay is mimicked more closely by nitrogen trichloride than by N-chlorosuccinimide. (See also W91-00476) (Lantz-PTT)
W91-00517

BY-PRODUCTS OF CHLORINATION AT TEN OPERATING UTILITIES.
Environmental Protection Agency, Cincinnati, OH.
A. A. Stevens, L. A. Moore, C. J. Slocum, B. L. Smith, and D. R. Seeger.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 579-604, 4 tab, 33 ref.

Descriptors: *Chlorination, *Drinking water, *Public health, *Trihalomethanes, *Water pollution sources, *Water treatment, Chlorine, Chlorine compounds.

Organic by-products of the drinking water disinfection process have been considered a public health issue and a water treatment problem since the I974 reporting of the formation of chloroform and three other trihalomethanes (THMs) during chlorination. It is now well established that the practice of drinking water chlorination for disinfection purposes produces numerous organic by-products other than THMs. Humic substances occurring naturally in water serve as precursor material for reaction with chlorine to produce a variety of non-THM compound classes, a large percentage of which are halogenated. The results of most available studies on this topic indicate that the number and identity of all possible chlorination by-products have not been determined. Compounds that can be attributed to the chlorination process have been found in one or more of the ten utilities' finished waters. About one-half of these compounds contain chlorine and many have been identified, but 128 compounds are still of unknown structure. (See also W91-00476) (Lantz-PTT)
W91-00521

ORGANIC HALIDE FORMATION DURING WATER TREATMENT UNDER FREE CHLORINE VERSUS CHLORAMINATION CONDITIONS.
Arizona Univ., Tucson. Dept. of Civil Engineering.
G. L. Amy, J. H. Greenfield, and W. J. Cooper.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 605-621, 2 fig, 6 tab, 20 ref.

Descriptors: *Chloramines, *Chlorination, *Chlorine, *Halides, *Trihalomethanes, *Water pollution sources, *Water treatment, Chloramination.

The objective of this research was to study and compare purgeable and non-purgeable organic halide formation, as well as THM formation, at two water treatment facilities operating using either free chlorine or chloramination. Both of these plants are situated in south Florida and use groundwater derived from the Biscayne Aquifer. This source water is characterized by high levels of aquatic organic matter and humic substances. The specific objectives of this study were to define and compare both short-term and long-term total organic halide (TOX), purgeable organic halide (POX), nonpurgeable organic halide (NPOX), and total trihalomethane (TTHM) formation at each of the two facilities during periods of free chlorination versus chloramination. Both facilities were sampled during each of two periods of temporary free chlorination. In this study, the NPOX fraction derived from free chlorination constituted as much as 78 and 91%, respectively, of the TOX found. This NPOX fraction has not been thoroughly characterized, nor have its potential health effects been adequately studied. THMs account for most of the POX found in waters derived from the use of either free chlorine or chloramines. (See also W91-00476) (Lantz-PTT)
W91-00522

EFFECT OF PREOZONATION ON TRIHALOMETHANE AND TOTAL ORGANIC HALOGEN FORMATION AT THE LOUISVILLE WATER COMPANY.
Louisville Water Co., KY.
For primary bibliographic entry see Field 5F.
W91-00523

TRIHALOMETHANE FORMATION POTENTIAL AND ORGANIC CONTENT: A NEW ANALYTICAL APPROACH.
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
For primary bibliographic entry see Field 5F.
W91-00524

CHLOROFORM FORMATION BY THE TRANSFER OF ACTIVE CHLORINE FROM MONOCHLORAMINE TO PHLOROACETOPHENONE.
RPC Environmental Management, Inc., Chicago, IL.
K. V. Topudurti, and C. N. Haas.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 649-664, 9 fig, 4 tab, 13 ref.

Descriptors: *Chlorination, *Chlorine, *Chloroform, *Trihalomethanes, *Water pollution sources, *Water treatment, Chemical reactions, Chloramination, Humic acids, Hydrogen ion concentration, Public health.

Trihalomethanes (THMs) are formed during the chlorination of waters containing precursors, predominantly humic substances, with chloroform being the predominant species. The kinetics and mechanism of THM formation in the reaction between free available chlorine (FAC) and model precursors were investigated by several researchers. This study demonstrated that chloroform can be formed as a product of the reaction between phloroacetophenone (PAP) and monochloramine at a neutral pH. Though the concentration of chloroform formed when monochloramine was the chlorinating agent was two orders of magnitude less than the chloroform concentration formed when FAC was the chlorinating agent, monochloramine could still produce chloroform in concentrations that could pose a health hazard. The kinetics of PAP disappearance were found to be first order in both PAP and the chlorinating agent. The rate constant was about five times greater. Results show that there is a direct transfer of Cl from NH2CL to PAP, leading to the formation of CHCl3 which may be of concern the treatment plant managers that are planning to switch to chloramination from chlorination. (See also W91-00476) (Lantz-PTT)
W91-00525

TRIHALOMETHANE FORMATION AND DISTRIBUTION IN BROMIDE-RICH AND AMMONIA-CONTAINING LAKE WATER.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
M. Rebhun, L. Grosman, J. Manka, D. Kimel, and B. Limoni.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 665-680, 9 fig, 3 tab, 10 ref.

Descriptors: *Ammonia, *Bromides, *Chlorination, *Lake Tiberias, *Path of pollutants, *Trihalomethanes, *Water pollution sources, *Water treatment, Chemical reactions, Graphical analysis, Halogens, Oxidation.

The major processes affecting trihalomethane (THM) formation and distribution (such as haloamination, oxidation of bromide to bromine, and the bromination or chlorination of the precursors) dominate differently at various sections of the

breakpoint chlorination curve. Thus, different formation modes and THM distribution along the chlorination curve can be expected. A study of THM formation and distribution in bromide-rich and ammonia-containing Lake Galilee water is reported. Results of the study conclude that: (1) high concentrations of THMs were formed in the pre-breakpoint region and significant THM production was obtained at pre-peak chlorine doses; (2) in bromide-free waters, no significant THM formation was observed in the pre-breakpoint region; (3) pre-peak and most of the pre-breakpoint THM formation was from a fast reacting precursor in the Lake Galilee water; (4) bromoform was the dominate THM from breakpoint; (5) the fastest THM formation rate was about 0.18 micrograms/L/hour; (6) 45% of total precursors showed fast kinetics; and (6) in the post-peak breakpoint region, the oxidation of bromide to bromine (hypobromous acid) was the fastest reaction. (See also W91-00476) (Lantz-PTT)
W91-00526

CHLORINATION OF SURFACE WATERS: EFFECTS OF BROMIDE CONCENTRATION ON THE CHLOROPICRIN FORMATION POTENTIAL.
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
H. Thibaud, J. DeLatt, and M. Dore.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 681-690, 3 fig, 3 tab, 10 ref.

Descriptors: *Bromides, *Chlorination, *Chloropicrin, *Wastewater treatment, *Water pollution sources, *Water treatment, Brominated hydrocarbons, Disinfection, Surface water.

The objectives of the investigation were (1) to determine the nature of organic precursors for chloropicrin formation from the chlorination of surface waters; and (2) to examine the influence of bromide concentration on the production of chloropicrin. Chlorination of raw sewage samples showed that an average of 90% of chloropicrin was produced from the organic precursors in the > 500 molecular weight range. Chloropicrin formation potentials obtained from various isolated aquatic humic materials and from natural waters were found to vary from 0.1 to 1.5 micrograms CCl3NO2/mg C. A decrease in the concentration of chloropicrin with increasing bromide concentrations was observed, and brominated trihalonitromethanes (CCl2BrNO2, CClBr2No2, CBr3NO2) were identified from the chlorination of simple organic nitro compounds in the presence of bromide. (See also W91-00476) (Lantz-PTT)
W91-00527

CORRELATIONS BETWEEN MEASUREMENTS OF ORGANIC HALIDE AND SPECIFIC HALOGENATED VOLATILE ORGANIC COMPOUNDS IN CONTAMINATED GROUNDWATER.
Arizona Univ., Tucson. Dept. of Civil Engineering.
G. Amy, J. H. Greenfield, and W. J. Cooper.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 691-701, 3 fig, 4 tab, 8 ref.

Descriptors: *Chlorination, *Groundwater pollution, *Halides, *Organic compounds, *Volatile organic compounds, Drinking water, Pollutant identification, Tetrachloroethylene, Trichloroethane, Trichloroethylene.

Considerable attention has focused on groundwater contamination by volatile organic compounds (VOCs). Halogenated VOCs are of particular concern because of their impact on drinking water quality. The specific halogenated VOCs that occur most often in contaminated groundwater systems are: trichloroethylene, tetrachloroethylene, 1,1,1-trichloroethane, and cis-, or trans-1,2-dichloroethene. Analysis of groundwater samples for specific VOCs is a time consuming and expensive endeavor requiring considerable analytical expertise. Recent developments in analytical procedures that may prove useful as monitoring tools for groundwater contamination involving halogenated organic compounds, include total organic halide (TOX) analyzers. The primary objective of this study was to compare measurements of individual halogenated VOCs with measurements of a nonspecific parameter, organic halide. Aliquots of a series of contaminated groundwater samples were analyzed for 15 individual halogenated VOCs by gas chromatography. Based on the formula weight and known chlorine content of each of the various measured compounds, an organochlorine concentration was calculated for each sample. The specific objectives of this study were to define statistical correlations between calculated organochlorine concentrations and measured TOX and to ascertain the utility of organic halide measurements as a potential monitoring tool in assessing the degree and extent of groundwater contamination. The organic halide parameter that was derived from either the TOX or POX mode of operation, provides a reasonably accurate estimate of the totality of chlorinated organic compounds present in samples of contaminated groundwater containing complex mixtures. (See also W91-00476) (Lantz-PTT)
W91-00528

EFFECTS OF COPPER (II) ON THE PRODUCTION OF TRIHALOMETHANES IN MODEL AND NATURAL WATERS.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
F. E. Scully, G. D. Howell, and M. Speed.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 703-712, 3 fig, 28 ref. EPA Agreement No. CR-809333.

Descriptors: *Chlorination, *Copper, *Trihalomethanes, *Water pollution sources, *Water treatment, Algae, Chemical reactions, Copper sulfate, Fulvic acids, Humic acids, Model studies, Natural waters.

Natural waters contain a complex mixture of organic compounds that can react with aqueous chlorine to form trihalomethanes (THMs). The reaction of humic and fulvic acids, which compose the largest fraction of organic substances in natural waters, is believed to be the major source of these compounds. Attempts to correlate the THM formation potential (THMFP) of natural waters with a simple chemical parameter, such as total organic carbon, have revealed only crude relationships and demonstrated that the characteristics of the organic components of various waters differ widely. Because many utilities add copper(II) to their raw waters to inhibit algal growth, and because both proteins and humic acids form complexes with copper(II), an investigation of the effect on the THMFP in model and natural waters having trace quantities of copper sulfate has been conducted. Proteins appear to be the major portion of amino nitrogen compounds in natural waters. Copper(II) forms complexes with the peptide bond of proteins in a reaction that is used by biochemists to quantitate protein concentrations. It was been shown that coordination of copper(II) by the peptide bond facilitates the formation of copper(III). The effect of added copper(II) on the reaction of a model protein with aqueous hypochlorite to produce THMs was studied along with the effect of added nitrite to see if the THM forming reaction might be affected by its presence. It was determined that although proteins contributed significantly to the THMFP, the nonprotein fraction (humic acid) still appeared to contribute the major portion of the THMFP. (See also W91-00476) (Lantz-PTT)
W91-00529

INFLUENCE OF ORGANIC NITROGEN COMPOUNDS ON THE PRODUCTION OF ORGANOCHLORINE COMPOUNDS IN THE CHLORINATION OF HUMIC MATERIAL.
Technische Hogeschool Delft (Netherlands). Lab. for Analytical Chemistry.
For primary bibliographic entry see Field 5F.
W91-00534

CHLORINATED ORGANIC BY-PRODUCTS OF THE REACTION OF N-CHLOROPIPERIDINE WITH STOMACH FLUID FROM LABORATORY ANIMALS.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
K. E. Mazina, F. E. Scully, and H. P. Ringhand.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 809-817, 2 fig, 1 tab, 14 ref. EPA Agreement No. CR-813092.

Descriptors: *Chemical reactions, *Chlorination, *Chlorine, *Chloropiperidine, *Path of pollutants, *Stomach, *Water pollution sources, *Water treatment, Biodegradation, Chloramines, Drinking water, Hydrogen ion concentration.

Because of the large number of the population exposed to chlorine oxidants used to disinfect drinking water, the long-range health effects of ingestion of these compounds are of interest. However, in the design of meaningful toxicological experiments, the chemistry of these labile oxidants in the gastrointestinal system should be understood. Recently, several N-chloramino acids have been identified which are formed when hypochlorous acid is mixed with stomach fluid from laboratory rats. At concentrations of hypochlorite administered to animals in toxicological studies, organic N-chloramines appear to form in the stomach and may contribute to the toxicological effects of aqueous chlorine observed in animal studies. In experiments that are described in this study, it became clear that N-chloropiperidine at concentrations of stomach fluid above 100 mg/L (as Cl2) was not completely reduced by components of stomach fluid, especially at pH values greater than 6. The amount of reduction becomes greater as the pH becomes lower, but only at the lowest pH value is chloramine almost completely reduced at all chloramine concentrations below 100 mg/L (as Cl2). These results suggest that the reducing capability of stomach fluid is pH dependent and can be exceeded at concentrations frequently used in toxicological experiments. If inorganic monochloramine is used in animal experiments in buffered solutions at pH values above 8, toxicological values may be skewed by the chemistry. (See also W91-00476) (Lantz-PTT)
W91-00538

SOME PHYSICAL AND CHEMICAL CHARACTERISTICS OF AN UNIDENTIFIED PRODUCT OF INORGANIC CHLORAMINE DECOMPOSITION.
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W91-00539

CHEMISTRY OF BROMINE TRANSFER: DISPROPORTIONATION AND HYDROLYSIS IN BROMAMINE SYSTEMS.
Hartford Univ., West Hartford, CT. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W91-00540

PROPOSED MECHANISM FOR THE REACTIONS OF CHLORINE DIOXIDE WITH AQUATIC ORGANIC MATERIALS.
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
For primary bibliographic entry see Field 5F.
W91-00541

HYDROLYSIS CONSTANTS OF CHLORINE MONOXIDE AND BROMINE CHLORIDE IN WATER.
Stanford Univ., CA.
M. Reinhard, G. D. Redden, and E. A. Voudrias.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 859-870, 3 fig, 2 tab, 28 ref. National Science Foundation Grant CEE-81-17561.

Descriptors: *Bromine chloride, *Chemical reactions, *Chlorination, *Chlorine monoxide, *Hydrolysis, *Path of pollutants, *Water pollution sources, *Water treatment, Bromine, Calorimetry, Chemical properties, Chlorine.

Kinetic evidence has indicated that chlorine monoxide (Cl2O) and bromine chloride (BrCl), both of which may result from chlorination of water, may act as powerful halogenating agents for aromatic compounds. However, there is little reliable thermodynamic data available to assess the relative equilibrium concentrations of the two agents in water and therefore their specific reactivity. In contrast to previous studies, the calorimetric tritrations reported here do not indicate a unique set but a range of (HOCl)aq(2)/(Cl2O)aq equilibrium constants (K2) and molar heat of hydrolysis delta-h-H(0) (Cl2O) values: the Cl2O hydrolysis equilibrium constant is > 1 and delta-h-H(0) is in the range of 0 to -1kJ/mol. Solution calorimetry was found to be unsuitable for the determination of the hydrolysis equilibrium of Cl2O due to an apparent small enthalpy of reaction. The range of K2 (> 1M) derived from the calorimetric data is consistent with K2 obtained from H2O/CCl4 (282 M at 0 C) partitioning data. The small heat of reaction suggested by the data indicates a very small temperature dependence of K2. Assuming delta-h-H(0) (Cl2O) and K2 (0 C) to be 0 to -1 kJ/mol and 282 M, K2 at 20 C may be estimated to range from 274 to 282 M. Using these data along with previous data, Henry's coefficients for Cl2O and HOCl were calculated as 49 +/-5 torr/M and 0.35 +/-0.02 torr/M at 10 C. Bromine chloride, a highly reactive brominating agent, may be formed in chlorinated water containing Br(-). The hydrolysis constant of BrCl was measured and has a value of 0.000021 +/-0.000013 M(2) at 10 C; 0.000032 +/-0.26 M92) at 20 C; and 0.000034 +/-0.16 M(2) at 30 C. (See also W91-00476) (Lantz-PTT)
W91-00542

MOSES LAKE CLEAN LAKE PROJECT. FINAL STAGE 3 REPORT.
For primary bibliographic entry see Field 5G.
W91-00554

SUPERFUND RECORD OF DECISION, BRODERICK WOOD PRODUCTS COMPANY.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00555

SUPERFUND RECORD OF DECISION MIDWEST MANUFACTURING, IO.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00556

HYDROGEOLOGIC INVESTIGATIONS SAMPLING PLAN.
For primary bibliographic entry see Field 7A.
W91-00557

INTERACTIONS OF CONTAMINANTS WITH SEDIMENT AND WATER IN RESERVOIRS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. Gunnison.
Army Corps of Engineers Water Operations Technical Support Information Exchange Bulletin, Vol. E-90-1, June 1990. 3 p, 2 ref.

Descriptors: *Path of pollutants, *Reservoirs, *Sediment contamination, *Water chemistry, Biodegradation, Cadmium, Chemical interactions, Copper, Equilibrium, Heavy metals, Hydrogen ion concentration, Iron, Lead, Manganese, Mercury, Water quality.

Many contaminants have a high affinity for sediments. Consequently, movement of sediment bound contaminants within a project is directly linked to the movement of sediment. Sediment-water interactions play a major role in determining whether contaminants remain with the sediments or are released from them. While the scientific principles underlying these interactions are fairly well understood, the ability to quantify them and then apply this knowledge to analyze and predict the effects of contaminated sediments on water quality Corp of Engineers (CE) reservoir projects is lacking. It has been determined from recent studies that many CE reservoirs are experiencing problems resulting from contaminants in project waters and sediments. Eighteen percent of 442 CE reservoir projects were reported to have problems with organic contaminants. An identical percentage of these projects reported difficulties with pH. Thirty-three percent of the projects had problems with metals other than iron and manganese, primarily cadmium, copper, mercury and lead. Problems with manganese and iron occurred in 24-25% of the projects. The US Army Engineer Waterways Experiment Station (WES) is conducting studies to determine: adsorption/desorption rates for major contaminants; the influence of sediment concentration on equilibrium distribution coefficients and adsorption/desorption kinetics; effects of particle composition; the effects of site specific conditions and environmental factors on contaminant-sediment-water interactions; and the significance of microbial transformations and mobilization processes on contaminated levels in reservoirs. The results will assist in describing contaminant movement in reservoirs. (Lantz-PTT)
W91-00560

PESTICIDES IN GROUND WATER DATA BASE: 1988 INTERIM REPORT.
Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.
W. M. Williams, P. W. Holden, D. W. Parsons, and M. N. Lorber.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-164230. Price codes: A03 in paper copy, A01 in microfiche. EPA Report No. 540/09-89-036, December 1988. 155p, 5 fig, 5 tab, 9 ref, 6 append.

Descriptors: *Data collections, *Data storage and retrieval, *Databases, *Groundwater pollution, *Pesticides, *Pollutant identification, Computers, Monitoring.

A pesticides database was developed to compile results from monitoring studies conducted by pesticide registrants, universities and government agencies. The Pesticides in Groundwater Data Base identifies the pesticides that have been searched for in groundwater, the areas that have been monitored, and the pesticides that have been detected. An important component in the development of the database was the data confirmation program which involves contacting the director or responsible agent for each study in order to document and assess the sample collection and analysis procedures used in the study. This report outlines the development of the database, the data confirmation program, and how the database will be used by the EPA to support the registration process for pesticides. An attempt is made to segregate the results according to the quality of the study and the origin of the contamination (i.e., point source origins vs. leaching through the soil following applications in accordance with registration). The report is an interim report in that the data confirmation continues and new data is added to it daily. (Author's Abstract)
W91-00569

QUALITATIVE VALIDATION OF POLLUTANT TRANSPORT COMPONENTS OF AN UNSATURATED SOIL ZONE MODEL (SESOIL).
Oak Ridge National Lab., TN. Computing and Telecommunications Div.
D. M. Hetrick, C. C. Travis, S. K. Leonard, and R. K. Kinerson.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-008965. Price codes: A03 in paper copy, A01 in microfiche. Report No. ORNL/TM-10672, March 1989. 39p, 15 fig, 7 tab, 32 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Aeration zone, *Model studies, *Organic compounds, *Path of pollutants, *Soil contamination, *Solute transport, Aldicarb, Atrazine, Diazinon, Groundwater pollution, Leaching, Lindane, Pesticides, Phenols.

Model predictions of a revised version of the soil compartment model SESOIL (seasonal soil) were compared with empirical measurements of pollutant transport in soil. Comparisons were performed using data from a laboratory soil column study involving six chemicals: dicamba; 2,4-dichlorophenoxyacetic acid; atrazine; diazinon; pentachlorophenol; and lindane, as well as data from field studies involving transport of aldicarb and atrazine. Results for several aspects of pollutant transport were compared including the location of the chemical peak versus time, the time dependent amount leached to groundwater, the depth distribution of the pollutant at various times, the mass of the chemical degraded, and the amount of pollutant in surface runoff. Overall, the SESOIL model predictions are in agreement with observed data for both laboratory study and field studies. (Lantz-PTT)
W91-00573

USERS MANUAL FOR THE SLUDGEMAN MODEL FOR THE GROUNDWATER PATHWAY IN THE MONOFILLING OF SEWAGE SLUDGE.
ICF Technology, Inc., Fairfax, VA.
For primary bibliographic entry see Field 5E.
W91-00575

COKRIGING TO ASSESS REGIONAL STREAM QUALITY IN THE SOUTHERN BLUE RIDGE PROVINCE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
H. I. Jager, M. J. Sale, and R. I. Schmoyer.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1401-1412, July 1990. 8 fig, 41 ref. Environmental Protection Agency Interagency Agreement 1824-1557-A1, Department of Energy Contract DE-AC05-84OR21400.

Descriptors: *Acid rain effects, *Acidification, *Kriging, *Path of pollutants, *Statistical analysis, *Streams, *Water chemistry, *Water quality, *Water quality monitoring, Acid neutralizing capacity, Headwaters, North Carolina, Southern Blue Ridge Province, Spatial distribution.

As concern for large scale environmental problems such as acid rain, global warming and climate change, ozone depletion, nonpoint source pollution of surface waters, and air pollution, has grown in recent years, the need for regional impact assessment has increased. Cokriging is used to predict stream chemistry at unsampled locations with the use of spatial and intervariable correlation. This technique was used to predict the acid neutralizing capacity (ANC) of streams in the Southern Blue Ridge Province (SBRP). ANC measurements between pairs of streams surveyed in this region were found to be spatially correlated over distances up to 40 km. Predictions were improved by including elevation in the analysis to represent the combined influence of elevational gradients in climate, geology, soils, hydrology, and vegetation on stream ANC. The cokriging analysis identified specific stream reaches predicted to be the most sensitive to acidification and located areas of high uncertainty. Stream ANC levels below 50 microeq/L were predicted for one-fifth of the upper nodes associat-

ed with digitized headwater reaches in the SBRP. The majority of these were located in the higher elevations of the Great Smokey Mountains National Park, in the vicinity of Mount Mitchell, and in the Blue Ridge Mountains in southern North Carolina. (Author's abstract)
W91-00589

COMPARATIVE ANALYSIS OF ALUMINUM BIOGEOCHEMISTRY IN A NORTHEASTERN AND A SOUTHEASTERN FORESTED WATERSHED.
Maine Univ., Orono. Dept. of Botany.
For primary bibliographic entry see Field 2K.
W91-00590

ANALYTICAL SOLUTIONS OF THE ONE-DIMENSIONAL ADVECTION EQUATION AND TWO OR THREE-DIMENSIONAL DISPERSION EQUATION.
Auburn Univ., AL. Dept. of Agronomy and Soils.
F. J. Leij, and J. H. Dane.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1475-1482, July 1990. 4 fig, 1 tab, 20 ref.

Descriptors: *Flow models, *Mathematical analysis, *Model studies, *Path of pollutants, *Porous media, *Solute transport, Advection, Dispersion, Fourier analysis, Laplace equation, Theoretical analysis.

Transport of soluble chemicals in porous media, an important topic for many researchers working in engineering, agriculture and hydrology, is generally assumed to occur by advection and dispersion. For many transport problems involving a one-dimensional flow a significant amount of solute might move in the direction transverse to the flow. The advection-dispersion equation was solved analytically to evaluate transient solute transport in a two-dimensional semi-infinite isotropic porous medium (half plane) with a step change in concentration along the inlet during one-dimensional flow. The solution was obtained with Laplace and Fourier transforms and verified with various numerical and analytical solutions. The same technique was used to obtain analytical solutions for some other concentration distributions at the inlet under conditions of either two-dimensional or three-dimensional dispersion. (Author's abstract)
W91-00594

MATHEMATICAL MODELING OF TRACER BEHAVIOR IN SHORT-TERM EXPERIMENTS IN FISSURED ROCKS.
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
P. Maloszewski, and A. Zuber.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1517-1528, July 1990. 11 fig, 2 tab, 29 ref, append. Polish Academy of Science CPBP 03.02.

Descriptors: *Geologic fractures, *Groundwater movement, *Mathematical models, *Model studies, *Path of pollutants, *Solute transport, *Tracers, Adsorption, Isotherms, Mathematical analysis, Physical properties, Porous media, Theoretical analysis.

A method was developed for the modeling of solute movement in fissured rocks. Transport equations for a single fissure in a porous matrix are coupled with a chemical model allowing for both an instantaneous equilibrium governed by a linear adsorption isotherm and a nonequilibrium kinetic reaction of the first order. The fitting procedure of the obtained solution is improved by additional fitting of the mass recovery curves, i.e., the fitting consists of a trial and error procedure applied in turn to the concentration tracer curve and the mass recovery curve until a given set of parameters gives the best fit of both theoretical curves to the experimental data. The model was tested against known multi-tracer experimental data from a fissured chalk formation. It is shown how some physical parameters can be obtained by a combined interpretation of the tracer and pumping data. However, in the case of adsorbable tracers, some of the parameters must be known from a nonsorbable tracer experiment. In spite of its approximate nature, the model works well for nonsorbable tracers and reasonably well for sorbable solutes. (Author's abstract)
W91-00598

MODELING THE MOVEMENT OF VOLATILE ORGANIC CHEMICALS IN COLUMNS OF UNSATURATED SOIL.
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
J. S. Gierke, N. J. Hutzler, and J. C. Crittenden.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1529-1547, July 1990. 8 fig, 6 tab, 51 ref.
National Science Foundation Grant ECE-8501395.

Descriptors: *Fate of pollutants, *Model studies, *Path of pollutants, *Soil water, *Unsaturated flow, *Volatile organic compounds, Clays, Diffusion, Dispersion, Experimental data, Laboratory methods, Mass transfer, Mathematical analysis, Numerical analysis, Sand, Soil columns, Tracers, Trichloroethene.

Mechanisms affecting the fate of nondegradable volatile organic chemicals (VOCs) in soils include (1) advection in air and water, (2) dispersion in air and water, (3) air-water mass transfer and equilibrium, (4) diffusion in immobile water, (5) mass transfer between mobile and immobile water, and (6) sorption. A deterministic model was developed to account for these processes in laboratory columns of unsaturated soil. The general form of the model was solved numerically. The numerical solution was verified with analytic solutions for simplified conditions. Column experiments were conducted to validate the model and to determine the relative importance of each mechanism in two soil types. The movement of trichloroethene was measured in a column packed with a uniform sand and one packed with uniformly sized aggregates that were made with clay. Parameter values for the model predictions were independently determined from direct measurements and literature correlations. Bromide tracer studies were performed to determine parameter values that could not be measured directly or were not estimated accurately by literature correlations. These parameter values were used in the model to predict the breakthrough and elution of trichloroethene in the two columns. To describe the column data, however, Henry's constant was increased from a literature value of 0.4 to 0.7, and the predicted gas dispersion coefficient was reduced by a factor of 10. Laboratory results and numerical calculations indicated the following about the mechanisms affecting the transport of VOCs in homogeneous, unsaturated soils: (1) both liquid dispersion and diffusion in immobile water are important, (2) vapor diffusion is not an important transport mechanism for trichloroethene in sands or structured soils when the average pore water velocities are greater than about 0.07 and 0.02 cm/s, respectively, and (3) the rates of mass transfer across the air-water and the mobile-immobile water interfaces are fast. (MacKeen-PTT)
W91-00599

TRANSPORT AND SEDIMENTATION OF POLLUTANTS IN A RIVER REACH: A CHEMICAL MASS BALANCE APPROACH.
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
R. Berndtsson.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1549-1558, July 1990. 5 fig, 4 tab, 37 ref.

Descriptors: *Hoje River, *Nonpoint pollution sources, *Path of pollutants, *Pollution load, *Sediment contamination, *Urban runoff, *Water pollution, Biochemical oxygen demand, Chlorides, Copper, Heavy metals, Lead, Mass transport, Phosphorus, Rural runoff, Sediment analysis, Suspended solids, Sweden, Zinc.

The River Hoje in the south of Sweden is a typical receiving water for urban and rural runoff. Mass balance calculations over a 17 month period indicate that pollutants are retained in the sediments of the investigated 5-km-long reach of the stream (90 tons of biochemical oxygen demand), 850 tons of chloride, 2.1 tons of copper, 3.2 tons of zinc, and 1.0 ton of lead.). Other pollutants such as suspended solids and phosphorus appear to be both retained and washed out, depending on loading rates and local stream conditions. The retained pollutants represent a substantial part of the total mass transport through the stream (14-47%). Almost half of the transported zinc is retained within the stream sediment. Subsequently, the deposited pollutants represent a potential pollution source. Analyses of sediment samples verify that the upper sediments contain high concentrations of heavy metals. (Author's abstract)
W91-00600

GAS EXCHANGE RATES FOR A FIRST-ORDER STREAM DETERMINED WITH DELIBERATE AND NATURAL TRACERS.
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2A.
W91-00606

EPISODIC ACIDIFICATION OF ADIRONDACK LAKES DURING SNOWMELT.
Syracuse Univ., NY. Dept. of Civil Engineering.
D. A. Schaefer, C. T. Driscoll, R. Van Dreason, and C. P. Yatsko.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1639-1647, July 1990. 7 fig, 3 tab, 38 ref.

Descriptors: *Acid rain, *Acidic water, *Adirondack Mountains, *Lake acidification, *New York, *Path of pollutants, *Snowmelt, *Water pollution sources, Acid neutralizing capacity, Nitrates, Seasonal variation, Sulfates, Water chemistry, Water pollution.

The Adirondack region of New York receives elevated inputs of acidic deposition and has geologic and edaphic characteristics which make surface waters susceptible to acidification. Maximum values of acid neutralizing capacity (ANC) in Adirondack, New York lake outlets generally occur during summer and autumn. During spring snowmelt, transport of acidic water through acid-sensitive watersheds causes depression of upper lake water ANC. In some systems lake outlet ANC reaches negative values. Outlet water chemistry from 11 Adirondack lakes during was examined 1986 and 1987 snowmelts. In these lakes, sulfate ion concentrations were diluted during snowmelt and did not depress ANC. For lakes with high baseline ANC values, springtime ANC depressions were primarily accompanied by basic cation dilution. For lakes with low baseline ANC, nitrate ion increases dominated ANC depressions. Lakes with intermediate baseline ANC were affected by both processes and exhibited larger ANC depressions. Ammonium dilution only affected wetland systems. A model predicting a linear relationship between outlet water ANC minima and autumn ANC was inappropriate. To assess watershed response to episodic acidification, hydrologic flow paths must be considered. (Author's abstract)
W91-00608

CONTAMINANT DISSOLUTION AND DIFFUSIONAL TRANSPORT WITH A STATIONARY PRECIPITATION FRONT.
California Univ., Berkeley. Dept. of Nuclear Engineering.
For primary bibliographic entry see Field 5E.
W91-00612

REGIONAL WATER QUALITY: EVALUATION OF DATA FOR ASSESSING CONDITIONS AND TRENDS.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W91-00619

MEASUREMENT OF IN SITU RATES OF SELENATE REMOVAL BY DISSIMILATORY BACTERIAL REDUCTION IN SEDIMENTS.
Geological Survey, Menlo Park, CA.
R. S. Oremland, N. A. Steinberg, A. S. Maest, L. G. Miller, and J. T. Hollibaugh.

Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1157-1164, August 1990. 6 fig, 4 tab, 35 ref.

Descriptors: *Anaerobic bacteria, *Drainage water, *Fate of pollutants, *Path of pollutants, *Radioactive tracers, *Sediment chemistry, *Selenium, *Wastewater treatment, *Water pollution treatment, Agricultural water, Denitrification, Heavy metals, Radiochemical analysis, Selenium radioisotopes, Soil treatment.

Oxyanions of selenium have been identified as toxic constituents in drainage waters from irrigated, seleniferous agricultural soils. Recently a novel process was reported by which anaerobic bacteria respire selenate, which in turn biochemically reduces this oxyanion to selenite and ultimately to elemental selenium. An understanding of how this process of dissimilatory selenate reduction operates should ultimately aid in the design of treatment schemes and the rehabilitation of selenate contaminated regions. Accordingly, a radioisotope method for measurement of bacterial respiratory reduction of selenate to elemental selenium in aquatic sediments was devised. Sediments were labeled with Se75 selenate, incubated, and washed, and Se75(s) was determined as counts remaining in the sediment. Core profiles of selenate reduction, sulfate reduction, and denitrification were made simultaneously in the sediments of an agricultural wastewater evaporation pond. Most of the in situ selenate reduction (85%) and all the denitrification activities were confined to the upper 4 to 8 cm of the profile whereas sulfate reduction was greatest below 8 cm (89% of total). The integrated areal rate of selenate reduction was 301 micromoles/sq m/day, which results in a turnover of water column selenate in 82.4 days. The rate of selenate reduction in sediments was enhanced in laboratory experiments by provision of the proper electron donors (e.g., acetate, lactate, hydrogen, etc.). When this is done in conjunction with removal of competitive electron acceptors like fertilizer-derived nitrate, a treatment scheme can be envisioned. (Author's abstract)
W91-00620

IDENTIFICATION OF SOLUBILITY-CONTROLLING SOLID PHASES IN A LARGE FLY ASH FIELD LYSIMETER.
Battelle Memorial Inst., Richland, WA. Pacific Northwest Labs.
J. S. Fruchter, D. Rai, and J. M. Zachara.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1173-1179, August 1990. 10 fig, 2 tab, 30 ref. Electric Power Research Institute, Inc. (EPRI) Contract RP2485-08, Leaching Chemistry.

Descriptors: *Fly ash, *Heavy metals, *Leachates, *Lysimeters, *Path of pollutants, *Water pollution sources, Aluminum, Barium, Calcium, Chemical interactions, Chemical speciation, Chromium, Copper, Electric powerplants, Equilibrium, Interstitial water, Ions, Iron, Pennsylvania, Silicon, Solubility, Sulfur, Water analysis.

The electric utility industry produces about 75 million tons of solid wastes annually, the vast majority of which consists of fly ash and bottom ash produced during the combustion of coal. Published accounts of fly ash leaching under field conditions are limited. In this study, samples of pore fluids and leachates were obtained from a large fly ash field lysimeter in central Pennsylvania at the Montour Power Station. The fly ash in the lysimeter was usually only partially saturated, and only 0.3 pore volumes of water leached through the lysimeter during the 3-year study period. The samples were analyzed for major and trace inorganic anions and cations. The resulting analyses were modeled by using an equilibrium speciation/solubility code to test the hypothesis that the solubilities of at least some species in the fly ash leachate were controlled by solid phases. Potential solubility-controlling solids were identified for aluminum (Al), barium (Ba), calcium Ca), chromium (Cr), copper (Cu), iron (Fe), sulfur (S), silicon (Si) and strontium (Sr) in the pore waters and leachates. Solid solutions appear to play an important role in controlling the concentrations of Ba, Sr, and Cr. The activity relationships were independent of location within the lysimeter and time of sampling. A laboratory experiment showed that equilibrium times between these nine elements and their solubility-controlling solids were on the order of days or less. Geochemical reactions controlling the concentrations of arsenic (As), boron (B), cadmium (Cd), molybdenum (Mo), and selenium (Se) were not identified. (Author's abstract)
W91-00621

MODEL OF ORGANIC CHEMICAL UPTAKE AND CLEARANCE BY FISH FROM FOOD AND WATER.
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
K. E. Clark, F. A. P. C. Gobas, and D. Mackay.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1203-1213, August 1990. 6 fig, 5 tab, 38 ref.

Descriptors: *Animal metabolism, *Bioaccumulation, *Biological magnification, *Fish, *Model studies, *Organic compounds, *Path of pollutants, Absorption, Bioavailability, Food chains, Organic pollutants, Water pollution effects.

One of the most important environmental transport and partitioning processes is bioaccumulation. A comprehensive model was presented that describes the bioaccumulation of organic chemicals by fish from food and water, using size and species-dependent parameters describing transport and transformation 'resistances' and parameters for metabolic conversion and bioavailability. Uptake of a nonmetabolizing chemical from water tends to result in the chemical adopting a fugacity in the fish approaching that in the water, as expressed by a bioconcentration factor. Uptake from food may result in a fish fugacity that is higher than the food or water fugacity, corresponding to biomagnification. This was postulated to be due to food digestion causing a fugacity increase in the gastrointestinal tract. This biomagnification phenomenon was most significant for very hydrophobic, slowly clearing, nonmetabolizing chemicals. The model also described food chain biomagnification, the dependence of fish concentration on rates of metabolism and growth, and the effect of reduced bioavailability. The model gave a satisfactory description of the phenomena of bioconcentration, biomagnification, metabolism, bioavailability, and food chain magnification for a range of chemical hydrophobicities. It demonstrated that the detailed flows of contaminant to and from the fish, through the gills and gut, vary considerably in relative magnitude and direction as the fish became contaminated. (Author's abstract)
W91-00622

FLUORESCENT POLYCYCLIC AROMATIC HYDROCARBONS AS PROBES FOR STUDYING THE IMPACT OF COLLOIDS ON POLLUTANT TRANSPORT IN GROUNDWATER.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
D. A. Backhus, and P. M. Gschwend.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1214-1223, August 1990. 8 fig, 3 tab, 38 ref. USAF and EPA Contract No. CR812466-01-0 and DOE Contract No. DE-FG02-86ER60413.

Descriptors: *Colloids, *Fluorescence, *Groundwater pollution, *Path of pollutants, *Polycyclic aromatic hydrocarbons, *Tracers, Analytical methods, Humic acids, Hydrophobic compounds, Perylene.

Organic colloids (OC) or inorganic colloids with organic coatings may enhance the transport of hydrophobic pollutants in groundwater. In this study, a fluorescence-quenching method was developed to assess the hydrophobic organic pollutant binding potential of organic colloids in unaltered natural waters. This method allows (1) direct assessment of the importance of OC-enhanced pollutant transport for environmental samples under in situ water chemistry conditions, without requiring the isolation of OC or separation of equilibrated phases; (2) testing of chemicals that suffer substantial wall losses from aqueous solutions; and (3) examination of unstable water samples such as anoxic samples. Experiments showed that some OC (Aldrich humic acids) fully quench OC-associated perylene fluorescence, but others (bovine serum albumin) do not. This implies that fluorescence-quenching results collected for a single OC concentration or over a limited OC concentration range provide only a lower limit estimate of the potential of OC association. Tests with groundwater, recharged with secondarily treated sewage and containing OC at approximately 1 mg of carbon/L, showed temporal variation in the ability of OC present to quench or bind perylene. (Author's abstract)
W91-00623

PO210 AND PB210 REMOBILIZATION FROM LAKE SEDIMENTS IN RELATION TO IRON AND MANGANESE CYCLING.
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
G. Benoit, and H. F. Hemond.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1224-1234, August 1990. 15 fig, 7 tab, 37 ref.

Descriptors: *Isotopic tracers, *Lake sediments, *Lead radioisotopes, *Path of pollutants, *Polonium radioisotopes, *Radioactive tracers, *Tracers, Environmental tracers, Iron, Manganese, Oligotrophic lakes, Precipitation scavenging, Radioactivity techniques.

(210)Polonium (Po210) and (210)lead (Pb210) are the final two long-lived daughters in the (238)uranium (U238) decay series. Since the source function of the two radionuclides is often known or easily measurable, they can serve as useful tracers of metal cycling in aquatic systems. In this study, the behavior of Po210 and Pb210 was studied in the water column of an oligotrophic, dimictic lake. Direct uptake of the radionuclides by sediments was negligible compared to removal on particles, and Pb210 scavenging was 4 times that of Po210. Both nuclides were found to be significantly remobilized from sediments into the stratified, anoxic water column. Releases seemed to be linked to the cycling of the transition metals, iron and possibly manganese. The distribution of both iron and Pb210 in stratified, anoxic waters can be modeled as constant release and rapid horizontal mixing/dilution; vertical turbulent transport had a negligible effect on element distributions. Upon contact with oxygen, iron rapidly reprecipitates, forming a particulate maximum and rescavenging Pb210. Unlike Pb210, much Po210 is released from sediments before overlying water becomes completely anoxic, leading to unsupported Po210. Po210 cycling in the stratified water column is more complex than that of Pb210, and additional removal mechanism(s) may be active, including perhaps oxidation of soluble Po(II) to insoluble Po(IV). (Author's abstract)
W91-00624

CONSTANT OR INCREASING NITROGEN CONCENTRATIONS IN SPHAGNUM MOSSES ON MIRES IN SOUTHERN SWEDEN DURING THE LAST FEW DECADES.
Lund Univ. (Sweden). Dept. of Ecology.
For primary bibliographic entry see Field 2H.
W91-00645

FATE OF AQUATIC AND WETLAND HABITATS IN AN INDUSTRIALLY CONTAMINATED SECTION OF THE ELBE FLOODPLAIN IN HAMBURG.
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
C. W. Heckman.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 75, No. 2, p 133-250, 1990. 35 fig, 11 tab, 305 ref.

Descriptors: *Aquatic habitats, *Drainage, *Germany, *Land use, *Path of pollutants, *Water pollution effects, *Water pollution sources, *Wet-

lands, Air pollution, Elbe River, Estuaries, Fallout, Halogenated hydrocarbons, Heavy metals, Industrial wastes, Mercury, Silt, Species diversity.

An investigation to determine the impact of silt drying pans on a former agricultural region in the alluvial floodplain of the Elbe Estuary (Germany) revealed that some of the water bodies and upper layers of sediment already had been moderately to strongly contaminated by Cd, Cu, Ni, Pb, Zn, As, and halogenated hydrocarbons, which arrive through the air as fallout and accumulate in the wetlands. The only toxic heavy metal traced exclusively to the drying pans is Hg, which is only detectable in water bodies directly contaminated with the Elbe silt and has not yet reached appreciable concentrations. Some local sources of ground water contain unusually high concentrations of ferrous or chloride ions. The most serious impact of the water drained from the drying pans on the biota can be attributed to very high concentrations of ammonium. A decimation of the species in one unmodified ditch receiving ammonium-rich outflow from the drying pans was observed during the year of the study. More damaging than the chemical contamination has been the extensive habitat destruction during the construction of the drying pans, which has eliminated completely several water bodies along with their vegetation and animals. The impoverishment of the region's diverse flora and fauna already has occurred. The shallow ditches draining the region of the drying pans act as sinks for the toxic heavy metals and persistent halogenated hydrocarbons, and the substances already deposited will present a constant danger to both man and the local wildlife for a long time to come. The deeper layers of sediment beneath the water bodies generally are free of these substances, attesting to their relatively recent input. The continual outflow of ammonium and other inorganic nutrients from the drying pans will greatly promote the eutrophication of the adjacent water bodies. Large discrepancies among numbers of species observed at individual sites were noted, but these cannot be attributed to the morphology of the water bodies, which is similar. Disregarding bacteria, the number of aquatic and marsh species found ranged from 41 to 165. (Author's abstract)
W91-00648

EFFECT OF TIDAL ACTION ON THE TRANSFORMATIONS OF NITROGEN IN FRESHWATER TIDAL FLAT SEDIMENTS.
Hamburg Univ. (Germany, F.R.). Fachbereich 14 - Biologie.
M. Kerner, H. Kausch, and G. Miehlich.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 75, No. 2, p 251-271, 1990. 7 fig, 2 tab, 47 ref.

Descriptors: *Cycling nutrients, *Germany, *Model studies, *Nitrates, *Path of pollutants, *Sediments, *Simulation, *Tidal effects, *Tidal flats, Denitrification, Differential equations, Elbe River, Estuaries, Mathematical models, Mathematical studies, Nitrification, Nitrogen, Numerical models, Oxygen.

A numerical model was used to simulate the vertical distribution of dissolved inorganic nitrate in tidal flat sediments. The effect of the periodically changing concentrations of oxygen and nitrate at the sediment surface on nitrification and denitrification during the tidal cycle was studied. The differential equations describing chemical transport and the biological sink or source reactions were solved by finite difference methods. First, the changes in the oxygen concentration with depth in the sediment were calculated by the transport of oxygen into the sediment and its biological reduction by nitrification processes. Typical nitrate profiles of the pore water were obtained for tidal flat sediments with different porosities and with different transport properties. The results show that biological processes strongly influence the nitrate profiles, causing differences in the concentrations with small changes in depth or time. It can be shown that exposure to the air and submersion of tidal flat sediments during a single tidal cycle produces alternating aerobic and anaerobic layers in the upper sediment zone. This layering moves into deeper sediment zones during the tidal cycle. The results of the numerical simulation of the nitrate distribution are correlated with the field data from sediments in the Elbe Estuary. The model predicts that only one fifth of the oxygen entering the tidal sediments is consumed by nitrification processes that lead to the nitrate concentrations measurable in the pore water. Modeled rates of nitrification and denitrification coincide with rates determined by laboratory experiments reported in the literature. The kinetics of denitrification in subtidal sediments showed a linear dependence on the nitrate concentration. In intertidal flat sediments, a Michaelis-Menten constant, K sub m, of 5 micromoles NO3-N/L was found. Thus, in this type of sediment, the horizontal and vertical transport of nitrate must influence the kinetics of denitrification. (See also W91-00650) (Author's abstract)
W91-00649

RELATIONSHIPS BETWEEN ACIDITY AND BENTHIC INVERTEBRATES OF LOW-ORDER WOODLAND STREAMS IN THE ADIRONDACK MOUNTAINS, NEW YORK.
Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W91-00657

OXIDATION OF S(IV) IN RAIN-WATER COLLECTED IN JAPAN.
Institute of Public Health, Tokyo (Japan).
H. Hara.
Atmospheric Environment ATENBP, Vol. 24A, No. 6, p 1427-1432, June 1990. 6 fig, 2 tab, 24 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Japan, *Oxidation, *Path of pollutants, *Sulfur, Chromium, Cobalt, Hydrogen peroxide, Iron, Kinetics, Manganese, Ozone, Rain, Snowmelt, Sulfates, Sulfuric acid, Vanadium.

Rates of S(IV) oxidation in 48 rain-water and snowmelt samples collected at 15 sites in Japan were determined to assess the significance of the autoxidation in the sulfate formation channels of the aqueous phase. Sodium bisulfite aqueous solution was added to each of the samples, and the S(IV) concentration was followed by a modified West-Gaeke method. Most sample systems showed pseudo-first order kinetics, with rate constants ranging from .00001 to .003/sec. In several cases, however, the logarithmic concentration-time plot definitely deviated from a straight line. Some other kinetics for the rate expression could reproduce these non-linear plots of the reactions. Strong correlations were found between the first-order rate constant and the concentrations of some transition metals (Cr, Fe, Co, V and Mn, in order of decreasing correlation coefficients). The experimental rate constants agreed typically within a factor of three with calculations for the Mn concentration, but were much smaller than the predictions for the Fe levels. The experimental rates in the rain-water samples were applied to the atmospheric oxidation rate of SO2 and were compared with those of H2O2 and O3. Compared with strong oxidant contributions, the autooxidation catalyzed by various metal ions is likely to contribute to a limited extent. After the depletion of H2O2, however, the catalyses would contribute to the same extent as O3 reactions. (Author's abstract)
W91-00668

WET DEPOSITION OF VOLCANIC GASES AND ASH IN THE VICINITY OF MOUNT SAKURAJIMA.
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
R. K. Kawaratani, and S. Fujita.
Atmospheric Environment ATENBP, Vol. 24A, No. 6, p 1487-1492, June 1990. 4 fig, 2 tab, 23 ref.

Descriptors: *Acid rain, *Ash, *Chemistry of precipitation, *Path of pollutants, *Sulfates, *Volcanoes, Air pollution, Aluminum, Chlorides, Fluorides, Gases, Ions.

Wet deposition of soluble materials was monitored for a 7-month period in the vicinity of Mount Sakurajima, which has been very active since 1955. Data obtained for the ionic composition of samples were used as a basis for considering the scavenging of volcanic emissions by precipitation. Precipitation samples with pH <4 were often collected in the vicinity of Mount Sakurajima during the course of the study. HCl, H2SO4 and HF were the primary contributors to the acidity of precipitation. The mole ratio of exCl(-)/exSO4(--) in precipitation was several times that of volcanic ash in the vicinity of the volcano and declined with distance from the volcano. Although most of the S in volcanic emissions is in the form of SO2, relatively little of this is washed out by precipitation in the immediate vicinity of the volcano. The deposition of S in the vicinity of the volcano can be adequately accounted for by assuming the scavenging of SO4(--) particles despite the relatively small share of total atmospheric S loading of particulate SO4(--) in the vicinity of Mount Sakurajima. (Author's abstract)
W91-00669

ORIGIN OF SOLUBLE CHEMICAL SPECIES IN BULK PRECIPITATION COLLECTED IN TOKYO, JAPAN: STATISTICAL EVALUATION OF SOURCE MATERIALS.
Tokyo Inst. of Tech. (Japan). Dept. of Environmental Chemistry and Engineering.
M. Tsurumi, A. Takahashi, and M. Ichikuni.
Atmospheric Environment ATENBP, Vol. 24A, No. 6, p 1493-1500, June 1990. 6 fig, 4 tab, 14 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Japan, *Mathematical models, *Path of pollutants, *Solutes, Air pollution, Anions, Cations, Inorganic acids, Sea breezes, Seasonal variation, Sulfates, Water pollution sources.

An iterative least-squares method with a receptor model was applied to data on precipitation samples collected at 23 points in suburban Tokyo, and the number and composition of the source materials were determined. Thirty-nine monthly bulk precipitation samples were collected in the spring and summer of 1987 from the hilly and mountainous area of Tokyo and analyzed for Na(+), K(+), NH4(+), Mg(++), Ca(++), F(-), Cl(-), NO3(-), SO4(--) and Br(-) by atomic absorption spectrometry and ion chromatography. The pH of the samples was also measured. A multivariate ion balance approach showed that the solutes in the precipitation were derived from just three major sources: sea salt, acid substance (a mixture of 53% HNO3, 39% H2SO4 and 8% HCl in equivalent) and CaSO4. The contributions of each source to the precipitation were calculated for every sampling site. Variations of the contributions of the three source materials explained the seasonal differences in the ion fluxes in spring and summer. In summer, the sea salt contribution decreased steeply with increasing distance from the coast, while the CaSO4 contribution slightly increased. The contribution of the acid substance slowly decreased with the distance in summer. The decreasing rate of the acid substance was lower than that of the sea salt. The difference in variation of these source contributions suggests that acid substance is transported over a longer distance than sea salt. In spring, contributions of the three source materials are relatively constant in every sampling site. The contribution of sea salt is higher in spring than that in summer. The difference in the contributions of each source between the two seasons was due to local prevailing wind directions in these seasons. In Tokyo, the southeasterly wind is predominant in summer, while the wind direction is variable in spring. (Geiger-PTT)
W91-00670

MESOSCALE MODELING OF ACIDITY PRODUCTION IN OROGRAPHIC CLOUDS AND RAIN.
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. Associe de Meteorologie Physique.
N. Chaumerliac, E. Richard, and R. Rosset.
Atmospheric Environment ATENBP, Vol. 24A, No. 6, p 1573-1584, June 1990. 10 fig, 2 tab,, 17 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Cloud chemistry, *Model studies, *Orographic precipitation, *Sulfates, Advection, Aerosols, Air pollution, Nucleation, Path of pollutants.

The two-dimensional version of a mesoscale meteorological model is applied to the removal of soluble and reactive species by orographically forced clouds and precipitation. The model includes both SO4(--) and acidity productions within typical maritime clouds. A quasi-spectral microphysical scheme allows for a detailed description of the partitioning of different constituents between air, cloud and rain. Model results indicate that this partitioning is influenced by the solubility and the reactivity of the species and also by microphysical processes. The sharing of dissolved species between cloud and rain is found to be different upwind and downwind from the mountain top, leading to higher acidity in rain downstream. Replenishment of new material into the cloud through advection, aerosol load through nucleation, chemical factors and microphysical processes all compete to affect the resultant acidity in cloud-water and rain-water. Model estimates for these overlying processes suggest that interaction between dynamics, microphysics and chemistry must be well represented to predict cloud and rain compositions. (Author's abstract)
W91-00671

LIMNOLOGICAL STUDIES OF FOUR POLLUTED PONDS IN AND AROUND DHAKA CITY WITH REFERENCE TO INDICATOR SPECIES.
Dacca Univ. (Bangladesh). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-00672

RESISTANCE TO ANTIBIOTICS AND HEAVY METALS OF PSEUDOMONAS AERUGINOSA ISOLATED FROM NATURAL WATERS.
Malaga Univ. (Spain). Facultad de Ciencias.
For primary bibliographic entry see Field 5C.
W91-00698

HEAVY METALS DISTRIBUTION AND ENRICHMENT IN THE SEDIMENTS OF SOUTHERN EAST COAST OF INDIA.
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
V. Subramanian, and G. Mohanachandran.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 324-330, July 1990. 3 fig, 2 tab, 24 ref.

Descriptors: *Coastal waters, *Heavy metals, *India, *Path of pollutants, *River systems, *Sediment chemistry, Cadmium, Chromium, Copper, Geochemistry, Iron, Manganese, Mercury, Water pollution, Zinc.

Fractionation of heavy metals occurs predominantly in the solid phase during transport processes in river systems. Studies of iron, manganese, copper, chromium, zinc, mercury, and cadmium were carried out on thirty-six samples of bed sediments collected from different parts of the southeast coast of India, including coastal, river and river mouth regions. Data indicate that the concentration of all the metals considered decreases towards the coast. For example, lead concentration at 65 km from the coast has an average value of 50 ppm; at 25 km from the coast, 20 ppm; and along the coast, 5-10 ppm. Grain size is a major controlling factor in the distribution of heavy metals in the coastal sediments. Geoaccumulation indices calculated for these metals show that cadmium is the most enriched metal, followed by lead. Other metals are at background concentrations. This high level of cadmium indicates that the area appears to be contaminated due to non-natural sources, such as pollution. (Author's abstract)
W91-00701

BEACH TAR CONTAMINATION IN JAMAICA.
University of the West Indies, Kingston (Jamaica). Dept. of Zoology.
M. A. J. Jones, and P. R. Bacon.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 331-334, July 1990. 1 fig, 1 tab, 13 ref.

Descriptors: *Beach contamination, *Coasts, *Jamaica, *Path of pollutants, *Tar, Hydrocarbons, Monitoring.

Since 1979 the Intergovermental Oceanographic Commission's Regional commission for the Caribbean and Adjacent Regions has conducted a monitoring program for petroleum pollution in the wider Caribbean area. One of the parameters measured in this study was stranded beach tar. The quantity of stranded beach tar on Jamaican beaches was measured by collecting beach tar residues from twenty-nine beach stations around the Jamaican coast on monthly visits for thirteen months. Stranded beach tar was found to be very persistent. The east coast and Kingston Harbor Area are subjected to constant relatively large amounts of fresh tar; the north coast, although receiving small amounts of fresh tar, appeared to have been impacted by a particular incident about two years ago, giving highly skewed distributions; the west coast is virtually clean and the south coast (with the exception of the Kingston Harbor Area) showed no evidence of stranded beach tar pollution at any time during the study. (Author's abstract)
W91-00702

USING SEABIRDS TO MONITOR MERCURY IN MARINE ENVIRONMENTS: THE VALIDITY OF CONVERSION RATIOS FOR TISSUE COMPARISONS.
Glasgow Univ. (Scotland). Dept. of Zoology.
D. R. Thompson, F. M. Stewart, and R. W. Furness.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 339-342, July 1990. 1 tab, 21 ref. NERC Grants GR3/7411 and GT4/86/AL5/15.

Descriptors: *Animal metabolism, *Bioaccumulation, *Bioindicators, *Mercury, *Water birds, Animal physiology, Conversion ratio, Marine environment.

The '7:3:1 rule' for converting mercury concentrations between feather, liver, and muscle tissue was evaluated by measuring total and methyl mercury levels in liver, muscle, and body feathers of a range of seabird species. Mean mercury concentrations were used to calculate feather-liver (both total and methyl) and feather-muscle ratios, results obtained being compared with the predicted values of 2.3 and 7.0. Feather-liver ratios approximated 2.3 when liver methyl mercury concentrations were considered, but elevated inorganic mercury concentrations in the livers of some species resulted in greater reduced feather-liver ratios for total mercury. Feather-muscle ratios varied from 3.8 to 15.3. Factors likely affect the values of feather-liver and feather-muscle mercury concentration ratios, such as the predominant form of mercury present in the liver tissue, sampling date relative to the stage of the molt sequence and types of feather used for analysis, preclude the 7:3:1 conversion ration being used without a measure of caution. (Author's abstract)
W91-00704

DETERMINATION OF THE ENVIRONMENTAL CAPACITY OF HAIFA BAY WITH RESPECT TO THE INPUT OF MERCURY.
National Inst. of Oceanography, Haifa (Israel).
M. D. Krom, H. Hornung, and Y. Cohen.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 349-354, July 1990. 8 fig, 1 tab, 23 ref.

Descriptors: *Bioaccumulation, *Haifa Bay, *Israel, *Mercury, *Path of pollutants, Fish physiology, Regression analysis, Waste disposal.

The Environmental Capacity of Haifa Bay, on the Mediterranean shoreline of Israel, has been estimated with respect to inputs of mercury. From 1956 to 1975, a chlor-alkali plant discharged effluent to the Bay without pollution abatement measures with a maximum discharge of 1900 kg/yr in 1975. From 1976 the input flux was drastically reduced until in 1981 the present level of 35 kg/yr was reached. Diplodus sargus (porgy) is a commercially important fish, chosen as a critical path to man. Mercury accumulates as a function of weight (age). A series of linear regressions of mercury content versus weight for the size range 40 to 175 g were calculated. Both the slopes of the regression lines of mercury content (measures of the rate of bioaccumulation), and the calculated concentrations in a 'standard 150 g fish' decreased with time in the polluted area, although the present level of 0.6 ppm is still significantly greater than the levels of 0.15 ppm in adjacent uncontaminated areas, an increase attributed to elevated levels of mercury in the sediment and benthic food chain. A simple linear regression was made between the mercury content in the muscle of Diplodus sargus and the mercury input to Haifa Bay over the preceding three years (the estimated age of a 150 g fish). If the unacceptable level of mercury is 1 ppm, then the level of mercury in the Bay is now acceptable; if the action level is 0.3 ppm, then despite the installation of pollution abatement measures, the mercury levels in the Bay are still considered to be unacceptably high. The Environmental Capacity concept is very useful for designing scientific studies for examining the problems of waste disposal in the sea. (Author's abstract)
W91-00706

SOME PRELIMINARY DATA ON THE NUTRIENT INFLUX INTO THE WESTERN BLACK SEA.
Water Management Office, Constanta (Romania).
R. Chirea, and M.-T. Gomoiu.
Cercetari Marine: Recherches Marines CMARDQ, Vol. 19, p 171-187, 1986. 3 fig, 4 tab, 18 ref.

Descriptors: *Black Sea, *Danube River, *Eutrophication, *Littoral zone, *Nutrients, *Water pollution sources, Ammonium, Nitrates, Nitrites, Nonpoint pollution sources, Path of pollutants, Phosphorus, Pollution load, Romania, Waste disposal.

The influx of ammonium, nitrates, nitrites, and phosphorus to the Romanian littoral waters and the contribution of various nutrient sources to Black Sea waters were estimated on the basis of 1600 analyses carried out periodically between 1976 and 1985. Based on this preliminary examination of the contribution of the Danube River and the southern Romanian effluents to the enrichment of Black Sea waters with ammonium, nitrite, nitrate, and phosphate, several conclusions were drawn. Between 1976 and 1985, an average of 214 cu km/yr was discharged into Romanian littoral waters, of which 99.9745% came from the Danube and only 0.0255% from the effluents. In 10 yr, freshwater discharges carried into the marine environment 17.59 million tons of nutrients, of which about 2.7% were ammonium, 1.2% were nitrite, 93.6% were nitrate, and 2.4% phosphate phosphorus. Great variability was seen in the concentrations of the nutrients analyzed, but generally the mean values were higher in the wastewaters than in Danube water. Compared to the situation in the 1960s, the concentrations of nutrients in the Danube are 1.2 times as great for ammonium, 1.7 times as great for nitrates, 1.5 times as great for phosphorus, implying that nutrient discharges into the Black Sea from this source have increased. Several measures are recommended for dealing with eutrophication, including: instituting wastewater filtration and nutrient extraction; discharge of secondary-treatment wastewaters offshore, far from beaches used by tourists; deployment of artificial reefs around discharge areas; and programs to control discharge of effluents into coastal ecosystems. (Rochester-PTT)
W91-00712

EFFECTIVE MODELLING OF A MAJOR INLAND OIL SPILL ON THE OHIO RIVER.
Ohio State Univ., Columbus. School of Natural Resources.
J. K. Cronk, W. J. Mitsch, and R. M. Sykes.
Ecological Modelling ECMODT, Vol. 51, No. 3/4, p 161-192, June 1990. 12 fig, 2 tab, 37 ref.

Descriptors: *Model studies, *Monongahela River, *Ohio River, *Oil spills, *Path of pollutants, Ecological effects, Performance evaluation, Simulation, Storms.

A model of a large (2700 cu m) inland oil spill on the Monongahela/Ohio River system, on 2 January 1988 is developed to estimate the fate and

transport time of the oil for 600 km downstream. The emphasis is on developing an effective modeling procedure that balances accuracy with simplicity, is user friendly, and is easily applicable to future spills. Model calibration with oil concentration data suggests that loss of oil due to sedimentation was important. After calibration, the model estimates that 1400 cu m or 52% of the spilled oil ended up in the sediments, most of it in the first few reservoir pools along the river. Both the model and field data agree on similar peak concentrations of oil of between 1.0 and 2.5 ppm (by volume) in the river pools between 130 and 240 km downstream of the spill. The model was further validated by comparing the output with the actual time of travel of the oil spill. Other simulations include the use of resuspension of oil during high flow conditions and an investigation of the role of storms on the time of travel of the oil spill. Model results suggest that the location of the most significant ecological impact was not at the spill site but was between 130 and 240 km further downstream because of the greater exposure time there. (Author's abstract)
W91-00714

TRANSFORMATION AND TRANSPORT OF AMMONIUM NITROGEN IN A FLOODED ORGANIC SOIL.
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
K. R. Reddy, P. S. C. Rao, and R. E. Jessup.
Ecological Modelling ECMODT, Vol. 51, No. 3/4, p 205-216, June 1990. 5 fig, 2 tab, 17 ref.

Descriptors: *Ammonium, *Flooding, *Nitrogen, *Nutrient transport, *Path of pollutants, *Soil chemistry, *Soil water, *Water pollution sources, Isotope studies, Light effects, Microcosms, Model studies, Organic matter, Simulation.

Outdoor microcosms were used to determine inorganic-N fluxes from a flooded organic soil to the overlying water column. In the two experimental systems evaluated, the floodwater was either exposed to daylight or was covered to block light entry. During the 217-day study, the estimated inorganic-N flux from the soil to the overlying water was in the range of 220-330 kg N/ha/yr. About 20-30% of the added 15NH4-N was lost from the soil via denitrification and NH3 volatilization. Losses of NH4-N were generally higher when the floodwater surface was exposed to light. Measured changes in porewater NH4(+) concentration profiles in the soil agreed with the trends predicted by a simulation model that coupled the dynamics of N transport and transformations in both the soil and the floodwater. (Author's abstract)
W91-00716

USE OF CHLOROFORM IN SEDIMENT TRAPS: CAUTION ADVISED.
Bergen Univ. (Norway). Dept. of Marine Biology.
For primary bibliographic entry see Field 7B.
W91-00731

BACTERIAL REGENERATION OF AMMONIUM AND PHOSPHATE AS AFFECTED BY THE CARBON:NITROGEN:PHOSPHORUS RATIO OF ORGANIC SUBSTRATES.
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
Y. Tezuka.
Microbial Ecology MCBEBU, Vol. 19, No. 3, p 227-238, May/June 1990. 7 fig, 3 tab, 23 ref.

Descriptors: *Bacteria, *Culturing techniques, *Cycling nutrients, *Freshwater, *Limnology, Ammonium, Biomass, Carbon, Nitrogen, Nutrient ratio, Organic matter, Phosphates, Phosphorus.

The effect of the carbon:nitrogen:phosphorus (C:N:P) ratio of organic substrates on the regeneration of ammonium and phosphate was investigated by growing natural assemblages of freshwater bacteria in mineral media supplemented with simple organic C, N, and P sources (glucose, asparagine, and sodium glycerophosphate, respectively) to give 25 different substrate C:N:P ratios. Both ammonium and phosphate were regenerated when C:N and N:P atomic ratios of organic substrates were < or = 10:1 and < or = 16:1, respectively. Only ammonium was regenerated when C:N and N:P ratios were < or = 10:1 and > or = 10-20:1, respectively. On the other hand, neither ammonium nor phosphate was regenerated when C:N and N:P ratios were > or = 15:1 and > or = 5:1, respectively. In no case was phosphate alone regenerated. As bacteria were able to alter the C:N:P ratio of their biomass, the growth yield of bacteria appeared primarily dependent on the substrate carbon concentration, irrespective of a wide variation in the substrate C:N:P ratio. (Author's abstract)
W91-00732

LONG-TERM SURVIVAL OF AND PLASMID STABILITY IN PSEUDOMONAS AND KLEBSIELLA SPECIES AND THE APPEARANCE OF NONCULTURABLE CELLS IN AGRICULTURAL DRAINAGE WATER.
Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands).
L. S. van Overbeek, J. D. van Elsas, J. T. Trevors, and M. E. Starodub.
Microbial Ecology MCBEBU, Vol. 19, No. 3, p 239-249, May/June 1990. 1 fig, 3 tab, 25 ref.

Descriptors: *Agricultural runoff, *Bacteria, *Fate of pollutants, *Klebsiella, *Path of pollutants, *Pseudomonas, Competition, Culturing techniques, Ecology, Isotope studies, Microorganisms, Phosphorus isotopes, Plasmids, Tracers.

One year after introduction into agricultural drainage water, Pseudomonas fluorescens R2f (RP4), Pseudomonas putida CYM318 (pRK2501), and Klebsiella aerogenes NCTC418 (pBR322) could be recovered on agar media. Survival of these introduced strains depended on competition with the indigenous microflora, the presence of nutrients, and the availability of air. In contrast to K. aerogenes NCTC418 (pBR322), both Pseudomonas species lost their plasmids, as indicated by the consistently lower colony counts on selective media compared with the counts on nonselective media. The plasmid loss did not depend on nutrient status and oxygen supply. P. fluorescens R2f cells could be detected with the immunofluorescence (IF) technique. Total cell counts determined by IF were consistently higher than corresponding colony counts. Even in samples where no colonies were recovered, R2f cells could be detected by IF. This indicated the occurrence of nonculturable R2f cells in drainage water. Homology with 32P-labeled plasmid RP4 DNA was found in several drainage water samples that originally received P. fluorescens R2f (RP4) by using the cell suspension filter hybridization technique. P. putida CYM318 and K. aerogenes NCTC418 cells also could be detected in sterile drainage water samples, after nonspecific staining with fluorescein isothiocyanate. Cell counts of both strains were consistently higher than corresponding plate counts. (Author's abstract)
W91-00733

WATER QUALITY IN THE BARYCZ RIVER AND ITS TRIBUTARIES WITHIN THE AREA OF THE LOW SILESIAN COMMERCIAL FISHERY FARM IN MILICZ (JAKOSC WODY RZEKI BARYCZY I JEJ DOPLYWOW NA OBSAZARZE DOLNOSLASKIEGO KOMBINATU RYBACKIEGO).
Akademia Rolnicza, Wroclaw (Poland). Dept. of Limnology.
J. Marek, and E. Szulkowska-Wojaczek.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 2, p 23-40, 1990. 2 fig, 2 tab, 15 ref. English summary.

Descriptors: *Agricultural runoff, *Aquaculture, *Barycz River, *Fish ponds, *Nonpoint pollution sources, *Poland, *Water pollution, Biological oxygen demand, Carp, Conductivity, Heavy metals, Hydrogen ion concentration, Mercury, Nutrients, Salinity, Water temperature, Zinc.

Chemical composition and physical properties of river water used for filling carp ponds was investigated. Samples from numerous stations in the Barycz River catchment area were collected in the years 1981 (36), 1982 (114), 1983 (76), and 1984 (57). Parameters investigated were water temperature, dissolved oxygen, phosphates, ammonia, nitrates, potassium, sodium, BOD5, color, total hardness, calcium, magnesium, sulfates, chloride, pH, conductivity, iron, manganese, copper, zinc, cadmium, and mercury. The river waters varied considerably in terms of their chemical and physical properties. Heavy metals were the most frequent cause of low water quality. Permissible levels were exceeded for Zn (up to 0.530 mg/cu dm) and mercury (up to 0.0153 mg/cu dm). Comparative studies conducted during prolonged drought and after heavy rains revealed that surface runoff from agricultural catchments carried a considerable load of pollutants. Content of the basic nutrients, sulfates, calcium, magnesium, and manganese increased considerably after heavy rains in rivers with no point sources of pollution. (Rochester-PTT)
W91-00734

MICROBIOLOGICAL INVESTIGATIONS OF LAKE NIEGOCIN (BADANIA MIKROBIOLOGICZNE JEZIORA NIEGOCIN).
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Zaklad Mikrobiologii Sanitarnej.
S. Niewolak.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 1, p 109-130, 1990. 1 fig, 7 tab, 15 ref. English summary.

Descriptors: *Aquatic bacteria, *Lakes, *Limnology, *Poland, *Water pollution sources, Actinomycetes, Correlation analysis, Fungi, Heterotrophic bacteria, Lake Niegocin, Path of pollutants, Physicochemical properties, Spatial distribution, Statistical analysis, Temporal distribution, Water circulation, Water pollution.

The results of investigations on numbers of bacterioplankton, heterotrophic bacteria, Actinomycetes and filamentous fungi in the waters of Lake Niegocin were analyzed. Samples were taken at six sites located at the most characteristic points of the lake. The investigations were carried out in annual cycles in 1978-1979. Statistical analyses were made including determination of correlation coefficients between the above mentioned microorganisms and selected physico-chemical indicators, and also of the bacteriological pollution level of Lake Niegocin waters. Numbers of bacterioplankton, heterotrophic bacteria and fungi, especially of yeasts (Actinomycetes were found only rarely and as single specimens) indicated a high level of pollution of the northern part of Lake Niegocin in the Gizycko region at sites located in the vicinity of communal and industrial sewage outflow, around Grajewska-Kepa Island, and the municipal baths. Clean or only slightly polluted water was noted in the southern part of the lakes in the region of Rydzewo and Bogaczewo, and periodically higher pollution levels in the region around Wilkasy. During the latter part of summer stagnation set in, and only bacterioplankton and heterotrophic bacteria occured in the metalimnion of only of the sites examined. The period of autumnal circulation was characterized by a somewhat more uniform distribution of bacterioplankton, heterotrophic bacteria and yeasts in the water, with few Actinomycetes and filamentous fungi. No highly significant correlation was noted between the number of the microorganisms under study in the water in Lake Niegocin, and its temperature, turbidity, electrolytic conductivity, suspended matter, oxygen content, oxidability, biological oxygen demand, nitrate, phosphate, and nitrate:phosphate ratio. Correlations were more frequently noted between total numbers of bacteria determined on broth-agar at temperatures of 20 C and 37 C and total coliforms, and also between total numbers of fecal coliforms (Escherichia coli) and numbers of fecal streptococci. (Author's abstract)
W91-00787

RADIOACTIVITY LEVEL OF BLACK SEA MARINE ALGAE BEFORE AND AFTER THE CHERNOBYL ACCIDENT.

Istanbul Univ. (Turkey). Dept. of Pharmaceutical Technology.
K. C. Guven, M. Plevneli, E. Cevher, S. Topcuoglu, and N. Kose.
Toxicological and Environmental Chemistry TXECBP, Vol. 27, No. 4, p 297-302, 1990. 2 fig, 1 tab, 11 ref.

Descriptors: *Algal physiology, *Chernobyl, *Path of pollutants, *Radioactivity, *Turkey, Bioaccumulation, Bioindicators, Chlorophyta.

Radioactive pollution of the algae collected at Sile and Sinop on the Black Sea coast of Turkey was investigated after the Chernobyl accident. The findings were compared with the results on the algae which had been collected before the accident. The highest accumulation of cesium-137 radionuclide was found in Chaetomorpha linum a green alga. The radioactivity reached a peak in all samples collected soon after the accident in 1986 and gradually diminished in the samples of 1987 and 1988. These results supported the hypothesis that measurements of radioactivity in marine algae could conveniently be taken as an indicator for determining radioactive pollution. (Author's abstract)
W91-00796

DISTRIBUTION AND CORRELATION OF ELEMENTS IN WATERS, SUSPENSIONS, SEDIMENTS, AND MARINE ORGANISMS FROM THE BLACK SEA.
Bulgarian Academy of Sciences, Varna. Inst. of Oceanography.
For primary bibliographic entry see Field 5A.
W91-00797

WATER MASSES AND EUTROPHICATION IN A GREEK ANOXIC MARINE BAY.
National Centre for Marine Research, Athens (Greece).
N. Friligos, and S. Barbetseas.
Toxicological and Environmental Chemistry TXECBP, Vol. 28, No. 1, p 11-23, 1990. 6 fig, 2 tab, 17 ref.

Descriptors: *Cycling nutrients, *Eutrophication, *Greece, *Path of pollutants, *Water pollution sources, Anoxic conditions, Destratification, Nutrient removal, Nutrient transport, Stratification, Water masses.

Water masses and nutrient circulation were studied during 1985 in the Elefsis Bay, an anoxic basin in the Saronikos Gulf. The water of Elefsis Bay was found to be well mixed during the winter, a condition resulting from surface heavy water formation and mechanical mixing. The greatest variations were found at the east and west ends where advective fluxes of warmer outside water generated gradients. During the spring, surface heating and reduced mechanical mixing permit the development of a stratification which effectively isolates the lower layers from anything but small diffusive exchanges with the upper layers. Destratification in Elefsis Bay due to winter cooling, heavy water formation, and mechanical mixing produces a homogeneous water column that is moderately stratified during the summer as a result of surface heating and reduced mechanical mixing. Nutrients, such as phosphorus and nitrogen, are important properties of water and sediment quality of marine environments. In Elefsis Bay, the concentrations of nutrients varied seasonally with destratification redistributing ammonium, phosphate, and silicate that was regenerated by the organic matter as well as oxygen from the surface. This redistribution has significant implications for nutrient cycles and organism distribution in the Bay. (Korn-PTT)
W91-00798

URBAN STORM-INDUCED DISCHARGE IMPACTS.
Environmental Protection Agency, Edison, NJ. Storm and Combined Sewer Technology Branch.
For primary bibliographic entry see Field 4A.
W91-00803

DISTRIBUTION AND TRANSPORT OF SEDIMENT-BOUND METAL CONTAMINANTS IN THE RIO GRANDE DE TARCOLES, COSTA RICA (CENTRAL AMERICA).
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W91-00804

BIODEGRADATION KINETICS OF SUBSTITUTED PHENOLICS: DEMONSTRATIONS OF A PROTOCOL BASED ON ELECTROLYTIC RESPIROMETRY.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
S. C. Brown, C. P. Leslie Grady, and H. H. Tabak.
Water Research WATRAG, Vol. 24, No. 7, p 853-861, July 1990. 6 fig, 1 tab, 19 ref. EPA Cooperative Agreement CR-813382-01-0.

Descriptors: *Biodegradation, *Fate of pollutants, *Kinetics, *Phenols, *Respirometry, *Substrates, *Wastewater treatment, Electrolytic respirometry, Experimental design, Nonlinear curve fitting, Oxygen uptake, Spreadsheets.

Biodegradation plays an important role in the fate of synthetic organic chemicals in both natural and engineered environments. As a consequence, prediction of the fate of such chemicals requires quantification of their biodegradation rates in the form of intrinsic kinetic parameters that can be used in mass balance equations. An easily obtained determination of the parameter value describing biodegradation is possible using oxygen uptake data collected automatically from batch reactors using electrolytic respirometry. Data from electrolytic respirometers were used to evaluate the kinetics of biodegradation of phenol, 2-chlorophenol (2-CP), 4-chlorophenol (4-CP), m-cresol, 2,4-dimethylphenol (2,4-DMP), 2,4-dinitrophenol (2,4-DNP), and 4-nitrophenol (4-NP) through the use of spreadsheets and nonlinear curve-fitting. The parameter estimates obtained are intrinsic in the sense that they are not dependent on the substrate concentration or the reactor system employed. However, the parameters are a function of the biomass used to determine them. The protocol is capable of detecting substrate inhibition and of quantifying the parameters describing it. In addition, the protocol is capable of detecting product inhibition. Of the phenols considered in this study, 4-chlorophenol exhibited substrate inhibition kinetics and 2,4-dinitrophenol exhibited product inhibition kinetics. The others could be characterized by Monod kinetics. Finally, based on the maximum specific growth rate (mu), the relative biodegradability of the compounds was phenol > 4-NP, 4-CP > m-cresol > 2,4-DMP > 2,4-DNP > 2-CP. (Korn-PTT)
W91-00809

ACTIVITY AND ADAPTATION OF NITRILOTRIACETATE (NTA)-DEGRADING BACTERIA: FIELD AND LABORATORY STUDIES.
Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W91-00811

ISOLATION OF DISSOLVED ORGANIC MATTER FROM THE SUWANNEE RIVER USING REVERSE OSMOSIS.
Georgia Inst. of Tech., Atlanta. School of Earth and Atmospheric Sciences.
S. M. Serkiz, and E. M. Perdue.
Water Research WATRAG, Vol. 24, No. 7, p 911-916, July 1990. 1 fig, 1 tab, 22 ref. EPA Cooperative Agreement No. CR813471-01.

Descriptors: *Georgia, *Humic substances, *Organic matter, *Pollutant identification, *Reverse osmosis, *Water analysis, Cation exchange, Data acquisition, Dissolved organic matter, Experimental design, Rivers, Suwannee River, Water chemistry.

Because dissolved organic matter (DOM) appears to play such an important biochemical and geochemical role in aquatic ecosystems, there is considerable interest in incorporating its chemical properties into predictive models of kinetic and equilibrium processes. Characterization of DOM is generally conducted using samples that have been isolated from the aquatic environment. However, it has been suggested that some DOM samples are highly fractionated and remarkably uniform and devoid of site-specific information that might be present in the original water samples. It has been recommended that efforts should be increased to isolate a higher percentage of DOM, so that the isolated DOM will be more representative of natural DOM. A portable reverse osmosis (RO) system was constructed and used to concentrate DOM from the Suwannee River in southeastern Georgia. Using this RO system, 150-180 l/h of river water could be processed with 90% recovery of DOM. After further cation exchange and lyophilization of the concentrated river water samples, large quantities of low-ash freeze-dried products were isolated. This RO method is highly recommended for concentration of DOM in fresh waters because; (1) a very high percentage of DOM is recovered, which indicates minimal fractionation of the original sample; and (2) the process is quite rapid, which permits large quantities of DOM to be concentrated in a reasonable length of time. (Author's abstract)
W91-00816

DEGRADATION OF POLYPHENOLS IN FIVE PLANT SPECIES IN THE AQUATIC ENVIRONMENT (DEGRADACAO DE PLOIFENOIS EM CINCO ESPECIES VEGETAIS EM AMBIENTES AQUATICOS).
Convenio Eletronorte/CNPq/INPA, Brazil.
For primary bibliographic entry see Field 2H.
W91-00821

BIOMONITORING OF CHEMICALS ON TROPICAL ECOSYSTEMS.
Universitaet des Saarlandes, Saarbruecken (Germany, F.R.). Inst. fuer Biogeographie.
P. Muller.
Amazoniana AMAZAP, Vol. 11, No. 1, p 71-89, 1989. 7 fig, 6 tab, 7 ref.

Descriptors: *Bioindicators, *Biomonitoring, *Environmental effects, *Monitoring, *Pesticides, *Tropical regions, Africa, Europe, Herbicides, Insecticides, Land use, Pollutants, South America.

In the absence of effective biomonitoring, detection of serious environmental contamination and threats to human health caused by chemical pollutants may occur only after critical and irreversible damage had been done. Between 1976 and 1989 the ecosystematic effects caused by various herbicides and insecticides tropical South America, Africa and Europe were analyzed. The regenerative power of the tropical ecosystems, after having been treated with insecticides, does not only depend on the type of pesticide or its formulation and concentration, but also on the ecophysiological capacity of different organisms in the tropical food chains. Experience in that tropical regions studied has proved that the application of chemicals does not represent a serious environmental problem, provided the chemical inputs on the ecosystems have already been evaluated, and the whole procedure and organization are carried out in a professional manner. Concerning the elimination of pests, it has been observed that various forms of land utilization in the tropics have a much more adverse effect than the effects induced by pesticide usage. (Author's abstract)
W91-00823

INCIDENCE OF VIBRIO PARAHAEMOLYTICUS IN U.S. COASTAL WATERS AND OYSTERS.
Food and Drug Administration, Dauphin Island, AL. Fishery Research Branch.
A. DePaola, L. H. Hopkins, J. T. Peeler, B. Wentz, and R. M. McPhearson.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2299-2302, August 1990. 4 tab, 27 ref.

Descriptors: *Bioaccumulation, *Enteric bacteria, *Oysters, *Path of pollutants, *Shellfish, *Vibrio, Alabama, California, Fecal coliforms, Florida, Louisiana, Rhode Island, Seasonal variation, Seawater, South Carolina, Texas, Virginia, Washington, Water temperature.

Vibrio parahaemolyticus is an enteric pathogen transmitted to humans primarily through consumption of raw or mishandled seafood. Oyster and seawater samples were collected seasonally from May 1984 through April 1985 from shellfish-growing areas in Washington, California, Texas, Louisiana, Alabama, Florida, South Carolina, Virginia, and Rhode Island which had been designated as approved or prohibited by the National Shellfish Sanitation Program. Fecal coliform counts, aerobic plate counts, and Vibrio parahaemolyticus densities were determined for the samples. Mean V. parahaemolyticus density was more than 100 times greater in oysters than in water, whereas density of fecal coliforms was approximately 10 times higher in oysters. Seasonal and geographical distributions of V. parahaemolyticus were related to water temperature, with highest densities in samples collected in the spring and the summer along the Gulf coast. The synthetic DNA probe for thermostable direct hemolysin hybridized with 2 of 50 isolates, one of which was positive by the Kanagawa test. (Author's abstract)
W91-00825

DECHLORINATION OF FOUR COMMERCIAL POLYCHLORINATED BIPHENYL MIXTURES (AROCLORS) BY ANAEROBIC MICROORGANISMS FROM SEDIMENTS.
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
J. F. Quensen, S. A. Boyd, and J. M. Tiedje.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2360-2369, August 1990. 8 fig, 3 tab, 14 ref.

Descriptors: *Biodegradation, *Dehalogenation, *Fate of pollutants, *Microbial degradation, *Polychlorinated biphenyls, *Sediments, Anaerobic bacteria, Aroclors, Hudson River, Massachusetts, Microorganisms, New York, Sediment contamination, Silver Lake.

The rate, extent, and patten of dechlorination of four Aroclors by inocula prepared from two polychlorinated biphenyl (PCB)-contaminated sediments were compared. The four mixtures used, Aroclors 1242, 1248, 1254, and 1260, averaged approximately three, four, five, and six chlorines, respectively, per biphenyl molecule. All four Aroclors were dechlorinated with the loss of meta plus para chlorines ranging from 15 to 85%. Microorganisms from an Aroclor 1242-contaminated site in the upper Hudson River dechlorinated Aroclor 1242 to a greater extent than did microorganisms from Aroclor 1260-contaminated sediments from Silver Lake, Mass. The Silver Lake inoculum dechlorinated Aroclor 1260 more rapidly than the Hudson River inoculum did and showed a preferential removal of meta chlorines. For each inoculum the rate and extent of dechlorination tended to decrease as the degree of chlorination of the Aroclor increased, especially for Aroclor 1260. The maximal observed dechlorination rates were 0.3, 0.3, and 0.2 microg-atoms of Cl removed per g of sediment per week for Aroclors 1242, 1248, and 1254, respectively. The maximal observed dechlorination rates for Hudson River and Silver Lake organisms for Aroclor 1260 were 0.04 and 0.21 microg-atoms of Cl removed per g of sediment per week, respectively. The dechlorination patterns obtained suggested that the Hudson River microorganisms were more capable than the Silver Lake organisms of removing the last para chlorine. These results suggest that there are different PCB-dechlorinating microorganisms at different sites, with characteristic specificities for PCB dechlorination. The dechloroination of Arochlor 1260 had not been demonstrated previously. It indicates that more PCB congeners are potentially degradable by a sequential anaerobic-aerobic treatment system. (Author's abstract)
W91-00827

DETECTION OF VIBRIO CHOLERAE O1 IN THE AQUATIC ENVIRONMENT BY FLUORESCENT-MONOCLONAL ANTIBODY AND CULTURE METHODS.
International Centre for Diarrheal Disease Research, Dacca (Bangladesh).
For primary bibliographic entry see Field 5A.
W91-00828

IRON-BINDING COMPOUNDS AND RELATED OUTER MEMBRANE PROTEINS IN VIBRIO CHOLERAE NON-O1 STRAINS FROM AQUATIC ENVIRONMENTS.
Valencia Univ. (Spain). Faculty of Physics.
C. Amaro, R. Aznar, E. Alcaide, and M. L. Lemos.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2410-2416, August 1990. 1 fig, 4 tab, 41 ref.

Descriptors: *Aquatic bacteria, *Bacterial physiology, *Iron uptake, *Nutrients, *Pathogenic bacteria, *Vibrio, Aquatic populations, Bacterial analysis, Microbiological studies.

A total of 156 strains of Vibrio cholerae non-O1 from aquatic origins were examined for the presence of iron uptake mechanisms and compared with O1 strains and other Vibrio species. All non-O1 strains were able to grow in iron-limiting conditions, withethylenediaminedi(O-hydroxyphenylacetic acid) ranging from 20 microM to 2 mM. The production of siderophores was demonstrated by growth in chrome azurol S agar and cross-feeding assays. All strains produced phenolate-type compounds, as assessed by the chemical tests and by bioassays with Salmonella typhimurium enb-7. Some of the strains also promoted the growth of S. typhimurium enb-1 (which can use only enterobactin as a siderophore) as well as some strains of Vibrio anguillarum deficient in the anguibactin-mediated system. The chromatographic analyses and absorption spectra of siderophores extracted from culture supernatants suggest that vibriobactin may be produced by the strains examined. Some strains also produced hydroxamate-type compounds, as determined by chemical tests, and were able to promote the growth of an aerobactin-deficient strain of Escherichia coli. These results were confirmed by the absorption spectra and chromatographic analyses of the culture extracts. The synthesis of iron-regulated outer-membrane proteins in representative strains was also examined. The molecular sizes of the main induced proteins ranged from 70 to 78 kilodaltons. These results indicate that several iron uptake mechanisms which could be involved in environmental survival and pathogenicity are present in environmental V. cholerae non-O1 strains. (Author's abstract)
W91-00830

TETRACHLOROETHENE TRANSFORMATION TO TRICHLOROETHENE AND CIS-1,2-DICHLOROETHENE BY SULFATE-REDUCING ENRICHMENT CULTURES.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
D. M. Bagley, and J. M. Gossett.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2511-2516, August 1990. 3 fig, 3 tab, 27 ref. U.S. EPA Grant R-814380-.

Descriptors: *Bacteria, *Biodegradation, *Chlorinated hydrocarbons, *Cleanup, *Site remediation, *Soil treatment, *Toxicity, *Water pollution treatment, Groundwater pollution, Inhibition, Methane bacteria, Model studies, Soil contamination, Trichloroethane, Trichloroethene.

Tetrachloroethene was reductively dechlorinated to trichloroethene and cis-1,2-dichloroethene by laboratory sulfate-reducing enrichment cultures. The causative organism or group was not identified. However, tetrachloroethene was dechlorinated to trichloroethene in 50 mM bromoethane-sulfonate-inhibited enrichments and to trichloroethene and cis-1,2-dichloroethene in 3 mM fluoroacetate-inhibited enrichments. Overall transformation varied from 92% tetrachloroethene removal in 13 days to 22% removal in 65 days, depending on conditions of the inoculum, inhibitor used, and auxiliary substrate used. Neither lactate, acetate, methanol, isobutyric acid, valeric acid, isovaleric acid, hexanoic acid, succinic acid, nor hydrogen appeared directly to support tetrachloroethene dechlorination, although lactate-fed inocula demonstrated longer-term dechlorinating capability. (Author's abstract)
W91-00833

TOLERANCE OF SCAPANIA UNDULATA (L.)DUM. TO FLUORIDE.
Wroclaw Univ. (Poland). Dept. of Ecology and Nature Protection.
For primary bibliographic entry see Field 5C.
W91-00835

ATMOSPHERIC CHEMISTRY OF PEROXIDES: A REVIEW.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
D. W. Gunz, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1601-1633, July 1990. 3 fig, 3 tab, 330 ref.

Descriptors: *Acid rain, *Acidification, *Air pollution, *Atmospheric chemistry, *Hydrogen peroxide, *Literature review, *Nitric acid, *Sulfuric acid, *Water pollution sources, Chemical reactions, Cloud chemistry, Free radical reactions, Photolysis, Urban areas.

Inorganic and organic peroxides have become the focus of increased attention by atmospheric chemists during the last decade. Hydrogen peroxide serves as an important link between gas phase radicals and aqueous phase chemistry in the atmosphere. As an important aqueous phase oxidant of S(IV), H2O2 is a significant species in photochemical smog as a chain terminator and as an index of hydroperoxyl radical concentrations. Hydrogen peroxide also plays a major role in the acidification of clouds, fogs, dew, and rain. Several studies have indicated that hydrogen peroxide and organic hydroperoxides are also considered to be potent plant phototoxins. A review of ambient H2O2 maxima for the United States and Central Europe ranged from 4-5 ppb vapor (ppbv) and 200-300 microMolar in the gas and aqueous phase, respectively. There appears to be a correlation between the presence of peroxides (hydrogen and organic), photoactivity (seasonal variations, spatial and temporal variation) and photochemical smog (O3, NOx). These apparent relationships suggest that the presence of H2O2 and organic hydroperoxides in the atmosphere is linked to the chemistry of their precursors. In addition, the production of H2O2 in the gas phase is a function of light intensity and the ambient concentrations of hydrocarbons, aldehydes, CO, NO, NO2, and O3. H2O2 can be produced in situ in cloud-water droplets or on surfaces. It is generally assumed that H2O2 is formed via photochemical and thermal reactions in the gas and aqueous phases of the atmosphere. (Korn-PTT)
W91-00841

FIELD INVESTIGATIONS ON THE SNOW CHEMISTRY IN CENTRAL AND SOUTHERN CALIFORNIA-I. INORGANIC IONS AND HYDROGEN PEROXIDE.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
D. W. Gunz, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1661-1671, July 1990. 16 fig, 2 tab, 65 ref. California Air Resources Board Contract A6-185-32.

Descriptors: *Acid rain, *Hydrogen peroxide, *Organic acids, *Path of pollutants, *Snow, *Snowpack, *Water pollution sources, Air pollution, Atmospheric chemistry, Atmospheric water, California, Chemistry of precipitation, Cloud chemistry, Cloud liquid water, Inorganic snow chemistry, Precipitation, Snow sampling, Snowmelt, Sulfates, Sulfur.

In recent years the chemistry of rain, fog, and clouds along the West Coast of the United States has been the focus of increased attention. Previous research has established the role of atmospheric deposition and interception of cloudwater in forests as pathways for the introduction of acidity to these regions. Measurements of various inorganic species in snow collected in central and southern California during the winter of 1987-1988 indicate a combined influence of anthropogenic and maritime sources, depending on the meteorological conditions and wind patterns. Ion balance calculations revealed that organic acids are significant contributors to the overall chemical budget in snow samples. Sixty to ninety-five per cent of the total SO4(2-) was calculated to have been derived from S(IV) oxidation. H2O2 concentrations up to 7.4 micromole/l were analyzed in fresh snow. No systematic trends in the concentrations of H2O2 were observed during collection periods in marked contrast to the behavior of inorganic species (e.g., Na(+), Cl(-), SO4(2-), and NO3(-)). H2O2 concentrations found in snow were 2-3 times lower than those found in rainwater collected during the same events at a lower elevation site, whereas inorganic ion levels were 2-7 times lower in snow. In an accumulated season snowpack a decrease if H2O2 and increase if SO4(2-) with depth was observed. (Author's abstract)
W91-00842

FIELD INVESTIGATIONS ON THE SNOW CHEMISTRY IN CENTRAL AND SOUTHERN CALIFORNIA-II. CARBONYLS AND CARBOXYLIC ACIDS.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
D. W. Gunz, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1673-1684, July 1990. 8 fig, 2 tab, 79 ref. California Air Resources Board Contract A6-185-32.

Descriptors: *Acid rain, *Carbonyls, *Carboxylic acid, *Fate of pollutants, *Organic acids, *Path of pollutants, *Snow, *Snowpack, *Water pollution sources, Acetic acid, Air pollution, Aldehydes, Atmospheric chemistry, Atmospheric water, California, Chemistry of precipitation, Cloud chemistry, Forests, Formaldehyde, Organic compounds, Snow sampling, Snowmelt.

Snow samples from central and southern California were collected during the winter of 1987-1988 from three storms and analyzed for carbonyl compounds and carboxylic acids. Approximately 90% of the samples contained total aldehyde concentrations up to 40 micromole. Formaldehyde and acetaldehyde were the dominant aldehydes observed; secondary aldehydes included glyoxal, methylglyoxal, and benzaldehyde. The highest aldehyde concentrations were observed in snow collected in areas where deciduous and coniferous forests are widespread. However, these aldehydes can be attributed also in part to primary and secondary products of anthropogenic activities. Formic and acetic acid were analyzed in all measured samples with concentrations ranging from 0.5 to 4.9 micromole for HCOOH and from less than 0.3 to 13.4 micro mole for CH3COOH. Maximum contribution of organic acids to precipitation-free acidity, calculated by assuming that the only sources of the measured formate and acetate were their respective acid forms, averaged 43.1% for samples with a pH </= to 5. A consistent correlation between NH4(+) and acetate was found. Concentrations of CH3COOH exceeded those of HCOOH in about 50% of the samples with the highest levels for CH3COOH measured in cores collected from lower elevated locations adjacent to the Los Angeles basin. Results suggest that dry deposition and/or scavenging of carbonyl compounds and organic acids to snow may be important sinks for these compounds. (Author's abstract)
W91-00843

WET AND DRY DEPOSITION FLUXES ABOVE THE NORTH SEA.
Vrije Univ., Brussels (Belgium). Dienst Analytische Scheikunde en Geochemie.
For primary bibliographic entry see Field 2B.
W91-00845

INTENSIVE STUDIES OF SIERRA NEVADA CLOUDWATER CHEMISTRY AND ITS RELATIONSHIP TO PRECURSOR AEROSOL AND GAS CONCENTRATIONS.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 2B.
W91-00846

EFFECT OF DAYTIME SURFACE EVAPORATION ON POLLUTION DISPERSION.
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
M. Segal, X. Jia, Z. Ye, and R. A. Pielke.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1801-1811, July 1990. 8 fig, 1 tab, 32 ref. EPRI Contract RP-1630-53 and NSF Grant ATM-8616662.

Descriptors: *Air pollution, *Air pollution sources, *Dispersion, *Evaporation, *Model studies, Atmospheric chemistry, Convective boundary layer, Mathematical studies, Path of pollutants, Surface evaporation.

The impact of wet surfaces on selected dispersion characteristics was studied in situations involved with extensive homogeneous areas with a uniform surface wetness. Illustrative situations typical to mid-latitude summer and winter days were considered. The simulation results suggest that an extreme variation in surface moisture availability over an extensive area may result in a change of one Pasquill stability class around noon. However, early in the morning and late in the afternoon the modification can be more substantial. A similar, general conclusion was obtained when the ratio w*/U (where w* is the convective scaling velocity and u the mean wind speed w/in the daytime convective boundary layer) was considered as an index for dispersion in the ABL. The impact of a change in the depth of the ABL, from very dry to an extremely wet surface, was indicated to be a factor of approximately 1.5 to 2. Thus, it is suggested, for example, that surface concentrations from a plume trapped within the ABL, or due to surface emissions, may be increased by a factor of 1.5-2 due to such surface moisture variations. On the other hand, a reduction in the ABL depth due to surface moistening may result in the penetration of such a plume to above the ABL capping inversion, thereby reducing significantly the surface concentrations. The last situation is most likely to occur in the morning hours, or in synoptic conditions in which the ABL is suppressed by a synoptic subsidence to the typical effective height of tall stacks. (Korn-PTT)
W91-00848

INFLUENCE OF OUTLIERS ON RESULTS OF WET DEPOSITION MEASUREMENTS AS A FUNCTION OF MEASUREMENT STRATEGY.
Netherlands Energy Research Foundation ECN, Petten.
J. Slanina, J. J. Mols, and J. H. Baard.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1843-1860, July 1990. 4 fig, 10 tab, 18 ref, append.

Descriptors: *Mathematical studies, *Network design, *Path of pollutants, *Sampling, *Statistical analysis, Mathematical equations, Networks, Outlier detection, Precipitation, Sampling strategy, Statistical methods, Statistical models.

The results of a wet deposition monitoring experiment, carried out by eight identical wet-only precipitation samplers operating on the basis of 24 hour samples, have been used to investigate the accuracy and uncertainties in wet deposition measurements. The experiment was conducted near Lelystad, The Netherlands over the period 1 March 1983-31 December 1985. By rearranging the data for one to eight samplers and sampling periods of 1 day to 1 month both systematic and random errors were investigated as a function of measuring strategy. A Gaussian distribution of the results was observed. Outliers, detected by a Dixon test (a=0.05) strongly influenced both the yearly averaged results and the standard deviation of this average as a function of the number of samplers and the length of the sampling period. The systematic bias in bulk elements, using one sampler, varies typically from 2 to 20%, and for trace elements from 10 to 500%. Severe problems are encountered in the case of Zn, Cu, Cr, Ni, and especially Cd. For the sensitive detection of trends generally more than one sampler per measuring station is necessary as the standard deviation in the yearly averaged wet deposition is typically 10-20% relative for one sampler. Using three identical samplers, trends of about 3%/year will be generally detected in 6 years. (Author's abstract)
W91-00849

CHEMICAL CHARACTERIZATION OF ACID PRECIPITATION IN ALBANY, NEW YORK.
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
For primary bibliographic entry see Field 5A.
W91-00850

SOURCE-RECEPTOR RELATIONSHIPS FOR WET SO4(2-) AND NO3(-) PRODUCTION.
G. R. Hilst, and E. G. Chapman.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1889-1901, July 1990. 8 fig, 3 tab, 19 ref, append. EPRI Contract RP1630-40 and RP2434-5.

Descriptors: *Acid rain, *Air pollution, *Chemistry of precipitation, *Data interpretation, *Mathematical studies, *Nitrates, *Path of pollutants, *Statistical analysis, *Sulfates, Nitrogen compounds, North America, Precipitation, Seasonal variation, Sulfur dioxide, Water pollution sources.

Precipitation chemistry data for the years 1982-1985 from 110 stations distributed across the continental U.S. and southern Ontario Province are used to describe the geographic distributions of SO4(2-) and NO3(-) in precipitation. Volume-weighted wet SO4(2-) and NO3(-) concentrations were averaged over the 4 years of observation by season and annually. Results of the observations show that coherent patterns with the maxima in the northeastern U.S. and southeastern Canada are about ten times greater than the minima observed in the Intermountain and Pacific Northwest regions. Tests for empirical source-receptor relationships indicate that in land areas with relatively low emissions of SO2 and NOx, the associations between wet SO4(2-) concentrations and SO2 emissions and wet NO3(-) concentrations and NOx emissions, within 560 km of each precipitation chemistry station, are weak or nonexistent (r2 </ = 0.42). The remaining land areas show moderate to strong associations between SO2 and SO4(2-) and NOx and NO3(-) during the spring and summer, but only weak to nonexistent associations during the winter. The associations between emissions and concentrations are equally well represented by either a linear or power law function. However, at the level of aggregation employed, the data do not substantiate a linear-proportional relationship between concentrations and anthropogenic emissions. Furthermore, emissions of SO2 and NOx are highly correlated, as are the emissions of reactive hydrocarbons and NOx. (Author's abstract)
W91-00851

TRACE METAL WET DEPOSITION IN SWEDEN: INSIGHT GAINED FROM DAILY WET ONLY COLLECTION.
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
H. B. Ross.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1929-1938, July 1990. 7 fig, 6 tab, 21 ref.

Descriptors: *Acid rain, *Air pollution, *Chemistry of precipitation, *Industrial development, *Path of pollutants, *Sweden, *Trace metals, *Water pollution sources, Air pollution sources, Arsenic, Atmospheric chemistry, Cadmium, Chemical analysis, Chromium, Copper, Heavy

metals, Iron, Lead, Manganese, Nickel, Pollutant identification, Statistical analysis, Vanadium, Zinc.

Industrialization has changed the biogeochemical cycling of a variety of trace metals. The so-called atmophile trace metals (e.g., Cd, Cu, Zn, Cr, V, and As) have the atmosphere as their major media for transport in the biosphere. One of the prime characteristics of atmophile metals is that wet deposition is the major mechanism for their removal from the atmosphere. Monthly bulk and daily wet only samples have been collected at two sites in Sweden and analyzed for trace metals (Cd, Cu, Fe, Mn, Pb, Zn, Cr, Ni, and V). Concentrations in the daily samples varied over four orders of magnitude with the most pristine samples (lower 10th percentile) approaching levels found in Greenland snow. It was also observed that monthly metal deposition is essentially governed by the meteorological history of individual precipitation events; namely that monthly metal deposits can be dominated by individual small storms and the remaining precipitation for the month merely dilutes the dirty precipitation. A comparison of deposition estimates from the two data sets indicate that Cd, Fe, Pb, Zn, Cr, Ni, and V wet deposition can be reasonably estimated by monthly bulk sampling. Due to contamination from the forest canopy, Mn wet deposition is overestimated by the bulk method. For Cu, contamination of the samples occurred in both collectors and indicates that new sampling protocols are needed for accurately determining wet deposition fluxes. (Author's abstract)
W91-00853

RELEASE OF HEAVY METALS FROM SNOWPACKS ON THE JAPAN SEA SIDE OF JAPAN.
Kanazawa Univ. (Japan). Dept. of Chemical Engineering.
F. J. Ecker, E. Hirai, and T. Chohji.
Environmental Pollution ENPOEK, Vol. 65, No. 2, p 141-153, 1990. 4 fig, 2 tab, 16 ref.

Descriptors: *Conductivity, *Heavy metals, *Hydrogen ion concentration, *Japan, *Path of pollutants, *Pollutant identification, *Snowmelt, *Snowpack, *Water pollution sources, Air pollution, Aluminum, Cadmium, Chemical composition, Copper, Iron, Lead, Manganese, Snow, Snow sampling, Zinc.

Daily snowfall and meltwater samples were collected at six stations on the Japan Sea (west) side of Japan. Samples were analyzed for ionic strength (EC), pH, and soluble and insoluble amounts of Fe, Mn, Pb, Cd, Cr, Cu, Zn, and Al. Consistent patterns of chemical composition were found in freshly fallen snow at all locations. However, meltwater from inland mountain snowpacks varied from coastal meltwater. At the coastal sites, lysimeter samples showed a release of meltwater from the snowpack to the ground all winter. At a remote mountain site the meltwater breakthrough was delayed and was restricted to a relatively short period. Most of the impurities at mountain sites were retained in the snowpack until spring. The first fraction of meltwater released between 50 and 90% of the total amount of soluble metal components. The last meltwater contained the maximum of insoluble metals. The high ionic strength and the enrichment of bioavailable heavy metals in the first meltwater breakthrough was caused by preferential elution; this impurity laden first release undoubtedly reaches aquatic systems and may affect aquatic biota. (Author's abstract) (Korn-PTT)
W91-00858

RELATIONSHIPS BETWEEN COPPER CONCENTRATIONS IN LARVAE OF PLECTROCNEMIA CONSPERSA (CURTIS) (TRICHOPTERA) AND IN MINE DRAINAGE STREAMS.
Polytechnic South West, Plymouth (England). Dept. of Biological Sciences.
A. M. Gower, and S. T. Darlington.
Environmental Pollution ENPOEK, Vol. 65, No. 2, p 155-168, 1990. 5 fig, 4 tab, 25 ref.

Descriptors: *Caddisflies, *Copper, *Larvae, *Mine wastes, *Path of pollutants, *Population exposure, *Stream pollution, *Sublethal effects, *Water pollution effects, Bioaccumulation, England, Heavy metals, Larval growth stage, Stream biota, Tolerance.

Mine drainage streams in the heavily mineralized moorland areas of Cornwall, south-west England, are characterized by continuous flow and hence continuous metal contamination. Since many of these streams have been in existence for up to 250 years, the aquatic communities consist of tolerant species. Although studies in the UK and the USA show that insects, especially Chironomidae, Trichoptera, and Ephemeroptera, are often the dominant macroinvertebrates in streams contaminated by heavy metals, comparatively little is understood about the tolerance mechanisms and concentrations of metals in insects under different environmental conditions. Elevated copper concentrations were determined for single larvae of Plectrocnemia conspersa in a copper-rich stream. Although larval copper concentrations were reduced by at least 50% after clearing gut contents, the exponential decrease with increasing body weight remained unchanged. Analysis of instar V larvae from different sampling stations showed a steep increase in the concentration of copper in the larvae, with that in the water at lower stream water concentrations followed by a progressively less steep increase at higher stream concentrations. When captive larvae from a clean stream were introduced into a mine drainage stream, the amount of copper in fed and unfed larvae steadily increased, suggesting metal uptake from water and food. Survival and growth were comparable for introduced and captive resident larvae suggesting copper tolerance to be a general characteristic of P. conspersa. (Korn-PTT)
W91-00859

SEASONAL, HYDROLOGICAL, AND LAND MANAGEMENT FACTORS CONTROLLING DISSOLVED ORGANIC CARBON CONCENTRATIONS IN THE LOCH FLEET CATCHMENTS, SOUTHWEST SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 2H.
W91-00862

F-SPECIFIC RNA BACTERIOPHAGES AND SENSITIVE HOST STRAINS IN FAECES AND WASTEWATER OF HUMAN AND ANIMAL ORIGIN.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
For primary bibliographic entry see Field 5A.
W91-00872

EFFECTS OF FAULTS ON FLUID FLOW AND CHLORIDE CONTAMINATION IN A CARBONATE AQUIFER SYSTEM.
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00877

MOVEMENT AND FATE OF ATRAZINE AND BROMIDE IN CENTRAL KANSAS CROPLANDS.
Kansas State Geological Survey, Lawrence.
M. Sophocleous, M. A. Townsend, and D. O. Whitemore.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 115-137, July 1990. 21 fig, 20 ref.

Descriptors: *Agricultural chemicals, *Atrazine, *Bromides, *Fate of pollutants, *Path of pollutants, *Pesticides, *Soil analysis, *Soil contamination, Biodegradation, Flow measurement, Lysimeters, Soil porosity, Soil water, Solute transport, Tracer studies.

Recent incidences of chemical contamination of groundwater by pesticides and other agricultural chemicals have increased concern for long-term environmental consequences of current agricultural practices on groundwater quality. Two flooding experiments were conducted at two sites with different soils to study the transport and fate of the commonly used herbicide atrazine and inorganic chemicals in the Great Bend Prairie croplands of south-central Kansas. The instantaneous profile method supplemented by the use of an organic (atrazine) and an inorganic (bromide) tracer chemical was used to characterize in situ the hydraulic and chemical properties of the appropriately instrumented field sites. Atrazine readily degraded to hydroxyatrazine and biodegradation by-products and was not detected deeper in the soil profile and underlying shallow aquifer. The classical processes of chemical movement based on porous media-equilibrium-diffuse flow did not fit the data well at either site. Incompletely mixed, slug flow appeared to predominate at one of the sites and preferential flow at the other. The slug movement caused 'piston-type' displacement of more saline solutions in the soil profile to the shallow water table. Recommendations for conducting related field studies based on this sampling experience are: (1) collect multiple samples per depth over a small area of interest (representing, in effect, a point measurement) and use the average concentration per depth for analysis; (2) sample the entire depth of interest in one continuous core; (3) do not rely entirely on suction lysimeters, both soil cores and suction lysimeters are recommended; and (4) chemical analyses should be conducted as soon as possible after sampling, so that problems can be addressed and resampling carried out if necessary. (Author's abstract)
W91-00882

THEORY AND APPLICATION OF AN APPROXIMATE MODEL OF SALTWATER UPCONING IN AQUIFERS.
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2F.
W91-00883

MOTION OF COASTAL GROUNDWATER IN RESPONSE TO THE TIDE.
Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
For primary bibliographic entry see Field 2F.
W91-00884

TOPOGRAPHIC EFFECTS ON FLOW PATH AND SURFACE WATER CHEMISTRY OF THE LLYN BRIANNE CATCHMENTS IN WALES.
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 2E.
W91-00888

SIMULATION OF NITRATE NITROGEN BREAKTHROUGH CURVES STEMMING FROM LEACHING OF AMMONIUM NITRATE THROUGH SOIL.
Orissa Univ. of Agriculture and Technology, Bhubaneswar (India).
B. K. Mishra, and C. Misra.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 377-384, July 1990. 4 fig, 13 ref.

Descriptors: *Ammonium salts, *Leaching, *Nitrates, *Nonpoint pollution sources, *Path of pollutants, *Soil chemistry, *Soil water, *Water pollution sources, Chemical analysis, Data analysis, Diffusion coefficient, Graphical analysis, Ion transport, Nitrification, Solute transport.

Simulations of breakthrough curves (BTCs) of NO3-N stemming from leaching a solution pulse of NH4NO3 requires the knowledge of several parameters, such as the distribution coefficient, R, for NH4(+)-N, convective diffusion coefficient, D, the nitrification rate constant, k1, and the nitrate reduction rate constant, k2, to be determined independently. Unlike D, the values of R do not affect the appearance of the BTCs of NO3-N or the velocity of the solute species. R can be estimated directly from the slope of the linear adsorption isotherms of a batch equilibrium study. Since the value of D is related to the velocity of ions, D can be estimated by curve fitting a BTC of Cl-, under identical conditions. Increasing k2 decreases the area under the NO3-N BTC. The value of k2 may be estimated by curve fitting the BTC of NO3-N stemming from leaching of a solution pulse of

Ca(NO3)2. With estimates of R, D, and k2 in hand, one has only to curve-fit the BTC of NO3-N stemming from leaching a solution pulse of NH4NO3 in order to estimate k1. For a given k2, increasing the value of k1 increases the area under BTCs of NO3-N for the earlier times. (Author's abstract)
W91-00896

UNDERGROUND STORAGE TANKS.
Clean Site, Inc., Alexandria, VA.
For primary bibliographic entry see Field 5G.
W91-00904

5C. Effects Of Pollution

SIMULATION MODEL OF PHOSPHORUS CYCLING IN THE EPILIMNION OF A EUTROPHIC LAKE.
Polish Academy of Sciences, Warsaw. Zaklad Paleobiologii.
For primary bibliographic entry see Field 2H.
W91-00003

RESEARCH ON THE FISHERIES OF SMALL LAKES (PIENTEN JARVIEN KALATUTKIMUKSET).
For primary bibliographic entry see Field 8I.
W91-00019

GENOTOXICITY OF DRINKING WATER: SIGNIFICANCE AND FUTURE APPROACH.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
J. F. Versteegh, P. G. Kramers, and J. van Genderen.
Aqua AQUAAA, Vol. 39, No. 2, p 101-106, April 1990. 1 ref.

Descriptors: *Drinking water, *Genotoxicity, *Mutagenicity, *Water pollution effects, *Workshops, Chlorination, Epidemiology, Public health, The Netherlands, Water treatment.

A workshop was organized by the National Institute for Public Health and Environmental Protection of the Netherlands and the Netherlands Waterworks Testing and Research Institute on the subject of genotoxicity of drinking water. Significant conclusions of this workshop included: (1) An important part of the mutagenicity of drinking water cannot be explained despite the identification of several potent mutagenic compounds. (2) In-vivo studies with drinking-water extracts do not yet confirm the mutagenic activity discovered in vitro. (3) Some epidemiological studies in the USA have shown that the prolonged consumption of chlorinated drinking water is associated with increased health risks. (4) It is to be recommended that, even though the implications of mutagenicity are not fully known, measures should be taken to decrease their concentration in drinking water. (Stoehr-PTT)
W91-00023

EFFECTS OF DRILL CUTTINGS ON A MODEL MARINE SEDIMENT SYSTEM.
Heinz and Co. Ltd., Hayes (England). Microbiology Dept.
F. K. Dow, J. M. Davies, and D. Raffaelli.
Marine Environmental Research MERSDW, Vol. 29, No. 2, p 103-134, 1990. 15 fig, 5 tab, 47 ref.

Descriptors: *Biodegradation, *Drill cuttings, *Drilling fluids, *Marine sediments, *Model studies, *Path of pollutants, *Water pollution effects, Anaerobic conditions, Environmental impact, Hydrocarbons, North Sea, Oil pollution, Sediment contamination.

An onshore tank system was used to model marine sediment contaminated with water, diesel oil, and paraffinic oil-based cuttings from offshore drilling installations. The relative environmental impact of the different cuttings was assessed over a 12-month period in terms of changes in sediment microbiology and chemistry. Changes in hydrocarbon chemistry were also determined to provide information on oil composition and mechanisms of oil loss from the cuttings. Water-based cuttings proved least damaging to the sediment system, only depressing Eh levels below those of control sediments during the first three months of exposure. Both types of oil-based cuttings stimulated microbial activity, depressing sediment Eh levels and increasing sulfide concentrations. The effects were less severe in more lightly contaminated sediments. Oil losses were proportionally greater from more dispersed cuttings and were dependent on both physical and biological weathering. Sediments heavily dosed with oil-based cuttings became anaerobic and failed to support hydrocarbon biodegradation. More dispersed low dosage applications were more readily susceptible to microbial attack. (Author's abstract)
W91-00044

MACROPHYTE ASSOCIATED INVERTEBRATES AND THE EFFECT OF HABITAT PERMANENCE.
Lund Univ. (Sweden). Dept. of Ecology.
For primary bibliographic entry see Field 2H.
W91-00052

MEASURING ECONOMIC LOSSES FROM GROUND WATER CONTAMINATION: AN INVESTIGATION OF HOUSEHOLD AVOIDANCE COSTS.
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
C. W. Abdalla.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 451-463, June 1990. 1 fig, 9 tab, 22 ref.

Descriptors: *Domestic water, *Economic aspects, *Groundwater pollution, *Water pollution effects, Bottled water, Pennsylvania, Volatile organic compounds, Water treatment, Well water.

Economic losses from groundwater contamination were estimated in a central Pennsylvania community. The averting expenditures method was applied by using a mail survey of households in which water contained the unregulated volatile organic chemical, perchloroethylene (PCE). Expenditures evaluated were for purchasing bottled water, hauling water, boiling water, and water treatment. Expenditures were estimated at $148,900 (1987 dollars) over the six-month contamination period or approximately $252 per household annually. These costs underestimate the lower bound measure of welfare losses to households from groundwater contamination. An upper bound measure of welfare losses was estimated at $383 per household annually. These estimates do not represent the full economic losses resulting from groundwater contamination since the study did not address municipal-level and business avoidance costs and losses from actual health effects, increased fear and anxiety, ecological damages, and nonuser groundwater benefits. The results expand the existing empirical base of information about municipal-level responses and economic losses from groundwater contamination to include household-level impacts. The findings indicate that households undertake substantial averting actions in response to groundwater contamination and that such actions can have significant economic consequences. The extent and magnitude of avoidance costs documented suggests that policy-makers should give greater attention to this category of economic losses. (Author's abstract)
W91-00086

LONGITUDINAL AND SEASONAL WATER CHEMISTRY VARIATIONS IN A NORTHERN APPALACHIAN STREAM.
Marian Coll., Indianapolis, IN. Dept. of Biology.
For primary bibliographic entry see Field 2K.
W91-00089

POSTTREATMENT EFFECTS OF FOREST FERTILIZATION ON THE PREDOMINANT BENTHIC COMMUNITY OF A HEADWATER STREAM IN EASTERN KENTUCKY.
Southern Illinois Univ., Carbondale. Dept. of Zoology.
M. A. Phillippi, and G. B. Coltharp.
Transactions of the Kentucky Academy of Science TKASAT, Vol. 51, No. 12, p 18-25, March 1990. 6 fig, 1 tab, 32 ref.

Descriptors: *Fertilizers, *Forest fertilization, *Forestry, *Invertebrates, *Kentucky, *Nitrates, *Water pollution effects, Benthic fauna, Biomass, Ephemeroptera, Flies, Plecoptera, Species composition, Species diversity, Streams, Water pollution.

A posttreatment analysis was conducted on the benthic invertebrate community of a small headwater stream in eastern Kentucky that had been affected by a forest fertilization project in 1975. During the biological sampling period (1978-1981), significantly higher concentrations of nitrate-nitrogen were present in the affected stream when compared with two unaffected streams. Standing-crop biomass of invertebrates (wet weight), volumetric displacement, and the number of individuals were not significantly different between the treated stream and one untreated stream, suggesting that the fauna was not using the nitrate-nitrogen subsidy to increase biomass. However, the number of taxa and species diversity (Sequential Comparison Index) were significantly higher in the stream located within the unfertilized watershed. The most abundant invertebrates in both streams were the Diptera, Ephemeroptera, and Pleocoptera. Most species were dipterans. The observed differences between the streams could indicate that the affected stream is in the process of recovery. This possibility seems unlikely considering the length of time since fertilization, the abundant sources of recolonizers, and the absence of any disturbance since fertilization. The benthic fauna is therefore, considered presently unaffected by the previous forest fertilization. (Author's abstract)
W91-00109

INFERENCES ABOUT POINT SOURCE LOADING FROM UPSTREAM/DOWNSTREAM RIVER MONITORING DATA.
International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 5B.
W91-00135

ASPECTS OF CARBON METABOLISM IN THE RECOVERY OF SELENASTRUM CAPRICORNUTUM POPULATIONS EXPOSED TO CADMIUM.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P. A. Thompson, and P. Couture.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 1-14, July 1990. 6 fig, 2 tab, 45 ref. NSERC Canada Grant No. A8123.

Descriptors: *Algae, *Carbon, *Heavy metals, *Toxicity, *Water pollution effects, Adenosine triphosphate, Biological oxidation, Cadmium, Chlorophyta, Lipids, Metabolism, Proteins, Respiration, Trace metals.

The role of macromolecules (proteins, lipids, polysaccharides, low molecular weight metabolites), adenylate nucleotides (ATP, ADP) and respiration was studied in Selenastrum capricornutum populations exposed to Cd to test the hypotheses that C metabolism is stimulated during exposure and recovery, and that growth recovery to Cd is promoted by the activation of an ATP-producing pathway. Populations acclimated to Cd despite growth inhibition. Higher protein and storage product cellular quotas appeared to maintain viability and allow recovery after Cd was complexed by EDTA. Growth recovery was related to a stimulation of respiration (oxidative phosphorylation) above control levels and is accompanied by higher ATP/cell and ATP/ADP ratios. In the more severely stressed population (100 micrograms Cd/L), recovery required the metabolism of lipids; cellular lipid levels first increase, and then at the onset of growth recovery lipids were used as a respiratory substrate. (Author's abstract)
W91-00191

REPRODUCTIVE STRATEGY OF DAPHNIA MAGNA AFFECTS THE SENSITIVITY OF ITS PROGENY IN ACUTE TOXICITY TESTS.
Ministry of Transport and Public Works, Lelystad (Netherlands). Lab. for Ecotoxicology.
For primary bibliographic entry see Field 5A.
W91-00192

INFLUENCE OF PH, TEMPERATURE AND SEDIMENT TYPE ON THE TOXICITY, ACCUMULATION AND DEGRADATION OF PARATHION IN AQUATIC SYSTEMS.
Ohio State Univ., Columbus. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W91-00193

AGE-DEPENDENT CHANGES IN TOXICITY OF N-NITROSO COMPOUNDS TO JAPANESE MEDAKA (ORYZIAS LATIPES) EMBRYOS.
California Univ., Davis. School of Veterinary Medicine.
G. D. Marty, J. M. Nunez, D. J. Lauren, and D. E. Hinton.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 45-62, July 1990. 6 fig, 4 tab, 41 ref. USPHS Grant No. ES-04699 and NIEHS Grant No. 5 T32 ES07055.

Descriptors: *Embryonic growth stage, *Fish physiology, *Mutagens, *Nitroso compounds, *Teratogenic effects, *Toxicity, *Water pollution effects, Animal metabolism, Chronic toxicity, Laboratory methods, Toxicology.

Three different developmental stages of embryonated eggs of Oryzias latipes were exposed to 2-h pulses of a number of different concentrations of N-nitroso-N-methylurea (MNU), N-methyl-N'-nitro-N-nitrosoguanidine (MNNG), and N-nitrosodiethylamine (DENA). Lethality and teratogenic end-points were assessed through 24 h posthatch. MNU (>= 2.5 mM) and MNNG (>= 0.75 mM) exposure at the multicell stage was lethal, but the same exposure during early organogenesis was largely teratogenic. Four days before hatching, embryos were very resistant to MNU and proceeded to hatch normally; 7.5 mM MNU was required to significantly reduce the percent normal hatch. Effects of DENA were equivocal and only seen at the multicell stage. In order to differentiate between potential changes in chorion permeability, and toxicity per cell, the same three stages were exposed to a series of radiolabeled compounds of varying hydrophobicity, and apparent uptake measured. There were no differences in uptake rate or equilibrium concentration between any of the compounds at the different stages. These results suggest that, as in mammals, certain stages of development are more susceptible than others, and that these differences are a result of embryo sensitivity rather than chemical bioavailability. the most sensitive indicator of exposure was posthatch inflation of the swimbladder. Other terata included pericardial edema, anisophthalmia, and partial rupture of the chorion. (Author's abstract)
W91-00194

COMPARATIVE QSAR STUDY ON FRESHWATER AND ESTUARINE TOXICITY.
Fraunhofer-Inst. fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany, F.R.).
M. Nendza, and W. Klein.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 63-73, July 1990. 4 fig, 4 ref, 14 ref.

Descriptors: *Aromatic compounds, *Structure-activity relationships, *Toxicity, *Toxicology, *Water pollution effects, Algae, Bacteria, Benzenes, Crustacea, Estuaries, Fish, Freshwater, Multivariate analysis, Phenols, Regression analysis, Statistical methods.

Biological testing is an expensive and time consuming-tool to assess the hazard of potential toxicants. Classification (i.e. ranking in toxicity) can be achieved using computational techniques and thus compounds to be examined in detail can be identified. Toxicity data obtained with one species are related to the structure of the chemicals, formalized by Quantitative Structure-Activity Relationships (QSARs). Regression analysis was applied to examine the structure-toxicity relationships regarding the acute toxicity of 10 phenol and benzene derivatines to various freshwater and estuarine organisms (fish, algae, crustacea, bacteria) for a series of substituted aromatic compounds. Linear relationships between the toxicity and the log P(oo) partition coefficient have been obtained for non-reactive chemicals. Increased partitioning into lipophilic phases of the biosystem enhances the toxic effect. The structure-toxicity relationships are evaluated with regard to species differences. Multivariate procedures reveal collinearities in the response of several aquatic organisms to aromatic compounds. Analysis of interspecies correlations demonstrates coinciding toxicity ranking with different aquatic test systems for chemicals acting by a uniform mode of action. (Author's abstract)
W91-00195

SEASONAL VARIABILITY IN THE SENSITIVITY OF FRESHWATER LENTIC COMMUNITIES TO A CHRONIC COPPER STRESS.
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner, A. Owen, and M. V. Moore.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 75-92, July 1990. 9 fig, 1 tab, 32 ref.

Descriptors: *Benthic environment, *Bioindicators, *Copper, *Lentic environment, *Seasonal variation, *Water pollution effects, Benthic fauna, Cladocera, Dissolved organic carbon, Ecosystems, Freshwater, Heavy metals, Phytoplankton, Ponds, Trace metals, Zooplankton.

In situ enclosures were used to evaluate differences in the seasonal response of planktonic and benthic communities to chronic Cu exposures in a small, oligotrophic pond. Communities were exposed to 0, 20 or 40 micrograms Cu/L for 5-wk durations during April, June-July and October-November. Both phytoplankton and zooplankton were much more sensitive to Cu in the spring than in the summer or fall. It is postulated that this is because of seasonal changes in the Cu-binding capacity of the pond water due to seasonal changes in dissolved organic carbon concentrations. Cladocerans, which are widely used as invertebrate 'white rats' to evaluate the toxicity of chemicals and predict their effect on freshwater ecosystems, were the least sensitive to Cu of all the zooplankton. This indicates that more caution should be exercised in projecting results of laboratory tests with supposedly sensitive species to complex, natural communities. (Author's abstract)
W91-00196

MODELING THE EFFECT OF ALGAL BIOMASS ON MULTISPECIES AQUATIC MICROCOSMS RESPONSE TO COPPER TOXICITY.
Washington Univ., Seattle. Applied Physics Lab.
G. L. Swartzman, F. B. Taub, J. Meador, C. Huang, and A. Kindig.
Aquatic Toxicology AQTODG, Vol. 17, No. 2, p 93-117, August 1990. 4 fig, 3 ref, 35 ref.

Descriptors: *Algae, *Copper, *Ecosystems, *Mathematical models, *Model studies, *Toxicity, *Water pollution effects, Biomass, Heavy metals, Mathematical equations, Microcosms, Phytoplankton, Statistical analysis, Trace metals, Water chemistry, Zooplankton.

A model was developed to simulate the effects of copper on an aquatic microcosm consisting of 10 phytoplankton species and 5 zooplankton species grown in a defined medium. The Cu toxicity equations in the model were based on the results of single species toxicity tests at different initial cell densities. Model output was evaluated by comparing predictions with results of replicated 35 day microcosm experiments having copper added at 3 different times (days 7, 14 or 21) at 500 ppb concentration. These experiments offered a wide range of plankton and nutrient conditions at the time of Cu addition. The baseline for these experiments was set by a control experiment, with no Cu addition and a model, MICMOD, developed to simulate microcosm behavior. Two toxicity models were tested; the 'neutral' model defined Cu toxicity to plankton as depending only on the dissolved Cu concentration in the medium, while the 'biomass' model also decreased toxicity in proportion to algal biomass. Graphical and statistical comparisons showed the toxicity model including algal biomass to better fit the data. Both the experimental results and the model suggest that the effects of Cu may be strongly influenced by the density and species composition of the biota and the related differences in water chemistry at the time of Cu addition. The apparent importance of algal biomass to Cu toxicity may be due to: (1) changing Cu availability either through direct absorption or adsorption; (2) production of chelates by the algae which complex Cu in less toxic forms; or, (3) changing the pH which affects Cu ionization and particularly the concentration of the cupric ion, Cu(+2), form, which is highly toxic. (Author's abstract)
W91-00197

INDUCED CYTOCHROME P-450 IN INTESTINE AND LIVER OF SPOT (LEIOSTOMUS XANTHURUS) FROM A POLYCYCLIC AROMATIC HYDROCARBON CONTAMINATED ENVIRONMENT.
Virginia Inst. of Marine Science, Gloucester Point.
P. A. Van Veld, D. J. Westbrook, B. R. Woodin, R. C. Hale, and C. L. Smith.
Aquatic Toxicology AQTODG, Vol. 17, No. 2, p 119-131, August 1990. 4 fig, 2 tab, 33 ref. NIH Grant No. CA44306 and ES4220, EPA Cooperative Agreement CR813155.

Descriptors: *Chesapeake Bay, *Cytochromes, *Fish, *Polycyclic aromatic hydrocarbons, *Water pollution effects, Animal metabolism, Bioindicators, Elizabeth River, Fish physiology, Immunoassay, Laboratory methods, Liver, River sediments, Sediment analysis, Sediment contamination.

Levels of total cytochrome P-450, of specific P-450 (determined immunologically with monoclonal antibody MAb 1-12-3 and referred to as P-450E) and ethoxyresorufin O-deethylase (EROD) were elevated in intestine and liver microsomes of spot (Leiostomus xanthurus) collected from the Elizabeth River, a polycyclic aromatic hydrocarbon (PAH) contaminated tributary of Chesapeake Bay. Fish were collected over a sediment PAH concentration gradient that ranged from 9 to 96000 micrograms PAH/kg dry sediment. Intestinal P-450E was near the lower limits of detection in fish collected at the relatively clean sites but was elevated 80-fold to 100-fold in fish collected from contaminated sites. Intestinal EROD activity exhibited a similar trend. Liver P-450E and associated EROD activity was detectable in all samples and was induced approximately eight-fold at the most heavily contaminated site. Despite the sensitivity of the intestine to PAH inducing agents, intestinal P-450E levels did not correlate well with sediment PAH, whereas liver P-450E did. Instead, the intestinal enzyme was induced to similar and high levels at all contaminated sites. The results suggest that the intestine plays an important role in the absorption and metabolism of dietary PAH and/or other PAH-type inducing agents and that intestinal P-450E may be a useful indicator of exposure to these compounds via the diet. (Author's abstract)
W91-00198

FUNCTIONAL AND PATHOLOGICAL IMPAIRMENT OF JAPANESE MEDAKA (ORYZIAS LATIPES) BY LONG-TERM ASBESTOS EXPOSURE.
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
S. E. Belanger, D. S. Cherry, and J. Cairns.
Aquatic Toxicology AQTODG, Vol. 17, No. 2, p 133-154, August 1990. 6 fig, 9 tab, 39 ref. DOI BuMines Grant No. G1174151.

Descriptors: *Asbestos, *Embryonic growth stage, *Fish, *Fish physiology, *Toxicity, *Water pollution effects, Animal metabolism, Animal pathology, Carcinogens, Chronic toxicity, Electron microscopy, Hatching, Histology, Laboratory methods, Toxicology.

Chrysotile asbestos is a fibrous contaminant of water supplies in the United States, Canada and abroad. Evaluations of the effects of chrysotile were made on all life stages of the cyprinodontid fish, the Japanese Medaka (Oryzias latipes). These included: egg hatchability and survival; larval to juvenile growth, survival, histopathology and asbestos bioaccumulation; and adult reproduction and asbestos bioaccumulation. Asbestos did not substantially impair the egg stage at concentrations of less than 100 million fibers/L. Larval and juvenile fish were the most sensitive stages with significant growth reductions occurring at 1-100 million fibers/L and 100% mortality at 10 billion fibers/L in 56 days of exposure. At 10 billion fibers/L, direct evidence (transmission electron microscopy of selected tissues) of chrysotile accumulation was present with concomitant epidermal lesions. A small percentage (5% of those originally exposed) of fish at 10 billion fibers/L developed ventral non-invasive epidermal hyperplastic plaques. Reproduction tests resulted in 33% greater spawning frequency in control populations (compared to 10,000 to 100 million fibers/L) and 25% more viable eggs. It is concluded that chrysotile may represent a significant environmental hazard, especially to young fish, and that asbestos should receive greater attention than it has historically received. (Author's abstract)
W91-00199

AMBIENT AMMONIA, DIET AND GROWTH IN LAKE TROUT.
Guelph Univ. (Ontario). Dept. of Zoology.
F. W. H. Beamish, and A. Tandler.
Aquatic Toxicology AQTODG, Vol. 17, No. 2, p 155-166, August 1990. 1 fig, 3 tab, 48 ref. NSERC Canada Grant No. A3218.

Descriptors: *Ammonia, *Fish growth, *Fish physiology, *Trout, *Water pollution effects, Feeding rates, Fish diets, Toxicity, Toxicology.

Juvenile lake trout were exposed to ambient free (un-ionized) ammonia concentrations of 0, 99, 198 and 297 micrograms NH3-N/L for 60 days and fed one of two diets which were similar in energy concentration. Diet did not influence food intake at ammonia concentrations of 0, 99 and 198 micrograms ammonia nitrogen (NH3-N)/L. Food intake was unaffected by ammonia concentrations of 0 and 99 micrograms NH3-N/L and was only temporarily reduced when ammonia was 198 micrograms NH3-N/L. Trout exposed to 297 micrograms NH3-N/L consumed significantly less food than fish exposed to the lower concentrations of ammonia. Food intake did not differ with diet during the first 30 days of exposure to 297 micrograms NH3-N/L but during the final 30 days, it was higher for trout fed the low protein diet. Growth, measured as a change in live body weight was not influenced by ammonia concentrations of 0, 99 and 198 micrograms NH3-N/L but declined significantly at 297 micrograms NH3-N/L. Weight gain tended to be larger for trout fed the high protein diet. Efficiency of protein-N gain was greater for trout fed the low protein diet, presumably as a consequence of a sparing effect afforded by high dietary lipid. Efficiency of protein-N gain was significantly reduced among lake trout exposed to the highest concentration of ammonia. Mortalities were observed only among trout exposed to the highest concentration of ammonia. (Author's abstract)
W91-00200

ARSENIC-INDUCED ULTRASTRUCTURAL CHANGES IN THE VEGETATIVE CELLS OF CYSTOSEIRA BARBATA FORMA REPENS ZINOVA ET KALUGINA (FUCOPHYCEAE, FUCALES).
Centre Univ. de Luminy, Marseille (France). Lab. de Biologie Marine Fondamentale et Appliquee.
L. Pellegrini, S. G. Delivopoulos, and M. Pellegrini.
Botanica Marina BOTNA7, Vol. 33, No. 3, p 229-234, May 1990. 6 fig, 33 ref. NATO Grant No. 87/0028.

Descriptors: *Arsenic, *Cytology, *Marine algae, *Toxicity, *Water pollution effects, Microscopic analysis, Seawater.

One of the most toxic marine pollutants appears to be arsenic and its accumulation in marine organisms, especially edible algae, has become a serious problem in some countries such as Japan. An attempt was made to observe whether ultrastructurally discernible effects involving any of the cell organelles could be visibly related with the arsenic toxicity on a brown alga a free-living form of Cystoseira barbata which is known for its uptake of metals. The effects of arsenic on the fine structure of this brown alga were examined by incubating the axes of thallus in 20 micrograms As/L of seawater for 6 and 16 days. Important changes were observed in different cell organelles. Mitochondria and golgi cisternae appeared to swell . The chloroplast and thylakoid membranes often became undiscernible. The outer cell walls showed some alterations with a loose arrangement of fibrils. (Hoskin-PTT)
W91-00202

GILL LESIONS IN THE PERCH, ANABAS TESTUDINEUS, SUBJECTED TO SEWAGE TOXICITY.
Gorakhpur Univ. (India). Dept. of Zoology.
A. S. Narain, A. K. Srivastava, and B. B. Singh.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 235-242, August 1990. 6 fig, 16 ref.

Descriptors: *Fish pathology, *Gills, *Histology, *Perch, *Sewage, *Water pollution effects, Animal pathology, India, Microscopic analysis, Municipal wastes, Municipal wastewater, Respiration.

Sewage is a major pollutant of the freshwater bodies of the Gorakhpur region of India. Sewage effluent has been found to cause considerable damage to the freshwater fish and shellfish of this region. This study describes the histopathological changes produced in the gills of the perch, Anabas testudineus, maintained in sewage. Gills were examined microscopically every 24 hr from fish exposed to sewage diluted to 25%. Hyperplasia of branchial epithelium was found to be the most pronounced damage caused by the sewage. This effect appeared by the second day of exposure and advanced progressively. The proliferated gill epithelium exposed to sewage for 6-10 d was also seen to separate from the pilaster stalk and the gill ray in many gill filaments. In a number of secondary gill lamellae of Anabas testudineus damaged by exposure to sewage for 7-10 d the pillar cell system also appeared to collapse. All of these changes would be likely to limit the respiratory capacity of the gills and cause respiratory distress, especially under the high temperature conditions that prevail in the Gorakhpur region. These results strengthen the recommendations that sewage deserves more attention than it presently gets in comparison to other pollutants such as heavy metals and pesticides. (Hoskin-PTT)
W91-00205

IN VITRO INHIBITION OF ACETYLCHOLINESTERASE FROM FOUR MARINE SPECIES BY ORGANOPHOSPHATES AND CARBAMATES.
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes. Lab. of Biochemistry.
For primary bibliographic entry see Field 5A.
W91-00206

BEHAVIORAL CHANGES IN GAMMARUS PULEX AND ITS SIGNIFICANCE IN THE TOXICITY ASSESSMENT OF VERY LOW LEVELS OF ENVIRONMENTAL POLLUTANTS.
Reading Univ. (England). Dept. of Physiology and Biochemistry.
J. T. Borlakoglu, and R. Kickuth.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 258-265, August 1990. 4 fig, 2 tab, 7 ref.

Descriptors: *Acute toxicity, *Animal behavior, *Bioindicators, *Chlorinated hydrocarbons, *Chlorination, *Gammarus, *Phenols, *Water pollution effects, Drinking water, Laboratory methods, Pollutant identification, Toxicity, Toxicology, Water treatment.

Chlorination of drinking water invariably results in the production of a complex, very low-concentration, mixture of chrorophenolic compounds due to the interaction of chlorine with phenolic contaminants. A study was conducted to assess the effects of these chemicals at very low levels. The fresh water amphipod Gammarus pulex, a sensitive indicator organism for environmental pollution, was exposed under controlled conditions to sub-lethal levels of a previously identified major plant-derived chorophenolic derivative. Swimming behavioral changes, escape reactions and measurements of activity of G. pulex were carried out at levels of 5% of the acute oral toxicity level. Sublethal intoxicant effects, defined as changes in expected behavior and biological response, were seen in G. pulex at these exposure levels. The observed changes in swimming behavior and activity of G. pulex are important alterations which could lead to an impaired survival ability in the natural ecosystem. These results suggest that behavioral studies provide important and vital information in understanding the ecotoxicology of environmental pollutants and their ecological significance. (Hoskin-PTT)
W91-00207

EFFECTS OF DELTAMETHRIN AND ETHANOL ON SURVIVAL, AND MECHANICAL RESPONSE OF DAPHNIA SPINULATA.
Universidad Nacional de Lujan (Argentina). Lab. of Ecotoxicology.
J. L. Alberdi, N. O. Santamaria, and D. A. Hernandez.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 266-271, August 1990. 2 fig, 2 tab, 9 ref.

Descriptors: *Acute toxicity, *Biocides, *Daphnia, *Pesticides, *Water pollution effects, Animal behavior, Bioassay, Toxicology.

Deltamethrin (DM) is a powerful biocide, extensively used in domestic pest control and in some agricultural practices. Species of the genus Daphnia are the most frequently used zooplankton organisms in toxicological bioassays. The effects of DM and its solvent on mortality and mechanical response of individuals of D. spinulata were evaluated. These experiments indicated a high sensitivity of D. spinulata to the toxic effect of this pesticide. At 24 hr of exposure, 50% of the individuals died in the concentration range 2.5-10.0 micrograms/L. At 48 hr the mortality increased up to 1.25 micrograms/L. At 72 hr, 45% of the individuals were dead in the lowest assayed concentration (0.31 micrograms/L). In the mechanical stimulus tests, no significant changes were observed at 48 hr exposure with concentrations of 0.31-0.62 micrograms/L. The survivors at 1.25 micrograms DM/L showed intoxication, indicated by a motor inability to get an effective response to mechanical stimulus. (Hoskin-PTT)
W91-00208

COMPARATIVE TOXICITY OF AN EFFLUENT FROM A CHLOR-ALKALI INDUSTRY AND HGCL2.
Berhampur Univ. (India). Dept. of Botany.
B. P. Shaw, and A. K. Panigrahi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 280-287, August 1990. 1 fig, 2 tab, 16 ref.

Descriptors: *Acute toxicity, *Industrial wastes, *Mercury, *Water pollution effects, *Water pollution sources, Alkalinity, Biological oxygen demand, Chemical oxygen demand, Heavy metals, Hydrogen ion concentration, India, Perch, Pollutant identification, Tilapia, Toxicology.

Though no Hg is utilized in the production process of a chlor-alkali plant, Hg is used as a cathode in the electrolytic process and some losses are inevitable. A toxicity assessment was performed on the effluent from a chlor-alkali factory in Ganjam, Orissa, India, whose effluent contains Hg ranging up to 1.5 mg/L. Whether the Hg present in the effluent caused the toxicity and whether the toxicity involved some other parameters of the effluent

as well were also studied. Two freshwater fish, Anabas scandens and Tilapia mossambica, were selected for the toxicity study. It was found that chemical oxygen demand (COD), biological oxygen demand (BOD), Hg, alkalinity and pH all contribute to the toxicity of the plant effluent. Mean BOD and COD values were as high as 69+/-18 mg/L and 448+/-120 mg/L, respectively. The total Hg level was 0.68+/-0.46 mg/L, out of which 0.15+/-0.18 mg/L was present in soluble form. The pH (10.31+/-0.98) and the alkalinity (620+/-385 mg/L) values were also very high. The effluent was highly toxic: 90% of A. scandens and T. mossambica died at 60% and 50% of the effluent concentration, respectively. At concentrations of 80-100% effluent, both species of fish died with 5-10 min. Comparison of tests performed using controlled amounts of HgCl2 with the effluent toxicity indicated that the Hg present in the effluent did not play any vital role in determining the acute lethal effect of the effluent. The lowest concentration of Hg (in the form of HgCl2) resulting in 50% death was 1.2 mg/L, a concentration much higher than the effluent's Hg content. It is clear from this study that the effluent studied is not fit for disposal into any water body as it will be hazardous to aquatic life. (Hoskin-PTT)
W91-00210

SEASONAL CHANGES IN THE TESTES OF FISH PUNTIUS TICTO, AND THEIR RELATION TO HEAVY METAL TOXICITY.
Holkar Science Coll., Indore (India). Dept. of Zoology.
R. Pundir, and A. B. Saxena.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 288-293, August 1990. 1 tab, 8 ref.

Descriptors: *Acute toxicity, *Cadmium, *Fish, *Heavy metals, *Water pollution effects, Aquatic productivity, Cytology, Histology, Microscopic analysis, Seasonal variation, Toxicology, Trace metals.

Seasonal environmental changes interacting with internal rhythms, regulate seasonal reproductive activity in fish. Other environmental factors impinge on organism's receptors and through them affect the central nervous system, hypothalamus, pituitary and finally the gonads. This study was performed to observe seasonal changes in the testes of the fish Puntius ticto and their relation to heavy metal toxicity. To observe the effect of heavy metals on the seasonal variation in testes, the fishes were captured in the wild during various seasons, brought to the laboratory and kept in a sublethal concentration (26 mg/L) of cadmium acetate for a 96-hr period. Cd treatment in the months October to December, a period of spermatogonial proliferation, produced some abnormal cytology. Fish treated in the months February to April, the early stage of testicular maturation, showed degenerative changes in the testes. Cd treatment in the months April to June, the advanced stage of testicular maturation, exhibited deformed testicular structure and spermatocyte destruction. Fish treated in the months July to September, a phase of functional maturation of the spermatogenetic tissue, produced deformities of spermatocytes, spermatids and spermatozoa. It thus appears from the present study that testicular cycle of Puntius ticto is adversely influenced by the heavy metal (Cd) treatment. (Hoskin-PTT)
W91-00211

BIOACCUMULATION OF MERCURY AND ITS EFFECT ON PROTEIN METABOLISM OF THE WATER HYACINTH WEEVIL NEOCHETINA EICHHORNAE (WARNER).
Indian Inst. of Chemical Technology, Hyderabad. Biology Group.
M. S. Hussain, and K. Jamil.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 294-298, August 1990. 2 tab, 18 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Mercury, *Path of pollutants, *Water beetles, *Water hyacinth, *Water pollution effects, Amino acids, Animal metabolism, Enzymes, Feeding rates, Proteins, Trace metals.

Water hyacinth growth is kept under control by the weed eating weevils Neochetina eichhornae and N. bruchi. Water hyacinth plants are continuously subjected to contamination by Hg and other heavy metals, but little is known about the interaction of heavy metals/plants/insects. The present study was performed to examine the bioaccumulation of Hg through the food chain in N. eichhornae and its impact on the beetle's protein metabolism. Hyacinths were grown in the laboratory at concentrations of mercuric chloride of 25, 50 and 75 ppm for 1 week. Leaves were then analyzed and fed to the weevils for 1 week. After one week the uptake of Hg by the plants was about 70-75%. A concentration dependent accumulation of Hg in water hyacinth leaves was found over a period of one week. At 25 ppm the total Hg accumulated was 15.16 micrograms/100 mg of leaves in male insects and 14.81 micrograms/100 mg in females. A similar pattern of bioaccumulation was observed at 50 and 75 ppm. It was also observed that the feeding of insects declined as the Hg concentration increased in the plants, an apparent avoidance mechanism of the insect to the toxicant. Hg was seen to interfere in the normal protein metabolism of the weevils, resulting in lower total protein content, higher levels of free amino acids and higher levels of aminotransferases, enzymes known to increase in these under stress conditions. The changes were most significant at 25 ppm Hg, which may be due to the decreased feeding rates at higher Hg concentrations. (Hoskin-PTT)
W91-00212

GONADAL HISTOPATHOLOGY FOLLOWING NICKEL INTOXICATION IN THE GIANT GAURAMI COLISA FASCIATUS (BLOCH AND SCHNEIDER), A FRESHWATER TROPICAL PERCH.
Gorakhpur Univ. (India). Dept. of Zoology.
K. Nath, and N. Kumar.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 299-304, August 1990. 6 fig, 12 ref.

Descriptors: *Acute toxicity, *Animal pathology, *Fish, *Heavy metals, *Nickel, *Perch, *Water pollution effects, Aquatic productivity, Histology, Microscopic analysis, Toxicity, Toxicology, Trace metals.

Very scanty data is available concerning the histopathological impact of nickel on fish tissues. In the present investigation, the impact of Ni on the histological architecture of gonads of both sexes of a freshwater tropical perch, Colisa fasciatus have been assessed. Adult, sexually-mature, gauramis were exposed to a sublethal concentration of nickel sulfate (64 mg/L) for 96 hr. Testis of the Ni-exposed fish exhibited marked degenerative alterations. There was general disorganization in the testicular lobules and spermatogenic activity was severely reduced. In female gouramis, ovaries presented significant alterations in the histological architecture, including the absorption of several oocytes. Thus sublethal Ni intoxication can result in significant reproductive impairment in this fish species. (Hoskin-PTT)
W91-00213

EFFECT OF CADMIUM ON BLOOD OF TILAPIA, OREOCHROMIS MOSSAMBICUS (PETERS), DURING PROLONGED EXPOSURE.
National Inst. of Occupational Health, Ahmedabad (India). Aquatic Toxicology Lab.
S. G. Ruparelia, Y. Verma, S. R. Salyed, and U. M. Rawal.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 305-312, August 1990. 2 fig, 3 tab, 17 ref.

Descriptors: *Blood, *Cadmium, *Chronic toxicity, *Heavy metals, *Tilapia, *Water pollution effects, Alkalinity, Cytology, Hardness, Toxicity, Toxicology, Trace metals.

Recent reviews on Cd have reported on acute and subacute effects on fish, mechanisms of toxicity, the role of toxicity-modifying factors and various sublethal effects, i.e. hematological and biochemical disorders. However, very little information is available on the subacute effects of Cd on the blood of fish exposed in hard water. The present study was carried out to observe the effects of Cd on the blood of tilapia (Oreochromis mossambicus) in hard and alkaline water to determine whether Cd causes changes in blood of fish kept in hard water in the same way that it causes changes in blood of fish kept in soft water. Tilapia were exposed to 0, 0.1, 1.0 and 10.0 ppm Cd for a period of 1, 3, 7, 14, 21 and 45 days in water at a hardness of 177.55+/-2.94 ppm. Hemoglobin, hemocrits and red blood cell counts all decreased significantly for fish exposed to Cd, with these abnormalities appearing earlier for higher Cd concentrations. Red blood cell indices such as mean cell volume, also were deranged for Cd-exposed tilapia. Macrocytic normochromic anemia with thrombocytosis, neutrophilia and cytological shift between large and small lymphocytes occurred in the studied fish during prolonged exposure to Cd in alkaline and hard water. These results were similar to those seen for other fish species in soft water. (Hoskin-PTT)
W91-00214

RECONNAISSANCE INVESTIGATION OF WATER QUALITY, BOTTOM SEDIMENT, AND BIOTA ASSOCIATED WITH IRRIGATION DRAINAGE IN AND NEAR STILLWATER WILDLIFE MANAGEMENT AREA, CHURCHILL COUNTY, NEVADA, 1986-87.
Geological Survey, Carson City, NV.
R. J. Hoffman, R. J. Hallock, T. G. Rowe, M. S. Lico, and H. L. Burge.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4105, 1990. 150p, 1 plate, 32 fig, 19 tab, 88 ref. Prepared in cooperation with the U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation.

Descriptors: *Aquatic life, *Bottom sediments, *Irrigation effects, *Nevada, *Nonpoint pollution sources, *Water pollution sources, *Water quality, Ecological effects, Nutrients, Pesticides, Radioisotopes, Trace elements.

An investigation was initiated to determine whether irrigation drainage in and near the Stillwater Wildlife Management Area has caused or has potential to cause harmful effects on human health or fish and wildlife, or may adversely affect the suitability of water for beneficial uses. Samples of surface and groundwater, bottom sediment, and biota were collected from sites upstream and downstream from the Fallon agricultural area in the Carson Desert and were analyzed for potentially toxic trace elements, including selenium. Other analyses included radioactive substances, major dissolved constituents, and nutrients in water, and pesticide residues in bottom sediments and biota. In areas affected by irrigation drainage, concentrations of the following constituents commonly were found to exceed baseline concentrations or federal and state criteria for the protection of aquatic life or the propagation of wildlife: In water, arsenic, boron, dissolved solids, sodium, and un-ionized ammonia; in bottom sediments, arsenic, lithium, mercury, molybdenum, and selenium; and in biota, arsenic, boron, chromium, copper, mercury, selenium, and zinc. In some wetlands, selenium and mercury appear to be biomagnified whereas arsenic is bioaccumulated (uptake by biota is several orders of magnitude greater than the concentrations in water or food). Some radioactive substances were substantially higher at the downstream sites compared with upstream background sites, but the significance of this to wildlife is unknown at present. Pesticide contamination in bottom sediments and biota was insignificant. Adverse biological effects observed during this reconnaissance included gradual vegetative changes and species loss, fish die-offs, waterfowl disease epidemics, and persistent and unexplained deaths of migratory birds. (Author's abstract)
W91-00351

EFFECT OF HUMIC SUBSTANCES ON THE TOXICITY OF ALUMINUM TO ADULT RAINBOW TROUT, ONCORHYNCHUS MYKISS (WALBAUM).
Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
H. E. Witters, S. Van Puymbroeck, J. H. D. Vangenechten, and O. L. J. Vanderborght.
Journal of Fish Biology JFIBA9, Vol. 37, No. 1, p 43-53, July 1990. 2 fig, 3 tab, 25 ref. Commission of the European Communities DGXII contract no. EV40116B.

Descriptors: *Acid rain effects, *Acidic water, *Acute toxicity, *Aluminum, *Chemical speciation, *Humic substances, *Trout, *Water pollution effects, Acid lakes, Bioaccumulation, Blood, Chemical analysis, Fate of pollutants, Fish physiology, Gills, Hydrogen ion concentration, Path of pollutants, Toxicity, Toxicology.

Much of the mortality of freshwater organisms in acidified lakes is due to the combined adverse effects of both low pH and elevated Al concentrations. The present study was conducted to evaluate the toxicity of Al in the presence of widespread natural complexing ligands: humic substances. Some physiological parameters were measured in adult rainbow trout during a 10-day exposure to 180 micrograms/L Al in acid water (pH 4-7) with or without humic substances (10 mg/L). The fish were acclimatized to pH 5.0 for 7 days prior to the experimental treatments. Chemical analyses revealed that, in the presence of humic substances, 74-80% of the Al was organic bound, while in the absence of humic substances, most of the Al (98%) occurred in the inorganic form. Al bound to humic substances (130-150 micrograms/L) did not alter the plasma NaCl concentration, nor the hematocrit value, of rainbow trout during an exposure period of 10 days. This contrasts with the high death rate obtained within 2-3 days when most of the Al (175 micrograms/L) was in the inorganic form. The lethality was accompanied by a 25% decrease in the plasma concentration of NaCl and a doubling of the hematocrit value. Bulk analysis revealed that when the metal was present in inorganic forms the total Al content of the gills (75 micrograms Al/g wet weight) was 15 times higher than when it was present as bound to the humic substances. These experiments showed that the accumulation of Al at the gills was accompanied by physiological disturbances, both being a function of the chemical speciation of Al. (Author's abstract)
W91-00371

ECOTOXICOLOGY: CONTAMINATION OF THE RHINE BY THE SANDOZ CHEMICAL ACCIDENT IN BASEL (OKOTOXIKOLOGIE AM BEISPIEL DER RHEINVERSCHMUTZUNG DURCH DEN CHEMIE-UNFALL BEI SADOZ IN BASEL).
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
H. Guttinger, and W. Stumm.
Naturwissenschaften NATWAY, Vol. 77, No. 6, p 253-261, June 1990. 6 fig, 4 tab, 23 ref. English summary.

Descriptors: *Accidents, *Agricultural chemicals, *Rhine River, *Toxicology, *Water pollution effects, Chronic toxicity, Ecosystems, Fish.

A fire at a chemical manufacturing plant at Schweizerhalle (near Basel) in November 1986 and the subsequent release of toxic agrochemicals into the Rhine River is taken as a basis to discuss some problems and needs in ecotoxicological research. Especially serious is the lack of knowledge about chronic effects of mixtures of chemicals to individuals and whole ecosystems. There is an urgent need for generally applicable principles and concepts. A discussion of the relationship between toxic effects to fish, exposure time, and concentration provides some hints about the direction towards which research should proceed. Finally, eight theses pertaining to ecotoxicology summarize what can be learned from the analysis of a chemical spill. (Author's abstract)
W91-00384

EFFECTS OF WASTES ON THE OCEAN: THE COASTAL EXAMPLE.
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
J. E. M. Capuzzo.
Oceanus OCEAAK, Vol. 33, No. 2, p 39-44, Summer 1990. 3 fig.

Descriptors: *Coastal zone management, *Marine environment, *Ocean dumping, *Path of pollutants, *Waste management, *Water pollution effects, Bioconcentration, Environmental policy, Fate of pollutants, Food chains, Industrial wastes, Marine biology, Marine resources, Marine sediments, Municipal wastes, Toxic wastes, Waste disposal.

Extending from the shore to the edge of the continental shelf, the coastal ocean is one of the most productive ecosystems in the world, providing 50% of the world's fisheries harvests, and the breeding and nursery grounds of many commercially important species. It receives a wide range of contaminants from human society, including discharges from industrial and municipal wastes, dredged material, atmospheric fallout, polluted river discharge and deliberate marine disposal of industrial and municipal wastes. The distribution, fate, and effects of contaminants in coastal marine environments are governed by natural processes that influence their persistence and availability to marine animals. Bioaccumulation can lead to increased levels of contaminants higher in the marine food chain. they may lead to specific ecological changes resulting in the destruction of commercially important species, and the contamination of human food sources. Exposure standards for human health exist for only a few contaminants, such as polychlorinated biphenyls, mercury, and DDT. There is considerable variation in policy recommendations from different agencies regarding seafood safety issues, resulting from different methods of analysis and risk assessment, and in the inherent assumptions used in establishing ostensibly safe limits. The first step in developing wise management of ocean-disposal policy is to control more tightly the production and utilization of toxic chemicals, and reduce their amounts in wastes. To develop regulations for handling the unavoidable waste that remains, additional information is required: the physical processes, (specifically currents) that influence contaminant distribution; the chemical processes that influence availability, persistence and degradation of these materials in sediment and water; and the long-term biological effects that alter the stability of animal populations and the consequences of those effects on recreational and commercial fisheries. Only through multidisciplinary studies involving ecologists, toxicologists and oceanographers will we develop the understanding of the causal relationship between pollution and coastal degradation and develop predictive approaches to environmental monitoring that will, in turn, enable the development of environmentally sound waste-disposal options. (Hoskin-PTT)
W91-00385

DETECTING THE BIOLOGICAL EFFECTS OF DEEP-SEA WASTE DISPOSAL.
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 5A.
W91-00386

RESPONSES OF ZOOPLANKTON AND ZOOBENTHOS TO EXPERIMENTAL ACIDIFICATION IN A HIGH-ELEVATION LAKE (SIERRA NEVADA, CALIFORNIA, U.S.A).
California Univ., Santa Barbara. Dept. of Biological Sciences.
L. A. Barmuta, S. D. Cooper, S. K. Hamilton, K. W. Kratz, and J. M. Melack.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 571-586, June 1990. 5 fig, 5 tab, 42 ref. California Air Resources Board Contract A6-184-32.

Descriptors: *Acid rain effects, *Acidification, *Aquatic life, *Lake acidification, *Lakes, *Plankton, *Sierra Nevada, *Water pollution effects, *Zooplankton, Altitude, Bioindicators, California, Competition, Copepods, Crustaceans, Indicators.

During the summer of 1987 an acidification experiment was conducted using large enclosures at Emerald Lake, a dilute, high-elevation lake in the Sierra Nevada, California, U.S.A. The experiment was designed to examine the effects of acidification on the zooplankton and zoobenthos assemblages of Sierran lakes. Treatments consisted of a control (pH 6.3) and pH levels of 5.8, 5.4, 5.3, 5.0 and 4.7; each treatment was run in triplicate. The experiment lasted 35 days. The zooplankton assemblage was sensitive to acidification. Daphnia rosea Sars emend. Richard and Diaptomus signicauda Lilljeborg decreased in abundance below pH 5.5-5.8, and virtually disappeared below ph 5.0 Bosmina longirostris (Muller) and Keratella taurocephala Ahlstrom became more abundant with decreasing pH, although B. longirostris was rare in the pH 4.7 treatment. These species might serve as reliable indicators of early acidification in lakes such as Emerald Lake. The elimination of D. rosea in acidified treatments probably allowed the more acid-tolerant taxa to increase in abundance because interspecific competition was reduced. Even slight acidification can therefore alter the structure of the zooplankton assemblage. In contrast to the zooplankton, there was no evidence that the zoobenthos in the enclosures was affected by acidification. (Author's abstract)
W91-00425

MACROFAUNA DISTRIBUTIONS AND SEDIMENT ANALYSES FROM THE BRUNSWICK, GEORGIA OCEAN DREDGED MATERIAL DISPOSAL SITE AND ENVIRONS.
Georgia Univ., Savannah. Marine Extension Service.
For primary bibliographic entry see Field 5E.
W91-00444

INTERIM: SELECTED CHEMICAL RESEARCH REPORTED BETWEEN CONFERENCES FIVE AND SIX.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5F.
W91-00477

HEALTH EFFECTS OF DISINFECTANTS AND DISINFECTION BY-PRODUCTS: A REGULATORY PERSPECTIVE.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5F.
W91-00482

TRIHALOMETHANES: IS SWIMMING POOL WATER HAZARDOUS.
For primary bibliographic entry see Field 5F.
W91-00484

COMPARISON OF MUTAGENIC ACTIVITY OF CHLORINATED AQUATIC AND COMMERCIAL HUMIC SUBSTANCES.
Environmental Protection Agency, Cincinnati, OH.
F. C. Kopler, H. P. Ringhand, J. R. Meier, and W. Kaylor.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 147-158, 2 fig, 5 tab, 17 ref.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Disinfection, *Humic substances, *Mutagens, *Water pollution effects, *Water treatment, Ames assay, Bioassay, Comparison studies, Humic acids.

One of the most important objectives of the US EPA research effort on the health effects of drinking water contaminants is to determine if adverse effects result from the presence of disinfection by-products in the finished water. The first attempts to produce samples of disinfection by-products to determine the potential health effects were per-

formed by concentrating organic fractions from representative waters before and after disinfection. The samples were further concentrated by freeze drying to volumes between 0.01 and 0.005 of the original concentration and filtered to remove precipitated salts. Two major problems were encountered with this approach: cost, and that the recovery of the compounds present in the water samples is not easily determined. When it became necessary to conduct long-term studies to address the health effects that may be associated with the by-products of disinfection, a decision was made to use a commercially available humic acid that could be dissolved and treated with disinfectant in the laboratory under reproducible conditions. The major advantages to using these laboratory-chlorinated humic acid solutions for biological testing instead of samples prepared by concentrating drinking water are that: (1) it is much less expensive; (2) chlorinated humic acid solutions can be prepared in sufficiently high concentrations for direct biological testing; (3) source water for any drinking water treatment plant changes constant, so even if the recovery efficiency for the organic compounds were known, this variable can prevent any dose certainty in administering to test organisms; and (4) samples prepared by chlorinating humic acid solutions remain in aqueous solution without a high salt concentration. Ames assay results obtained with the various chlorinated humic substances are essentially the same regardless of their sources. Results obtained with the chlorinated fulvic acid solution are very similar to those observed for concentrates of chlorinated drinking water and to tests on a known chlorine-humic acid by-product, MX. (See also W91-00476) (Lantz-PTT)
W91-00488

MUTAGENICITY OF THE NONVOLATILE REACTION PRODUCTS OF AQUEOUS CHLORINATION OF L-TRYPTOPHAN.
Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
J. O. Yaw, W. B. Wheeler, and C. I. Wei.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 179-191, 1 fig, 4 tab, 30 ref. EPA Grant No. R-810416.

Descriptors: *Chemical reactions, *Chlorination, *Disinfection, *Tryptophan, *Water pollution effects, *Water treatment, Ames test, Chlorine compounds, Detritus, Fulvic acids, Humic acids, Mutagens, Toxicity.

During water chlorination, a number of halogenated and nonhalogenated by-products are produced from the reactions of free chlorine and decaying vegetation (fulvic and humic substances) and other biological materials present in water, including amino acids and proteins. Many chlorination reaction products and chlorinating agents such as hypocholorites have been shown to be mutagenic or carcinogenic. Amino acids are of particular concern. The nature of mutagens produced by aqueous chlorination of L-tryptophan was studied. Liquid-liquid extraction was used to extract reaction products following pH adjustments of the reaction mixture. The different fractions were tested using the Ames mutagenicity test. The neutral ethyl ether extract showed potent bacterial mutagenic activity and was further tested using sister chromatid exchange in Chinese hamster ovary cells. Gas chromatography/mass spectrometry was used to try to identify some of the by-products formed. Tryptophan reacted readily with different molar concentrations of aqueous chlorine, and the aqueous reaction products exhibited mutagenic activity in both tester strains at all levels used. The mutagens formed were not very stable. (See also W91-00476) (Lantz-PTT)
W91-00491

CARCINOGENICITY OF CHLORINATED ACETIC ACIDS.
Health Effects Research Lab., Cincinnati, OH. Toxicology and Microbiology Div.
A. B DeAngelo, and L. P. McMillan.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 193-199, 1 fig, 4 tab, 15 ref. EPA Contract No. 68-03-3215.

Descriptors: *Acetic acid, *Carcinogens, *Chlorination, *Disinfection, *Drinking water, *Toxicity, *Water pollution effects, Dichloroacetic acid, Mammals, Public health, Trichloroacetic acid, Water treatment.

The discovery of haloacetic acids, dichloroacetic acid (DCA) and trichloroacetic acid (TCA), in finished drinking water at levels comparable to the concentration of chloroform, and the demonstration of their formation in the gut following ingestion of water containing sodium hypochlorite, increased concern about the health effects of chronic exposure to these chemicals. Liver enlargement is a characteristic response of laboratory animals exposed to xenobiotic chemicals and can result from a combination of cellular hyperplasia and hypertrophy. This enlargement represents an adaptive response to metabolic alterations induced by xenobiotics. Both the DCA and TCA increased liver weights in exposed mice, and the degree of enlargement correlated with the carcinogenicity of the acid. Results of the study indicate that: (1) DCA and TCA produced liver cancer in mice without prior initiation by ethylnitrosourea. DCA appeared to be a more potent carcinogen than TCA; (2) peroxisome proliferation did not appear to be a primary mechanism underlying the carcinogenicity of the chloroacteic acids; and (3) the role of cellular hyperplasia in DCA and TCA carcinogenesis was not determined and requires further study. (See also W91-00476) (Lantz-PTT)
W91-00492

COMPARISON OF DRINKING WATER DISINFECTANTS USING MUTAGENICITY TESTING.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-00493

MUTAGENIC ACTIVITY OF CONCENTRATED WATER EXTRACTS IN CULTURED MAMMALIAN CELLS AND DROSOPHILA MELANOGASTER.
Research Ltd., Ware (England). Genetic Toxicology Section.
P. Wilcox, S. Williamson, and R. Tye.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 239-260, 3 fig, 6 tab, 29 ref.

Descriptors: *Chlorination, *Disinfection, *Flies, *Mammals, *Mutagens, *Water pollution effects, *Water treatment, Bioassay, Chemical reactions, Drinking water, Toxicity.

Some raw water sources used for drinking abstraction contain mutagenic pollutants. Most of the activity in final drinking water is produced when it is disinfected with chlorine. The identity of the compounds responsible for most of the mutagenicity is still unknown, but they are believed to be reaction products between chlorine and naturally occurring organics in the water, such as humic, fulvic, and amino acids. Two studies were conducted using Drosophila. In a preliminary toxicity study, no significant difference in survival or fertility was seen between the vehicle control and flies treated with drinking water extracts. There was no obvious frequency of sex-linked recessive lethal mutations except in the flies treated with positive control (EMS). In study no. 2 the flies were allowed to feed on 1% sucrose solutions prepared using either meat or half-strength water extracts for three consecutive days. With this extended exposure period, some toxicity was observed in the flies exposed to the water extract, with only 74 of 150 flies surviving in the top dose group. Exposure to the water extract did not produce any significant increase in the frequency of sex linked mutations. This experiment demonstrates that drinking water extracts will also induce structural chromosome damage in human lymphocytes. Although clear evidence of clastogenic activity was observed, the results obtained in mammalian cell point mutation assays were not convincing. (See also W91-00476) (Lantz-PTT)
W91-00495

TOXICOLOGICAL EFFECTS ASSOCIATED WITH DRINKING WATER DISINFECTANTS AND THEIR BY-PRODUCTS.
Dugway Proving Ground, UT.
L. W. Condie.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 281-292, 3 tab, 43 ref.

Descriptors: *Chlorination, *Chlorine dioxide, *Disinfection, *Drinking water, *Toxicity, *Water pollution effects, Bioassay, Trihalomethanes, Water treatment.

The Toxicology and Microbiology Division of the Health Effects Research Laboratory (TMD-HERL) of the EPA has been conducting and sponsoring toxicology research to evaluate the possible adverse health effects of various disinfectants and their by-products. A research program at TMD-HERL has revealed that the drinking water disinfectant and disinfection by-product issue is more complex than previously thought. Initially, the primary concern was the production of trihalomethanes (THMs) from chlorination of drinking water. The solution to this problem was to use alternative disinfectants such as ClO2 that did not produce THMs. Additional problems have been identified with the disinfection practices of Cl2 and ClO2. A variety of chlorination by-products have been identified in addition to THMs. Many of the identified by-products have been demonstrated to possess mutagenic or carcinogenic properties. At levels as low as 50 ppm, ClO2 produces signs of hemolytic stress in animals. Because of concerns about the hemolytic and thyroid effects of ClO2 and ionized ClO2, it has been recommended that total residues of these products not exceed 1 ppm in finished drinking water. ClO2 at low doses (2 ppm) coupled with a marginal calcium diet produced elevations in serum cholesterol and evidence of atherosclerosis when pigeons received normal and high lipid diets. ClO2 at higher doses (15 ppm) was shown to elevate serum cholesterol only when the experimental animals were maintained on a marginal calcium, high lipid diet. If these findings are borne out in species such as man, serious consequences may result from disinfection of drinking water, because a high fat diet with low calcium consumption are common in the United States. (See also W91-00476) (Lantz-PTT)
W91-00497

ASSOCIATION BETWEEN CHLORINATED DRINKING WATER AND DECREASED SERUM HDLC IN TWO MONKEY SPECIES DURING DIETARY ATHEROGENIC STRESS.
Environmental Protection Agency, Cincinnati, OH.
J. P. Bercz, L. Jones, T. Mills, J. Stober, and J. Cicmanec.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 293-299, 3 tab, 18 ref.

Descriptors: *Chlorination, *Disinfection, *Drinking water, *Mammals, *Water pollution effects, Hyperlipidemia, Mutagens, Organic compounds, Toxicity.

Chlorine treatment of surface water as practiced in municipal water treatment plants is known to generate halogenic molecules from naturally occurring organics. Some such exogenous by-products of disinfection were shown to be mutagens and suspected carcinogens. The gastrointestinal fate of the highly reactive chlorine species is manifested in the endogenous (intra-alimetary) organifications of chlorine, giving rise to halogenated, and oxidized nutrients. Recently an association was found between water chlorination and increased serum cholesterol in Wisconsin communities. As an adjunct to EPA's ongoing clinical trial with chlorinated drinking water the hypothesis that subchronic consumption of superchlorinated water (0.17 and 0.84 mmol) influences hyperlipidemia induced in nonhuman primates by the atherogenic diet was tested. Additionally, the effect of hypochlorite (OCl) on serum lipids and lipoproteins was examined in the same monkey colony, in the absence of dietary stress. A hyperlipidemic diet was administered ad libitum and supplemented with fruit rations. Throughout the 0.84-mmol OCl period, water and food consumption were measured daily, and cholesterol and chlorine doses were computed. From the data, ingestion of chlorinated water apparently may have some as yet unknown exacerbating effect on the course of dietary hyperlipidemia. Because a zero chlorine-dose group was not available in this study, the possibility that the interpretation of the data is confounded by stress-induced lipoprotein changes cannot be ruled out. (See also W91-00476) (Lantz-PTT)
W91-00498

EFFECTS OF DRINKING WATER CHLORINE ON HUMAN LIPID AND THYROID METABOLISM.
Cincinnati Univ., OH. Coll. of Medicine.
R. G. Wones, L. Mieczkowski, and L. A. Frohman.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 301-308, 3 fig, 1 tab, 9 ref.

Descriptors: *Chlorination, *Chlorine, *Disinfection, *Drinking water, *Human physiology, *Water pollution effects, *Water treatment, Human pathology, Lipids, Public health, Thyroid.

Animal studies have shown that chlorine in drinking water can raise levels of plasma cholesterol and lower levels of serum thyroxine. These effects were most prominent when the animals were fed a calcium-deficient, high cholesterol, high-fat diet. Under these conditions, biologically and statistically significant effects were seen at concentrations of chlorine typically consumed by humans. The purpose of this study was to explore whether chlorine at concentrations typically found in drinking water affects human lipid and thyroid metabolism. Nineteen healthy men who were not receiving medications, who ranged in age from 24 to 62, were used in the study. Each subject served as his own control, and there was no separate, comparison control group that did not receive chlorine. While diet and other factors known to affect lipid and thyroid metabolism were very carefully controlled, one cannot be absolutely certain with this study design that the observed changes were not caused by effects of the diet or the protocol independent of the administration of chlorine. This controlled metabolic trial demonstrated that chlorine in drinking water at concentrations potentially consumed by humans may raise total plasma cholesterol and serum thyroxine. The changes are much smaller in magnitude than changes seen in animals and are of questionable clinical significance. Because this protocol was a pilot study for humans and was designed to maximize the chances of finding small differences, further research is necessary to better define and confirm these results. (See also W91-00476) (Lantz-PTT)
W91-00499

EFFECT OF DRINKING WATER CONTAINING CHLORINE AND MONOCHLORAMINE ON CHOLESTEROL AND TRIGLYCERIDE LEVELS IN THE LIVER OF THE PIGEON AND RABBIT.
Oak Ridge Research Inst., TN.
N. W. Revis, G. Holdsworth, and P. McCauley.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 309-317, 5 fig, 14 ref.

Descriptors: *Animal physiology, *Chlorination, *Disinfection, *Drinking water, *Liver, *Monochloramine, *Water pollution effects, *Water treatment, Birds, Cholesterol, Mammals, Triglycerides.

Previously, significant increases in plasma cholesterol in pigeons exposed to chlorine and monochloramine for periods of up to nine months were observed. However, in rabbits, plasma cholesterol remained normal following exposure to these disinfectants for similar periods. In both the pigeon and the rabbit liver, cholesterol increased significantly following 3 months of exposure to 15 ppm chlorine. During this same period, plasma cholesterol was significantly elevated following three months of exposure to 15 ppm chlorine. During this same period, plasma cholesterol was significantly elevated only in pigeons given these disinfectants. Following nine months of exposure, plasma cholesterol was elevated in the pigeon, but not in the rabbit. In contrast, liver cholesterol in the rabbit was significantly increased at 3 to 9 months of exposure, where as in the pigeon, cholesterol levels in the liver remained normal at nine months of exposure. These results suggest that chlorine affects the excretion of cholesterol from the liver in both species. Although liver cholesterol and triglycerides were increased following the exposure to chlorine and monochloramine, a clear dose response effect between these lipids and the drinking water disinfectants was not observed. To determine the effect of dietary calcium on liver cholesterol in the presence of the disinfectants, animals were given both a deficient and an adequate calcium diet. Results showed that calcium alone did not significantly affect liver cholesterol levels. However, liver cholesterol in the rabbit exposed to 6 ppm chlorine and monochlorine was higher when calcium was adequate. (See also W91-00476) (Lantz-PTT)
W91-00500

LONG-TERM EFFECTS OF CHLORINE-CONTAINING DISINFECTANTS ON PLASMA LEVELS OF CHOLESTEROL AND THYROXINE IN RABBITS AND PIGEONS.
Oak Ridge Research Inst., TN.
G. Holdsworth, and P. McCauley.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 319-328, 4 tab, 11 ref. EPA Contract No. 68-03-3201.

Descriptors: *Chlorination, *Disinfection, *Water pollution effects, *Water treatment, Animal physiology, Birds, Cholesterol, Mammals, Public health, Thyroxine.

To delineate the possible associations between chlorine in drinking water and plasma cholesterol, and to investigate the possible mechanisms by which these parameters may be linked, the long term (9 months) effects of the drinking water disinfectants chlorine and monochloramine on cholesterol levels of thyroxine (TH) were studied. Reduced T4 levels in plasma were shown to be associated with hypercholesterolemia in humans and in the white Carneau pigeon, and might be an important determinant of cardiovascular risk. Almost no statistically significant effects of drinking water disinfectants on plasma cholesterol and T4 levels were seen. Where they did occur (e.g. rabbits receiving 15 ppm chlorine and calcium-depleted at six months, or pigeons receiving 2 or 6 ppm monochloramine and calcium depleted at three months), the effects did not form part of a coherent dose-dependent response. However, the absence of any clear dose dependent, statistically significant effects of chlorine on plasma cholesterol levels in pigeons in the longer time period in these studies argues that any relationship between drinking water chlorine and hypercholesterolemia in this animal model may be extremely tangential and perhaps subject to adaptation. The possibility that thyroid hormones might be affected by chlorine intake had been considered because of earlier demonstrations of reduced T4 in response to drinking water chlorine in pigeons, and the concept that the metabolism of the thyroid might be a primary target for metabolic perturbations featuring the chlorine molecule. In these studies, as with plasma cholesterol, there were no dose dependent effects of drinking water disinfectants on plasma T4 levels and very few groups that differed significantly from controls. (See also W91-00476) (Lantz-PTT)
W91-00501

BIOCHEMICAL MECHANISMS OF IN VITRO CHLOROPROPANONE TOXICITY.
Health Effects Research Lab., Cincinnati, OH. Toxicology and Microbiology Div.
B. A. Merrick, J. R. Meier, C. L. Smallwood, D. L. McKean, and L. W. Condie.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 329-339, 3 fig, 2 tab, 15 ref.

Descriptors: *Biochemistry, *Chlorination, *Chloropropanone, *Disinfection, *In vitro tests, *Toxicity, *Water pollution effects, *Water treatment, Chemical reactions, Drinking water, Hydrogen ion concentration.

Toxicology studies performed on chloropropanone compounds have primarily focused on mutagenicity testing in which many chloropropanones are limited. Three chloropropanones capable of reacting directly with the sulfhydryl nucleophile, GSH, were tested in an in vitro buffer system without the need for metabolic activation. Reactions of alpha-haloketones with nucleophilic reagents, including sulfhydryls were used in various chemical synthetic and kinetic studies. The increasing rate of reaction of chloropropanones with GSH proceeding from pH 6 to 8 indicates a preferential interaction of chloropropanones with an ionized sulfhydryl group with a free pair of electrons, rather than the protonated form of GSH which predominates at a more acidic pH. In terms of in vivo toxicology by oral exposure to chloropropanones, the present study suggests that the direct cytotoxic action of these compounds in sufficient concentrations would make exposed tissues subject to contact necrosis. (See also W91-00476) (Lantz-PTT)
W91-00502

FISH HEPATOCYTE MODEL FOR INVESTIGATION OF THE EFFECTS OF TRIHALOMETHANES.
Environmental Research Lab., Narragansett, RI.
For primary bibliographic entry see Field 7B.
W91-00503

CHLORINE DIOXIDE DEPRESSES T3 UPTAKE AND DELAYS DEVELOPMENT OF LOCOMOTOR ACTIVITY IN YOUNG RATS.
Miami Univ., Oxford, OH. Dept. of Zoology.
S. A. Mobley, D. H. Taylor, R. D. Laurie, and R. J. Pfohl.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 347-358, 2 fig, 3 tab, 34 ref. EPA Grant CR-809618.

Descriptors: *Chlorination, *Chlorine dioxide, *In vitro tests, *Water pollution effects, *Water treatment, Animal physiology, Biochemistry, Chlorite,

Disinfection, Drinking water, Liver, Mammals, Thyroxine.

Chlorine dioxide has been suggested as an alternative to chlorine as a drinking water disinfectant. One advantage of using chlorine dioxide is that it has disinfectant abilities comparable to chlorine, but does not facilitate the formation of potentially harmful organohalides. An epidemiological study compared similar communities in which one community disinfected their drinking water with high levels of chlorine dioxide and the other used conventional disinfection methods. A positive correlation was shown between chlorine dioxide exposure, premature birth, and greater weight loss of newborns following birth. Administration of chlorine dioxide at 100 ppm in drinking water has resulted in depressed serum thyroxine levels in monkeys. Because the liver is the production site of the major thyroid hormone binding proteins, a change in liver activity would be expected if there was a substantial increase in the synthesis of hormone binding proteins. Increased (H)-thymidine uptake and analine hydroxylase activity in the liver have both been seen in rats following exposure to chlorine dioxide or chlorite in drinking water. Chlorite ions may be the active agent either directly or indirectly responsible for previously reported behavioral abnormalities following chlorine dioxide exposure. This suggestion is based on the knowledge that chlorite is the major breakdown product or metabolite of chlorine dioxide. It was found that indirect exposure to chlorine dioxide and chlorite results in similar behavioral changes. (See also W91-00476) (Lantz-PTT)
W91-00504

REVIEW OF RECENT EPIDEMIOLOGICAL STUDIES REPORTING ASSOCIATIONS BETWEEN DRINKING WATER DISINFECTION AND CANCER.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W91-00505

CASE-CONTROL STUDY OF COLON CANCER AND VOLATILE ORGANICS IN WISCONSIN MUNICIPAL GROUNDWATER SUPPLIES.
Wisconsin Univ.-Madison.
T. B. Young, M. S. Kanarek, D. A. Wolf, and D. A. Wilson.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 373-386, 1 fig, 8 tab, 8 ref. EPA Grant No. R808685, EPA Cooperative Agreement No. CR812252.

Descriptors: *Cancer, *Chlorination, *Disinfection, *Drinking water, *Water pollution effects, *Water treatment, *Wisconsin, Case studies, Dichloroethylene, New York, North Carolina, Public health, Tetrachloroethylene, Trichloroethene.

Studies in New York and North Carolina suggest that trihalomethanes (THMs) and other chlorination by-products were associated with colon cancer. To test this hypothesis specifically, a study of life-time THM exposure, based on estimates from a predictive model, was conducted using newly diagnosed colon cancer cases and controls. Although no risk was found for THM exposure, a small risk of exposure to chlorinated water persisted. The association between colon cancer and chlorinated drinking water could not be explained by chlorination by-products, but appeared to be due to an indirect association of both chlorination and colon cancer with municipal groundwater. When the relationship for municipal groundwater was explored further, elevated colon cancer risk was found for trichloroethylene, tetrachloroethylene, 1,1,1-trichloroethane, and 1,2-dichloroethylene. These four compounds are not chlorination by-products but can be considered indicators of groundwater contamination. To determine if the presence of groundwater contamination is a surrogate for other exposures, the covariation of VOCs with other factors was explored. No differences in demographics, such as ethnicity, or in community industrial character could be associated with the communities with higher-VOC wells. Similarly, no consistent pattern emerged from an exploration if the type of land use around community wells. Future studies will focus on other groundwater contaminants, including inorganic compounds. (See also W91-00476) (Lantz-PTT)
W91-00506

CASE-CONTROL STUDY OF MULTIPLE CANCER SITES AND WATER CHLORINATION IN IOWA.
Iowa Univ., Iowa City. Dept. of Preventive Medicine and Environmental Health.
C. F. Lynch, S. F. VanLier, and K. P. Cantor.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 387-398, 6 tab, 7 ref. EPA grant No. CR806301, NCI Grant No. NO1CP43200, EPA Grant No. CR813616.

Descriptors: *Cancer, *Chlorination, *Iowa, *Public health, *Trihalomethanes, *Water pollution effects, Bladder, Data acquisition, Drinking water, Human diseases, Hydrogen ion concentration, Pesticides, Volatile organic compounds, Water treatment.

Potential associations between chlorinated drinking water and cancer incidence are evaluated using two major components: a case control interview study, and drinking water studies. The case control study consists of 2800 cancer cases of a variety of cancers suspected as being associated with chlorinated drinking water in Iowa. Mailed out questionnaires were sent to individuals who verbally consented to participate. Completion of this component is not expected until Fall 1988, and is presently only 25% finished. The municipal water survey was begun in May 1987 and includes all utilities surveyed in 1979 plus 39 utilities serving towns in Iowa. Drinking water will be analyzed for trihalomethanes (THMs), six other volatile organic compounds (VOCs), total organic carbon (TOC), total organic halide (TOX), pesticides, pH, water temperature, total solids, and dissolved solids. Data from the National Bladder Cancer Study indicate an association between bladder cancer and chlorinated drinking water. The fact that the risk estimates increase with increasing duration of exposure to chlorinated drinking water supports the existence of an association with bladder cancer. A relationship with smoking appears important because the odds ratios calculated generally increase with increasing exposure to cigarette smoking and chlorinated drinking water. Due to small numbers of participants, the wide confidence intervals make definitive interpretation of this relationship difficult. (See also W91-00476) (Lantz-PTT)
W91-00507

CASE-CONTROL STUDY OF BLADDER CANCER IN MASSACHUSETTS AMONG POPULATIONS RECEIVING CHLORINATED AND CHLORAMINATED DRINKING WATER.
Brown Univ., Providence, RI. Dept. of Community Health.
S. Zierler, L. Feingold, R. A. Danley, and G. F. Craun.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 399-410, 5 tab, 22 ref. EPA Grant CR812080.

Descriptors: *Cancer, *Chlorination, *Drinking water, *Massachusetts, *Public health, *Water pollution effects, *Water treatment, Chloramination, Chloramines, Disinfection, Epidemiology, Human diseases.

A positive association was detected between usual and life-time chlorinated drinking water, and bladder cancer mortality. The bladder cancer association was highest for life-time residents of chloraminated drinking water communities relative to life-time residents of chloraminated drinking water communities. Some groundwaters have also been found to be contaminated with synthetic organics such as trichloroethylene, carbon tetrachloride, tetrachloroethylene, and 1,1,1-trichlorethane. These potential confounders were avoided in this study because the contrast of disease rates among groups defined as exposed and non-exposed to chlorinated by-products was measured only among consumers of surface water in which the disinfection strategy differed primarily by the addition of ammonia to one of the groups. This design achieved a high level of comparability in the distributions of correlates of the disinfection methods as well as characteristics of the study subjects that may have had bearing on bladder cancer risk. This study finds an increased frequency of bladder cancer mortality among life-time residents of communities receiving chlorinated drinking water. The findings confirm reports of an association between bladder cancer and chlorinated drinking water and suggests that the estimate of association may be stronger than those found in other studies. The study was confined to surface water sources to avoid potential noncomparability of water sources where exposure to chlorinated surface water has been compared to unchlorinated groundwater. Because almost all surface waters are disinfected, the index of no exposure to chlorinated by-products was chloraminated drinking water. The study does not address the effect of bladder cancer risk among users of chloraminated water relative to unchloraminated water. (See also W91-00476) (Lantz-PTT)
W91-00508

BLADDER CANCER, TAP WATER CONSUMPTION, AND DRINKING WATER SOURCE.
National Cancer Inst., Bethesda, MD.
K. P. Cantor, R. Hoover, P. Hartge, T. J. Mason, and D. Silverman.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 411-419, 4 tab, 10 ref.

Descriptors: *Cancer, *Chlorination, *Drinking water, *Public health, *Water pollution effects, *Water treatment, Bladder, Disinfection, Groundwater quality, Human diseases, Toxicology.

The primary focus here is the risk of bladder cancer as a function of fluid intake, especially tap water, and as a function of duration of residence served by chlorinated surface water. Most chlorinated surface sources have much higher levels of chlorination by-products than most chlorinated or nonchlorinated groundwater sources. The findings of this study suggest a correlation between chlorinated drinking water and bladder cancer risk. Among the criteria for judgement in assessing causality from epidemiological findings are: internal and external consistency, dose response gradients, coherence, high relative risks, and biological plausibility. With minor exception, the results are similar for men and for women and are consistent among the geographic areas. Dose-response patterns, both with regard to tap water intake and exposure duration would be difficult to explain by invoking the action of one or more confounding factors. Toxicological evaluations have demonstrated the genotoxicity and transforming activity of chlorination by-products in a variety of testing systems. The results suggest that about 12% of bladder cancers in this study population were caused by surface water contaminants. Among non-smokers the attributable risk was about 27%. There is clearly a need to have the finding from this study replicated by other investigators in different settings. (See also W91-00476) (Lantz-PTT)
W91-00509

SERUM LIPID LEVELS IN NEIGHBORING COMMUNITIES WITH CHLORINATED AND NONCHLORINATED DRINKING WATER.
Oak Ridge National Lab., TN.
E. A. Zeighami, A. P. Watson, and G. F. Craun.

IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 421-432, 2 fig, 4 tab, 20 ref.

Descriptors: *Chlorination, *Drinking water, *Human physiology, *Lipids, *Public health, *Water treatment, Human diseases.

Animal studies have produced some evidence indicating that chlorine intake in drinking water can effect serum lipids as well as have an effect on thyroid function. Clinical studies in humans has also found suggestive evidence of an effect of chlorine consumption on serum lipids. Potential changes in lipid levels caused by chlorine intake are important because of the near universal use of chlorination in public water supplies and the major role that lipid levels play in the risk of coronary artery disease and cerebrovascular disease. This study examined serum lipid levels in a human population consuming chlorinated and unchlorinated water of varying hardness. Because drinking water hardness, or total calcium intake, might be related to the same physiological characteristics and may exhibit physiological interaction with chlorine intake, a range of water hardness was desired in the choice of communities. For females, community mean levels of serum cholesterol (SV) were clearly higher in the chlorinated communities. For males, differences in community serum cholesterol levels are less apparent and not significantly different. Higher SC and low density lipoprotein (LDL) levels were found for study participants in communities with chlorinated drinking water, which suggests association between water chlorination and cholesterol levels. This is the first epidemiologic study to report this possible association. The possibility also exists that the observed association may have resulted from some unknown or undetermined variable in the chlorinated communities. The implications for cardiovascular risk are also unclear, because no association was found between high density lipoprotein (HDL) levels and water chlorination. Additional epidemiology studies in different populations, clinical studies, and experimental animal studies are required. (See also W91-00476) (Lantz-PTT)
W91-00510

FIELD EVALUATION OF THE EFFECT OF CHLORINATED TREATED SEWAGE ON SETTLEMENT OF OYSTERS (CRASSOSTREA VIRGINICA GMELIN) AND BARNACLES (BALANUS SP).
Virginia Inst. of Marine Science, Gloucester Point.
M. H. Roberts, B. B. Casey, C. S. Strobel, and E. Wilkins.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 435-452, 5 fig, 2 tab, 20 ref.

Descriptors: *Barnacles, *Chlorination, *Estuaries, *James River, *Oysters, *Wastewater treatment, *Water pollution effects, Biological studies, Chlorine, Field tests, New Haven Harbor, Toxicity, Wastewater outfall.

Larval stages of oysters (Crassostrea virginica) are extremely sensitive to stress. Laboratory studies show that bivalve embryos and larvae are among the estuarine organisms most sensitive to chlorine and chlorinated sewage. Chlorinated sewage added to estuarine water yielded chlorine-produced oxidant (CPO) concentrations between 0.01 and 0.03 mg/L inhibiting larval attachment; dechlorination can reverse this effect. In contrast, newly set spat (post metamorphosis) can tolerate at least 0.5 mg/L in 4-d exposures suggesting significant improvement in tolerance of chlorinated water after metamorphosis. This field study was initiated to monitor larval set and spat survival and growth to verify whether severe impacts predicted from laboratory experiments are actually experienced near a sewage treatment plant. Differences between laboratory and field conditions necessitated such a study to properly interpret the laboratory results. During both years of the study, spat-fall was monitored intensively around a chlorinated sewage discharge to evaluate whether effects observed in the laboratory can be demonstrated in the field. During the second year, field experiments were performed to measure post-metamorphic survival and growth. The result of this study showed no measurable effect of chlorinated treated sewage on oyster larvae or barnacle settlement. Dramatic inhibition in spat-fall was observed in New Haven Harbor; chlorine produced oxidant (CPO) was elevated at the stations where spat-fall was inhibited, ranging from 0.27 and 0.33 mg/L CPO. These residuals are at least an order of magnitude above predicted and previously observed CPO concentrations at the James River study site. While no impact of CPO was detectable on initial settlement, there might still be significant effects on mortality and growth on young spat leading to reduced yields at stations near the discharge. (See also W91-00476) (Lantz-PTT)
W91-00511

POTENTIAL FOR ADAPTATION OF THE ESTUARINE COPEPOD EURYTEMORA AFFINIS TO CHLORINE-PRODUCED OXIDANT RESIDUALS, HIGH TEMPERATURE, AND LOW OXYGEN.
Maryland Univ. Baltimore County, Catonsville. Dept. of Biological Sciences.
R. M. Davis, and B. P. Bradley.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 453-461, 2 tab, 15 ref.

Descriptors: *Chesapeake Bay, *Chlorination, *Copepods, *Wastewater treatment, *Water pollution effects, Adaptation, Disinfection, Estuaries, Oxygen, Temperature.

Populations of the estuarine copepod Eurytemora affinis were exposed to chlorine residuals and to low oxygen levels. Chlorine is frequently encountered by the species as a whole, although the local impact may be considerable; lowered oxygen is encountered seasonally in temperate aquatic environments, but possibly not at critical levels in the case of Eurytemora. Temperature stress is experienced during the summer months by Eurytemora in the Chesapeake Bay. A study was conducted to compare the potential adaptation of Eurytemora affinis to chlorine residuals, high temperature. and low oxygen by measuring the tolerance of individual males and females and the genetic variation in tolerance to the three stressors. The following conclusions can be drawn as a result of this work: (1) females have a higher chlorine oxidant tolerance than males, but data for low oxygen and high temperature were ambiguous; (2) males show a tendency toward less genetic variation than females for all three tolerances; (3) potential for genetic adaptation is lower for chlorine oxidant tolerance than for low-oxygen or high-temperature tolerances; and (4) selection for low oxygen or high-temperature tolerance has not been shown to be specifically in one direction. (See also W91-00476) (Lantz-PTT)
W91-00512

TOXICITY AND FATE OF TOTAL RESIDUAL CHLORINE IN OUTDOOR EXPERIMENTAL STREAMS.
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
R. O. Hermanutz, K. N. Allen, and S. F. Hedtke.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 463-477, 6 fig, 4 tab, 13 ref.

Descriptors: *Chlorination, *Chlorine, *Environmental effects, *Toxicity, *Wastewater treatment, *Water pollution effects, Aquatic animals, Bluegills, Catfish, Fish, Sucker, Trout.

Toxicity to freshwater aquatic life is usually expressed as the concentration of total residual chlorine (TRC). TRC can be a composite of chlorine forms, primarily free chloride (hypochlorous acid and hypochlorite ion) and combined chlorine (monochloramine, dichloramine, and trichloramine). Selected portions of a two year study are addressed including the toxicity to four fish species (bluegill, Lepomis macrochirus; channel catfish, Ictalurus punctatus; white sucker, Catostomas commersoni; and rainbow trout, Salmo gairdneri, of the downstream degradation of TRC in streams and diel changes in TRC concentrations within the streams. When chlorine was added as a single toxicant, TRC probably caused marginal effects in channel catfish. No effects were observed in the other three species at the highest concentrations tested for bluegills, white suckers and rainbow trout. When 3 mg/L total ammonia was added with chlorine, the TRC did cause effects on channel catfish at a concentration below the national criteria. These findings indicate that significant long-term toxicity differences do exist among TRC forms. (See also W91-00476) (Lantz-PTT)
W91-00513

CHLORINE SENSITIVITY OF EARLY LIFE STAGES OF FRESHWATER FISH.
Agency for Toxic Substances and Disease Registry, Atlanta, GA.
S. C. Tsai, J. S. Mattice, J. R. Trabalka, M. B. Burch, and K. B. Packard.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 476-489, 5 fig, 2 tab, 15 ref. EPA Interagency Agreement DOE 40-740-78, DE-AC05-84OR21400.

Descriptors: *Bioassay, *Chlorination, *Chlorine, *Ecological effects, *Fish, *Lethal limit, *Powerplants, *Toxicity, *Water pollution effects, Aquatic environment, Electric powerplants, Embryonic growth stage.

Elemental chlorine is widely used in electric powerplants to control aquatic organisms that attach to the condensor cooling system and the microfouling organisms that affect the efficiency of heat transfer from hot steam in the generator to cooling water flowing through the condensors. In a typical powerplant, about 220 kg of chlorine is flushed through the condensor cooling system daily and discharged into receiving waters. The major variable affecting the chlorine sensitivity of fish in this study was the life stage of the test fish. The embryonic stages are far less sensitive to chlorine than other life stages. The 10-hr-old hardened egg of common carp, with a 1-hr LC of 158 (128-213) mg/L in the original test medium, was the least sensitive life stage. The most sensitive life stage is the prolarvae. The data suggest that sensitivity of fish to chlorinated discharges may depend on the life stage that it is exposed. If data can be generalized, it appears that fish larvae, especially those just hatched, may provide the most appropriate stage for testing. The current chlorine criteria were based on 48-hr and 96-hr exposures. Although current data do not support quantification of differences in effects when exposure times are substantially shorter, such quantification is needed to support cost effective decisions regarding the assessment and control of chlorine in intermittent effluents. (See also W91-00476) (Lantz-PTT)
W91-00514

ACUTE TOXICITY, SUBLETHAL EFFECTS, AND BIOCONCENTRATION OF CHLORINATION PRODUCTS, VIRUSES, AND BACTERIA IN EDIBLE SHELLFISH: A REVIEW.
South Carolina Univ., Columbia. School of Public Health.
G. I. Scott, W. P. Davis, J. M. Marcus, T. G. Ballous, and J. A. Dahlin.
IN: Water Chlorination: Chemistry, Environmen-

tal Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 491-518, 7 tab, 79 ref.

Descriptors: *Bacteria, *Chlorination, *Literature review, *Sublethal effects, *Toxicity, *Viruses, *Wastewater treatment, *Water pollution effects, Bioaccumulation, Chlorine, Lethal limit.

Chlorination products were the only compounds identified in a review of published data (not bacteria or viruses) that were acutely toxic to shellfish; LC50 values ranged from 1 to 880,000 micrograms/L, with an LC50 value of 1 microgram/L in M. mercenaria larvae being the lowest LC value observed. Most chlorination products were moderately toxic to supertoxic for the edible shellfish species tested. Published studies on the sublethal effects of chlorination products and bacteria indicate that the lowest chlorine concentration causing sublethal effects was 5 micrograms/L, whereas 1000 total coliform bacteria/100 ml was the lowest bacteria density causing sublethal effects. No studies were identified using sublethal effects of viruses in edible shellfish. Uptake/depuration rate kinetic studies for chlorination products, bacteria and viruses indicated: (1) a significant uptake of viruses from food, sediments and water; (2) a significant uptake of chlorination products from water; and (3) a significant uptake of bacteria from water. These studies generally indicate only slight bioconcentration potential for chlorination products in water and viruses in sediment. Much higher bioconcentration potentials were observed for shellfish exposed to viruses in food and water and from bacterial exposure in water. (See also W91-00476) (Lantz-PTT)
W91-00515

DEVELOPMENT AND CALIBRATION OF A MODEL FOR PREDICTING OPTIMUM CHLORINATION SCENARIOS FOR BIOFOULING CONTROL.
Miami Univ., Coral Gables, FL. Dept. of Civil and Architectural Engineering.
B. Al-Hoti, T. Waite, and W. Chow.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 521-534, 11 fig, 2 tab, 11 ref. EPRI Agreement No. RP2300-9.

Descriptors: *Biofouling, *Chlorination, *Electric powerplants, *Model studies, *Water pollution prevention, *Water treatment, Biological studies.

The need to minimize chlorine usage in powerplants has become a major factor in plant operation. Biofouling is the biological mediation of the deposition of organic and inorganic material on cooling system surfaces that results in a reduction of heat transfer capability in the condensors, and an increased drop in pressure in the turbines from the increase in frictional resistance. A modeling approach can provide the most efficient chlorination schedules based on chlorine concentration, contact time, and number of applications per day in seasonal conditions. Using these treatment schedules, chlorine treatment can maintain powerplant condensor-tube cleanliness, resulting in a reduction in operation costs. By choosing the most effective chlorine treatment scenario, it may be possible to keep cooling water total residual chlorine concentration in the discharge within EPA guidelines. The model presented has been tested on a limited number of powerplants. More testing should be done using the model to refine its predictability. For plants where the model has been used, it has always predicted fouling correctly. Beside predicting the presence of fouling in the condensor, which is the model objective, it also correctly predicted the amount of fouling that could be expected. (See also W91-00476) (Lantz-PTT)
W91-00516

MANGANESE DEPOSITION IN CHLORINATED POWER PLANT COOLING WATER.
Public Service Electric and Gas Co., Newark, NJ.
For primary bibliographic entry see Field 5F.
W91-00518

WATER CHLORINATION: IS THERE ENVIRONMENTAL RISK.
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5F.
W91-00550

MICROBIOLOGICAL PERSPECTIVE ON RISKS FROM WATER CHLORINATION.
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5F.
W91-00551

PESTICIDES AND WETLANDS OVERSEAS: A FRAMEWORK FOR MITIGATING ADVERSE IMPACTS.
California Univ., Berkeley. Graduate School of Public Policy.
For primary bibliographic entry see Field 5G.
W91-00570

PLASMA ELECTROLYTES, GILL ALUMINUM CONTENT, AND GILL MORPHOLOGY OF JUVENILE ATLANTIC SALMON (SALMO SALAR) AND BROOK TROUT (SALVELINUS FONTINALIS) INDIGENOUS TO ACIDIC STREAMS OF NOVA SCOTIA.
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
G. L. Lacroix, D. J. Hood, C. S. Belfry, and T. G. Rand.
Canadian Journal of Zoology CJZOAG, Vol. 68, No. 6, p 1270-1280, June 1990. 5 fig, 4 tab, 60 ref.

Descriptors: *Acid rain effects, *Aluminum, *Nova Scotia, *Salmon, *Toxicity, *Trout, *Water pollution effects, Acid streams, Animal pathology, Blood, Electrolytes, Fish physiology, Gills, Ions, Tissue analysis.

Plasma electrolytes and gill aluminum (Al) concentrations were determined and gill morphology and histology were examined in Atlantic salmon (Salmo salar) parr and brook trout (Salvelinus fontinalis) from feral populations in acidic streams of southwest Nova Scotia. Plasma sodium (Na) and chloride (Cl) ion concentrations were lowest in fish from streams with the lowest pH levels, but there were no correlations between plasma Na(+) or Cl(-) and exchangeable Al concentrations in streams for both species. Gill Al increased exponentially with increasing exchangeable Al in water, but was less than 100 micrograms/g dry weight in both species. There were no correlations between plasma Na(+) or Cl(-) and gill Al for both species, and plasma Na(+) and Cl(-) were ultimately linked to low pH. Scanning electron microscopy of gills showed normal primary and secondary lamellae, with few signs of fusion or hyperplasia, only a slight amount of mucus, regular chloride cell crypts, and epithelial cells with distinct microridges. Histology of gill sections showed few lesions in the primary lamellae but some focal histologic lesions in the secondary lamellae of greater than 50% of fish, regardless of ambient pH or Al concentration. The histopathology included hypertrophy of individual epithelial, mucous, and chloride cells, clubbing of tips of secondary lamellae, and localized epithelial hyperplasia. These features were focal and not comparable to the extensive morphological changes of histologic lesions usually attributed to high Al concentrations at low pH. Dissolved organic carbon concentrations greater than 5 mg/L in the acidic streams apparently afforded protection against Al effects at concentrations of at least 360 micrograms total Al/L. (Author's abstract)
W91-00616

INFERRED EFFECTS OF LAKE ACIDIFICATION ON DAPHNIA GALEATA MENDOTAE.
Ontario Ministry of the Environment, Sudbury.
W. Keller, N. D. Yan, K. E. Holtze, and J. R. Pitblado.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1259-1261, August 1990. 2 fig, 1 tab, 27 ref.

Descriptors: *Acid lakes, *Acid rain effects, *Canada, *Daphnia, *Toxicity, *Water pollution effects, Air pollution effects, Baseline studies, Bioassay, Biomass, Crustaceans, Hydrogen ion concentration, Lethal limit, Mortality, Population exposure, Regional analysis, Sulfur.

Large numbers of Canadian Shield lakes have been acidified by the atmospheric deposition of anthropogenic sulfur. Demonstrations of widespread biological effects of acidification have been greatly hampered by the general absence of observations of the occurrence or abundance of important, ubiquitous species in large numbers of lakes ranging widely in acidity, coupled with laboratory determinations of lethal acid thresholds for these species. In this report, determination of the lethal acid threshold of Daphnia galeata mendotae Dirge, a large, ubiquitous, planktonic crustacean, was coupled with results of extensive lake surveys, to examine if the acidification of lakes in Ontario has resulted in widespread losses of daphnia. Daphnia were collected in zooplankton surveys from four areas of Ontario, spanning a wide range in sulfur deposition regimes. This zooplankton occurred in 44 to 92% of the lakes with pH greater than 6.0 in each data set, and it was absent from virtually all lakes with pH less than 5.5. The biomass of D. galeata mendotae in the lakes assayed was significantly ($P < 0.05$) correlated with pH. In laboratory tests, the 4-day LC50 pH values ranged from 5.69 to 5.98 and were not significantly different; pooling the data yielded a LC50 pH of 5.85. The data strongly suggest that widespread damage to D. galeata mendotae populations has occurred as a result of anthropogenic influences, i.e., elevated sulfur emissions in North America. This damage commences at comparatively low levels of acidity, near or even above pH 6.0. It is estimated that there are at least 19,000 lakes that now have pH levels less than 6.0 in Ontario. (VerNooy-PTT)
W91-00626

FATE OF AQUATIC AND WETLAND HABITATS IN AN INDUSTRIALLY CONTAMINATED SECTION OF THE ELBE FLOODPLAIN IN HAMBURG.
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
For primary bibliographic entry see Field 5B.
W91-00648

OCCURRENCE OF HYPOLIMNETIC BLOOMS OF THE PURPLE SULFUR BACTERIUM, THIOPEDIA ROSEA, AND THE GREEN SULFUR BACTERIUM, CHLOROBIUM LIMICOLA, IN AN AUSTRALIAN RESERVOIR.
University of New England, Armidale (Australia). Dept. of Resource Engineering.
R. J. Banens.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 2, p 223-235, 1990. 6 fig, 2 tab, 33 ref.

Descriptors: *Australia, *Bacteria, *Eutrophic lakes, *Limnology, *Reservoirs, *Sulfur bacteria, *Water pollution effects, Anaerobic conditions, Chlorophyll, Hypolimnion, Light quality, New South Wales, Puddledock Reservoir, Seasonal variation, Transparency, Turbidity.

Seasonal blooms of green and purple sulfur bacteria were found in the anoxic hypolimnion of Puddledock Reservoir, a small, eutrophic water-supply reservoir in northeastern New South Wales. The blooms were dominated by the green sulfur bacterium Chlorobium limicola and were sometimes overlain by a bloom of the purple sulfur bacterium Thiopedia rosea. The generally formed a plate just below the oxycline at a depth of between 4 and 6 m in the shallow, sulfuretted, nutrient-rich hypolimnion. The blooms increased in density from about mid summer until holomixis, when the return

to oxygenated conditions killed the sulfur bacteria. Maximum bacterial chlorophyll levels varied with the light regime, but typically reached 250 microgram/L, although the maximum recorded value was 410 microgram/L. The Secchi transparency during summer stratification was variable, but was typically around 1.2 m, with extremes ranging from 4.5 m on one occasion to as low as 0.8 m for an extended period as a result of epilimnetic algal levels of 40 microgram/L chlorophyll. Gilvin (g440) levels during these bacterial blooms always were less than 2.5/m. Sulfur bacteria were absent during one summer; this was attributed to a dramatic change in the light regime as a result of a major inflow event, which resulted in a Secchi depth of 0.75 m associated with very high gilvin levels of 7.5-11.0/m and high inorganic turbidity levels. The result would have been a very dim red light regime in the hypolimnion. (Author's abstract)
W91-00652

RELATIONSHIPS BETWEEN ACIDITY AND BENTHIC INVERTEBRATES OF LOW-ORDER WOODLAND STREAMS IN THE ADIRONDACK MOUNTAINS, NEW YORK.
Syracuse Univ., NY. Dept. of Civil Engineering.
M. E. Smith, B. J. Wyskowski, C. M. Brooks, C. T. Driscoll, and C. C. Cosentini.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1318-1329, July 1990. 10 fig, 3 tab, 47 ref.

Descriptors: *Acid rain effects, *Acid streams, *Benthic fauna, *Invertebrates, *New York, *Species diversity, *Water pollution effects, Adirondack Mountains, Animal populations, Aquatic insects, Ecology, Mountain streams.

Benthic invertebrates were collected during January, April, July, and October 1985 from three low-order woodland streams in the Adirondack Mountains, New York to evaluate relationships between acidity and stream invertebrates. Total invertebrate generic richness, generic diversity, Ephemeroptera density and richness, collector-gatherer richness, and scraper density and richness were positively correlated with stream pH. Ephemeroptera and Naididae (Oligochaeta) were absent from the acidic sampling site. Enchytraeid oligochaetes and Turbellaria were collected at all sites, but in significantly higher densities at the acidic site. Elmid beetles (Optioservus ovalis, Oulimnius latiusculus, and Promoresia tardella), mayflies (Cinygmula and Baetis), and caddisflies (Glossosoma, Apatania, and Micrasema) were abundant at the sites where the pH was highest and were absent from other sampling locales. Total invertebrate density was not decreased at the acidic site when compared with most other sampling sites. Multiple regression analyses revealed that pH and benthic organic matter were the two most important measured stream parameters in describing the variance of invertebrate communities in the three study streams. (Author's abstract)
W91-00657

PHYTOPLANKTON COMMUNITIES OF LAKES EXPERIMENTALLY ACIDIFIED WITH SULFURIC AND NITRIC ACIDS.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. L. Findlay, and S. E. M. Kasian.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1378-1386, July 1990. 9 fig, 2 tab, 27 ref.

Descriptors: *Acid lakes, *Acid rain effects, *Lake acidification, *Limnology, *Nitric acid, *Ontario, *Species diversity, *Succession, *Sulfuric acid, Biomass, Chrysophyta, Cyanophyta, Diatoms, Dinoflagellates, Ecology, Seasonal variation.

Additions of sulfuric acid to the South Basin and nitric acid to the North Basin of Lake 302 (Experimental Lakes Area, Ontario) caused major change in the phytoplankton communities. The basins were separated by a nylon-reinforced vinyl sea curtain. In the South Basin, below pH 5.6, species composition shifted from chrysophycean dominance to one of Dinophyceae. Diatoms and cyanophytes were eliminated below pH 5.3. Phytoplankton species diversity decreased as pH decreased. Total epilimnetic biomass was unchanged, except in the late fall, when entrainment of dense layers of hypolimnetic species caused increases. The assemblage of the North Basin changed immediately upon additions of HNO3 to resemble systems experimentally fertilized with N. Chrysophycean dominance gave way to chlorophytes and dinoflagellates. Once pH decreased below 6.0, diatoms and cyanophytes were eliminated from assemblage, as in the South Basin. Phytoplankton species diversity decreased, but total epilimnetic biomass remained unaffected. (Author's abstract)
W91-00659

RESPONSE OF A BROOK TROUT (SALVELINUS FONTINALIS) POPULATION TO A REDUCTION IN STREAM BENTHOS FOLLOWING AN INSECTICIDE TREATMENT.
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
D. P. Kreutzweister.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1387-1401, July 1990. 7 fig, 10 tab, 47 ref.

Descriptors: *Brook trout, *Fish populations, *Invertebrates, *Ontario, *Stream biota, *Water pollution effects, Aquatic communities, Fish food organisms, Fish growth, Icewater Creek, Insecticides, Permethrins.

A forest stream (Icewater Creek, Ontario) was treated with permethrin to determine the response of brook trout to a reduction in the aquatic food resources following insecticide treatment. The treatment resulted in massive invertebrate drift and significant reductions in benthos, but did not produce trout mortality or evidence of unusual behavior. The density, population age structure, movement patterns, and condition of brook trough were not affected measurably by the permethrin treatment. The growth rates of 0+ and 1+ age-classes were significantly lower following the insecticide application than form the same age-classes of pretreatment years. This reduction in growth rate resulted in significantly smaller trout after treatment. A significant reduction in the growth of trout collected during the same period from a nearby untreated stream indicated that unusually high summer temperatures were at least partially, if not entirely, responsible for the reduced growth rate of treated fish. Growth rates returned to or exceeded pretreatment levels by the overwinter period of the pretreatment year. (Author's abstract)
W91-00660

INFLUENCE OF UPWELLINGS, STORMS, AND GENERATING STATION OPERATION ON WATER CHEMISTRY AND PLANKTON IN THE NANTICOKE REGION OF LONG POINT BAY, LAKE ERIE.
Ontario Hydro, Toronto. Research Div.
For primary bibliographic entry see Field 2H.
W91-00662

EFFECT OF FLUORIDE COMPLEXATION ON ALUMINUM TOXICITY TOWARDS JUVENILE ATLANTIC SALMON (SALMO SALAR).
INRS-Eau, Sainte-Foy (Quebec).
K. J. Wilkinson, P. G. C. Campbell, and P. Couture.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1446-1452, July 1990. 6 fig, 4 tab, 37 ref. Fisheries and Oceans Canada DSS Contract FP707-7-2356/01-XSK.

Descriptors: *Acid rain effects, *Aluminum, *Chemical interactions, *Fluorides, *Salmon, *Toxicity, *Water pollution effects, Acidic water, Bioaccumulation, Bioassay, Gills, Juvenile growth stage.

In 7-day semistatic bioassays, fluoride complexation attenuated Al toxicity to juvenile Atlantic salmon (Salmo salar; age 1+) and the accumulation of Al in gill tissue, but not to the extent predicted by the free-ion model of metal toxicity. Bioaccumulation and toxicity persisted even in the presence of an excess of the complexing ligand. An equilibrium model, involving the formation of a mixed ligan complex (F-Al-L-gill) at the gill surface, is proposed to explain this residual toxicity (L-gill = ligand at the gill surface). Exposure to Al, or to a combination of Al and F, led to a decrease in the plasma sodium levels even for sublethal conditions. Aluminum concentrations as low as 2 micromolar adversely affected the salmon. The similarity of the osmo-regulatory response to the H(+) ion, to Al(3+), and Al(F), suggested that the mechanisms of toxicity in the presence of fluoride did not differ markedly from that observed by previous workers for salmonid species exposed to moderately acidic media containing Al but without added fluoride. (Author's abstract)
W91-00663

PHOSPHORUS AND NITROGEN LIMITATION OF PHYTOPLANKTON GROWTH IN THE FRESHWATERS OF NORTH AMERICA: A REVIEW AND CRITIQUE OF EXPERIMENTAL ENRICHMENTS.
California Univ., Davis. Div. of Environmental Studies.
For primary bibliographic entry see Field 2H.
W91-00664

CYANOBACTERIA IN FISH PONDS.
Laboratoire d'Ichtyologie Generale et Appliquee, Paris (France).
For primary bibliographic entry see Field 2H.
W91-00665

LIMNOLOGICAL STUDIES OF FOUR POLLUTED PONDS IN AND AROUND DHAKA CITY WITH REFERENCE TO INDICATOR SPECIES.
Dacca Univ. (Bangladesh). Dept. of Botany.
M. Khondker, A. K. M. Nurul Islam, Z. N. Tahmida Begum, and S. Haque.
Bangladesh Journal of Botany BJBTB3, Vol. 19, No. 1, p 51-63, June 1990. 4 fig, 5 tab, 23 ref.

Descriptors: *Bioindicators, *Euglena, *Eutrophic lakes, *Limnology, *Water pollution effects, Algae, Bangladesh, Euglenophyta, Eutrophication, Fertilizers, Organic matter, Species composition.

Four ponds displaying various levels of pollution and located in the Dhaka City vicinity of Bangladesh were studied for twelve months for limnological characteristics and associated indicator organisms, in particularly, the euglenophyta. The ponds were slightly acidic to alkaline (pH 6.1-7.6) but showed a wide range of variation in electrolytic conductivity (75-1000 microS/cm). The variation in dissolved oxygen content was remarkable, i.e., anoxia to a vary high concentration of 17.77 mg O2/L. The bicarbonate alkalinity and CO2 concentration varied from 0.04 to 1.9 meq/L and 0.123 to 3.19 mg/L, respectively. The number of euglenoid species were higher in organically enriched ponds than the inorganically fertilized ones. Euglenoid algae was more dominant than zooplankton in late October due to higher levels of decaying organic matter. (Author's abstract)
W91-00672

EFFECTS OF NUTRIENTS AND WATER LEVELS ON SPECIES COMPOSITION IN PRAIRIE WHITETOP (SCOLOCHLOA FESTUCACEA) MARSHES.
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
For primary bibliographic entry see Field 2H.
W91-00674

HUMAN ACTIVITIES LEADING TO CONTACT WITH WATER IN A SCHISTOSOMIASIS ENDEMIC AREA, SOUTHWEST SAUDI ARABIA: PRELIMINARY OBSERVATIONS.
King Saud Univ., Riyadh (Saudi Arabia). Coll. of Medicine.
A. A. Al-Madani, and M. S. Omar.

Southeast Asian Journal of Tropical Medicine and Public Health SJTMAK, Vol. 21, No. 1, p 145-148, March 1990. 1 tab, 11 ref.

Descriptors: *Human diseases, *Infection, *Parasites, *Saudi Arabia, *Schistosomiasis, *Water pollution effects, Drinking water, Public health, Recreation, Swimming, Water use.

Methods of human infection by Schistosomiasis were investigated in Asir Province, Southwest Saudi Arabia. Transmission of schistosomiasis requires contact with infected water. Villages and streams were visited during working days and weekends for one year in the province. Observations of human activities were made at different times during the period between 06:00 and 18:00 hr on different days. Results of the observations were similar to those of other researchers who found that people of Asir Province contacted water containing Schistosomiasis during occupational, domestic, and recreational activities. During agricultural activities all family members usually expose their unprotected forearms and barefeet to water. During the transport of water, adult males usually contact water when they use hoses to get water from wells, streams, and water reservoirs of dams to fill up their trucks. People may use schistosomiasis-contaminated water from wells for drinking, cooking, bathing, and washing their clothes. Contaminated stream water may be contacted when bathing, or washing cars or clothes. Family members use contaminated water for swimming and wading, and ablution. Urination and defecation in streams by infected humans may be the main source of reinfecting water with schistosomiasis. (Geiger-PTT)
W91-00678

DEGRADATION OF A STREAM CROSSING THE CITY OF ADDIS ABABA, ETHIOPIA.
Addis Ababa Univ. (Ethiopia). Dept. of Biology.
T. Berhe, A. D. Harrison, and H. B. N. Hynes.
Tropical Freshwater Biology, Vol. 2, No. 1, p 112-120, 1989. 1 fig, 2 tab, 21 ref.

Descriptors: *Ethiopia, *Eutrophication, *Stream degradation, *Stream pollution, *Water pollution effects, Algae, Biochemical oxygen demand, High flow, Invertebrates, Nitrates, Organic pollutants, Phosphates, Seasonal variation, Species diversity.

Twenty stations along 13.9 km of a stream flowing through the high altitude urban area of Addis Ababa, Ethiopia, were sampled during the dry and wet seasons. The temperature increased slightly in the downstream direction, and nitrate, phosphate and biochemical oxygen demand increased very greatly, indicating a steady increase of generalized organic pollution. At the same time there were changes in the algal populations, and the invertebrate diversity declined. Clearly some species were susceptible to the degradation, while a few benefited. But in the lower reaches, even the least sensitive animals began to decline in numbers. The study, therefore, produced a list of taxa that may serve to indicate degradation of streams at high altitudes in East Africa. The dry and wet season samples differed, indicating that high water dilutes the pollution, although it increased degradation in clean stations, presumably by wash-in. The algal populations were much reduced by high water, as were the invertebrates. Some of the latter decrease may have been caused by relatively less effective sampling in the deep water, but it is certain that some taxa became more abundant during the rainy season. (Author's abstract)
W91-00680

ESTIMATION OF THE CRITICAL OXYGEN TENSION FOR AND RECOVERING CAPABILITIES OF RED TILAPIA (OREOCHROMIS NILOTICUS X OREOCHROMIS MOSSAMBICUS) HYBRIDS.
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. of Animal Production in the Tropics and Subtropics.
For primary bibliographic entry see Field 2H.
W91-00683

VEGETATIVE GROWTH OF SPIRODELA POLYRRHIZA AS AFFECTED BY MEDIUM CONCENTRATION, DAYLIGHT INTENSITY AND AGE.
Benin Univ., Benin City (Nigeria). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-00684

LEAD POISONING IN MAGPIE GEESE ANSERANUS SEMIPALMATA FROM INGESTED LEAD PELLET AT BOOL LAGOON GAME RESERVE (SOUTH AUSTRALIA).
Australian National Parks and Wildlife Service, Berri.
M. J. Harper, and M. Hindmarsh.
Australian Wildlife Research AWLRAO, Vol. 17, No. 2, p 141-145, 1990. 1 fig, 2 tab, 14 ref.

Descriptors: *Australia, *Bool Lagoon, *Heavy metals, *Lead, *Recreation impact, *Sediment contamination, *Toxicity, *Water birds, *Water pollution effects, Mortality, Water depth, Wetlands.

A high mortality of magpie geese, Anseranus semipalmata, was associated with the ingestion of lead pellets, which had accumulated in the sediment at the Bool Lagoon Game Reserve, South Australia. Receding water levels in the autumn of 1986 enabled the geese to feed in areas containing high densities of lead pellets. The goose population of 320 birds was reduced by an estimated 44% during this period. Post-mortem examination of the contents of the gizzards from 30 dead geese showed that 93% contained ingested lead pellets. Analyses of the blood from 34 sick and dying geese showed lead levels of between 5 and 34 mol/L. The death of these geese raises concern about lead poisoning in other waterbird species throughout Australia in similar wetlands to Bool Lagoon. (See also W91-00686) (Author's abstract)
W91-00687

RESISTANCE TO ANTIBIOTICS AND HEAVY METALS OF PSEUDOMONAS AERUGINOSA ISOLATED FROM NATURAL WATERS.
Malaga Univ. (Spain). Facultad de Ciencias.
A. De Vincente, M. Aviles, J. C. Codina, J. J. Borrego, and P. Romero.
Journal of Applied Bacteriology JABAA4, Vol. 68, No. 6, p 625-632, June 1990. 3 fig, 4 tab, 24 ref. WHO grant SPA-06-K.

Descriptors: *Antibiotics, *Bacterial physiology, *Fecal coliforms, *Heavy metals, *Path of pollutants, *Resistance, *Water pollution effects, Arsenic, Epidemiology, Mercury, Spain.

The resistance patters of Pseudomonas aeruginosa strains isolated from freshwater and seawater to different antimicrobial agents and heavy metals were investigated. Resistance in these environment is linked to the level of fecal pollution. All strains were resistant to ampicillin and tetracycline but sensitive to carbenicillin, amikacin, tobramycin, and colistin, and to the assayed concentrations of silver, cadmium, lead, and molybdenum. Resistance to gentamicin, sulfadiazine, mercury, arsenic, and chromium was variable, so their use as epidemiological markers was considered. There was a close relationship between the degree of pollution and the frequency of heavy metal resistant strains of Pseudomonas aeruginosa. The highest frequencies of resistance to mercury and arsenic were obtained from marine environments with little fecal pollution, where the highest incidence of multi-resistant strains was also observed. (Author's abstract)
W91-00698

MICROCYSTIN COMPOSITION OF AN AXENIC CLONAL STRAIN OF MICROCYSTIS VIRIDIS AND MICROCYSTIS VIRIDIS-CONTAINING WATERBLOOMS IN JAPANESE FRESHWATERS.
National Inst. for Environmental Studies, Tsukuba (Japan).
K. Kaya, and M. M. Watanabe.
Journal of Applied Phycology JAPPEL, Vol. 2, No. 2, p 173-178, June 1990. 2 fig, 3 tab, 14 ref.

Descriptors: *Algal growth, *Algal toxins, *Cyanophyta, *Eutrophication, *Japan, *Water pollution effects, Human diseases, Population dynamics, Proteins.

Toxic blooms of cyanobacteria are often involved in the poisoning of animals, and implicated in human health problems. Toxic cyclis heptapeptides (microcystin) in cells of an axenic clonal strain of Microcystis viridis were analyzed quantitatively. Cells from the logarithmic, stationary and death phases of batch culture contained 670, 618, and 372 microg. toxic heptapeptides per g dry cells., respectively. The toxic peptides of the cells from the stationary phase consisted of microcystin RR (65%), microcystin LR (22%), microcystin YR (10%) and microcystin LA (3%). The composition of the toxic peptides changed only slightly through the phases of batch culture. Toxicities and the toxic peptide contents of Microcystis viridis-containing waterblooms in Japanese waters were found to have toxic effects on mice after intraperitoneal injection. The toxic peptides in the samples were composed mainly of microcystin RR (50%) and microcystin LR (30%). (Author's abstract)
W91-00699

ARSENATE SENSITIVITY IN MARINE PERIPHYTON COMMUNITIES ESTABLISHED UNDER VARIOUS NUTRIENT REGIMES.
Goeteborg Univ. (Sweden). Dept. of Botany.
S. A. Wangberg, and H. Blanck.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 139, No. 1/2, p 119-134, July 10, 1990. 7 fig, 1 tab, 44 rcf. National Swedish Environmental Protection Board Grant 5333071-5333076.

Descriptors: *Arsenic compounds, *Bioindicators, *Nutrient concentrations, *Periphyton, *Photosynthesis, *Toxicity, Algal physiology, Chlorophyll, Nitrogen, Phosphates.

The sensitivity of carbon dioxide fixation to arsenate was measured in marine periphyton communities established under different nutrient regimes in flow-through aquaria. An increase of the phosphate concentration in the incubation media from 0.1 to 0.8 microM did not cause any immediate changes in sensitivity to arsenate. However, after 72 h of phosphate enrichment, sensitivity to arsenate had decreased > 3000-fold (EC20 values increased from 0.3 microM to > 1 mM). Decreases in sensitivity to arsenate were also seen during natural and simulated upwelling episodes when both the nitrate and the phosphate concentrations increased. The sensitivity to arsenate correlated with the phosphorus status of the communities, measured either as total phosphorus or surplus phosphorus, but not with their nitrogen or chlorophyll contents. The role of internal or external competition between arsenate and phosphate may be important in possible mechanisms for the phosphate-dependent tolerance. The key role of nutrient prehistory in modifiying periphyton sensitivity to arsenate is stressed. The time of the year and current nutrient situation will affect the phosphorus status of the algae, and should therefore be considered when performing toxicity tests and when making hazard assessments for arsenate. (Author's abstract)
W91-00700

RAPID METHOD FOR ASSESSING GROWTH RATES OF CORAL IN RELATION TO WATER POLLUTION.
Glasgow Univ. (Scotland). Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W91-00705

COLONIZATION OF AMPHIPODS AND POLYCHAETES TO SEDIMENTS EXPERIMENTALLY EXPOSED TO OIL HYDROCARBONS.
Abo Akademi, Turku (Finland). Dept. of Biology.
E. Bonsdorff, T. Bakke, and A. Pedersen.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 355-358, July 1990. 2 fig, 1 tab, 30 ref. Norwe-

gian Marine Pollution Research and Monitoring Programme grant FOH 204.

Descriptors: *Amphipods, *Animal physiology, *Hydrocarbons, *Oil, *Polychaetes, *Sediment chemistry, *Water pollution effects, Metamorphosis, Recruitment, Toxicity.

Settling and metamorphosis are generally considered to be the most critical phases in the development of marine benthic invertebrates. The harmful effects of pollution can be expected to be the most severe during recruitment of individuals to sedimentary bottoms. Field experiments using colonization trays with or without cover, and larger enclosures were used to investigate the effects of the water soluble fractions of oil hydrocarbons (Ekofisk Crude oil) on recruitment of zoobenthos to shallow soft bottoms. The experiments were performed in situ at 8 m depth off Bergen, Norway. The main macrofaunal immigrants (July to December, 1980) were amphipods (mainly Corophium bonelli) and polychaetes (mainly capitellids, cirratulids, orbinids, and spionids). Covered trays are lower colonization by polychaetes than open trays, but addition of low levels of oil hydrocarbons did not affect polychaete density. Corophium bonelli showed similar rates of colonization to open and covered trays, but the covered trays showed that exposure to oil had a negative effect on population density, especially on juveniles. The reduced density in the oil exposure treatment may have been due to reduced survival of the marsupial embryos, or increased swimming activity (escape reactions to the oil). Natural predations on the amphipods in the uncovered trays was high enough to mask any negative effect of exposure to oil. These experiments also show that even very low doses of the water soluble fractions of oil (30 to 40 microg/L) may cause significant effects on the recruitment of the marine benthic organisms. (Brunone-PTT)
W91-00707

REMARKS ON THE ZOOPLANKTON POPULATION STRUCTURE NEAR WASTEWATER OUTFALLS ON THE ROMANIAN SHORE OF THE BLACK SEA (REMARQUES SUR LA STRUCTURATION DES POPULATIONS ZOOPLANCTONIQUES DANS LES ZONES DES EMISSAIRES D'EAUX USEES DU LITTORAL ROUMAIN DE LA MER NOIRE).
Institutul Roman de Cercetari Marine, Constanta (Romania).
A. Petran.
Cercetari Marine: Recherches Marines CMARDQ, Vol. 19, p 55-72, 1986. 2 tab, 9 fig, 16 ref. English summary.

Descriptors: *Black Sea, *Population dynamics, *Romania, *Wastewater outfall, *Water pollution effects, *Zooplankton, Animal populations, Community structure, Dominance, Ecology, Species diversity.

Results are presented on the structural evolution of zooplankton communities in inshore waters of the southern part of the Romanian coast, close to industrial and domestic wastewater effluents. Two hundred and sixty samples were analyzed and the results were analyzed (diversity index, dominance index, species frequency) to show the consequences of eutrophication and local pollution on the structural pattern of zooplankton communities in shallow waters. Depletion of communities is expressed both by their qualitative and quantitative scarcity within the contact zone between the effluent fan and the receptor seawater mass and by the development of two of the most opportunistic species, Acartia clausi and Pleopis polyphemoides. Structural parameters depend significantly on seasonal influences during the whole cycle. For instance, in summer one or two species could form rich populations, often organized even at the monospecific level. (Author's abstract)
W91-00711

IMPACT OF HEAVY METALS ON THE PRIMARY PRODUCTION.
Alexandria Univ. (Egypt). Dept. of Oceanography.
A. N. Khalil, and A. M. Ibrahim.
Cercetari Marine: Recherches Marines CMARDQ, Vol. 19, p 189-203, 1986. 2 fig, 2 tab, 29 ref.

Descriptors: *Chlorophyll a, *Heavy metals, *Primary productivity, *Red Sea, *Water pollution effects, Cadmium, Lead, Nickel, Saudi Arabia, Sharm Abhur, Toxicity, Zinc.

The effect of different concentrations of some heavy metals (2 or 3 metals, with final total concentration of 4 ppb) on primary production was studied at two localities near Jeddah (Red Sea), by estimating chlorophyll a. Metal toxicity at low concentrations influenced the productivity of the phytoplankton according to the following order: Pb > Zn > Ni > Cd. More depression of phytoplankton productivity took place when Zn accompanied was present with another/other metal(s) in the media. Impact of heavy metals on the primary production at a sheltered area (Obhur Creek) was relatively higher than that observed at an exposed area (open sea). (Author's abstract)
W91-00713

COMPARATIVE STUDY OF TOXIC LEAD EFFECT ON GILL AND HEMOGLOBIN OF TILAPIA FISH.
Instituto Politecnico Nacional, Mexico City. Dept. de Farmacologia y Toxicolgia.
For primary bibliographic entry see Field 5A.
W91-00722

MECHANISM OF TOXICITY OF ZINC TO THE MARINE DIATOM NITZSCHIA CLOSTERIUM.
Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Fuel Technology.
J. L. Stauber, and T. M. Florence.
Marine Biology MBIOAJ, Vol. 105, No. 3, p 519-524, June 1990. 7 tab, 32 ref.

Descriptors: *Diatoms, *Heavy metals, *Toxicity, Copper, Detoxification, Glutathione, Metabolism, Nitzschia, Photosynthesis, Plant growth, Respiration, Ultrastructure, Zinc.

The effect of zinc on cell division, photosynthesis, ultrastructure, respiration, ATP levels, mitochondrial electron-transport chain (ETC) activity, total thiols, and glutathione in the marine diatom Nitzschia closterium (Ehrenberg) W. Smith was investigated. Although 65 microgram Zn/L halved the cell division rate, photosynthesis and respiration were unaffected by zinc concentrations up to 500 microgram Zn/L. Most of the Zn associated with the cells was bound at the cell surface, with only 3 to 4% of this extracellular Zn penetrating the cell membrane. Once inside the cell, Zn exerted its toxicity at a number of sites. Increased ATP production and ETC activity were observed in Zn-treated cells. Zinc also enhanced cellular thiols and total glutathione, and Zn toxicity was reversible by the addition of thiol compounds such as cysteine. Zinc-thiol binding may be a detoxification mechanism for the cell. It is suggested that increased ATP production may provide the energy required for increased glutathione synthesis at the expense of other energy-requiring processes including cell division. The mechanisms of toxicity of ionic Zn and copper to N. closterium differ. Whereas oxidation of thiols, particularly GSH, may be the primary toxic effect of copper, zinc-thiol binding may be a detoxification mechanism. (Author's abstract)
W91-00729

SEASONAL CHANGES OF THE ENVIRONMENTAL CONDITIONS IN DIMICTIC LAKES DIFFERING AS TO THEIR TROPHIC STATE (SEZONOWE ZMIANY WARUNKOW SRODOWISKA W JEZIORACH DYMIKTYCZNYCH O ROZNYM STOPNIU EUTROFIZACJI).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 2H.
W91-00735

INFLUENCE OF SEWAGE POLLUTION ON A ROCKY INTERTIDAL COMMUNITY DOMINATED BY THE MYTILID BRACHIDONTES RODRIGUEZI.
Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Buenos Aires.
J. J. Lopez Gappa, A. Tablado, and N. H. Magaldi.
Marine Ecology Progress Series MESEDT, Vol. 63, No. 2/3, p 163-175, May 29, 1990. 9 fig, 4 tab, 49 ref. National Council for Scientific Research and Technology PID Grant 035/88.

Descriptors: *Argentina, *Intertidal areas, *Mussels, *Wastewater pollution, *Water pollution effects, Benthic environment, Biomass, Chlorophyta, Marine environment, Outfall, Periphyton, Stratification.

The characteristic Brachidontes rodriguezi community was absent from the highly polluted intertidal area surrounding a sewage outfall at Quequen (Argentina). It began to recover in lower tidal levels with better water renewal and shorter desiccation periods. The chlorophyte Ulva lactuca was the most abundant organism at intermediate pollution levels, but reached its highest abundance in association with B. rodriguezi. The pulmonate limpet Siphonaria lessoni, the chlorophytes Cladophora sp. and Enteromorpha compressa, and blue-green algae increased in the vicinity of the outfall. A decrease in epilithic community biomass in the highly polluted area could be inferred from changes in percent cover, stratification and bare substratum proportion. Highest diversity was reached at intermediate levels of pollution. Diversity decreased at higher levels due to low specific richness and also in relatively unpolluted areas due to space monopolization by B. rodriguezi. Therefore, sewage pollution could be regarded as a disturbance factor preventing space monopolization by the most successful competitor. Sewage effects on the benthic community were similar to the decrease in abundance observed towards upper intertidal levels. Community structure proved to be a better pollution indicator than seawater variables since it can be considered as reflecting an average of varying environmental conditions. (Author's abstract)
W91-00764

EFFECTS OF CHANGES IN SEWAGE POLLUTION ON SOFT-BOTTOM MACROFAUNA COMMUNITIES IN THE INNER OSLOFJORD, NORWAY.
Tromsoe Univ. (Norway). Inst. of Fisheries.
M. M. Aschan, and A. M. Skullerud.
Sarsia SARIA3, Vol. 75, No. 2, p 169-187, 1990. 10 fig, 3 tab, 34 ref, 3 append.

Descriptors: *Fjords, *Norway, *Path of pollutants, *Water pollution effects, Macroinvertebrates, Species diversity, Statistical analysis.

The macrobenthic fauna of Vestfjorden, inner Oslofjord was sampled in 1980 and 1985 at 19 stations in order to detect possible faunal changes following the start of a sewage treatment plant in 1982. The faunal data were analyzed by a variety of methods including diversity indices, log-normal distribution of individuals among species and classification and ordination analysis. The results show a decline in species number and abundance which may be related to increased pollution. However, the diversity and the evenness have increased. The area within a radius of 2-3 km from the outlet of the treatment plant shows clear pollution effects while the marginal areas show improved conditions. Although there was not a distinct pollution gradient according to distance to outlet for each station, the five station groups had a distribution pattern determined by distance to the point source and depth. The reason why the new discharge area of Vestfjorden does not show even more obvious changes in benthic fauna due to pollution is that the inner Oslofjord has been receiving sewage and polluted waters for a long time period. The macrobenthos in the fjord has established a 'second stage equilibrium' or 'neighborhood stability' where deposit feeders dominate and distinct pollution effects are not detectable. The intermediate levels of pollution maintain an increased diversity and a large number of species by ensuring that dominance by

any one species is only temporary and a stable climax is never reached. (Brunone-PTT)
W91-00788

IMPLICATIONS OF HEAVY METAL TOXICITY RELATED TO EDTA EXPOSURE.
Bundesgesundheitsamt, Berlin (Germany, F.R.).
H. H. Dieter.
Toxicological and Environmental Chemistry TXECBP, Vol. 27, No. 1-3, p 91-95, 1990. 11 ref.

Descriptors: *Drinking water, *Ethylenediamine tetraacetic acid, *Heavy metals, *Toxicity, *Water pollution effects, Binding affinity, Food additives, Pharmacodynamics, Pharmacokinetics, Public health.

Owing to its poor degradability, ethylenediamine tetraacetic acid (EDTA) can be found in relatively high concentrations in many drinking waters produced from surface waters and river bank filtrates. In a toxicological assessment, heavy metals found in these waters are present mainly in the form of their EDTA complexes whose chronic low-dose toxicity has not yet been adequately investigated. Moreover, the biochemistry, pharmacodynamics and pharmacokinetics of the EDTA molecule itself preclude at present a definitive answer as to its toxicological profile. Some recent biochemical data show that EDTA could intensify the renal toxicity of cadmium due to the higher binding affinity of this complexing agent for zinc. EDTA after single and high dosage is distributed not only extracellularly but it also enters the renal tubulus cells. In this form it is able to destabilize their Zn-thionein pool. The pharmacokinetic half-life for the excretion of intracellular EDTA is not known but it seems to be significantly longer than that of extracellular EDTA. Therefore, considering its limited metabolisation, the intracellular accumulation of EDTA under chronic exposure seems to be possible. Under such conditions, a destablization of the renal Zn-thionein pool could become toxicologically relevant due to the high avidity of EDTA for zinc ions. A simultaneous increase of the concentration of cytosolic free cadmium could be the consequence. Therefore, there is a need for a toxicological re-evaluation of EDTA whose admission as a food additive in some European countries is based on data obtained at least 14 years ago. (Author's abstract)
W91-00792

EFFECTS OF NICKEL ON DAPHNIA MAGNA DURING CHRONIC EXPOSURE AND ALTERATIONS IN THE TOXICITY TO GENERATIONS PRE-EXPOSED TO NICKEL.
Staatliches Amt fuer Wasser- und Abfallwirtschaft, Herten (Germany, F.R.).
A. Munzinger.
Water Research WATRAG, Vol. 24, No. 7, p 845-852, July 1990. 7 fig, 5 tab, 45 ref.

Descriptors: *Daphnia, *Nickel, *Sublethal effects, *Toxicity, *Water pollution effects, Chronic toxicity, Life cycles, Population exposure, Populations, Reproduction, Statistical analysis.

Daphnia magna was cultured at sublethal nickel concentrations. The mean life expectancy was significantly less when exposed to greater than or equal to 40 ppb Ni. Statistically significant reductions of the number of offspring, maximum body length of adults and of neonates were caused by greater than or equal to 80 ppb Ni. The length and brood size of the primiparous animals were significantly less when exposed to greater than or equal to 120 ppb Ni. The intrinsic rate of population growth (r) was inversely proportional to nickel concentrations. During seven successive generations exposed to 160 ppb Ni, both the mean life span and the length of primiparous animals decreased significantly with increasing time. The progeny of nickel pre-exposed generations exhibited no adaptation towards nickel except an altered reproduction pattern which induced an increase of r. After the transfer into nickel-free water, the progeny of nickel pre-exposed generations showed an increase of body length, mean life span, number of offspring, brood size and brood number as well as the maximum body length of neonates. However, the progeny of pre-exposed generations remained smaller than the progeny of an untreated generation. (Author's abstract)
W91-00808

SIMPLE CONTINUOUS-FLOW TOXICITY TEST SYSTEM FOR MICROSCOPIC LIFE STAGES OF AQUATIC ORGANISMS.
California Univ., Santa Cruz. Inst. of Marine Sciences.
For primary bibliographic entry see Field 5A.
W91-00814

TOXICITY OF 1,1,1-TRICHLOROETHANE AND TRICHLOROETHENE ON A MIXED CULTURE OF METHANE-OXIDIZING BACTERIA.
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5G.
W91-00832

TOLERANCE OF SCAPANIA UNDULATA (L.)DUM. TO FLUORIDE.
Wroclaw Univ. (Poland). Dept. of Ecology and Nature Protection.
A. Samecka-Cymerman, and A. J. Kempers.
Aquatic Botany AQBODS, Vol. 37, No. 2, p 163-170, July 1990. 6 tab, 6 ref.

Descriptors: *Aquatic plants, *Bioaccumulation, *Fluorides, *Toxicity, *Water pollution effects, Groundwater, Lethal limit, Liverworts, Mineralization, Plant growth, Plant physiology, Poland, Sudeten, Water chemistry.

Fluoride is a common ion in surface water and groundwater, usually occurring in low concentrations. Increased concentrations of fluoride may be provoked by fluorite mineralization. Studies were made of the aquatic liverwort Scapania undulata from 21 Sudeten streams in Poland. It was found that this species, containing from 10 to 652 mg/kg dry weight of fluoride, grows in water with fluoride contents from traces to 0.3 ppm. According to bioassays the lethal concentration of fluoride (48 h LC(100)) for S. undulata appeared to be 400 or 450 ppm, depending on the population from which the liverworts were chosen. Exposure to 100 ppm fluoride for 16 days may be recognized as harmless for S. undulata. This liverwort is characterized by an ability to accumulate fluoride whereby the accumulation capacity depends on the fluoride level in the water of the growing site. This was demonstrated by an increase of 21-67% of fluoride in plants cultivated in water with concentrations of 250 ppm fluoride. (Author's abstract)
W91-00835

EFFECTS OF LOW PH AND LOW CALCIUM CONCENTRATION ON THE PULMONATE SNAIL PLANORBELLA TRIVOLVIS: A LABORATORY STUDY.
Oakland Univ., Rochester, MI. Inst. of Biological Sciences.
R. D. Hunter.
Canadian Journal of Zoology CJZOAG, Vol. 68, No. 7, p 1578-1583, July 1990. 2 fig, 4 tab, 26 ref.

Descriptors: *Acid rain effects, *Acidification, *Mollusks, *Snails, *Water pollution effects, Calcium, Eggs, Growth rates, Hydrogen ion concentration, Juvenile growth stage, Laboratory methods, Mature growth stage.

Mollusks are among the groups of freshwater animals which are most sensitive to acidification. Freshwater pulmonate snails (Planorbella trivolvis) were maintained in the laboratory in stream water with manipulated pH and Ca(2+). Low pH treatments (4.6 and 4.7) resulted in significantly lower adult growth rates and reduced gross fecundity compared with circumneutral pH treatments (7.2 and 7.4) regardless of the Ca(2+) level. None of the eggs laid in low pH treatments hatched, mostly because of developmental arrest (gastrula or earlier). Eggs in low Ca(2+) treatments took longer to complete development and had a higher incidence of abnormality compared with eggs in the high pH, high Ca(2+) treatment. Juveniles that successfully hatched from the low Ca(2+) grew very little and all died within 100 days, whereas > 7.2% of those in the high Ca(2+), circumneutral pH treatment were alive at day 100, some of which had become adults and were laying eggs. This study suggests that both low pH (4.6) and low Ca(2+) (1-2 mg/L) are lethal to P. trivolvis, with embryos and juveniles showing much greater sensitivity than adults. Given the range of the two variables used in this study (1000-fold for H(+) and approximately 30-fold for Ca(2+)), pH has the greater negative impact and, when below 5.0, led to recruitment failure in P. trivolvis; a similar effect on other pulmonate species would be expected. Furthermore, a Ca(2+) concentration as low as 2 mg/L alone, regardless of pH, would be sufficient to cause recruitment failure by reducing juvenile survival. These data suggest that increasing Ca(2+) levels does not protect P. trivolvis from the effects of low pH. (Author's abstract)
W91-00838

RELATIONSHIPS BETWEEN COPPER CONCENTRATIONS IN LARVAE OF PLECTROCNEMIA CONSPERSA (CURTIS) (TRICHOPTERA) AND IN MINE DRAINAGE STREAMS.
Polytechnic South West, Plymouth (England). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W91-00859

HEALTH EFFECTS OF HAZARDOUS WASTE.
South Carolina State Dept. of Health and Environmental Control, Columbia. Bureau of Preventive Health Services.
C. W. Heath.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 3.17-3.27, 3 fig.

Descriptors: *Epidemiology, *Hazardous materials, *Hazardous waste disposal, *Public health, *Risk assessment, Hazard assessment.

Hazardous chemicals and the ways in which the health risks posed by exposure to waste chemicals are measured are addressed. Whatever the setting, risk assessment is critically dependent on three types of data: (1) data concerning the nature of potentially toxic exposure; (2) data concerning the existence and nature of disease or biologic abnormalities; and (3) data concerning the degree to which exposure and biologic abnormalities may be etiologically linked in any particular setting. In order to determine the health risks it is necessary to document the toxins present and to characterize the exposure setting; evaluate the chemical properties; measure the spread of contamination; and test exposed persons. Since different toxic chemicals can have quite different biologic effects, both as a result of differing chemical properties for individual target tissues and in relation to their doses and pathways of exposure, many different kinds of disease and biologic change need to be considered. Complete case ascertainment is as crucial as accurate case diagnosis. Epidemiologic investigations describe frequencies of illness in populations and relate those frequencies to various characteristics of those populations. Situations requiring assessment of possible hazardous-waste health effects can take either of two forms. One entails assessing the toxic potential of a known waste-disposal site and then seeking patterns of human illness which might result from site exposure. In the other the epidemiologist is called upon to assess an apparently unusual pattern of disease in a community and, in the process, to seek a possible environmental cause. It is also frequently necessary to extrapolate high-dose animal toxicologic data to low-dose human exposures and to use subclinical observations as a theoretical basis for predicting future human disease. (See also W91-00900) (White-Reimer-PTT)
W91-00908

5D. Waste Treatment Processes

IMPROVING THE SLUDGE CONDITIONING POTENTIAL OF MORINGA SEED.
Nigeria Univ., Nsukka. Dept. of Civil Engineering.
J. O. Ademiluyi, and R. M. Eze.
Environmental Management EMNGDC, Vol. 14, No. 1, p 125-129, January/February 1990. 3 fig, 23 ref.

Descriptors: *Digested sludge, *Moringa seeds, *Sludge, *Sludge conditioning, *Wastewater treatment, Chemical treatment, Chlorides, Filtration, Model studies.

In the search for a cheaper material to effectively condition sludge, oil-free moringa seed was prepared and tested. A Soxhlet apparatus was used to extract the oil from moringa seed (Moringa oleifera). The oil-free seed (marc) has been found to have higher conditioning potential than the ordinary moringa seed. (However, the traditional ferric chloride is still better sludge conditioner than moringa seed marc). For the digested domestic sludge used, optimum conditioning dosages were found to be 0.6, 0.80, and 1.10 percent of the total solids for ferric chloride, marc of the moringa seed, and ordinary moringa seed, respectively. Since little or no operational material is lost in the extraction process, the moringa seed marc is a promising conditioner in place of the ordinary seed. (Author's abstract)
W91-00028

ENERGY HEAD IMPLICATIONS OF THE INSTALLATION OF CIRCULAR FLAP GATES ON DRAINAGE OUTFALLS.
Liverpool Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W91-00068

UTILITY APPROACH TO STORMWATER MANAGEMENT.
Jones and Henry Engineers, Inc., Fort Wayne, OH.
For primary bibliographic entry see Field 4A.
W91-00104

UPGRADING THE OWL'S HEAD WASTEWATER TREATMENT PLANT.
Metcalf and Eddy of New York, NY.
A. N. Borowiec, and J. T. Miller.
Public Works PUWOAH, Vol. 121, No. 6, p 91-92, June 1990. 1 fig.

Descriptors: *New York, *Project planning, *Upgrading, *Wastewater treatment facilities, *Water treatment facilities, Aeration, Pumping plants, Secondary wastewater treatment, Settling basins, Sewers, Sludge digestion, Sludge treatment, Wastewater treatment.

Bound by the constraints of existing structures and systems that must provide continuous service during construction, large-scale upgrading projects often require extraordinary management efforts to meet the simultaneous objectives of onging operation and new construction. At the Owl's Head Wastewater Treatment Facility in Brooklyn, New York, a 14-year, $475-million rehabilitation and upgrading project is underway to change the treatment process from modified aeration to full secondary, thereby complying with the Clean Water Act and New York State environmental permits. Analysis of existing facilities and future needs yielded four conclusions: The facility's mechanical and electrical equipment required replacement; The pump and powerhouse structure could be salvaged with renovation; The six existing sludge digestion tanks (four primary digesters and two gas extractors) were not salvageable; and The aeration and settling tanks required replacement for the facility to meet full secondary treatment standards. Using these findings, New York City formulated a comprehensive program to develop a facility capable of meeting the current, more stringent treatment requirements. The plan provided for a new sludge processing complex, a renovated pump and powerhouse building, new primary and secondary settling tanks, new aeration tanks, a new and rehabilitated seawall, new outfall sewer, and new chlorination facilities. The public's ongoing participation has ensured that the inevitable construction difficulties have had a minimal impact on neighborhood life. The city has helped to develop and implement programs to aid delivery and construction, and subcontractors have responded to the often-demanding schedules of a major construction project. (Mertz-PTT)
W91-00107

OPTIMIZING POLYMER DOSAGE IN SLUDGE DEWATERING PROCESS.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
H. W. Campbell, and P. J. Cresuolo.
Water Engineering and Management WENMD2, Vol. 137, No. 6, p 31-32, June 1990.

Descriptors: *Canada, *Polymers, *Sludge conditioning, *Sludge drying, *Wastewater treatment, Cost analysis, Costs, Dewatering, Economic aspects, Operating costs, Wastewater facilities.

The sludge conditioning controller is an innovative device that measures and adjusts dosages of polymer used in the sludge dewatering process every 30 seconds. Since large sewage treatment plants can spend thousands of dollars per year on polymer, the potential cost savings as a result of more efficient polymer usage are substantial. The development of the sludge conditioning controller evolved from applied research conducted at the Wastewater Technology Center, in Ontario, Canada. In 1986, the sludge conditioning controller was installed at the Guelph Water Pollution Control Plant where it successfully demonstrated a significant reduction in polymer usage. Polymer saving was calculated to be 24%. The sludge conditioning controller consists of two major subsystems: the sampling system and the central control panel. The sampling system consists of a tank, feed and drain pinch valves, three spray rinsing nozzles and the measurement head assembly. The measurement head includes the rheology sensor and its drive motor, a signal conditioning amplifier and a level sensor. The central control panel houses the microcomputer that receives the raw rheological measurements and calculates the parameters of interest and output control signal for the appropriate polymer pump controller. (Mertz-PTT)
W91-00112

MOVING SLUDGE.
Lockwood, Andrews and Newman, Inc., Dallas, TX.
J. Moseley.
Water Engineering and Management WENMD2, Vol. 137, No. 6, p 28-29, June 1990. 2 fig.

Descriptors: *Sludge drying, *Wastewater treatment, Dallas, Dewatering, Economic aspects, Environmental protection, Filter presses, Polymers, Sludge, Texas, Waste disposal, Wastewater disposal, Wastewater facilities.

Dallas Water Utilities treats almost 200 million gallons of wastewater each day. This wastewater is sent to one of two facilities, the Southside Wastewater Treatment Plant or the Central Wastewater Treatment Plant, where the solids are removed. The solids removed from the wastewater at both treatment plants are sent to the sludge dewatering facilities at the Southside plant. The liquid sludge is pumped onto belt filter presses where it is mixed with a polymer that coagulates the solids and separates it from the water. Programmable logic controllers, installed at each belt filter press, control belt speeds, tension, polymer and sludge pump speeds, polymer mixing energy and fluid levels. At the pug mill facility, the dewatered sludge is mixed with on-site granular soils prior to ultimate disposal in a dedicated 200-acre sludge-only landfill. Mixing in the pug mill facility is more economical than field mixing. It also uses approximately 50% less soil. To protect the environment and prevent contaminated groundwater migration, the monofill is surrounded by a 31-foot deep soil-slurry cutoff wall; levees protect the site from flooding, and groundwater monitoring wells encircle the entire site. (Mertz-PTT)
W91-00113

HIGH-SOLIDS CENTRIFUGES TURN OUT TO BE SURPRISE DEWATERING CHOICE.
Passaic Valley Sewerage Commissioners, Newark, NJ.
S. Lipke.
Water Engineering and Management WENMD2, Vol. 137, No. 6, p 22-24, June 1990. 3 fig.

Descriptors: *Centrifugation, *New Jersey, *Sludge drying, *Wastewater treatment, Dewatering, Filter presses, Odor control, Sludge, Wastewater facilities, Wet oxidation process.

The first step in implementing a land-based alternative to ocean dumping is to mechanically dewater the sludge. The Passaic Valley Sewerage Commissioners investigated methods to dewater sludge, both in the U.S. and by observing European technology. A wet-air oxidation system to condition the sludge for dewatering in recessed chamber filter presses, belt filter presses in conjunction with polymers for sludge conditions, and European technology that used high-solids centrifuges were considered. Centrifuges had several advantages over other technologies: they were totally enclosed, drastically reducing odors that needed to be treated and they operated without sprays or exposed sludge. Historically, though, they are known for rapid wear and high-moisture cakes. A life-cycle analysis of the alternatives showed that twice as many belt filter presses were needed as centrifuges to handle the same sludge volume. The filter-press facility would have been similar in size to a centrifuge dewatering facility, but the centrifuges needed much less of an odor-control system than either of the other alternatives. Soon after completion of the dewatering section of the Passaic Valley Sewerage Commissioners' Facilities Plan, they began the design of an Interim Dewatering Facility to meet a New Jersey State-mandated deadline for ending ocean dumping by March, 1991. The Interim plan will use the existing wet-air oxidation/filter press installation to dewater about 70% of the raw sludge production. The remaining sludge will be dewatered by 7 high-solids centrifuges. Start-up and testing of the facility will begin in January 1991. (Mertz-PTT)
W91-00114

USE OF STATISTICAL METHODS IN INDUSTRIAL WATER POLLUTION CONTROL REGULATIONS IN THE UNITED STATES.
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W91-00125

CONTINUOUS EFFLUENT CONSENTS: MODELLING AND COMPLIANCE TESTING.
WRc Engineering, Swindon (England).
For primary bibliographic entry see Field 5G.
W91-00126

STATISTICS-BASED SYSTEM FOR TREATMENT PLANT OPERATION.
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
P. M. Berthouex, W. Lai, and A. Darjatmoko.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 247-269, November 1989. 11 fig, 1 tab, 55 ref. USEPA Assistance Agreement CR-812655-01-0.

Descriptors: *Computer programs, *Information systems, *Statistical models, *Statistics, *Wastewater treatment, Computers, Wastewater facilities, Wastewater management.

The mission of a wastewater treatment plant is to transform raw sewage into an effluent that meets permitted discharge standards. Research is being conducted to develop a convenient computer system to improve everyday operation and control of the wastewater treatment process. The goal is to

help the operator detect the problems in the process and to select appropriate control actions. The system, known as STATEX, comprises subsystems for a data base management, data analysis including several statistical methods, and an expert advisory system. The statistical methods investigated include construction of external reference distributions, computation of moving averages, graphical methods, discriminant functions for early detection of upsets, and several kinds of control charts. The latter two methods are still under development and are not built into the system. Reference distributions are used to help define the fuzzy terms such as high and low for the conditions of the variables involved in the expert system control rules. The system is written in dBase-III and Lotus-123 and has a user-friendly interface for the communication between the user and the system. (Author's abstract)
W91-00129

STATE ESTIMATION IN WASTEWATER ENGINEERING: APPLICATION TO AN ANAEROBIC PROCESS.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
R. M. Jones, J. F. Macgregor, and K. L. Murphy.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 271-282, November 1989. 6 fig, 13 ref, append.

Descriptors: *Model studies, *Statistical analysis, *Statistical models, *Statistics, *Wastewater treatment, Data interpretation, Mathematical models, Wastewater management.

A dynamic model for wastewater treatment is composed of a set of equations relating state variables, which may include temperature, pH, and the concentrations of feed and effluent components in the wastewater, and input variables, which include feedrate, addition rate of a base used to control pH, or the flow of steam to a heat exchanger used to maintain a constant temperature. The treatment process is also affected by unmeasured stochastic disturbances and some complex mechanisms that do not appear in the mechanistic models used to describe the treatment process. The use of an extended Kalman filter for state estimation in biological wastewater treatment processes is a way of incorporating the effects of unmeasured disturbances and unknown mechanisms by introducing additional stochastic state variables to the model. The application of the technique requires an adequate mechanistic dynamic model and the identification and modeling of the major sources of stochastic disturbances in the process. The filter allows the on-line tracking of process variables which are not directly measurable. Use of an extended Kalman filter is demonstrated by a simulated application to a high rate anaerobic wastewater treatment process. Unmeasured stochastic disturbances were incorporated into the model through simple random walk functions. (Tappert-PTT)
W91-00130

EVALUATION OF PHOSPHORUS LOADS FROM ONTARIO MUNICIPAL WASTEWATER TREATMENT PLANTS.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
D. Chapman, W. Randle, and H. Monteith.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 307-321, November 1989. 6 fig, 4 tab, 11 ref, append.

Descriptors: *Canada, *Lake Erie, *Lake Ontario, *Phosphorus, *Pollution load, *St Lawrence River, *Wastewater facilities, *Wastewater treatment, *Water pollution sources, Chemical treatment, Comparison studies, Eutrophication, Monte Carlo method, Secondary treatment, Wastewater disposal.

As a part of efforts to reduce the rate of eutrophication, effluent phosphorus limits have been placed on municipal treatment plants that discharge into the Great Lakes and the St. Lawrence River. Results are presented from an evaluation of the nature and accuracy of phosphorus loads discharged by Ontario municipal wastewater treatment plants into the Great Lakes. Data were examined for the 96 plants treating flows in excess of 4546 cubic meters per day for the period 1981 to 1985. For the Lake Erie, Lake Ontario/St. Lawrence River and Upper Great Lakes basins, total basin phosphorus loads were classified according to type of wastewater treatment system, the type of chemical added for phosphorus removal, plant capacity, and sampling frequency. Load estimation techniques were compared using the 1985 daily data from three representative treatment plants. Annual phosphorus loads were compared using the complete data records for the plants and using Monte Carlo techniques to simulate an incomplete data record typical of once per week effluent phosphorus sampling. Potential sources of bias were identified in annual phosphorus load estimates from municipal treatment plants, including inaccurate flow measurement, inconsistent practices concerning data round-off, and plant bypass during storms or spring snowmelt. The data indicate that a comparatively small number of large plants in each basin accounted for the majority of the annual load discharged and that 16% of the Lake Ontario phosphorus load and 43% of the Upper Great Lakes phosphorus load originated from plants which did not add any chemical to remove phosphorus. (Tappert-PTT)
W91-00132

DESIGN OF DETENTION BASINS FOR INDUSTRIAL SITES.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
D. D. Meredith, A. C. Middleton, and J. R. Smith.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 586-591, July/August 1990. 3 fig, 16 ref, append.

Descriptors: *Detention reservoirs, *Runoff forecasting, *Storm wastewater, *Storm water, *Surface runoff, *Wastewater collection, Design criteria, Hydraulic engineering, Industrial plants, Optimization, Overflow, Regulations, Storm runoff, Water pollution prevention.

Regulations require management of runoff from industrial plant sites so as not to discharge toxic or hazardous pollutants to receiving waters. The purpose of the detention basin is to store the stormwater during periods of runoff and release it at a lower rate to the treatment process. A procedure that uses all of the available rainfall records for a site has been developed for sizing detention basins for stormwater runoff where all of the runoff must be treated. The procedure is simple and results in a design related to overflow rather than inflow recurrence intervals. The use of treatment duration and storage duration curves allows the designer to study the tradeoffs between the design variables to obtain a more nearly optimal solution. The procedure has been used successfully to design several detention basins for industrial plant sites in the United States. (Fish-PTT)
W91-00188

ADSORPTION REMOVAL OF CRESOL BY GRANULAR ACTIVATED CARBON FOR MEDICAL WASTE WATER TREATMENT.
Tokushima Univ. (Japan). Dept. of Public Health.
M. Tanada, T. Miyoshi, T. Nakamura, and S. Tanada.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 170-176, August 1990. 1 fig, 4 tab, 14 ref.

Descriptors: *Activated carbon, *Cresol, *Granular activated carbon, *Hospitals, *Medical wastes, *Phenols, *Pretreatment of wastewater, *Waste treatment, *Wastewater treatment, Adsorption, Hydrogen ion concentration, Mathematical equations, Municipal wastewater.

Waste water from medical facilities contain large quantities of disinfectants which hinder the purification abilities of aerobic bacteria and thus prevent the use of the activated sludge method for medical waste water treatment. Because solid adsorbents such as activated carbon have been used for removing organic substances from wastewater, an investigation was made of the characteristics of adsorption removal of cresol, one of the disinfectants, onto granular activated carbon for medical wastewater treatment. The adsorption isotherms of cresol onto activated carbon at 25 degrees were of the Freundlich type. In order to elucidate which adsorbent properties most affected the amount of cresol adsorbed, the correlation coefficients between the amount adsorbed and physicochemical properties of the activated carbon were calculated. It was concluded that the amount of cresol adsorbed in low equilibrium concentrations was primarily affected by the surface pH of the activated carbon. (Hoskin-PTT)
W91-00203

STATE SPACE APPROACH TO THE BEHAVIOR OF SEWER SYSTEMS.
Barcelona City Dept. of Public Works (Spain). Planning Div.
R. Vazquez Garcia.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 301-312, 1987. 4 fig, 9 ref.

Descriptors: *Hydraulics, *Mathematical models, *Model studies, *Sewer systems, *Stochastic hydrology, Hydraulic models, Mathematical analysis, Mathematical equations, Stochastic models, Weirs.

A state space approach may be a useful tool to develop didactic procedures, build up automatic control systems and draw simple simulation models related to flow routing through storm sewer systems. Systems engineering provides a lot of examples in civil engineering in which the general methodology of the state space approach fits quite well to the mathematical abstraction of the physical reality. By means of state space-based equations, the evolution in a discrete form of debts in different nodes of a sewer system can be followed. A simple model called CSMUSK was developed with the aim of developing a fast way to model weir overflow behavior. (Hoskin-PTT)
W91-00375

HERCULEAN LABORS TO CLEAN WASTEWATER.
Golob's Oil Pollution Bulletin, Cambridge, MA.
T. M. Hawley.
Oceanus OCEAAK, Vol. 33, No. 2, p 72-75, Summer 1990. 1 fig, 1 tab.

Descriptors: *Advanced wastewater treatment, *Nutrient removal, *Wastewater treatment, Biological wastewater treatment, Nitrogen removal, Phosphorus removal, Physiochemical treatment, Primary wastewater treatment, Secondary wastewater treatment, Sludge, Wetlands.

Although standard 'primary' and 'secondary' wastewater treatment technologies effectively separate solid wastes from the water that carries them, they produce considerable amounts of sludge in the process, and usually fail to remove many inorganic nutrients. Those nutrients must be removed if the water is not to contribute to algal blooms and eutrophication. Options for sludge disposal are decreasing. Because of this, alternative sewage treatment technologies are under development. These systems usually address either sewage's biological potential more directly than does standard treatment, or technologically lower sludge production. A system called 'advanced primary' treatment adds synthetic polymers and ferric chloride to wastewater early in the treatment process, which cause suspended solids in primary settling tanks to coagulate and sink. In advanced primary treatment, biological oxygen demand removal and sludge production is about midway between primary and secondary treatment, and suspended solids removal is about equal to secondary treatment. Another alternative treatment system is the use of reclaimed and natural wetlands to 'polish' the effluent prior to its discharge into the general water system. An example is the Orlando Easterly Wetlands Reclamation Project, where effluent already clean to secondary standards flows through the reclaimed wetlands prior to its discharge into the St. Johns River. In 1989, this system removed 80-90% of the total nitrogen and phosphorus from the water flowing through it. Artificial wetlands

are in use for cleaning wastewater even in areas with short growing seasons, such as New England. One system, called 'System Aquatics' treats either raw sewage or septage by passing it through a greenhouse where a series of 5000 liter clear plastic silos are home to engineered ecosystems that convert the organic nutrients into biomass. In Providence, Rhode Island, a Solar Aquatics system treats nearly 60,000 liters a day of domestic sewage laced with heavy metals. Although these various innovative technologies are promising, some large U.S. cities have a long way to go before achieving environmentally friendly sewage treatment and sludge disposal. Every avenue, such as source reduction by on-site composting, should be explored. (Hoskin-PTT)
W91-00387

INVESTIGATING SEPTIC DISPOSAL SITES USING A VELOCITY PERMEAMETER.
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
K. J. Rose, and G. E. Merva.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 5, p 533-552, July 1990. 5 fig, 1 tab, 26 ref.

Descriptors: *Hydraulic conductivity, *Measuring instruments, *Permeameters, *Septic tanks, *Site selection, *Soil properties, *Wastewater treatment, Field tests, Michigan, On-site tests, Statistical analysis.

In the state of Michigan there is no field test to determine the acceptability of a site for a septic disposal system other than the decision of the sanitarian in whose jurisdiction the system is to be installed. The use of a new instrument for determining saturated hydraulic conductivity, the velocity permeameter, was investigated. The velocity permeameter method is based on Darcy's Law, and uses a sample cup to enclose a small volume of soil through which water is forced under some pressure. Field testing was done in conjunction with site evaluations of potential septic system sites by sanitarians in the counties surrounding Lansing, Michigan. Excellent agreement between the velocity permeameter method and the standard method for determination of hydraulic conductivity (constant head method) was found in field/laboratory testing for hydraulic conductivity in the 0.0001-0.76 m/h range. The minimum acceptable value for hydraulic conductivity selected for a septic disposal system site was 0.025 m/h. All 13 sites that were rejected by the sanitarians were also rejected by the velocity permeameter test. The velocity permeameter is a useful tool for evaluating septic disposal sites with borderline soil hydraulic conductivities. (MacKeen-PTT)
W91-00394

GAS-PHASE AND ACTIVATED CARBON MEDIATED THERMAL HYDROGENOLYSIS OF HALOGENATED ORGANICS.
Leiden Rijksuniversiteit (Netherlands). Gorlaeus Labs.
R. Louw, and P. Mulder.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 5, p 555-569, July 1990. 2 fig, 3 tab, 20 ref.

Descriptors: *Cleanup operations, *Halogenated hydrocarbons, *Hazardous wastes, *Industrial wastes, *Waste treatment, Activated carbon, Chemical treatment, Economic aspects, Gas phase, Thermal hydrogenolysis.

Thermal hydrogenolysis may be considered as an alternative to the combustion of halogenated (i.e. chlorinated, fluorinated, and brominated) hazardous wastes. The desired reactions proceed well at temperatures below 1000 C and yield mixtures of light hydrocarbons and some soot. The halogens are converted into HX (with X= Cl, F, or Br). In the presence of excess hydrogen, virtually no chlorine, fluorine, or bromine gases or dioxins are formed. Since carbon monoxide, carbon dioxide, and water do not interfere with hydrogenolysis, syngas, made from coal or oil gasification, is an attractive hydrogen source. A promising process has been designed on this basis which may treat highly halogenated wastes economically. Activated carbon catalyzes the desired dehalogenating reactions and, for many halogenated organics, essentially complete conversion to HX occurs at temperatures less than or equal to 600 C. This alternative seems especially attractive for waste cleanup operations. (Author's abstract)
W91-00395

BASIC GUIDELINES FOR SPECIFYING THE DESIGN OF ULTRAVIOLET DISINFECTION SYSTEMS.
Stottler, Stagg and Associates, Inc., Cape Canaveral, FL.
M. V. Thampi.
Pollution Engineering PLENBW, Vol. 22, No. 5, p 65-69, May 1990. 2 fig, 15 ref.

Descriptors: *Disinfection, *Ultraviolet radiation, *Wastewater reactors, *Wastewater treatment, Design criteria, Dose, Hydraulic properties, Microorganisms, Secondary wastewater treatment, Sewage bacteria, Suspended solids.

Ultraviolet (UV) light disinfection is being increasingly used at wastewater treatment plants in the United States. Characteristics important in the design of UV disinfection systems include lamp type, dose intensity, hydraulic performance characteristics, and monitoring germicidal efficiency. The UV lamp is filled with low pressure mercury vapor and argon and has an available germicidal output of 20-25% of the lamp rating and an expected lifetime of 7,000 to 10,000 hours. High suspended solids shield microorganisms from UV rays. An effluent absorbance of 0.2/cm or less is recommended. For organisms found in secondary wastewater effluent prior to disinfection, 16,000 microW-sec/sq cm is sufficient for inactivation. The desired flow condition in UV reactors is plug flow with minimal longitudinal dispersion. The salt tracer conductivity residence time distribution curve can be used to determine hydraulic performance parameters in UV and other reactors. Coliform assays, viral assays and DNA fluorimetry are used to indicate germicidal inactivation. UV irradiation for disinfection is a viable alternative, and when used with peroxide and ozone, it catalyzes the degradation of toxic organics. (MacKeen-PTT)
W91-00401

SPECIFER'S GUIDE TO POLYMER FEED SYSTEMS.
G. R. Mace.
Pollution Engineering PLENBW, Vol. 22, No. 5, p 75-79, May 1990. 2 fig, 2 tab.

Descriptors: *Polymers, *Suspended solids, *Wastewater treatment, *Water treatment, Design criteria, Equipment, Flocculation, Sludge treatment, Wastewater treatment facilities, Water treatment facilities.

The use of polymers to coagulate and separate suspended solids in water and wastewater and the features of commercially available equipment to mix and dilute polymers are discussed. Four basic types of concentrated polymer are commercially available: dry, emulsion, liquid solution and mannich. Jar tests must be conducted to quantify the performance of the different polymer types for a given water, wastewater or sludge. The four general applications for polymers in increasing order of volume are granular media filtration or polishing, dissolved air flotation/thickening, clarification, and sludge dewatering. The most important step in polymer preparation is the initial introduction of the concentrated polymer into the dilution medium. Additional steps are mixing, aging, metering pump and final dilution. The cost of polymer equipment varies widely and is directly related to the degree of automation. Other factors which should be considered in the design of a polymer system include size of system, bulk storage, type of polymer, operator preferences, system end use, location of polymer addition, frequency of use, ease of operation versus degree of polymer activation obtained, first costs, space and location, and prepackaging. (MacKeen-PTT)
W91-00402

ALTERNATE TECHNOLOGIES FOR WASTEWATER TREATMENT.
J. Hauck, and S. Masoomian.
Pollution Engineering PLENBW, Vol. 22, No. 5, p 81-84, May 1990. 3 fig, 1 tab.

Descriptors: *Advanced wastewater treatment, *Chemical treatment, *Physicochemical treatment, *Wastewater treatment, Aeration, Clarification, Electrodialysis, Ion exchange, Membrane processes, Ozonation, Reverse osmosis, Sequencing batch reactors, Ultrafiltration, Water treatment.

A summary of alternative wastewater treatment technologies is presented. The technologies were designed to complement existing treatment facilities. Ultrafiltration (UF) uses a hollow fiber or spiral wound element to remove organics from water at relatively low feed pressures. UF applications include preparation of water for use in high technology industries, recovery of mixed solvents and treatment of pulp and paper industry wastewater. Reverse osmosis also uses spiral or hollow fiber membranes; however its function is to remove dissolved salts from wastewaters. Electrodialysis uses a series of membranes to separate and concentrate ions, such as concentration of chrome in cooling towers, and in treatment of brackish water and colloids in fresh water. Fine bubble aeration results in a significant reduction in horsepower in the provision of air to the waste treatment system. Sequencing batch reactors are self-contained treatment systems incorporating equalization, aeration and clarification. They have been used to treat wastewater from two hazardous waste sites. Parallel plate clarification enhances particle removal from a flow stream. Insoluble starch xanthate was developed by the U.S. Department of Agriculture to remove trace quantities of heavy metals from plating wastewater. Arsenate and arsenic can be removed by sorption in polymer-chelated ferric ion in a ligand exchanger. Ozonation can be used to disinfect drinking water by killing both bacteria and viruses, and to oxidize organics. (MacKeen-PTT)
W91-00403

BIOLOGICAL TREATMENT OF HAZARDOUS WASTES, SLUDGES AND WASTEWATER.
New Jersey Inst. of Tech., Newark.
P. N. Cheremisinoff.
Pollution Engineering PLENBW, Vol. 22, No. 5, p 87-94, May 1990. 3 fig, 1 tab.

Descriptors: *Biological wastewater treatment, *Hazardous wastes, *Sludge treatment, *Waste treatment, *Wastewater treatment, Activated sludge process, Aerated lagoons, Aerobic conditions, Anaerobic conditions, Bacteria, Denitrification, In situ treatment, Nitrification, Roughing filters, Trickling filters.

A summary of the biological treatment of hazardous wastes, sludges and wastewater is presented. Biological treatment is typically applied to aqueous streams with organic contaminants. Classified according to nature of biological growth, biological process reactors are either suspended growth reactors or attached growth (fixed film) reactors. Fluidized bed reactors represent highly efficient fixed film reactors in which biomass build-up occurs on an inert or active fluidized support media high in external surface area. The principle suspended growth biological treatment processes are: the activated sludge process, the suspended growth nitrification process, aerated lagoons, the aerobic digestion process and high rate oxidation ponds. Aerobic attached growth biological treatment processes are usually used to remove organic matter found in wastewater, or to achieve nitrification. They include trickling filters, roughing filters, rotating biological contactors and fixed bed nitrification reactors. Anoxic denitrification can be accomplished by suspended or attached growth processes. Anaerobic treatment processes include the anaerobic digestion process, anaerobic contact process, and the attached growth anaerobic filter process. Combined anaerobic/anoxic and aerobic processes include facultative stabilization and tertiary maturation ponds. Liquid/solids treatment systems rely on efficient mass transfer controlled by adequate

mixing and aeration. In situ treatment, co-metabolism and denitrification are areas of developing technologies in the biological treatment of hazardous wastes. (MacKeen-PTT)
W91-00404

IMPROVED PERFORMANCE OF UPFLOW ANAEROBIC SLUDGE BLANKET (UASB) REACTORS BY OPERATING ALTERNATIVES.
Korea Advanced Inst. of Science and Technology, Seoul (Republic of Korea). Dept. of Civil Engineering.
H. S. Shin, and B. C. Paik.
Biotechnology Letters BILED3, Vol. 12, No. 6, p 469-474, June 1990. 5 fig, 8 ref.

Descriptors: *Anaerobic digestion, *Biological wastewater treatment, *Operating policies, *Sludge, *Wastewater facilities, *Wastewater treatment, Advanced wastewater treatment, Biogas, Chemical oxygen demand, Effluents, Lipids, Load distribution, Methane, Performance evaluation, Proteins.

The advanced anaerobic process upflow anaerobic sludge blanket (UASB) has been shown to produce high quality effluent and significant cost savings in treating soluble low, medium and complex high strength wastewaters. The successful performance of the UASB process was absolutely dependent on sludge granulation to obtain good settleability and high methanogenic activity of sludge. However, the serious foaming problem and precipitation of proteins in the reactor when overloaded were inhibitory to the release of biogas entrapped in the sludge, which accelerated flotation of the sludge. The efficient operation of UASB reactors treating complex soluble wastewater containing high protein and lipid content was attempted by mixing the reactor content in different modes: a control, a reactor with effluent recirculation, and a reactor mixed with a type of paddle impeller. Higher superficial flow rate increased chemical oxygen demand removal efficiency, sludge retainment, and methane content in biogas not only in the start-up period but also at high volumetric loading rates. However, formation of sludge particles in larger size was hindered by increased upflow liquid velocity. It was concluded that cautious operation is required for an effective UASB reactor as characteristics suitable for granulation of methanogenic sludge are limited and optimal operational protocol for each specific waste is not well established. Results show that the effluent recycle method is one of the proper operational strategies for the successful performance of a UASB reactor treating complex wastewaters containing high concentrations of proteins and lipids. (Agostine-PTT)
W91-00416

SUPERFUND RECORD OF DECISION: INDEPENDENT NAIL, SC.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00446

DESTRUCTION OF HAZARDOUS CHEMICAL WASTE BY OXIDATION IN SUPERCRITICAL WATER.
Los Alamos National Lab., NM.
C. K. Rofer, and G. E. Streit.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-012595. Price codes: A03 in paper copy, A01 in microfiche. June 1989. 24p, 3 tab, 10 ref, append.

Descriptors: *Chemical reactions, *Hazardous wastes, *Oxidation, *Wastewater oxidation, *Wastewater treatment, *Water temperature, Chemical wastes, Free radicals, High pressure, Kinetics, Model studies.

The chemistry of oxidation in supercritical water is being investigated for development into a practical destruction process for hazardous chemical waste. In principle, a wide variety of waste streams might be treated by this technology, including those that are unsuitable for incineration because of high water content. To establish a basis for extrapolation of kinetic measurements to a variety of compounds, a mechanism is being developed for oxidation in supercritical water on the basis of conventional free-radical reactions, with modifications for high pressures and high concentrations of water. Global rate expressions for oxidation of methane and methanol in supercritical water have been determined. A base mechanism and modifications to the mechanism to account for the roles of hydrogen bonding and water dimer formation have been investigated for CO. On this limited basis, reasonable agreement between model and experimental results has been obtained. Further, verification of the model with experimental results will provide insight into the roles of hydrogen bonding and water dimer formation in oxidation in supercritical water. (Author's abstract)
W91-00450

WATER CHLORINATION: CHEMISTRY, ENVIRONMENTAL IMPACT AND HEALTH EFFECTS. VOLUME 6.
For primary bibliographic entry see Field 5F.
W91-00476

FORMATION AND PROPERTIES OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE, A POTENT MUTAGEN IN CHLORINATED WATERS.
Abo Akademi, Turku (Finland). Lab. of Forest Products Chemistry.
For primary bibliographic entry see Field 5B.
W91-00486

IDENTIFICATION OF THE STRONG MUTAGEN 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE AND ITS GEOMETRIC ISOMER E-2-CHLORO-3-(DICHLOROMETHYL)-4-OXOBUTENOIC ACID IN MUTAGENIC FRACTIONS OF CHLORINE-TREATED HUMIC WATER AND IN DRINKING WATERS.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W91-00487

FIELD EVALUATION OF THE EFFECT OF CHLORINATED TREATED SEWAGE ON SETTLEMENT OF OYSTERS (CRASSOSTREA VIRGINICA GMELIN) AND BARNACLES (BALANUS SP).
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5C.
W91-00511

POTENTIAL FOR ADAPTATION OF THE ESTUARINE COPEPOD EURYTEMORA AFFINIS TO CHLORINE-PRODUCED OXIDANT RESIDUALS, HIGH TEMPERATURE, AND LOW OXYGEN.
Maryland Univ. Baltimore County, Catonsville. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-00512

TOXICITY AND FATE OF TOTAL RESIDUAL CHLORINE IN OUTDOOR EXPERIMENTAL STREAMS.
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
For primary bibliographic entry see Field 5C.
W91-00513

ACUTE TOXICITY, SUBLETHAL EFFECTS, AND BIOCONCENTRATION OF CHLORINATION PRODUCTS, VIRUSES, AND BACTERIA IN EDIBLE SHELLFISH: A REVIEW.
South Carolina Univ., Columbia. School of Public Health.
For primary bibliographic entry see Field 5C.
W91-00515

METHOD FOR DETERMINING THE COMPLETENESS OF DECHLORINATION WITH SULFITE.
Maryland Univ., College Park. Dept. of Chemistry.
A. C. Nweke, and G. R. Helz.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 741-750, 6 fig, 20 ref.

Descriptors: *Chlorination, *Dechlorination, *Disinfection, *Sulfites, *Wastewater treatment, *Water pollution control, *Water quality control, Chemical analysis, Chlorine, Monitoring, Pollutant identification.

Concern about the toxicity to aquatic organisms of chlorinated discharges has produced pressure on operators of wastewater treatment plants to reduce residual chlorine in effluents. Many operators feel that they can not meet disinfection standards if they significantly reduce the amount of chlorine they apply. Therefore, they are turning increasingly to dechlorination, which permits them to remove residual chlorine after disinfection is completed. Although dechlorination can be accomplished in several ways, application of S(IV) compounds (i.e., sulfur dioxide gas or sulfite salts) is by far the most common approach. A focus on analytical development efforts on the use of formaldehyde to inactivate excess S(IV) through formation of hydroxymethanesulfonate is presented. A neutral pH and 350 mM formaldehyde will quantitatively bind S(IV) species in 1 min or less. At this concentration and pH, formaldehyde does not react appreciably with three test organic chloramines. If the pH of the solution is reduced to 4 after the S(IV) is bound, then iodine will be stable long enough for determination by standard titrimetric procedures. Quantitative recovery of N-chlorotrialanine in a standard solution is possible using formaldehyde to block interference from S(IV) species, when the latter are present, at concentrations commonly found in dechlorinated effluents. Complete analysis of a sample takes approximately 3-4 minutes. Sample manipulation is minimal. (See also W91-00476) (Lantz-PTT)
W91-00532

IDENTIFICATION OF ORGANIC N-CHLORAMINES IN WASTEWATER.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5A.
W91-00533

MODELING THE IMPACT OF NITROGENOUS COMPOUNDS ON WASTEWATER DISINFECTION.
Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
R. A. Isaac, and J. C. Morris.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 917-930, 9 fig, 2 tab, 14 ref.

Descriptors: *Disinfection, *Model studies, *Nitrogen compounds, *Wastewater treatment, Bacteria, Chemical reactions, Chlorination, Chlorine, Mathematical models.

Quantitative insight into the impact that organic chloramines can have on the disinfection of secondary (non-nitrified) wastewater effluent is provided. The chemical species known to be important to disinfection are tracked by a simple kinetic model, and the concentrations of the various disinfectants are expressed as equivalents of HOCl. The equivalences are based on disinfection and not on chemical relationships. Bacterial survival versus exposure based on total residual chlorine (TRC) as the measure of disinfectant is compared to the survival of bacteria when the impacts of the individual disinfectants are taken into account. This

approach improves agreement with the simple disinfection model. Several conclusions can be drawn as a result of this study: (1) the relationship between exposure values in complex systems and bacterial reduction can be improved by taking into account the relative disinfection capabilities of the various chemical species; (2) mathematical models allow for the complex reactions to be tracked and resulting exposure values to be calculated; and (3) experimental confirmation is extremely limited, and appropriately designed investigations are needed to fully evaluate the approach suggested. (See also W91-00476) (Lantz-PTT)
W91-00546

NEW HALAMINE WATER DISINFECTANTS.
Auburn Univ., AL. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W91-00547

INACTIVATION OF ENTERIC VIRUSES IN CHLORINATED WASTEWATER SPRAYED ON VEGETABLES.
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
Y. I. Lasowski, and Y. Kott.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 945-953, 5 tab, 15 ref.

Descriptors: *Chlorination, *Disinfection, *Viruses, *Wastewater irrigation, *Wastewater treatment, Chlorine, Fruit crops, Kohlrabi, Lettuce, Onions, Parsley, Tomatoes, Vegetable crops.

Enteric viruses can be isolated from wastewater and are shown to be noxious and resistant to chlorination, compared with pathogenic bacteria. The combination of natural die-off and survival of enteric viruses, after chlorination, on vegetables and fruits has seldom been investigated. The aim of this study was to follow the die-off of enteric viruses in chlorinated wastewater sprayed on vegetables and to find out whether chlorine and solar radiation are factors affecting virus inactivation. In this study, poliovirus LSC 1, coxsackievirus A9, coxsackievirus B5, and echovirus 6 were introduced to secondary wastewater, which was then chlorinated and sprayed on parsley, lettuce, onion leaves, kohlrabi, and tomato. The vegetables, which are kept outdoors, were free of viable viruses within a few days; the same results were obtained when a grape vine was irrigated. The application of chlorine to the wastewater apparently enhanced the inactivation of the viruses. Results illustrated that although natural conditions such as solar activity, humidity, and temperature had an inactivation effect, the activation of chlorine probably stimulated the overall inactivation process. These results should encourage further research in the use of chlorine or other disinfectants to ensure the safety of vegetables and fruits irrigated with secondary wastewater. (See also W91-00476) (Lantz-PTT)
W91-00548

USE OF CHLORINE DIOXIDE IN DISINFECTION OF WASTEWATER.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
N. Narkis, R. Offer, E. Linenberg, and N. Betzer.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 955-966, 8 tab, 11 ref.

Descriptors: *Chlorine dioxide, *Disinfection, *Wastewater treatment, Chlorination, Chlorine, Secondary wastewater treatment.

The feasibility of using ClO2 as an alternative to chlorine in the disinfection of effluents and wastewaters, is examined in this study. Use of ClO2 could help ensure environmentally acceptable finished water suitable for various reuses. The behavior of chlorine dioxide has been investigated in sewage treatment plant effluents and compared to its behavior in organic-free media, such as distilled and tap water. The aim of this research was to investigate whether secondary effects of chlorine dioxide application to effluents exist and if these affect its effectiveness as a disinfectant. Particular attention was paid to the interaction of ClO2 with the inorganic and organic components of effluents and their effects on chlorine dioxide residuals. High efficiency of ClO2 in effluent disinfection is shown. ClO2-treated water was of high bacteriological quality. Efficient disinfection of the effluents is achieved with relatively low ClO2 doses and short contact times in the neutral and acidic pH ranges. Preliminary results regarding the potential of ClO2 as an efficient disinfectant in sewage treatment plant effluents, as compared to Cl2, necessitate additional work, for a comprehensive understanding of disinfection processes of ClO2 in effluent systems. Improved analytical methods are required to overcome complications associated with the determination of ClO2, chlorine, and the accompanying oxygenated chlorine compounds. Dealing with sewage treatment plant effluents further complicates analytical procedures and interpretation of the system's behavior. (See also W91-00476) (Lantz-PTT)
W91-00549

COMBINED SEWER OVERFLOW: A MANAGEMENT STUDY.
Environmental Protection Agency, Washington, DC. Office of Marine and Estuarine Protection.
A. Reilly.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-190151. Price codes: A03 in paper copy, A01 in microfiche. EPA Report No. 600/9-89/010, 1988. 27p, 2 fig, 29 ref.

Descriptors: *Combined sewer overflows, *Management planning, *Urban runoff, *Urbanization, *Wastewater management, Combined sewers, Sewers, Storm wastewater, Wastewater disposal.

In many of the older cities of the United States, the capacity of the combined sewer is exceeded on a daily basis due to both wet weather storm surges and increased volumes of waste generated by new development. As a result, billions of gallons of untreated sewage are discharged on an annual basis into the nations marine bays and estuaries in episodes called 'combined sewer overflow'. There are two primary reasons for the increasing frequency and severity of overflow episodes: (1) the population of cities in coastal areas are growing at rates that far exceed the ability of the sewer infrastructure to accommodate them; and (2) the built-in efficiencies of the original design and of the combined sewer are being exploited by many municipalities to compensate for the increased volumes of sewage associated with the population growth. Since each combined sewer, the area that it drains, and the receiving water into which it discharges, constitutes a unique system, a management strategy should be site specific. This document proposes a framework within which a site-specific and cost-effective management strategy may be formulated. Emphasis is placed on providing tools and methods rather than explicit solutions. (Lantz-PTT)
W91-00568

STAINLESS STEEL IN WASTEWATER TREATMENT PLANTS.
Tuthill Associates, Blacksburg, VA.
A. H. Tuthill.
Water Engineering and Management WENMD2, Vol. 137, No. 7, p 31-33,64, July 1990. 3 fig, 1 tab, 4 ref.

Descriptors: *Construction materials, *Corrosion control, *Pipes, *Steel, *Wastewater facilities, Design standards, Hydraulic equipment, Underground structures, Underwater.

To obtain the best results from the stainless steel selected for wastewater treatment plants, the suitability and performance of several grades of stainless steels must be recognized. Stainless steel equipment is exposed to several different environments including the local atmospheric environment, different process environments, and underground conditions in buried piping and tanks. Type 304, 304L, 316 and 316L are austenitic stainless steels which have about 18% chromium (for corrosion resistance) and also contain 8% nickel. The low carbon grade 304L produced to the A778 specification is fully suitable for wastewater treatment plant service except in those few geographic locations where chlorides in the local water exceed 200 ppm. For these locations type 316L would be preferred, since stainless steels are subject to localized corrosion in tight stationary crevices in aqueous environments when chlorides are present. Since ASTM specifications do not cover shop fabrication of piping, each shop must develop its own specifications for butt welding and fabrication of piping to the pipe drawings. The practice of full immersion pickling after welding is helpful in reducing surface contamination that might otherwise lead to rust streaking and pitting and in improving resistance to microbiological influenced corrosion. (VerNooy-PTT)
W91-00628

GROWTH OF BIOPELLETS ON GLUCOSE IN UPFLOW ANAEROBIC SLUDGE BED (UASB) SYSTEMS.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
P. A. L. N. S. Sam-Soon, R. E. Lowenthal, M. C. Wentzel, and G. R. Marais.
Water SA WASADV, Vol. 16, No. 3, p 151-164, July 1990. 3 fig, 3 tab, 10 ref, 3 append.

Descriptors: *Anaerobic digestion, *Biopellets, *Butyrates, *Glucose, *Sludge bed, *Wastewater treatment, Biodegradation, Chemical oxygen demand, Fermentation, Hydrogen, Substrates, Volatile solids.

An investigation was made into the response of an upflow anaerobic sludge bed (UASB) system using a defined substrate, glucose. Glucose was selected because its biochemical fermentation pathways are well known and this allowed process identification from product formation. It also eliminated the presence of a polymer in the influent as a possible cause for pellet formation. Excellent pellet formation was observed in the single UASB reactor system. The single reactor was separated into 2 in-series reactors with the first operating in the high hydrogen partial pressure (high pH2) phase. In the high pH2 reactor it was found that: (1) butyrate was generated at a sludge age less than about 2 days; when the sludge age exceeded about 2 to 3 days, no butyrate was observed, apparently because butyrate oxidizers became established; (2) soluble chemical oxygen demand (COD) removal was about 21% on average; (3) the overall volatile solids (pellet solids plus suspended solids) yield was 0.47 mg volatile suspended solids (VSS)/mg COD removed; (4) from a glucose balance the hydrogen flux was estimated and the gross yield of the hydrogenotrophs (organism plus polymer) calculated, 0.23 mg VSS/mg COD(H2). This is about 6 times greater than the reported values for hydrogenotrophs (0.043 mg VSS/mg COD(H2)) and is due to polymer formation. (See also W91-00632 and W91-00633) (Author's abstract)
W91-00631

EFFECT OF NITROGEN LIMITATION ON PELLETISATION IN UPFLOW ANAEROBIC SLUDGE BED SYSTEMS.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
P. A. L. N. S. Sam-Soon, R. E. Lowenthal, M. C. Wentzel, and G. R. Marais.
Water SA WASADV, Vol. 16, No. 3, p 165-170, July 1990. 2 tab, 1 fig, 2 ref.

Descriptors: *Anaerobic digestion, *Biopellets, *Chemical oxygen demand, *Glucose, *Nitrogen, *Sludge bed, *Wastewater treatment, Biodegradation, Fermentation, Hydrogen, Limiting nutrients, Substrates, Volatile solids.

An upflow anaerobic sludge bed (UASB) reactor was set up to operate in the high hydrogen partial pressure phase at 30 C. In this UASB system treating the carbohydrate substrate glucose, in order to obtain unimpeded pellet formation, the influent TKN/COD must be greater than that required for cell synthesis and amino acid/polypeptide formation, estimated at about 0.02 mg nitrogen/mg influent chemical oxygen demand (COD). As the influent TKN/COD decreases below this level; (1) growth of the pellet forming hydrogenotroph Methanobacterium Strain AZ is increasingly inhibited, (2) associated pellet formation decreases and (3) an increasingly high excess hydrogen partial pressure develops, giving rise to hydrogen loss from the system as a gas. Hydrogen escaping can account for a loss of up to 14% of the influent COD. If the influent TKN/COD falls below that required for cell synthesis, estimated at about 0.0086 mg nitrogen/mg influent COD, acidogen synthesis is inhibited and their specific yield is reduced. (See also W91-00631 and W91-00633) (Author's abstract)
W91-00632

PELLETISATION IN A UASB SYSTEM WITH PROTEIN (CASEIN) AS SUBSTRATE.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
R. E. Moosbrugger, R. E. Lowenthal, and G. R. Marais.
Water SA WASADV, Vol. 16, No. 3, p 171-178, July 1990. 5 fig, 2 tab, 11 ref.

Descriptors: *Anaerobic digestion, *Biopellets, *Casein, *Chemical oxygen demand, *Proteins, *Sludge bed, *Wastewater treatment, Biodegradation, Fermentation, Hydrogen, Organic loading, Substrates, Volatile solids.

Biological pellet formation was readily established in a laboratory-scale upflow anaerobic sludge bed (UASB) reactor treating a proteinaceous substrate, casein. Pellets were small (less than 2 mm), fragile and black. To obtain information on bed behavior, the bed was divided and operated as a 2 in-series reactor system, the first reactor operating in a high and the second in a low hydrogen partial pressure state. The first reactor produced (virtually) all the pellets with a sludge yield of 0.26 mg volatile suspended solids (VSS)/mg chemical oxygen demand (COD) removed (COD removal 3500 mg/L for influent COD 10,000 mg/L). However, 2/3 of the VSS generated was lost to the second reactor due to pellet break-up. Deamination generated ammonium in excess of nitrogen requirements for pellet formation, and generated sufficient alkalinity to buffer the minimum pH in the bed to approximately 6.2 without alkalinity supplemented in feed; maximum pH in bed was about 7.6. With influent COD of 10,000 mg/L maximum loading was achieved at 65 kg COD/cu m pelletized bed (without signs of failure), with soluble COD removal 75% of influent COD. (See also W91-00631 and W91-00632) (Author's abstract)
W91-00633

CASE HISTORIES OF SULFIDE CORROSION: PROBLEMS AND TREATMENTS.
Brown and Caldwell, Sacramento, CA.
For primary bibliographic entry see Field 8G.
W91-00768

HYDROGEN SULFIDE TREATMENT SYSTEMS IN SANITARY SEWERS.
HDR Engineering, Inc., Denver, CO.
J. D. Chwirka, and T.T. Satchell.
Water Environment & Technology WAETEJ, Vol. 2, No. 7, p 48-53, July 1990. 2 fig, 1 tab, 5 ref.

Descriptors: *Hydrogen sulfide, *Sewer systems, *Wastewater treatment, *Wastewater treatment facilities, Cost analysis, Gravity sewers, Interceptor sewers, Mathematical studies, Model studies, Odor control, Oxidation, Pumping plants.

The prevention and control of hydrogen sulfide generation is an important aspect of wastewater collection that must be understood by those who design and operate these systems. Hydrogen sulfide generation in sanitary sewer systems may be minimized or prevented by limiting the use of pump stations in the collection system, maintaining proper grades in gravity sewers, and by adding chemicals to the wastewaters to oxidize sulfides. There are, however, many situations where pump stations are a necessity, where sewers must be constructed using flat grades, and where the use of oxidizing chemicals is not cost effective. Where conditions promote the generation of hydrogen sulfide, it may be appropriate to use corrosion-resistant materials in the sewer system and to remove hydrogen sulfide from the foul air by treatment. The decision to use a hydrogen sulfide treatment system in lieu of prevention methods is a matter of economics. Treatment systems may be cost-effective in situations where a large quantity of hydrogen sulfide is generated and the wastewater flow is high, and when hydrogen sulfide is expected to be a problem in large interceptor sewers. The treatment system design should be developed around three elements: effective collection of the foul air, treatment to remove hydrogen sulfide, and discharge of the treated air. Specifics are given for: (1) sewer ventilation design, which includes the prediction of hydrogen sulfide generation by the commonly used Pomeroy-Parkhurst equation; (2) hydrogen sulfide treatment, accomplished by the two processes adsorption and absorption; and (3) discharge of treated air, which includes methods for dispersion of the discharged air. (Agostine-PTT)
W91-00769

COMMERCIAL OXYGEN USE IN WATER-QUALITY MANAGEMENT.
Vanderbilt Univ., Nashville, TN.
R. E. Speece, N. Nirmalakhandan, and G. Tchobanoglous.
Water Environment & Technology WAETEJ, Vol. 2, No. 7, p 54-61, July 1990. 10 fig, 2 tab, 4 ref.

Descriptors: *Aeration, *Commercial oxygen, *Oxygen, *Oxygenation, *Wastewater treatment, *Water quality control, Activated sludge, Aeration tanks, Aerators, Clarifiers, Cost analysis, Dissolved oxygen, Fluidized bed process, Oxygen generation, Rotating biological contactors, Sewers, Water mains.

Commercial oxygen use in water-quality management is in some cases more economical than air as an oxygen source when based on total cost per ton of oxygen dissolved. Two specific issues must be addressed when considering the use of commercial oxygen: the total cost per pound of oxygen dissolved in the water and water quality objectives that cannot be met economically using air, but can be met using commercial oxygen. All potential applications for the use of commercial oxygen require elevated dissolved oxygen (DO) concentrations that make aeration with air progressively expensive and commercial oxygen more attractive. Special design conditions are necessary for oxygen dissolution equipment using commercial oxygen to ensure high absorption. Among the aerators described are a downflow bubble contact aerator, U-tube contactor, countercurrent packed column contactor, and a conventional diffused aerator. Process considerations are given for the following potential uses of commercial oxygen: gravity sewers, force mains, primary clarifiers, activated sludge aeration tanks, rotating biological contactors, and fluidized-bed biological reactors. The oxygen may be generated on-site or liquid oxygen (LOX) may be trucked in and stored. If LOX is stored on-site, a cryogenic storage vessel must be available. The two processes used most commonly to generate high-purity oxygen are pressure-swing adsorption (PSA) for small applications and the cryogenic air-separation process for large applications. It is concluded that with careful attention to design details, the use of oxygen offers significant environmental and economic advantages over the use of oxygen from air. (Agostine-PTT)
W91-00770

SLUDGE MANAGEMENT SYSTEMS
Montgomery (James M.) Consulting Engineers, Inc., Pasadena, CA.
J. M. Montgomery Consulting Engineers.
Water Environment & Technology WAETEJ, Vol. 2, No. 7, p 62-69, July 1990. 7 fig, 4 tab, 25 ref.

Descriptors: *Sludge, *Sludge treatment, *Waste management, *Wastewater treatment, *Wastewater treatment facilities, Effluents, Permits, Secondary wastewater treatment, Sludge thickening, Sludge volume index, Waste disposal.

Reasons for National Pollutant Discharge Elimination System (NPDES) permit limit noncompliance at publicly owned treatment works (POTWs) have been ascertained through the use of comprehensive performance evaluations. Most of these POTWs treated less than 37,850 cu m/d (10 mgd) of wastewater through secondary treatment. Sludge management system limitations were major contributors to noncompliance at about 49% of the plants evaluated and were grouped into three categories: sludge thickening and wasting, stabilization, and ultimate disposal. More than one limitation contributed to effluent quality excursions above permit limits. Several studies revealed that most limitations may be attributed to inaccurately estimated masses or waste sludge volumes, inadequately sized processing equipment to address waste sludge mass or volume variations, and inflexibility in sludge processing operations and sludge management options. Design considerations which should be addressed for each sludge system component are presented. These include: mass production and accumulation considerations, volume and concentration considerations, management system design considerations, and system flexibility. It is concluded that if these elements are not thoroughly addressed by system designers and plant staff, there is bound to be continued facility discharge permit violations induced by identifiable sludge management system limitations. (Agostine-PTT)
W91-00771

MICROTUNNELING TECHNIQUES AID SEWER INSTALLATION.
Houston Dept. of Public Works, TX.
For primary bibliographic entry see Field 8A.
W91-00773

LAGOONS, LEACH FIELDS, AND OTHER ASSISTANTS OF NATURE.
Water Environment & Technology WAETEJ, Vol. 2, No. 8, p 37-41, August 1990. 3 tab, 4 ref.

Descriptors: *Biological wastewater treatment, *Lagoons, *Land treatment, *Leach fields, *Wastewater treatment, Aquatic plants, Permits, Septic tanks, Septic wastewater, Wetlands.

Natural wastewater treatment systems, the oldest recorded form of wastewater treatment can be divided into two categories: soil-based systems (e.g., septic tank leach fields) and aquatic-based systems (e.g., facultative lagoons). Historically, natural systems have been favored by small communities because like most natural systems they are economical and require fewer operations personnel, consume less energy, and produce less sludge than conventional wastewater treatment processes. There are four major types of soil-based systems: slow rate (SR), rapid infiltration (RI), overland flow (OF), and subsurface systems (leach fields or absorption beds). Lagoons, constructed and natural wetlands, and floating plant systems are the primary forms of aquatic systems. Land availability and cost are key factors in deciding whether or not a natural system is appropriate. If sufficient land is available, then cost, effluent-quality objectives, and site characteristics must be evaluated. The ability to discharge wastewater to surface waters must also be considered. While natural systems offer significant advantages, there are potential problems that should be considered before selecting or when working with a natural system. These problems include: unclear objecting; providing adequate operator training; natural systems can take years to reach their optimum performance; and proper construction is critical. (Korn-PTT)
W91-00799

DEVELOPMENT OF A NEW METHODOLOGY FOR THE ASSESSMENT OF SPECIFIC METHANOGENIC ACTIVITY.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James, C. A. L. Chernicharo, and C. M. M. Campos.
Water Research WATRAG, Vol. 24, No. 7, p 813-825, July 1990. 14 fig, 6 tab, 18 ref.

Descriptors: *Methane, *Methanogenesis, *Sludge, *Sludge treatment, *Wastewater treatment, Anaerobic conditions, Anaerobic digestion, Data acquisition, Respirometry, Warburg respirometer.

The measurement of the methanogenic activity of anaerobic sludge is important in order to classify its potential for converting soluble substrate to methane and carbon dioxide. Previously, the measurement of the potential of anaerobic sludges to convert soluble substrate into CH4 and CO2 has mainly been carried out in two different ways: (1) by the so called specific methanogenic activity test (SMA), through the methane production rate; and, (2) by the assessment of the coenzyme F420 contents in the sludge. However, a very poor correlation was found between the measurements of F420 concentrations and the SMA test using acetate as substrate. Therefore, improvements of the SMA test through a methodology that could easily be controlled and standardized would lead to more reliable results. A new methodology using a modified Warburg respirometer has been successfully used for the assessment of specific methanogenic activity. The Warburg respirometer has the ability to test several samples simultaneously which gives increased accuracy through replication. The test can be shortened when it is used to assess the mathanogenic activity, as the methane production rate does not change significantly. However, when the aim of the test is to establish the degree of degradability, it should be run until the rate of gas production drops sharply, because the assessment of degradability is a function of the area under the curve CH4-production versus time. (Korn-PTT)
W91-00805

COMPARISON OF MEDIA TYPES IN ACETATE FED EXPANDED-BED ANAEROBIC REACTORS.
Illinois Univ., Urbana. Dept. of Civil Engineering.
P. Fox, M. T. Suidan, and J. T. Bandy.
Water Research WATRAG, Vol. 24, No. 7, p 827-835, July 1990. 10 fig, 2 tab, 26 ref.

Descriptors: *Anaerobic digestion, *Granular activated carbon, *Methanogenesis, *Wastewater treatment, Acetates, Biofilms, Experimental design, Microorganisms, Shear stress, Sludge.

A synthetic feed, containing acetate as the only carbon source, was used to start-up four different anaerobic expanded-bed reactors containing three different types of microbial attachment media. The media types used were low-density anthracite, granular activated carbon (GAC) and two sizes of sand. All media types were of the same average diameter, 0.7 mm, except for a smaller sand, 0.35 mm. These media types were chosen to compare surface roughness, macroscopic shear stresses due to upflow velocity and sphericity. The 0.7 mm sand required the greatest upflow velocity, 16 cm/s, while the other reactors had upflow velocities of 5.5-6.0 cm/s. Sand had the least surface roughness and GAC had the roughest surface, while anthracite had the most angular shape. At steady-state, the GAC reactor retained 3.75-10 times the attached biomass retained on the other media tested and the GAC reactor accumulated biomass at a faster rate during start-up. Shear losses reflected the biomass accumulation with the two sand and anthracite media having shear loss coefficients 6-20 times greater than that of the GAC medium. Sand induced the formation of sludge granules in both sand reactors with two species of methanogens and stability of the sludge blankets was critical to reactor performance. Scanning electron microscopy demonstrated that attached growth developed in crevices where biomass was protected from shear forces. Attached growth on the sand and anthracite media was located only in crevices, while the GAC medium is completely covered with crevices and biofilm developed on the entire GAC particle. Surface roughness was critical to biofilm development with the rougher surface providing the better attachment medium. (Author's abstract)
W91-00806

PHOTOCHEMICAL DISINFECTION OF EFFLUENTS-PILOT PLANT STUDIES.
Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
A. Acher, E. Fischer, R. Zellingher, and Y. Manor.
Water Research WATRAG, Vol. 24, No. 7, p 837-843, July 1990. 7 fig, 3 tab, 15 ref. U.S.-Israel Binational Agricultural Research and Development Fund (BARD) US 613-83 and NCRD Israel-DFVLR, Koeln-Porz, Germany WT-8812-581.

Descriptors: *Disinfection, *Solar radiation, *Wastewater treatment, *Wastewater utilization, *Water reclamation, *Water reuse, Dissolved oxygen, Experimental design, India, Methylene blue, Municipal wastewater, Pilot plants, Solar disinfection, Wastewater disposal.

A new method of photochemical disinfection of domestic effluents for crop irrigation was investigated in a pilot plant. It uses sunlight as the energy source, the oxygen dissolved in water (DO) as the oxidizing agent and methylene blue (MB) as an intermediary for the absorption and transfer of the sunlight energy (red range) to activate DO and/or to destabilize the organic matter. The pilot plant consists of a series of six identical reactors, each 488 cm in length and 35 cm in height. The reactors were constructed from welded galvanized steel plates having a trapezoidal cross-section. A height differential of about 10 cm between two adjacent reactors ensured free overflow of the treated effluent through the pilot plant. Hydraulic experiments carried out with different effluent flow rates led to the construction and mounting of hydraulic devices which improved the relative residence time of the effluent in the reactors and decreased the hydraulic short-circuiting of the flowing effluent. The lack of DO in the supplied effluent was overcome by using a new method of adding O2 (from 0.1-0.5 to 4-6 mg/l, by introducing the effluent under pressure. The best microbiological results were obtained in disinfection experiments done under the following conditions: pH, 8.8-8.9 (CaO 80-90 g/cubic m); DO, 4.5-5.5 mg/L, MB, 0.85-0.90 g/ cubic m; effluent flow rate, 10 cubic m/h; effluent depth, 20 cm; average sunlight exposure, 58 min; and sunlight intensities, 700-2000 micro square E/s. The decrease in the microorganism count was (logs): coliforms, 3.0; fecal coliforms, 3.1; enterococci, 3.76; and poliovirus, 1.8. These results were reproducible and could be improved by technical amelioration of the pilot plant. (Author's abstract)
W91-00807

BIODEGRADATION KINETICS OF SUBSTITUTED PHENOLICS: DEMONSTRATIONS OF A PROTOCOL BASED ON ELECTROLYTIC RESPIROMETRY.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 5B.
W91-00809

RESPIRATION INHIBITION KINETIC ANALYSIS.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
V. T. Volskay, and C. P. Leslie Grady.
Water Research WATRAG, Vol. 24, No. 7, p 863-874, July 1990. 5 fig, 6 tab, 19 ref. EPA Cooperative Agreement CR-813382-01-0.

Descriptors: *Biodegradation, *Butyrates, *Inhibition, *Kinetics, *Respirometry, *Wastewater treatment, Experimental design, Monod term, Oxygen uptake, Substrates.

A protocol was developed for measuring the inhibitory effects of synthetic organic compounds on the biodegradation of naturally occurring (biogenic) organic matter. A tiered approach based on respirometry was employed. In the first tier, compounds were screened to determine if their effects were sufficiently inhibitory to warrant further testing. This was done at an inhibitor concentration of 1000 mg/l, or the solubility limit if lower, and at both high and low biogenic substrate concentrations. If a compound cause more than 50% inhibition in a screening test, the stability of its effect was determined next. Finally, compounds causing stable responses were subjected to the respiration inhibition kinetic analysis in which the Monad kinetic parameters describing the biodegradation of butyric acid were measured in the presence of several inhibitor concentrations by using a technique based on that of Cech, thereby allowing the effects of inhibitor concentration on biodegradation kinetics to be quantified. The respirometric technique of Cech offers a convenient and simple means for determining the impact of xenobiotic organic compounds on the biodegradation of biogenic organic matter. (Author's abstract)
W91-00810

ACTIVITY AND ADAPTATION OF NITRILOTRIACETATE (NTA)-DEGRADING BACTERIA: FIELD AND LABORATORY STUDIES.
Montana State Univ., Bozeman. Dept. of Microbiology.
G. A. McFeters, T. Egli, E. Wilberg, A. Alder, and R. Schneider.
Water Research WATRAG, Vol. 24, No. 7, p 875-881, July 1990. 4 fig, 40 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Microbial degradation, *Nitrilotriacetic acid, *Sediment contamination, *Wastewater treatment, Adaptation, Experimental design, River sediments, Sand, Suspension, Water pollution.

Adaptation of bacterial activity for the degradation of nitrilotriacetate (NTA) was studied using natural sediment samples and an NTA-degrading bacterium (strain ATCC 29600). Sediment samples from a river with persistent levels of NTA had much higher NTA-degradative activity than comparable samples from a less contaminated control site. When sediment from the control site was exposed to high levels of NTA a 5 day lag preceded an abrupt increase in NTA degradation while strain 29600 colonized on sand and grown in the absence of NTA became induced within eight hours. The induction of strain 29600 was compared between bacteria in suspension and cells attached to sand. The sand-associated bacteria became induced 4 to 5 hours before the planktonic suspension and displayed over threefold greater specific activity. Suspensions of strain 29600 became adapted within 8 hours when placed in membrane diffusion chambers that were immersed within a municipal wastewater reactor containing NTA. These findings support the concept that induction is a part of the process of bacterial adaptation to degrade NTA and sand-associated bacteria can adapt more quickly to and have a greater degradation activity for NTA than planktonic cells. (Author's abstract)
W91-00811

USE OF A GEL-FORMING BIOPOLYMER DIRECTLY DISPENSED INTO A LOOP FLUIDIZED BED REACTOR TO RECOVER DISSOLVED COPPER.
California State Univ., Long Beach. Dept. of Microbiology.
L. K. Jang, G. G. Geesey, S. L. Lopez, S. L. Eastman, and P. L. Wichlacz.
Water Research WATRAG, Vol. 24, No. 7, p 889-897, July 1990. 7 fig, 2 tab, 20 ref, append. NSF Grant CTS-9000897, CBT-8721943, and ECE-8701462.

Descriptors: *Absorption, *Chemical recovery, *Copper, *Fluidized bed process, *Gels, *Waste recovery, *Wastewater treatment, Alginate gel, Chemical interactions, Copper binding, Experimental design, Instrumentation, Wastewater reactors.

A novel technique for the recovery of copper from synthetic aqueous solutions containing 60-200 ppm dissolved copper was developed. A 3.2% by

weight of algin solution is a favorable absorbent for dissolved copper. A viscous solution of sodium alginate (a kelp-derived biopolymer known to bind copper) was dispensed dropwise, using a multi-tip dispenser, into the synthetic solution circulating in an air-lift glass loop fluidized bed reactor. Upon contact with the copper-containing solution, the alginate gelled into stable spheres which continued to circulate in the reactor to absorb copper. When a drop of concentrated sodium alginate solution hits the surface of an aqueous solution containing Cu(2+) at a sufficiently high concentration, a spherical bead is formed as a result of a bridging reaction between Cu(2+) and the uronate residues of the alginate molecules. The percent of copper recovered at the lower ionic strength (0.01 M NaNO3) was found to be greater than that at the higher ionic strength (0.1 M NaNO3) of the solution. Consequently, the conditional copper-binding stability constant for the lower ionic strength solution was greater. An intrinsic copper-binding stability constant, independent of the ionic strength of the solution, was obtained by using a two-phase model modified from the work of Jang. This two-phase model allows the estimation of the activity of free, unbound Cu(2+) in the gel fluid. (Author's abstract)
W91-00813

STUDY OF PHOSPHATASE ACTIVITY IN ANAEROBIC SLUDGE DIGESTION.
Beijing Solar Energy Research Inst. (China).
W. Zhenglan, G. Yue, and L. Lanying.
Water Research WATRAG, Vol. 24, No. 7, p 917-920, July 1990. 2 fig, 1 tab, 6 ref.

Descriptors: *Anaerobic digestion, *Phosphatases, *Wastewater facilities, *Wastewater treatment, Enzymes, Hydrogen ion concentration, Methane, Volatile acids.

The start and operation of large anaerobic digesters are generally carried out in a conservative way because of the unpredictability of imminent failure in the anaerobic digestion process. Phosphatases are enzymes which cleave phosphate groups from their substrates and their activities have a high correlation with the populations of acid-producing bacteria and phosphatase-producing bacteria. The acid and alkaline phosphatase activities at different organic loadings in an anaerobic plug-flow digester and a UASB digester were determined together with volatile acid concentrations, pH values, and methane production. Increases in alkaline and acid phosphatase activity (especially in acid phosphatase) were found in both digesters to be overfed to the level of souring and failure. These increases were observed up to 10 days before the occurrence of more volatile fatty acids production and lower pH values. Phosphatase activity in the digesters appears to be a rapid biochemical test for crediting the instability or failure of anaerobic digestion. (Author's abstract)
W91-00817

EFFECTS OF ANILINES AND HYDANTOINS ON THE METHANOGENIC DEGRADATION OF SELECTED PHENOLS.
Alberta Univ., Edmonton. Dept. of Microbiology.
P. M. Fedorak, W. B. Kindzierski, and S. E. Hrudey.
Water Research WATRAG, Vol. 24, No. 7, p 921-925, July 1990. 4 fig, 29 ref.

Descriptors: *Coal wastes, *Methane, *Phenols, *Wastewater treatment, Anaerobic conditions, Anilines, Degradation, Hydantoins, Inhibition, Methanogenesis, Toluidines.

Wastewaters generated during coal gasification, liquefaction and coking contain a complex mixture of organic and inorganic compounds. Phenols are the major organic contaminate in such wastewaters. Although the concentration of the phenols are frequently high enough to inhibit biological wastewater treatment processes, other unidentified, and presumably nonphenolic organics contribute to the inhibitory nature of these wastewaters. The anaerobic methanogenic process for phenolic removal has met with little success, in the absence of activated carbon, because of these inhibitory compounds. In this study, five anilines and two hydantoins commonly found in coal conversion wastewaters were evaluated in batch culture, serum bottle tests to determine whether they inhibited phenol-degrading, or p-cresol-degrading methanogenic cultures. Working with individual compounds, phenol degradation and subsequent methanogenesis were not affected by 29 mg/L N-methylaniline, 97 mg/L aniline, 300 mg/L o-methylaniline, 300 mg/L m-methylaniline or 300 mg/L p-methylaniline. Neither p-cresol degradation or subsequent methanogenesis was affected by 500 mg/L hydantoin or 500 mg/L 5,5-dimethylhydantoin. Extended incubation periods showed that none of the three isomers of ring substituted methyl anilines and neither of the two hydantoins were readily degraded to methane. (Author's abstract)
W91-00818

EXPERIMENTAL INVESTIGATION OF SIZE DISTRIBUTION OF SUSPENDED PARTICLES IN GRANULAR BED FILTRATION.
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
For primary bibliographic entry see Field 5F.
W91-00819

QUANTITATIVE MICROBIOLOGICAL ANALYSIS OF BACTERIAL COMMUNITY SHIFTS IN A HIGH-RATE ANAEROBIC BIOREACTOR TREATING SULFITE EVAPORATOR CONDENSATE.
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie.
U. Ney, A. J. L. Macario, E. Conway de Macario, A. Aivasidis, and S. M. Schoberth.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2389-2398, August 1990. 3 fig, 4 tab, 52 ref.

Descriptors: *Bacterial analysis, *Biological wastewater treatment, *Wastewater reactors, *Wastewater treatment, Anaerobic bacteria, Biofilms, Fermentation, Methane bacteria, Microbiological studies, Pulp wastes.

The bacterial population of a high-rate, anaerobic, fixed-bed loop reactor treating sulfite evaporator condensate from the pulp industry was studied over a 14-month period. This period was divided into seven cycles that included a startup at the beginning of each cycle. Some 82% of the total biomass was immobilized on and between the porous glass rings filling the reactor. The range of the total number of microorganisms in these biofilms was 2-7 x 10(9) cells/ml. Enumeration and characterization by microbiological methods and by phase-contrast, epifluorescence, and electron microscopy showed that the samples consisted mainly of the following methanogens: a Methanobacterium species a Methanosarcina species a Methanobrevibacter species and a Methanothrix species as well as furfural-degrading sulfate-reducing bacteria resembling Desulfovibrio furfuralis. Viable counts of hydrogenotrophic methanogens were relatively stable (mostly within the range of 320 million to 750 million cells/ml), but Methanobrevibacter cells increased from less than 5 to 30% of the total hydrogenotrophic count after transfer of the fixed bed into a second reactor vessel. Acetotrophic methanogens reached their highest numbers of 130 million to 260 million cells/ml in the last fermentation cycles. They showed a morphological shift from sarcina-like packets in early samples to single coccoid forms in later phases of the fermentation. Furfural-degrading sulfate reducers reached counts of 10 million to 58 million cells/ml. The distribution of the chief metabolic groups between free fluid and biofilms was analyzed in the fifth fermentation cycle: 4.5 times more furfural degraders were found in the free fluid than in the biofilms. In contrast, 5.8 times more acetotrophic and 16.6 times more hydrogenotrophic methanogens were found in the biofilms than in the free liquid. The data concerning time shifts of morphotypes among the trophic groups of methanogens corroborated the trends observed using immunological assays on the same samples. (Author's abstract)
W91-00829

DETECTION AND ANALYSIS OF TWO SEROTYPES OF AMMONIA-OXIDIZING BACTERIA IN SEWAGE PLANTS BY FLOW CYTOMETRY.
ORPEGEN, Medizinisch-Molekularbiologische Forschungsgesellschaft mbH, Heidelberg, Germany.
A. Volsch, W. F. Nader, H. K. Geiss, G. Nebe, and C. Birr.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2430-2435, August 1990. 4 fig, 1 tab, 32 ref. Baden Wurttemberg Grant PA 86.036, German Minister for Research and Technology Grant 02 WA 8940/5.

Descriptors: *Bacterial analysis, *Nitrification, *Wastewater facilities, *Wastewater treatment, Activated sludge, Ammonia removal, Bacteria, Flow cytometry, Heidelberg, West Germany.

Two different serotypes of the genus Nitrosomonas were isolated from samples of the Heidelberg sewage plant Heidelberg. These nitrifers were enumerated in activated sludge of various other sewage plants after immunofluorescent labeling and staining with propidium iodide by flow cytometry. The concentrations of these serotypes of Nitrosomonas spp. were in the range of 0.1 to 2%. A test to determine the activity of ammonia-oxidizing bacteria was also developed. Nitrite-oxidizing bacteria were specifically inhibited with sodium chlorate, and the activity of ammonia-oxidizing bacteria could be calculated from the increase of nitrite. Concentrations and activities of ammonia oxidizers were measured for a period of 6 months in the Heidelberge sewage plant. With one exception, activities and concentrations of ammonia-oxidizing bacteria decreased and increased in parallel. (Author's abstract)
W91-00831

CARBON AND NITROGEN TRANSFORMATIONS IN WASTEWATER DURING TREATMENT WITH HYDROCOTYLE UMBELLATA L.
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
K. K. Moorhead, and K. R. Reddy.
Aquatic Botany AQBODS, Vol. 37, No. 2, p 153-161, July 1990. 6 fig, 3 tab, 16 ref.

Descriptors: *Aquatic plants, *Biological oxygen demand, *Nitrification, *Wastewater treatment, Denitrification, Effluents, Oxygen transfer, Primary wastewater treatment, Secondary wastewater treatment.

The transport of oxygen through aerial plant tissue of aquatic plants into the root zone has important ramifications on C and N transformations in wastewater. Oxygen transport by pennywort (Hydrocotyle umbellata L.) and its effects on biological oxygen demand (BOD) and nitrification were investigated for primary and secondary treated sewage effluent. The treatments included flasks sealed with a rubber stopper to serve as a control, open flasks to determine effects of oxygen diffusion from the atmosphere, flasks with a plant held by a split rubber stopper and open flasks with a plant. The N-15 labeled effluents were analyzed at 0, 1, 2, 4 and 8 days for dissolved oxygen, BOD, total Kjeldahl N (TKN), ammonia nitrogen and nitrate nitrogen. The plants were analyzed for TKN. Pennywort was shown to be very effective in reducing BOD in primary sewage effluent. A 42% reduction of BOD in 4 days was attributed to oxygen transport by pennywort with an additional 30% due to oxygen diffusion from the atmosphere. Nitrification was difficult to document in either sewage effluent although 22-26% of the added N-15 was not accounted for in treatments with plants and was presumably lost through denitrification. (Author's abstract)
W91-00834

COMPARISON OF GROWTH AND NUTRIENT REMOVAL EFFICIENCY OF CHLORELLA PYRENOIDOSA IN SETTLED AND ACTIVATED SEWAGES.
Hong Kong Polytechnic, Kowloon. Dept. of Ap-

plied Biology and Chemical Technology.
N. F. Y. Tam, and Y. S. Wong.
Environmental Pollution ENPOEK, Vol. 65, No. 2, p 93-108, 1990. 5 fig, 2 tab, 31 ref.

Descriptors: *Activated sludge, *Chlorella, *Nitrogen removal, *Nutrient removal, *Wastewater treatment, Algae, Cultures, Culturing techniques, Denitrification, Effluents, Hong Kong, Nutrients, Wastewater.

The microscopic green alga, Chlorella pyrenoidosa was grown in settled and activated sewage under two different culture systems, batch and semi-continuous. Good growth was obtained in both types of wastewater and the algal production was comparable to and even higher than that found in commercial Bristol medium. The semi-continuous culture supported more growth than the batch system. There was a close relationship between algal growth and the amount of nutrient removed from both settled and activated sewage. A more rapid drop in NH4(+)-N was found in settled rather than activated sewage; from an initial 27 mg/L to 5 mg/L in both culture systems. On the other hand, the NO3(-)-N of activated sewage started to decrease from day 2 onward; the final NO3(-)-N concentration was <1 mg/L (over 90% removal efficiency). The amount of total inorganic nitrogen being reduced due to algal culture was similar to both types of sewage. The changes of phosphate content followed the same trend in both sewages; the P concentration increased slightly in the first two days then decreased, especially in the semi-continuous cultures. The final ortho-P in the sewages treated by Chlorella in semi-continuous culture was < 5 mg/L (about 62% reduction). Such removal efficiency was slightly lower than those reported in previous studies. In general, the semi-continuous algal culture appeared to be a more suitable and efficient way for wastewater treatment than the batch system. With Chlorella cells, there was no significant difference between settled and activated sewage. (Author's abstract)
W91-00857

BACTERIA DEGRADING PHENOLIC ACIDS ISOLATED ON A POLYMERIC PHENOLIC PIGMENT.
Granada Univ. (Spain). Dept. of Microbiology.
J. Perez, A. Ramos-Cormenzana, and J. Martinez.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 1, p 38-42, July 1990. 4 tab, 20 ref.

Descriptors: *Bacterial physiology, *Biodegradation, *Industrial wastewater, *Phenols, *Wastewater treatment, Bacteria, Farm wastes, Metabolites, Pseudomonas, Soil bacteria.

A high proportion of the organic matter in wastewater from olive oil extraction plants consists of pigments of a phenolic nature. Thirty-eight bacterial strains were isolated from the wastewater of olive oil mills, olives and soil in chemically-defined media containing the pigment of these wastes as the sole carbon source. Most of the organisms were Pseudomonas species. Four of the six phenolic acids associated with polymeric pigments in olive oil waste degradation were used by three strains. Only one Pseudomonas strain was able to use five acids. Strains degrading a great number of acids in extent, and metabolizing methoxylated aromatics (associated with lignin degradation and possibly also to pigment transformation) could prevent undesirable properties in wastewater from olive oil mills which are a result of its phenolic content. (Hoskin-PTT)
W91-00873

EFFECT OF WITHDRAWAL OF MORPHOLINE FROM THE INFLUENT AND ITS REINSTATEMENT ON THE PERFORMANCE AND MICROBIAL ECOLOGY OF A MODEL ACTIVATED SLUDGE PLANT TREATING A MORPHOLINE-CONTAINING INFLUENT.
Leeds Univ. (England). Dept. of Microbiology.
V. R. Brown, and J. S. Knapp.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 1, p 43-53, July 1990. 4 fig, 39 ref.

Descriptors: *Activated sludge process, *Biological wastewater treatment, *Chemical wastes, *Microbial degradation, *Microorganisms, *Morpholine, *Wastewater treatment, Genetics, Industrial wastes, Mycobacterium, Wastewater facilities.

Biological treatment is the method of choice for effluents from chemical manufacture, but it can be complicated by the variability (both quantitative and qualitative) which is often characteristic of such effluents. An activated sludge plant was established which was capable of treating an influent containing morpholine. When this compound was deleted from the influent the ability of the activated sludge to degrade morpholine was reduced. This reduction took the form of an increase in the length of the lag period before morpholine degradation was detected in a die-away test from 0 to ca. 100 h. The decreased ability of the activated sludge to degrade morpholine was accounted for by a decline in the specific population of morpholine-degrading microbes. In this activated sludge all morpholine degraders were Mycobacterium species. In the absence of morpholine in the influent most mycobacteria in the activated sludge retained their morpholine-degrading phenotypes. This is despite the fact that some of these organisms can lose this phenotype when grown under non-selective conditions. It is likely that the problem of loss of or decline in a specific degradative capability of activated sludge is very widespread and results in inefficient treatment of many effluents particularly those containing industrial effluents. Problems will be more acute where a compound is degraded only by slow-growing microbes and their severity will probably be related to the prevailing sludge age. (See also W91-00875) (Hoskin-PTT)
W91-00874

INSTABILITY OF THE MORPHOLINE-DEGRADATIVE PHENOTYPE IN MYCOBACTERIA ISOLATED FROM ACTIVATED SLUDGE.
Leeds Univ. (England). Dept. of Microbiology.
V. R. Brown, J. S. Knapp, and J. Heritage.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 1, p 54-62, July 1990. 3 fig, 38 ref.

Descriptors: *Activated sludge, *Biological wastewater treatment, *Microbial degradation, *Morpholine, *Mycobacterium, *Plasmids, *Wastewater treatment, Chemical wastes, DNA, Genetics, Industrial wastes, Microorganisms.

The stability of the morpholine-degradative phenotype was studied in a group of nine distinct strains of mycobacteria, all isolated from an activated sludge plant treating morpholine. Variants incapable of morpholine degradation arose from all strains at high frequency following growth under non-selective conditions. However, strains differed with respect to the frequency at which Mor(-) variants arose. No spontaneous reversion to wild type could be demonstrated. Six of the nine mycobacterial strains contained plasmids, each had a different plasmid profile. The plasmid profiles of wild type and Mor(-) variants were compared. In no case could loss of the ability to grow on morpholine be correlated with loss of a complete plasmid. However, the evidence suggests that in two strains loss of the morpholine-degradative phenotype may be correlated with a decrease in the size of a very large plasmid implying deletion of the DNA encoding morpholine degradation. A large number of methods have been employed to screen for plasmid DNA but, as most studies use only one method, few comparisons between them are available. In this study the method of Bennett was found to give comparable results to a CsCl/ethidium bromide density gradient centrifugation technique. The method of Kado and Liu was also tested but found to be inferior to that of Bennett. (See also W91-00874) (Hoskin-PTT)
W91-00875

STANDARD HANDBOOK OF HAZARDOUS WASTE TREATMENT AND DISPOSAL.
McGraw-Hill Book Company, New York. 1989. 1036p. Edited by Harry M. Freeman.

Descriptors: *Handbooks, *Hazardous waste disposal, *Hazardous wastes, *Waste disposal, *Waste treatment, Environmental engineering, Environmental protection, Land disposal, Legal aspects, Recycling, Sampling techniques, Waste recovery.

The major environmental issue for industrial countries throughout the 70s and 80s has been the management of hazardous wastes. This issue has manifested itself in the form of two questions: how to prevent environmental deterioration caused by the generation of hazardous wastes, and how to effectively clean up the problems caused by past examples of improper disposal. Both of these questions are complex, depending for resolution on many social and technical factors. This handbook has been developed to be used as a reference book for engineers, industrial managers, government officials, researchers, teachers, and others involved with the management and disposal of hazardous chemical wastes. Subjects covered include: laws and regulations; hazardous-waste characteristics, quantities, and treatment capacities; hazardous waste topics and issues; special hazardous wastes; waste minimization and recycling; hazardous-waste recovery processes; physical and chemical treatment; thermal processes; biological processes; land storage and disposal; comprehensive hazardous-waste treatment facilities; remedial-action techniques and technology; sampling and analysis techniques for hazardous waste; and engineering considerations. (See W91-00901 thru W91-00960) (White-Reimer-PTT)
W91-00900

ACTIVATED-CARBON ADSORPTION.
Michigan State Univ., East Lansing. Dept. of Civil and Environmental Engineering.
T. C. Voice.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. 6.3-6.21, 6 fig, 19 ref.

Descriptors: *Activated carbon, *Adsorption, *Hazardous waste treatment, *Wastewater treatment, Organic compounds, Pollutants, Process design.

Activated-carbon adsorption can be used to remove a wide variety of contaminants from liquid or gaseous streams. It is most frequently used for organic compounds although some inorganic species are also efficiently adsorbed. A variety of attractive forces exists between fluid-phase molecules and the molecules of a solid adsorbent, all having their origin in the electromagnetic interactions of nuclei and electrons. Activated carbon can be manufactured from a number of carbonaceous raw materials including coal, coke, peat, wood and nutshells. A summary of the properties of the adsorbate, adsorption equilibria, and adsorption kinetics is presented. The manner in which the adsorbate is exposed to the adsorbent is an important design consideration. The different reactor configurations include completely mixed reactors, column reactors, and combined adsorption and biological treatment processes. Carbon adsorption should be considered as a potential removal process for organic contaminants that are nonpolar, of low solubility, or of high molecular weight. In order to determine the specific process design it is necessary to conduct studies for: (1) pretreatment and treatability; (2) pilot-scale and full-scale design; (3) regeneration; and (4) cost estimates. Operational considerations will include performance monitoring and the determination of operational problems such as head loss, biological growth, and premature exhaustion of the carbon capacity. (See also W91-00900) (White-Reimer-PTT)
W91-00912

DISTILLATION.
Research Triangle Inst., Research Triangle Park, NC.
T. N. Rogers, and G. Brant.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.23-6.38, 7 fig, 7 ref.

Descriptors: *Distillation, *Hazardous waste treatment, *Industrial wastes, *Wastewater treatment, Batch distillation, Continuous distillation, Design criteria, Economic aspects.

Broadly defined, distillation is the separation of more volatile materials from less volatile materials by a process of vaporization and condensation. Distillation systems vary in complexity from simple batch processes to very sophisticated multiple-column units, with the system configuration depending on the objectives of the operation. Distillation can be conducted in one of two possible modes: batch or continuous. Most large-scale industrial applications utilize continuous distillation; however, batch distillation can prove to be advantageous in some situations. In distillation processes, the number of plates or stages required for a given separation is dependent on the reflux rate. As the reflux is increased, the required number of stages falls. When selecting the best equipment designs for the process, consideration may be given to such factors os fouling tendency, corrosivity, throughput, versatility, and cost. The following pieces of hardware and equipment variations are available and may be needed to meet different process conditions: (1) column shell; (2) column internals; (3) control instruments; (4) reboiler; (5) condenser; (6) preheaters and coolers; (7) vent condensers; and (8) pumps. Operating costs are highly variable depending on the complexity of the system. Based on a case study it was found that distillation tends to be energy-intensive and thus expensive unless the product can be recycled or sold. From an environmental standpoint distillation has the potential for both volatile-organic air emissions and process residuals. Generally vent condensers and incineration can be used to avoid discharge and disposal problems. (See also W91-00900) (White-Reimer-PTT)
W91-00913

ELECTROLYTIC RECOVERY TECHNIQUES.
General Motors Technical Center, Warren, MI.
A. A. Aguwa, and C. N. Haas.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.39, 3 fig, 9 ref.

Descriptors: *Electrochemistry, *Electrolytic recovery, *Hazardous waste treatment, *Heavy metals, *Waste recovery, *Wastewater treatment, Case studies, Costs, Industrial wastes.

Electrolytic techniques have been used to recover a variety of heavy metals from process streams or rinse waters. These processes have been demonstrated for the recovery of gold, silver, cadmium, nickel, nickel-iron alloy, copper, zinc, and other metals. The conventional electrochemical reactor consists of the electrodes, associated appliances such as recirculation pumps, and a power supply. The advantages of the recovery technique include: (1) valuable metals are recovered, re-used, or sold; (2) discharge of toxic heavy metals is reduced or eliminated; (3) initial investment for the process is low; (4) production of toxic sludges is eliminated; (5) operating expenses are low; and (6) equipment maintenance is minimal. Parameters that affect the recovery of metals using electrochemical means are the initial concentration of the metal, power supply, and characteristics of the electrodes. Case studies indicate that many metals can effectively and economically be recovered using electrolytic techniques. The capital cost of electrolytic recovery equipment depends on the flow rate, initial metal concentration, desired effluent concentration, and whether the metal is complexed. The operational cost depends on the cost of electricity, cost of pumps, and labor costs for cell operation and maintenance. (See also W91-00900) (White-Reimer-PTT)
W91-00914

HYDROLYSIS.
BDT, Inc., Clarence, NY.
A. Wilds.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.47-6.58, 3 fig.

Descriptors: *Hazardous materials, *Hazardous waste disposal, *Hazardous waste treatment, *Hydrolysis, *Waste treatment, *Wastewater treatment, Case studies, Chemical reactions, Economic aspects.

Hydrolysis can remove reactivity from organic and inorganic substances in the gas, liquid, or solid phase. The technology is based on the fact that water, under controlled conditions, modifies certain reactive chemical elements and compounds safely. Furthermore, the resultant species can be handled safely. Hazardous chemicals, such as potassium metal and lithium amide can be reacted to produce less hazardous substances. In the process, solutions with high or low pH may be produced, as well as toxic and flammable gases. The evolved gases must be handles appropriately and the pH of the solutions must be adjusted to more neutral values to render them safe for processing at a commercial wastewater-treatment facility. Any solids filtered from the solution can be drummed and sent to a secure landfill. A case study involving carbides is presented which includes the chemical reactions, process description, and equipment needed. Safety and monitoring are important considerations. During processing, reactive materials can produce explosive (methane, propane, butane, acetylene, ethylene oxide) and toxic (hydrogen cyanide, hydrogen sulfide, hydrogen bromide, phosgene, chlorine) gases. All of these materials and many others can cause fatalities or serious health problems. A major advantage of the hydrolysis technology is that it can be designed to be totally self-contained for solids and liquids. Consequently, the potential for contaminating the local groundwater, rivers, lakes, or land is reduced to an extremely low probability. There is no known technology that compares with hydrolysis in the range of reactives to which it can be successfully applied. Although the costs associated with hydrolysis are high, it has the advantage of being able to treat open or closed packages without the risk of handling accidents. (See also W91-00900) (White-Reimer-PTT)
W91-00915

ION EXCHANGE.
Eco-Tec Ltd., Pickering (Ontario).
C. J. Brown.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.59-6.75, 5 fig, 3 tab, 34 ref.

Descriptors: *Hazardous materials, *Hazardous waste treatment, *Ion exchange, *Waste treatment, *Wastewater treatment, Effluent polishing, Electroplating industry, Metal recovery.

Ion exchange is a very versatile and effective tool for the treatment of aqueous hazardous wastes. The process is usually carried out cyclically, alternating between service and regeneration modes, and can be either manually or automatically controlled. Ion-exchange resins can be described simply as solid, insoluble acids or bases which are capable of entering into chemical reactions in the same way as their mineral or organic acid analogs. Although it is possible to conduct ion-exchange reactions 'batch' style in stirred tanks, it is generally more efficient to operate the resin in vertical columns in which the resin is 'fixed.' Several different fixed-bed ion-exchange equipment types, with different column designs and process flowsheets, are being used in the treatment of hazardous wastes. Broadly speaking, these can be grouped into four classes: cocurrent, countercurrent, short bed, and mixed bed. One of the industries that is most beset by hazardous-waste disposal problems is the electroplating industry. Ion-exchange has been used in this industry for: (1) recovery of chromic acid from plating rinsewater; (2) recovery of metals from acid copper-plating and nickel-plating rinsewater; (3) recovery of metals from mixed rinsewater; and (4) effluent polishing. It has also been used in the nuclear industry for radioactive wastes. Recent advances in the field include the development of synthetic adsorbents, inclusion polymers, molecular-sieve zeolites, the Devoe-Holbein process, and centralized ion-exchange recovery systems. (See also W91-00900) (White-Reimer-PTT)
W91-00916

SOLVENT EXTRACTION.
Risk Science International, Washington, DC.
J. B. Berkowitz.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. 6.77-6.89, 1 fig, 2 tab, 25 ref.

Descriptors: *Hazardous materials, *Hazardous waste treatment, *Oil wastes, *Solvent extraction, *Waste treatment, *Wastewater treatment, Petroleum, Phenols, Separation techniques.

Solvent extraction is a physical separation process, used for the transfer of constituents from one liquid solution (or solid matrix) to another. The constituents are unchanged chemically. The principal waste-treatment application of solvent extraction is removal of phenols from wastewater effluents from petroleum-refinery, coke-oven, and phenol-resin plant operations. Suitable extraction solvents include crude oil, light oil, benzene, toluene, isopropyl ether, tricresyl phosphate, methyl isobutyl ketone, methyl chloride, and butyl acetate. The phenols transferred to the solvent phase can be recovered by subsequent extraction with caustic. Removal efficiencies are typically in the range of 90 to 98% and can exceed 99% in some applications with the use of special equipment. The four basic components of a solvent extraction process are: (1) solvent-feed contact; (2) extract and raffinate separation; (3) extract treatment; and (4) raffinate treatment. In designing the process it is necessary to consider energy and materials requirements; process efficiency; emissions and residuals management; recovery; safety; costs; and regulations. (See also W91-00900) (White-Reimer-PTT)
W91-00917

MEMBRANE SEPARATION TECHNOLOGIES.
Environmental Strategies Corp., San Jose, CA.
J. MacNeil, and D. E. McCoy.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.91-6.106, 10 fig, 4 tab.

Descriptors: *Hazardous waste treatment, *Membrane processes, *Separation techniques, *Wastewater treatment, Electrodialysis, Hyperfiltration, Membranes, Reverse osmosis, Ultrafiltration.

Membrane separation processes include reverse osmosis, ultrafiltration, hyperfiltration, and electrodialysis, each of which separates a contaminant (solute) from a liquid phase (solvent, typically water). Membrane separation processes can function in several ways: volume reduction, recovery and/or purification of the liquid phase, and concentration and/or recovery of the contaminant or solute. When choosing a membrane separation technique, a number of basic characteristics should be taken into account. Reverse osmosis is primarily used to separate water from a feed stream containing inorganic ions. The purity of the recovered water is relatively high, and the water is generally suitable for recycling. The maximum achievable concentration of salt in the reject stream is usually about 100,000 mg/L because of the osmotic-pressure considerations. Hyperfiltration separates ionic or organic components from water by limiting the size of membrane pores through which a contaminant can pass. It is typically used to remove contaminants having a molecular weight of 100 to 500 from water. Ultrafiltration is primarily used to separate organic components from water according to the size (molecular weight) of the organic molecules. Membranes are manufactured with the capability to remove contaminants with molecular weights between 500 and 1,000,000. Electrodialysis is used to remove ionic components from water. It produces moderate-quality product water (i.e., several hundred mg/L salt), and is capable of producing concentrate streams containing up to 20% salt. (See also W91-00900) (White-Reimer-PTT)
W91-00918

AIR STRIPPING AND STEAM STRIPPING.
Polaroid Corp., Cambridge, MA.
J. V. Boegel.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Com-

pany, New York. 1989. p 6.107-6.118, 3 fig, 1 tab, 20 ref.

Descriptors: *Air stripping, *Hazardous materials, *Hazardous waste treatment, *Steam stripping, *Wastewater treatment, Alcohols, Chlorinated hydrocarbons, Distillation, Industrial wastes, Ketones, Volatile organic compounds.

Stripping is a physical unit operation in which dissolved molecules are transferred from a liquid into a flowing gas or vapor stream. The driving force for mass transfer is provided by the concentration gradient between the liquid and gas phases, with solute molecules moving from the liquid to the gas until equilibrium is reached. Air stripping is useful for the removal of volatile organic compounds (VOCs) from water or aqueous waste streams. These include chlorinated solvents like methylene chloride, tetrachloroethylene, and 1,1,1-trichloroethane; aromatic solvents like benzene and toluene; and trihalomethanes. Air stripping applications are limited to dilute liquid aqueous wastes with volatile-organic concentrations less than about 100 mg/L. In its simplest form, air stripping converts a water-pollution problem to an air-pollution problem. Current research in the technology of air stripping includes (1) the development and demonstration of improved packings and (2) experimental work on high-temperature air stripping. Like air stripping, steam stripping can be used to remove VOCs from water or aqueous waste streams; however, steam stripping is more broadly applicable. Steam stripping has been successfully demonstrated for the decontamination of a groundwater containing ketones and alcohols as well as chlorinated solvents at 1,000 ppm. Steam stripping may be employed for the treatment of industrial wastewaters, particularly where the organic contaminants can be recovered for reuse or concentrated for more efficient destruction on site. Since steam stripping is essentially a distillation process, the design equations and methodology developed for continuous fractional distillation applies. Steam stripping produces a treated bottoms stream suitable for appropriate discharge to a municipal sewage-treatment system or into surface water, or for reuse in on-site industrial processes. (See also W91-00900) (White-Reimer-PTT)
W91-00919

THIN-FILM EVAPORATION.
Research Triangle Inst., Research Triangle Park, NC.
C. C. Allen, and S. I. Simpson.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.119-6.131, 4 fig, 6 tab, 5 ref.

Descriptors: *Hazardous materials, *Hazardous waste treatment, *Thin-film evaporation, *Waste treatment, *Wastewater treatment, Economic aspects, Organic compounds, Solvents, Thin films, Waste recovery.

Thin-film evaporators can be used to remove or recover organic components from waste streams. This includes the recovery of high-boiling water-soluble solvents such as ethylene glycol, without adding water to the recovered product. Hazardous wastes which can be treated in a thin-film evaporator include waste solvents from the chemical, plastics, electronics, and pharmaceutical industries. Both halogenated and nonhalogenated organics can be recovered. Thin-film evaporators do not work well for wastes which react immediately when heated, or for extremely viscous materials. A major advantage of thin-film evaporators is that organic compounds can be recovered from viscous liquids. Disadvantages include the need to leave a fraction of the organics in some sludges to maintain fluidity. In designing the process the following must be considered: (1) capacities, flows, and other specification; (2) possible efficiencies, and capabilities; (3) construction materials; (4) maintenance; (5) relation to other processes; and (6) utility support. A thin-film evaporation system has three streams which exit the system--the distillate which has evaporated and then condensed back to the liquid phase, the concentrates stream which was not evaporated, and the noncondensible gases which are vented from the condenser. Often only 85 to 90% of the organics are recovered. In some cases the residual sludge has been landfilled and burned for its fuel content. Economic evaluations considered in the process design include capital, operating, and maintenance costs. (See also W91-00900) (White-Reimer-PTT)
W91-00920

FREEZE-CRYSTALLIZATION.
Heist Engineering Corp., Raleigh, NC.
J. A. Heist.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. 6.133-6.143, 4 fig.

Descriptors: *Freeze-crystallization, *Hazardous materials, *Hazardous waste treatment, *Waste treatment, *Wastewater treatment, Air pollution, Economic aspects, Waste disposal.

A freeze-crystallization process separates water from solutions by cooling the solution until ice crystals begin to form. Ice, with few exceptions, crystallizes as a pure material. The ice is separated from the remaining liquid and impurities, washed, and melted to produce a purified stream. The dissolved components of the stream are concentrated into a reduced volume. The cost is typically $0.025 to $0.15 per gallon of purified water, including equipment amortization. Hazardous components of liquid wastes are concentrated into a smaller volume, which can be more economically destroyed by thermal oxidation or solidified. The flexibility of the freeze-crystallization process enhances its integration with both the generating and the disposal processes. The design variables for freeze-crystalization equipment fall into three categories: (1) process characteristics, dictated by the application; (2) production objectives, which are often an optimization of the total costs of freeze-crystallization and final disposal; and (3) equipment and process options. In the area of environmental concerns it has been determined that there are virtually no air emissions from the process, wastewaters generally meet requirements and are easily monitored, and solids discharged from the process can be directly landfilled. (See also W91-00900) (White-Reimer-PTT)
W91-00921

FILTRATION AND SEPARATION.
Memtek Corp., Billerica, MA.
L. S. Liang.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.3-7.19, 4 fig, 3 tab, 27 ref.

Descriptors: *Filtration, *Hazardous waste treatment, *Separation techniques, *Waste treatment, *Wastewater treatment, Case studies, Clarification, Design criteria, Dewatering, Industrial wastes.

Filtration is a method for separating solid particles from a fluid through the use of a porous medium. The applications of filtration to treatment of hazardous waste fall into two categories: clarification, in which suspended solid particles in concentrations of typically less than 100 ppm are removed from an aqueous stream; and dewatering of slurries of typically 1 to 30% solids by weight. The processes used include granular-bed filters, rotary vacuum belt filters, rotary vacuum precoat filters, filter presses, and bed filter presses. Design considerations for any specific application include: (1) design constraints; (2) capacities and capabilities; (3) construction materials; and (4) relation to other processes. Air emissions from filtration processes exposed to the atmosphere can occur if there are volatile components in the wastewater or sludges. The filtrate from granular-media filters, vacuum precoat filters, and cross-flow filters may be clean enough to be recycled as service water in the waste treatment plant. Metals in filter cakes from dewatering processes may be recovered economically, depending on the composition of the cake. Filtration and separation processes have been successfully used in the manufacture of organic chemicals, plastics, and fibers; metal-forming and plating operations; arsenic-sludge dewatering; and dewatering of textile-waste activated sludge. (See also W91-00900) (White-Reimer-PTT)
W91-00922

CHEMICAL PRECIPITATION.
Metcalf and Eddy, Inc., Wakefield, MA.
N. K. Chung.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.21-7.31, 3 fig, 2tab, 3 ref.

Descriptors: *Chemical precipitation, *Hazardous waste treatment, *Waste treatment, *Wastewater treatment, Design criteria, Heavy metals, Industrial wastes, Metal-finishing wastes, Precipitants.

Chemical precipitation is a process by which a soluble substance is converted to an insoluble form either by a chemical reaction or by changes in the composition of the solvent to diminish the solubility of the substance in it. The precipitated solids can then be removed by settling and/or filtration. Chemical precipitation is applicable to the treatment of aqueous hazardous wastes containing toxic constituents that may be converted to an insoluble form. This includes wastes containing the metals arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc. Major industries that are sources of metal-containing wastes are metal plating and polishing, steel and nonferrous metals, inorganic pigments, mining, and the electronics industry. Hazardous wastes containing metals are also generated from cleanup of uncontrolled hazardous-waste sites. A chemical precipitant is added to the metal-containing aqueous waste in a stirred reaction vessel. Different chemical precipitants that have been shown to be effective in removing heavy metals from aqueous wastes include hydroxide, sulfide, carbonate, sodium borohydride, cementation, and others. The design considerations and alternatives related to the use of precipitation for treatment of hazardous wastes are associated either with the precipitation processes themselves or with the nature of the hazardous metal-bearing wastes to be treated. These considerations and alternatives include waste segregation and pretreatment, jar testing, lime or caustic, heat of reaction, and precipitation of complexed metals. (See also W91-00900) (White-Reimer-PTT)
W91-00923

PHOTOLYSIS.
Agricultural Research Service, Beltsville, MD. Natural Resources Inst.
P. C. Kearney, and P. H. Mazzocchi.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.33-7.40, 3 fig, 1 tab, 18 ref.

Descriptors: *Hazardous waste treatment, *Photolysis, *Waste treatment, *Wastewater treatment, Dioxins, Munitions wastes, Pesticides, Photochemical processes.

Photochemical processes that can be effectively employed to photodegrade selected hazardous wastes are described. Various techniques like the use of sensitizers and commercial high-intensity light sources, which effectively remove the wavelength limitation of sunlight, make the large-scale photodegradation of hazardous wastes a viable process. An important parameter in determining the efficiency of a photochemical reaction is the quantum yield. Quantum yield is defined as the ratio of the number of molecules of material undergoing that process to the number of quanta light absorbed. Photochemical equipment generally consists of two components: a vessel to contain the material being irradiated, and the light source. For most purposes low-pressure or medium-pressure mercury lamps are most convenient for large-scale reactions. Applications of photochemical processes include removal of pesticides, dioxins, and munitions. Some of the pesticide products of photolysis may pose some potential toxicological problems even though they are less toxic than the starting material. Consequently it may be advantageous to

have a secondary treatment process that mineralizes the photoproducts to CO2, H2O, and Cl. There is very limited information on the costs of destroying toxic wastes by photolysis. The capital costs can be substantial depending on the equipment used. (See also W91-00900) (White-Reimer-PTT)
W91-00924

CHEMICAL OXIDATION AND REDUCTION.
Chemical Waste Management, Inc., Riverdale, IL.
E. G. Fochtman.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.41-7.51, 5 tab, 16 ref.

Descriptors: *Chemical reduction, *Chemical treatment, *Chromium, *Hazardous waste treatment, *Oxidation, *Waste treatment, *Wastewater treatment, Metals, Organic wastes, Oxidation reagents, Reduction reagents.

Chemical oxidation-reduction reactions are those reactions in which the oxidation state of one reactant is increased and the oxidation state of another reactant is decreased. Oxidation-reduction or 'redox' reactions have an important role in treatment of waste. Such reactions are used in treatment of metal-bearing wastes and of inorganic wastes such as metal-containing wastes, sulfides, cyanides, and chromium, and also in the treatment of many organic wastes such as phenols, pesticides, and sulfur containing compounds. Chemical oxidation is widely used to treat both hazardous and nonhazardous wastes. The technology is well-established and represents a safe means of waste treatment that is easily monitored and controlled. The most prevalent use of reduction in current waste treatment is the reduction of chromium(VI) to chromium(III). The Cr(3+) is much less toxic than Cr(6+) and can be precipitated as the relatively insoluble Cr(OH)3 for removal. Commonly used oxidizing agents include sodium hypochlorite, hydrogen peroxide, calcium hypochlorite, potassium permanganate, and ozone. The most common reducting agents are sulfur dioxide and sodium borohydride. In general, chemical treatment costs are highly influenced by the chemical cost. Thus, oxidation and reduction treatment tends to be most suitable for low concentrations (less than 1%) in wastes. (See also W91-00900) (White-Reimer-PTT)
W91-00925

DEHALOGENATION.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
A. Kornel.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.53-7.63, 1 tab, 34 ref.

Descriptors: *Dehalogenation, *Dioxins, *Hazardous waste treatment, *Polychlorinated biphenyls, *Waste treatment, *Wastewater treatment, Oil, Soil contamination.

The application of chemical dehalogenation reactions for the purpose of detoxification or destruction of hazardous compounds is a relatively recent phenomenon. Perhaps the best-known problem compounds of current times are the polychlorinated biphenyls (PCBs), their mixtures, and the polychlorinated dibenzodioxins (PCDDs). The commercial process for decontamination of PCB-laden dielectric, heat-exchange, or hydraulic fluids represent a classical case of application of chemical dehalogenation. Proven commercial processes exist for PCB dehalogenation in oils; however, these processes have major limitations when their use is attempted in any other matrix--e.g. soils or sediments which contain water or are exposed to atmospheric oxygen. One of the first groups to research this area applied a new dehalogenation reagent, NaPEG, for possible in situ dehalogenation of PCBs in soils. Soil studies employing this reagent under laboratory conditions showed promise for the reagents ability to perform under in situ conditions. However field studies revealed a greater susceptibility to water deactivation than had previously been expected. The NaPEG reagent and other similar reagents developed all employ alkaline polyethylene glycolates (APEGs) as the reactive species. There are a number of groups who are investigating innovative and novel dehalogenation techniques. These techniques include catalytic (low-temperature) and electrochemical processes and are all directed at dehalogenation of PCBs, though they may be applied toward other haloorganics. Some concern is now being given to the presence of aliphatic halogenated solvents in ground and drinking water. As chemists have not until recently been asked to look at these problems, there are no specific solutions. There are, however, applications of existing technologies which could render a solution to these problems. (See also W91-00900) (White-Reimer-PTT)
W91-00926

OZONATION.
H2M Corp., Melville, NY.
F. C. Novak.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.65-7.76, 4 fig, 8 ref.

Descriptors: *Hazardous waste treatment, *Ozonation, *Waste treatment, *Wastewater treatment, Case studies, Disinfection, Economic aspects, Inorganic compounds, Organic compounds, Oxidation.

Ozone has been used for more than 80 years, primarily for disinfection of municipal drinking water. Ozone treatment has also been used for industrial and hazardous-waste applications, and organic and inorganic reactions. Ozone is relatively unstable, but one of the strongest oxidizing agents known. It can be substituted for conventional oxidants such as chlorine, hydrogen peroxide, and potassium permanganate. Since hazardous wastewaters are normally complex, laboratory and/or pilot-plant studies are needed to determine if ozone is feasible for use with a specific waste. Ozone utilization, or transfer efficiency, is determined by a number of factors such as wastewater characteristics, kinetics, pH, and temperature. Advantages of using ozone include: it is generated on site from air with no storage or handling needed; strong oxidation properties and reaction with a wide variety of organics and inorganics; and less critical temperature and pH constraints than other oxidants. The disadvantages of using ozone are a higher capital cost, inability to degrade low-molecular-weight chlorinated organics, and residual oxidant (ozone) is essentially nonexistent. Considerations necessary for designing a system include: background information on ozone equipment; materials of construction; pressure, temperature, and dew point; and monitoring and control. All ozone systems should include some type of ozone-destruction equipment to prevent excess ozone from entering the environment. Ozonation has been used successfully in the auto industry for cyanide destruction, textile wastewater treatment, and at hazardous waste sites. Capital costs can vary as much as 50% depending on the interpretation of ozone-generator performance specifications. Ozone-generator operating costs depend primarily on the cost of electrical energy. (See also W91-00900) (White-Reimer-PTT)
W91-00927

EVAPORATION.
Ground/Water Technology, Inc., Rockaway, NJ.
B. T. Delaney, and R. J. Turner.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.77-7.84, 3 fig.

Descriptors: *Evaporation, *Hazardous waste treatment, *Waste treatment, *Wastewater treatment, Design criteria, Economic aspects, Inorganic compounds, Metal-finishing wastes, Organic compounds, Physicochemical properties, Radioactive wastes.

Evaporation has long been used as a unit operation in the manufacture of various products in the chemical-process industries. In addition, it is currently being used for the treatment of hazardous wastes such as radioactive liquids and sludges, metal-plating wastes, and other organic and inorganic wastes. Design choice is dependent on the liquid to be evaporated. This means that the waste stream must be completely characterized and relatively homogeneous in nature. The processes generally used for evaporation are called boiling heat transfer and flash vaporization. The three most common types of evaporation equipment are the rising-film, falling-film, and forced-circulation evaporators. The first two rely on boiling heat transfer and the latter relies on flash vaporization. Heat exchangers, flash tanks, and ejectors are common auxiliary equipment items incorporated with evaporator bodies to complete an evaporator system. Properties of the liquid to be evaporated are critical in final selection of an appropriate evaporator system. Since operating costs are a significant factor in overall cost, heat-transfer characteristics and energy requirements are important considerations. Properties of liquids which are critical to the determination of final design include: heat capacity, heat of vaporization, density, thermal conductivity, boiling point rise, and heat-transfer coefficient. Evaporation is an expensive technology, both in terms of capital costs and operating costs. Additionally, mechanical evaporation produces a condensate and a bottoms stream, one or both of which may require further processing or disposal. (See also W91-00900) (White-Reimer-PTT)
W91-00928

SOLIDIFICATION AND STABILIZATION TECHNOLOGY.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
C. C. Wiles.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.85-7.101, 2 fig, 3 tab, 14 ref.

Descriptors: *Hazardous waste treatment, *Physicochemical treatment, *Waste solidification, *Waste stabilization, Binders, Containment mechanisms, Design criteria, Land disposal, Waste management, Waste treatment.

Solidification and stabilization (S/S) are treatment processes designed to either improve waste-handling and physical characteristics, decrease surface area across which pollutants can transfer or leach, or limit the solubility of or detoxify the hazardous constituents. Advantages and disadvantages of S/S will vary with the process, the binders, the waste, the site conditions and other unique factors. Solidification and stabilization technology may be characterized by the binder used or by the binding or containment mechanism; or it may be categorized by process type. Binder systems consist of two categories: inorganic and organic. Pollutant binding mechanisms include: sorption, pozzolan reactions, pozzolan-portland cement reactions, thermoplastic microencapsulation, and macroencapsulation. The S/S processing schemes used are in-drum processing, inplant processing, mobile-plant processing, and in situ processing. Factors that affect the selection, design, implementation, and performance of S/S processes and products include treatment objective, waste characteristics, process type and processing requirements, S/S waste-management requirement, regulatory requirements, and economics. As restrictions on landfilling become stronger and wastes are banned from land disposal, S/S technology could potentially be an important alternative technology with a major use being to treat waste in order to make it acceptable for land disposal. Lower permeability, lower contaminate leaching rates, and similar characteristics may make hazardous wastes acceptable for land disposal after stabilization. (See also W91-00900) (White-Reimer-PTT)
W91-00929

LIQUID-INJECTION INCINERATORS.
Four Nines, Inc., Plymouth Meeting, PA.
J. J. Santoleri.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.3-8.18, 11 fig, 3 tab, 7 ref.

Descriptors: *Hazardous waste disposal, *Incineration, *Liquid-injection incinerators, *Waste treatment, Design criteria, Thermal properties, Waste characteristics, Waste disposal.

In the field of hazardous-waste incineration, there is more experience with liquid-injection incinerators than all other types combined. Liquid-injection incinerators are usually refractory-lined chambers, generally cylindrical and equipped with a primary combustor (waste and auxiliary-fuel fired) and often secondary combustors or injection nozzles for low-calorific-value materials (aqueous wastes containing either organic or inorganic compounds, or both). When considering the liquid-injection incinerator, one must be concerned about the ability of the entire system, i.e., the design, components, controls, and pollution-control system, to meet the requirements of the federal and state regulations. The physical, chemical, and thermodynamic properties of the waste must be considered in the basic design requirements of the total incinerator system. This includes storage tanks, mixers, pumps, control valves, piping, atomizers, combustors, refractory, heat recovery, quench system, and air-pollution control equipment. In the process industries, waste liquids are generated which are numerous in kind and defy easy definition. The wastes can be categorized as organic, aqueous organic, and aqueous organic-inorganic. Each of these can again be divided into those that are considered hazardous and those considered nonhazardous. A further distinction is made between aqueous organics with and without ash. Since most liquid-injection incinerators do not generate solids or ash, the air-pollution control problem is minimized. In most cases, it is a matter of providing the proper scrubber for absorption of the acid gases generated. The wastewater discharge is usually dependent on the acid gases formed in the incinerator, the ash composition and size, and the scrubber system employed. (See also W91-00900) (White-Reimer-PTT)
W91-00930

ROTARY KILNS.
Boliden Allis, Inc., Milwaukee, WI. Minerals Systems Div.
C. F. Schaefer, and A. A. Albert.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.19-8.30, 10 fig, 1 tab, 4 ref.

Descriptors: *Design criteria, *Hazardous waste disposal, *Incineration, *Rotary kilns, *Waste treatment, Heat transfer, Waste characterization.

Rotary kilns provide a number of functions necessary for incineration. They provide for the conveyance and mixing of solids, provide a mechanism for heat exchange, serve as host vessel for chemical reactions, and provide a means of ducting the gases for further processing. When designing a kiln to process solid hazardous wastes, it is first necessary to characterize the material to be processed as to chemical composition, specific heat, size consistency, calorific value, moisture content, bulk density, and dynamic angle of repose. The flow of material through a rotary kiln is determined by the kiln's slope and rotational speed as well as by the characteristics of the material being processed. The length-to-diameter ratio of the kiln determines how many supports are required. As the length-to-diameter ratio increases, additional supports may be required. Heat transfer appears to be proportional to the square of the kiln's internal diameter. The rules of thumb which attribute 60 to 80% of kiln heat transfer to radiation are presently under investigation. Numerous tests and demonstrations indicate that the bulk of the heat transfer may well be attributable to convective heat transfer. There are two categories of plants for processing solid hazardous wastes--permanent installations and transportable plants. Permanent installations are at the sites of generators of solid hazardous wastes, or are installed as regional facilities accepting wastes from multiple sources. Transportable facilities can be constructed in skid-mounted and/or wheel-mounted modules. This type of plant is most likely to be used to clean up existing abandoned dump sites. (See also W91-00900) (White-Reimer-PTT)
W91-00931

FLUIDIZED-BED THERMAL OXIDATION.
Waste-Tech Services, Inc., Golden, CO.
G. F. Rasmussen, R. W. Benedict, and C. M. Young.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.31-8.40, 6 fig, 13 ref.

Descriptors: *Fluidized bed process, *Hazardous waste disposal, *Thermal oxidation, *Waste treatment, Combustion, Design criteria, Economic aspects.

Fluidized beds offer an economical means for the safe thermal destruction of hazardous and toxic wastes. The technology is the choice in many cases where thermal oxidation is to be applied to many hazardous and toxic wastes. The reasons are: (1) its superior combustion environment created by the bed turbulence; (2) the 'thermal inertia' associated with the mass of the bed; (3) the process simplicity resulting from the lack of moving parts associated with the high-temperature vessel; and (4) the versatility of the technology, with capability to destroy solids, liquids, and sludges. Systems for fluidized-bed thermal oxidation of hazardous waste generally consist of the principal elements which may be segmented into the air fluidization system, fluidized-bed vessel, feed systems, and off-gas cleanup equipment. A variety of bubbling-type fluidized-bed designs exist. The primary environmental impacts of fluidized-bed combustion are air emissions and ash generation. Fluidized beds have a lower capital cost than rotary types of incinerators and are more expensive than liquid-injection incinerators. Operating costs of fluidized beds are comparable to those for rotary technologies. Maintenance costs are lower than for rotary technologies and comparable to those for liquid-injection systems. A major development area is the use of active beds rather than inert beds. A two-stage bed has been used with catalytic and dry off-gas cleanup applicability. (See also W91-00900) (White-Reimer-PTT)
W91-00932

CEMENT KILNS.
General Portland, Inc., Dallas, TX.
J. F. Chadbourne.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.57-8.75, 1 fig, 3 tab, 29 ref.

Descriptors: *Cement kilns, *Fuel, *Hazardous waste disposal, *Incineration, *Waste disposal, Alternative fuels, Cements, Regulations.

An overview of cement kilns is presented. Cement kilns are a versatile alternative for the management of a wide variety of hazardous wastes. Materials present in the feed, fuels, or hazardous waste introduces into the kiln become part of the cement product, become part of a waste material known as cement-kiln dust, or are converted to other forms within the kiln. With few exceptions, materials introduced into cement kilns will be oxidized and stabilized, requiring no further treatment. Both solid and liquid wastes can be used. Although cement kilns can accommodate a variety of materials both as fuel and as feed in the cement process, there are limitations on the use of hazardous-waste materials and there are materials which are not desirable in the cement process. Unacceptable materials can be divided into two categories: those which are technologically unacceptable because of process constraints, and those which are unacceptable because of public opinion. Cement kilns are manufactured in a variety of designs and sizes. However, the high temperatures and the chemistry of cement production are essentially the same in all cement kilns from the burning zone to the calcining zone. In the United States, hazardous-waste fuel is subject to federal regulations that require development of procedures to prevent hazards, contingency and emergency plans, personnel training, waste analysis, inspections, record keeping and manifesting of waste, and adequate spill containment to prevent or control releases to the environment. Comparative emission tests on kilns burning conventional fuels and hazardous waste fuels show that there is no significant change in air emissions when hazardous waste fuel is properly used to replace conventional fuels. (See also W91-00900) (White-Reimer-PTT)
W91-00933

WET OXIDATION.
Zimpro, Inc., Rothschild, WI.
W. M. Copa, and W. B. Gitchel.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.77-8.90, 6 fig, 4 tab, 23 ref.

Descriptors: *Hazardous waste treatment, *Oxidation, *Waste treatment, *Wet oxidation, Case studies, Economic aspects, Organic compounds, Thermal processes.

Wet oxidation is an aqueous-phase oxidation process brought about when an organic and/or oxidizable inorganic-containing liquid is mixed thoroughly with a gaseous source of oxygen (usually air) at temperatures of 150 to 325 C. The process may be carried out in a batch reactor, but usually a continuous-flow system is used. The elements of the systems are a high-pressure liquid-feed pump, oxygen source, reactor, heat exchangers, and process regulators. Most organic compounds are stoichiometrically oxidized, the carbon going to carbon dioxide, the hydrogen to water, any halogen to halides, any sulfur to sulfate, any phosphorus to phosphate, and any nitrogen to ammonia or elemental nitrogen. The most resistant compounds are the halogenated aromatics. Wet-oxidation equipment is available in four basic configurations for application of this technology to hazardous-waste treatment: (1) aboveground vertical-column reactor; (2) stirred-tank reactor; (3) supercritical water; and (4) underground vertical-tube reactor. Hazardous wastes are treated by wet oxidation for the purpose of detoxification. Ultimately two effluent streams, off gas and oxidized liquid effluent, exit from the wet-oxidation process. The liquid effluent can be further separated in some cases into a liquid fraction, with all soluble components, and insoluble solids. The environmental impact of these effluent phases--gas, liquid, and solid--must be addressed when considering wet oxidation for hazardous-waste treatment. In most cases where wet oxidation is applied to hazardous wastes, the treatment objectives are the detoxification of the wastewater for subsequent biological treatment, which can be accomplished in a publicly owned treatment works or an industrial treatment plant. Case studies are presented demonstrating the use of wet oxidation in a hazardous-waste disposal facility in California, chemical manufacturing wastes in Michigan, spent coke-oven gas in Ontario, and scrubbing liquors from an ethylene production facility in Illinois. Capital costs for wet oxidation depend on several factors such as capacity of the system, oxygen demand of the wastewater, severity of oxidation required to meet the treatment objectives, and materials of construction of the wet-oxidation system. (See also W91-00900) (White-Reimer-PTT)
W91-00934

PYROLYSIS.
Midland-Ross Corp., Toledo, OH. Surface Div.
J. K. Shah, T. J. Schultz, and V. R. Daiga.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.91-8.104, 9 fig, 4 tab.

Descriptors: *Hazardous waste treatment, *Incineration, *Pyrolysis, *Waste treatment, Carbonaceous material, Corrosion, Economic aspects, Thermal processes.

Pyrolysis is a thermal process for transformation of solid and liquid carbonaceous materials into gaseous components and a solid residue containing fixed carbon and ash. Pyrolysis is especially applicable to hazardous-waste treatment because it provides precise control of the combustion process. The pyrolysis process can be applied to solids,

sludges, and liquid wastes. Pyrolysis is an intermediate process step in thermal treatment of hazardous waste. It generates a gaseous stream and a solid residue. Environmental protection regulations require that all effluents from a hazardous-waste treatment facility be safely disposed. Pyrolysis processes can be carried out in a variety of furnace designs, such as: rotary hearth, rotary kiln roller hearth, roller rail, and car bottom. Pyrolyzer furnaces can either be direct-fired or they can be indirectly heated by radiant tubes or electrical heaters. Pyrolytic systems are normally custom-designed to treat a specific waste. It is advisable to use corrosion-resistant, high-temperature alloy steels for metallic components in contact with the corrosive, reducing (oxygen-deficient) atmosphere in a pyrolyzer. Capital cost and operating cost can vary with the type of waste to be processed and the degree of process sophistication required. (See also W91-00900) (White-Reimer-PTT)
W91-00935

OCEANIC INCINERATION.
SITEX Environmental, Inc., Research Triangle Park, NC.
D. G. Ackerman, and R. A. Venezia.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.105-8.120, 2 fig, 7 tab, 48 ref.

Descriptors: *Hazardous waste disposal, *Incineration, *Oceanic incineration, *Waste treatment, Air pollution, Case studies, Economic aspects, Liquid-injection, Organochlorines, Polychlorinated biphenyls.

Oceanic incineration of liquids is a straightforward adaptation of land-based technology. All oceanic incineration systems to date have been vertical liquid-injection units, but there have been several conceptual designs for horizontal liquid-injection units. Wastes burned at sea have been almost exclusively organochlorines because they are more costly to dispose of on land. Specific types of wastes burned at sea have included distillation ends from manufacture of vinyl chloride, herbicide Agent Orange, and mineral-oil dielectric fluid containing polychlorinated biphenyls (PCBs). Currently, only pumpable liquid wastes are suited for oceanic incineration, as existing vessels are not designed to burn solids. Oceanic incinerators have been straightforward adaptations of land-based technology. The principal difference between oceanic and land-based incinerators is that mounting an incinerator in a ship requires compactness in both envelope and height. Another major difference is that scrubbers are not required on oceanic incinerators because the sea has a buffering capacity more than adequate to neutralize acidic emissions and because incineration sites are located far enough from land that the emissions will not degrade buildings or other structures or adversely affect human health and welfare. Oceanic incineration has been shown not to cause measurable or adverse environmental effects when conducted in accordance with international regulations. Before certification, currently operating ships were tested for their ability to incinerate organochlorines, PCBs, and Agent Orange. Unit costs vary widely and depend on factors related to the specific waste, and to packaging, transportation, density of generators, and regulatory programs. (See also W91-00900) (White-Reimer-PTT)
W91-00936

MOLTEN-GLASS PROCESSES.
Battelle Pacific Northwest Labs., Richland, WA.
J. L. Buelt.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.121-8.136, 4 fig, 2 tab, 24 ref.

Descriptors: *Hazardous waste disposal, *Molten-glass processes, *Waste treatment, Economic aspects, Glass, Liquid organics, Nitrates, Solid wastes, Thermal processes, Vitrification.

Various molten-glass processes are becoming commercially available for the destruction and/or immobilization of hazardous wastes. Molten glass processes fall into the following three basic categories: in situ vitrification, vertical joule-heated glass melters, and horizontal joule-heated glass melters. The various processes available include: in situ vitrification; vertical glass melter; and horizontal glass melters. The destruction of wastes applies mainly to solid and liquid organics and nitrate-bearing chemicals associated with the waste. Immobilized constituents consist of heavy metals, radionuclides, combustion ash, and other nonvolatile and semivolatile constituents such as silica, alumina, and alkaline oxides. Because of the diversity of waste types, molten-glass processes, and scale of equipment, it is impossible to project reliable cost estimates for the molten-glass processes. Cost evaluations must be performed on a case by case basis. Extensive leach studies with waste glasses have shown the waste form to be highly stable, possessing leach characteristics better than granite, marble, and common bottle glass. (See also W91-00900) (White-Reimer-PTT)
W91-00937

DEEP-SHAFT WET-AIR OXIDATION.
Smith (J.M.) and Associates, Cincinnati, OH.
J. M. Smith.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.137-8.151, 7 fig, 6 tab,14 ref.

Descriptors: *Deep-shaft wet-air oxidation, *Hazardous waste treatment, *Oxidation, *Waste treatment, *Wet oxidation process, Chemical oxygen demand, Design criteria, Economic aspects, Performance evaluation, Waste disposal.

The concept and practice of wet oxidation of organic waste materials is well established in the United States. Configuration of the deep-shaft wet-air oxidation reactor is unique to its purpose. Wastewater flows down the center tube of two concentric vertical tubes and returns in the annular space. Deep-shaft wet-air oxidation can be classified as subcritical or supercritical. Subcritical oxidation refers to maximum operating reactor temperatures below the critical point of water, 374 C and 22,120 kN/sq m. The supercritical process for deep-shaft wet-air oxidation attains maximum reactor temperatures and pressures above the critical point of water. Performance data for a full-scale plant is available from the subcritical-temperature EPA-sponsored facility at Longmont, Colorado. The data released from the study show that 75 to 85% of the COD of the sludge is destroyed with remaining COD mainly as acetic acid; 90 to 96% of the volatile suspended solids (VSS) were destroyed. These results were obtained with a residence time of 45 to 50 min in the oxidation zone. According to the process owner, the observed demonstration-plant COD reductions exceeded laboratory bench-test results by 3 to 5%. Ash removed from the process has been tested and found to easily pass the extraction procedure toxicity test for heavy metals. The reactor for deep-shaft wet-air oxidation is constructed utilizing conventional oil-field equipment and installation techniques. Total costs have been projected for supercritical reactors processing 100 gpm to 750 gpm of wastes at detention times of 1 to 5 min. the costs for the process range from $0.07 to $0.15 per gallon of throughput. The cost of the supercritical reactor and the well amounts to approximately one-half of the total system cost. (See also W91-00900) (White-Reimer-PTT)
W91-00938

SUPERCRITICAL-WATER OXIDATION.
Modell Development Corp., Framingham, MA.
M. Modell.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.153-8.169, 3 fig, 3 tab, 28 ref.

Descriptors: *Hazardous waste treatment, *Oxidation, *Supercritical wet oxidation, *Waste treatment, *Wet oxidation process, Heat exchangers, Organic compounds, Reactors, Waste disposal, Water pressure.

Supercritical-water oxidation (SCWO) is the oxidation of organics, with air or oxygen, in the presence of a high concentration of water under temperatures and pressures above the critical-point values of water. In theory, SCWO is applicable to any waste stream containing organics: concentrated organic liquids, vapors, and solids; aqueous solutions containing dissolved or suspended organic; or inorganic solids with adsorbed organics. In practice, the applicability of the process may be limited by waste pressurization, char formation, or solids removal. Supercritical-water oxidation of organics is significantly superior to wet oxidation in destruction efficiency. The major advantages of operating supercritically are (1) enhanced solubility of oxygen and air in water; (2) rapid oxidation of organics in short residence times; (3) complete oxidation of organics; (4) potential removal of inorganic constituents as solids and brines; and (5) recovery of the heat of combustion as high-temperature process heat or power. The reactor and heat exchanger are the key components in the SCWO system and their design involves considerations of residence time, temperature, and materials of construction. SCWO produces aqueous and sometimes solid effluents. As with other oxidation processes, the key to success is avoiding upsets or off-spec conditions, which can lead to incomplete oxidation and contaminated effluents. Costs for SCWO may vary with throughput and heating value of the waste. (See also W91-00900) (White-Reimer-PTT)
W91-00939

PLASMA SYSTEMS.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
C. C. Lee.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.169-8.177, 4 fig, 2 tab, 4 ref.

Descriptors: *Hazardous waste treatment, *Plasma systems, *Plasmavarc, *Waste treatment, Design criteria, Dioxins, Economic aspects, Liquid-waste feed system.

Although plasma arc itself has been successfully applied in the metals industry for many years, application of the plasma arc to hazardous-waste destruction is still in a pilot-scale research stage. Initial test results have shown that the plasma arc is a promising alternative for destruction of difficult to treat wastes such as dioxin-contaminated sludges. The most common method of plasma generation is electrical discharge through a gas. The gas used is relatively unimportant in creating the discharge, but will ultimately affect the products formed. The major components of the process include a liquid-waste feed system, plasma torch, reactor, caustic scrubber, on-line analytical equipment, and flare. The key component is the electrodes to produce the necessary arc. A plasma-arc system generally can destroy hazardous wastes to more than 'six nines' destruction removal efficiency. Only limited environmental data are currently available, and considerable efforts are still necessary to characterize the environmental effects from plasma-arc application. In evaluating the costs of the process it is necessary to consider the following factors: (1) it is a pyrolysis process, and does not need the energy to heat excess air required by conventional incinerators; (2) a smaller capacity of downstream cleanup systems is needed because no excess air is involved; and (3) the energy source is electricity which is more expensive compared with the oil used to fire incinerators. (See also W91-00900) (White-Reimer-PTT)
W91-00940

MOBILE THERMAL TREATMENT SYSTEMS.
IT Corp., Knoxville, TN.
S. G. DeCicco, and W. L. Troxler.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.179-8.194, 4 fig, 4 tab, 19 ref.

Descriptors: *Hazardous waste treatment, *Heat treatment, *Incineration, *On-site waste disposal,

*Waste treatment, Economic aspects, Hazardous materials, Treatment criteria, Waste disposal.

On-site treatment by a mobile thermal treatment system may be considered for a site which contains several thousand tons of materials which are considered toxic, reactive, or not readily amenable to treatment by other technologies. Examples of such wastes include materials contaminated with PCBs, dioxins, chlorinated phenols, pesticides, herbicides, and explosives and propellants. Truly mobile systems are generally truck-mounted, have minimal field-erection and installation requirements, and can be relatively easily mobilized and demobilized. The primary factors determining the throughput or processing capacity of a thermal treatment system are the waste characteristics, the operating temperature, excess-air requirements, and heat-transfer considerations. Upper processing limits are typically set by either gas-handling or heat-transfer considerations, with the controlling criteria dependent upon the type of equipment and the type of waste being processed. Commercial systems available include: rotary kiln with a secondary combustion chamber; indirectly heated thermal desorber with a secondary combustion chamber; fluidized bed; infrared furnace; cascading-bed reactor; and plasma arc. Treatment costs are a function of waste type, waste quantity, processing rate, and capital costs. (See also W91-00900) (White-Reimer-PTT)
W91-00941

CATALYTIC INCINERATION.
Four Nines, Inc., Plymouth Meeting, PA.
Y. H. Kiang.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.195-8.201, 2 fig.

Descriptors: *Catalysis, *Catalytic incineration, *Hazardous waste treatment, *Incineration, *Waste treatment, Liquid wastes, Pollution control, Waste disposal.

The primary application of catalytic incineration systems is the oxidation of organic compounds in gaseous streams. Liquid wastes can also be treated in a catalytic incineration system. However, application of catalytic incineration to liquid-waste disposal is rather limited. Catalytic incineration systems cannot be used for solid-waste disposal. The poison and masking of catalysts are a major concern in the application of catalytic incineration and must be studied before a catalytic system is selected. The important design parameters for a catalytic incinerator include the superficial-gas velocity, the catalysts used, the geometric support of catalysts (i.e. the form of the catalyst element), the depth of the catalyst bed, waste type and composition, and the incineration temperature. Air-pollution control systems can be used so that air emissions from a well-run catalytic incinerator will not affect the environment; however, the wastewater from the air-pollution system may require further treatment. The residues discharged from a catalytic incineration system are from spent catalysts, and can be landfilled or sold for precious-metal recovery. (See also W91-00900) (White-Reimer-PTT)
W91-00942

AEROBIC PROCESSES.
Notre Dame Univ., IN.
R. L. Irvine, and P. A. Wilderer.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 9.3-9.18, 3 fig.

Descriptors: *Aerobic treatment, *Biological treatment, *Hazardous waste treatment, *Waste treatment, *Wastewater treatment, Case studies, Design criteria, Organic wastes, Toxicity.

An overview of aerobic biological treatment for hazardous wastes is presented. Most 'hazardous organics' can be treated biologically provided that the proper organism distribution can be established. A substance that is hazardous for one group of organisms may be a valuable food source for another group. It is only by viewing biological treatment systems as a dynamic population of microbes whose composition is subject to various selection pressures that proper systems can be designed, maintained, and corrected when problems arise. The wastes subject to aerobic biological treatment are characterized by high organic content, low and high pH, elevated salt levels, presence of heavy metals, and presence of hazardous organics. Factors that affect the system are extent of biodegradability, applicability of conventional technology, effects of toxic and nontoxic inorganics, effects of toxic and nontoxic organics, load variations, nutrient requirements, pH, oxygen supply, and temperature. In designing an aerobic biological treatment process for leachates and highly contaminated wastewaters it is necessary to consider biological principles, general flow diagrams, and bioreactor flow diagrams. Contaminated soils can be excavated and placed in bioreactors and then mixed and aerated. In general, the biological principles for liquids are directly applicable to soils. Case studies conducted at DuPont's Chambers Works site at Deepwater, New Jersey and at CECOS International's hazardous waste disposal in Niagara Falls, New York demonstrated the feasibility of these systems for treating hazardous wastes. However, a program of quality control and chemical equalization on the entering streams must be established so that potentially harmful or persistent substances are excluded; and temperature variations, especially during the transition to cold weather conditions, must be controlled. (See also W91-00900) (White-Reimer-PTT)
W91-00943

ANAEROBIC DIGESTION.
Remediation Technologies, Inc., Kent, WA.
M. F. Torpy.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 9.19-9.28, 3 tab, 35 ref.

Descriptors: *Anaerobic digestion, *Hazardous waste treatment, *Waste treatment, *Wastewater treatment, Anaerobic filters, Anaerobic-sludge blanket process, Biological treatment, Methane, Methanogenesis, Organic wastes, Toxicity.

Anaerobic digestion is a sequential, biologically destructive process in which hydrocarbons are converted, in the absence of free oxygen, from complex to simpler molecules, and ultimately to carbon dioxide and methane. Hazardous waste streams often consist of hydrocarbons in high concentrations of chemical oxygen demand (COD). The treatability of the waste depends on the susceptibility of the hydrocarbon content to anaerobic biological degradation, and also on the ability of the organisms to resist detrimental effects of biologically recalcitrant, and toxic organic and inorganic chemicals. The metabolic interactions between the various groups of organisms are essential to the successful and complete mineralization of the organic molecules. Various parameters are monitored to maintain efficient operating conditions within the reactor. They relate to the influent quality, the biological activity of the reactor, and the quality of the reactor environment. The biochemical methane potential (BMP) assay is a conventional test used to evaluate the anaerobic treatability of the waste. The two major reactor types are the anaerobic filter in which the bacteria attach as a thin biofilm to the surface within the reactor, and the upflow anaerobic-sludge blanket which contains highly settleable sludge particles. Other reactor types that may be appropriate for particular wastes are the two-stage reactor, lagoon with full-length biomass contact, and hybrid. (See also W91-00900) (White-Reimer-PTT)
W91-00944

LAND TREATMENT OF HAZARDOUS WASTES.
Woodward-Clyde Consultants, Santa Ana, CA.
T. Phung.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 9.41-9.51, 1 tab, 11 ref.

Descriptors: *Hazardous waste disposal, *Land disposal, *Landfills, *Waste disposal, Biological treatment, Degradation, Environmental effects, Microorganisms, Soil characteristics.

Land treatment is a waste treatment and disposal process whereby a waste is mixed with or incorporated into the surface soil and is degraded, transformed, or immobilized through proper management. If properly managed, soil may serve as an effective treatment and disposal sink for many hazardous wastes. In land treatment, the organic fraction must be biodegradable at reasonable rates so as to minimize environmental problems associated with migration of hazardous-waste constituents. Some principal factors affecting the operation of the system are waste characteristics, soil characteristics, microorganisms, and waste degradation which is affected by soil pH, moisture content, temperature, nutrients and other factors. Considerations in the operation and design of a system are area and facility layout, equipment, water management, soil erosion, waste application, facility inspection and record keeping, site monitoring, and closure and postclosure. Predicting the environmental effects of soil-waste interactions is difficult because of the inherent variability of the waste and of the treatment medium (soil), and the unpredictable influence of climatic variability. Without a detailed analysis of land treatment components and a sound design and management plan, adverse environmental effects can result from land treatment practices. Harmful effects associated with land treatment of hazardous wastes can be of a biological, chemical, physical mechanical, or psychological nature. Hazards associated with field operations include those linked to equipment operations, fire and explosion, dust and aerosols, and odor problems. (See also W91-00900) (White-Reimer-PTT)
W91-00945

BIODEGRADATION OF ENVIRONMENTAL POLLUTANTS.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
P. R. Sferra.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 9.53-9.60, 27 ref.

Descriptors: *Biodegradation, *Biological treatment, *Hazardous waste disposal, *Waste treatment, *Wastewater treatment, Aerobic treatment, Anaerobic digestion, Detoxification, Genetic engineering, Microbial degradation.

Among the methods considered for the destruction of hazardous and toxic wastes is the use of living organisms or their products to detoxify or destroy the polluting chemicals by means of a process known as biodegradation, In biodegradation there is the potential for low-cost, highly effective treatment with little or no consequential harm to the environment. The different biological processes or biotechnologies can be classified as being either conventional or emerging. Among the conventional systems are (1) aerobic treatments such as activated sludge, aerated lagoons, trickling filters, and rotating biological contactors; and (2) anaerobic treatments, of which there are three main types: anaerobic digestion, anaerobic contact, and anaerobic fixed-film. The search for useful biological agents to destroy hazardous wastes consists of an assortment of methodologies ranging from attempts to isolate pure strains from real-life contaminated situations to sophisticated genetic-engineering applications to produce a tailor-made organism capable of degrading a specific compound. There are two types of chemicals in the environment, xenobiotic and natural. When xenobiotic compounds are released into the environment they are subjected to the processes of adsorption, sedimentation, and chemical reactions including biotransformation and photolysis. Microorganisms adapt to degrade new synthetic compounds either by utilizing catabolic enzymes they already possess or by acquiring new metabolic pathways. In pollution control the need is for the organism that can process the xenobiotic. Among the innovative or emerging methods to develop microorganisms specifically suited to degrade hazardous wastes are plasmid-assisted molecular breeding, gene-engineering, and enhancement of indigenous microorganisms. Potential risks of this approach are described as 'low probability of high-consequence risks'; that is, while there is only a small possibility

that damage could occur, the damage that could occur is great. (See also W91-00900) (White-Reimer-PTT)
W91-00946

ENZYME SYSTEM AND RELATED REACTIVE SPECIES.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
J. A. Glaser.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 9.61-9.73, 3 fig, 6 tab, 31 ref.

Descriptors: *Detoxification, *Enzymes, *Hazardous waste disposal, *Waste treatment, Hydrolases, Inhibition, Kinetics, Oxidoreductases.

The use of enzymes as a means to detoxify hazardous-waste constituents is a new and growing research area. The reactions of detoxifying enzymes are not limited to intracellular conditions but have been demonstrated through the use of immobilized enzyme extracts on several liquid waste streams. In order to evaluate the ability of enzyme systems to accomplish the detoxification transformations on the substrate molecule it is necessary to determine the rate of reaction associated with the transformation and any other rates that may be limiting. The action of enzymes is limited by two basic considerations. The physical constraints of the active site within the enzyme molecule and the attendant kinetic expression relating the rate of disappearance of substrate to time result in a series of kinetic limitations referred to as enzyme inhibition that are integral to an understanding of enzyme use. A subtle limitation is the resistance of the enzyme to destruction by outside agents. Enzymes used in the process include oxidoreductases and hydrolases. Common applications of cell-free enzyme extracts have generally involved some sort of immobilization. The enzyme can be chemically bound to a support and is then assembled into a bed through which a solution containing the substrate is passed. Although there is information detailing the expenses of industrial enzyme scaleup, very little cost-comparison information is available for this type of enzymatic application. (See also W91-00900) (White-Reimer-PTT)
W91-00947

HAZARDOUS-WASTE LANDFILL CONSTRUCTION: THE STATE OF THE ART.
SCS Engineers, Inc., Long Beach, CA.
For primary bibliographic entry see Field 5E.
W91-00948

SUBSURFACE INJECTION OF LIQUID HAZARDOUS WASTES.
Missouri Univ.-Rolla. School of Mines and Metallurgy.
For primary bibliographic entry see Field 5E.
W91-00950

SURFACE IMPOUNDMENTS.
Brown (K.W.) and Associates, Inc., College Station, TX.
For primary bibliographic entry see Field 5E.
W91-00951

5E. Ultimate Disposal Of Wastes

IMPLICATIONS OF ENVIRONMENTAL PROGRAM PLANNING FOR SITING A NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA, USA.
Department of Energy, Carson City, NV. Nevada Nuclear Waste Project Office.
C. R. Malone.
Environmental Management EMNGDC, Vol. 14, No. 1, p 25-32, January/February 1990. 2 tab, 28 ref.

Descriptors: *Environmental effects, *Environmental policy, *Nevada, *Radioactive waste disposal, *Underground waste disposal, Environmental management, Environmental protection, Geological surveys, Hydrologic aspects, Site selection.

The US Department of Energy (DOE) plans to conduct site characterization studies at Yucca Mountain, Nevada, to determine if the location is a suitable site for a nuclear waste repository. In lieu of traditional environmental review in accordance with the National Environmental Policy Act of 1969, the DOE is relying on an environmental assessment (EA) mandated by the Nuclear Waste Policy Act of 1982 as the cornerstone of its environmental program for the Yucca Mountain Project. Because of statutory restrictions, the EA is not based on comprehensive baseline information. Neither does it address fundamentals of environmental analysis such as ecological integrity and assessment of cumulative impacts. Consequently, the present environmental program for Yucca Mountain reflects decisions made without complete information and integrated environmental review. The shortcomings of the program risk compromising the natural integrity of Yucca Mountain and invalidating future assessment of the ability of a nuclear waste repository located at the site to protect the environment. Significant improvements are needed in the repository siting program before it can serve as a model of how society can evaluate the long term environmental consequences of advanced technologies. (Author's abstract)
W91-00026

GEOLOGIC AND HYDROLOGIC ISSUES RELATED TO SITING A REPOSITORY FOR HIGH-LEVEL NUCLEAR WASTE AT YUCCA MOUNTAIN, NEVADA, U.S.A.
Department of Energy, Carson City, NV. Nevada Nuclear Waste Project Office.
C. R. Malone.
Journal of Environmental Management JEVMAW, Vol. 30, No. 4, p 381-396, June 1990. 80 ref.

Descriptors: *Geohydrology, *Nevada, *Radioactive wastes, *Site selection, *Underground waste disposal, Environmental policy, Seismic properties, Tectonics, Waste management, Yucca Mountain.

After three decades, policy in the United States for managing high-level nuclear wastes has settled on disposal of the wastes in deep geologic repositories. The site selection program for this endeavor currently is focused on a single site at Yucca Mountain, Nevada. A number of important and unresolved issues have arisen with respect to the geologic and hydrologic suitability of Yucca Mountain for isolating nuclear wastes. These include concerns such as the potential for future tectonic and volcanic events to occur at the site and the unknown nature of the unsaturated zone at Yucca Mountain. This paper reviews these issues and concludes that much of the information used to support nomination of the Yucca Mountain site for characterization is incomplete and equivocal. Moreover, reliable methods and techniques do not always exist for resolving the uncertainties with deterministic methods based on empirical data. (Author's abstract)
W91-00030

AUDITING THE QUALITY OF EFFLUENT DISCHARGES.
Anglian Water Authority, Peterborough (England).
For primary bibliographic entry see Field 5G.
W91-00127

ESTIMATION OF PHOSPHORUS FROM THE NIAGARA RIVER TO LAKE ONTARIO.
Waterloo Univ. (Ontario).
M. E. Thompson, and A. H. El-Shaarawi.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 323-330, November 1989. 1 fig, 4 tab, 4 ref.

Descriptors: *Canada, *Lake Ontario, *Niagara River, *Path of pollutants, *Phosphorus, *Pollution load, *Statistical studies, Data interpretation, Wastewater disposal.

A predictive or model based approach for making inferences about the loading of a contaminant from a point source has been developed, using a statistical approach. The model has been used to estimate the total phosphorus (TP) loading from the Niagara River to Lake Ontario for the years 1967 to 1982. Information about explanatory variables and/or autodependence among successive observations can be easily included in the model; this allows more accurate inferences to be made. Typically for this kind of investigation, daily values for river flow are known while values for the concentration of phosphorus are known for some but not all days. The model utilized matrix notation and a Gaussian distribution of phosphorus concentrations to predict the phosphorus loading on days with no TP measurement. Results of the application to the Niagara River show that a major decrease in TP loading has occurred during the study period. (Tappert-PTT)
W91-00133

SLUDGE DISPOSAL, DALLAS STYLE.
Lockwood, Andrews and Newman, Inc., Dallas, TX.
J. L. Moseley, L. N. Patterson, and R. B. Sieger.
Civil Engineering (ASCE) CEWRA9, Vol. 60, No. 8, p 50-52, August 1990. 3 fig.

Descriptors: *Sludge disposal, *Sludge drying, *Texas, *Wastewater treatment, Coagulation, Composting, Environmental protection, Hydraulic engineering, Land disposal, Liquid sludge, Monitoring.

The efficiency of wastewater treatment directly affects the overall water quality of rivers, lakes, and streams. Dallas (Texas) Water Utilities treats approximately 200 million gallons per day from individuals, businesses, and surrounding communities. The two treatment facilities use natural processes to remove the solids and sludge. In the past, the liquid sludge from the two facilities was combined and then injected into dedicated land disposal fields. However, problems (weather-dependency, acreage requirements) with this method caused the city council to adopt a sludge master plan. It required comparison of risks, and consideration of environmental issues, community acceptance, regulatory constraints, operational concerns, administration interests, and energy consumption. A facility was designed to meet requirements until 2010. Innovations that helped meet the goals of the master plan included: (1) environmental protection of the surrounding environment through a soil slurry cutoff wall; (2) soil and groundwater monitoring; (3) flexibility in ultimate sludge disposal through sludge monofill, dedicated-land disposal, or eventual composting; (4) transfer of dewatered sludge cake through pipeline to the sludge monofill using high pressure hydraulic piston pumps; (5) pretesting of dewatering equipment prior to acceptance to assure that guaranteed parameters were met; (6) a system of sludge-soil mixing and processing prior to disposal in monofill; (7) a privatization request for proposal enables the monofill to be operated by contract services; and (8) belt filter presses which dewater the sludge using polymer as a coagulant. The project is one of the largest engineering assignments in the history of Dallas. (Fish-PTT)
W91-00143

STREAMFLOW SIMULATION USING DETERMINISTIC MODEL.
Dames and Moore, Park Ridge, IL.
For primary bibliographic entry see Field 2E.
W91-00174

GEOHYDROLOGIC ASPECTS FOR SITING AND DESIGN OF LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL.
M. S. Bedinger.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Survey Circular 1034. 36p, 28 fig, 1 tab, 76 ref.

Descriptors: *Geohydrology, *Hazardous waste disposal, *Radioactive waste disposal, *Site selection, *Underground waste disposal, Aeration zone, Design criteria, Groundwater movement, Hydrologic properties, Waste containment.

The objective for siting and design of low-level radioactive-waste repository sites is to isolate the waste from the biosphere until the waste no longer poses an unacceptable hazard as a result of radioactive decay. Low-level radioactive waste commonly is isolated at shallow depths with various engineered features to stabilize the waste and to reduce its dissolution and transport by groundwater. The unsaturated zone generally is preferred for isolating the waste. Low-level radioactive waste may need to be isolated for 300 to 500 years. Maintenance and monitoring of the repository site are required by federal regulations for only the first 100 years. Therefore, geohydrology of the repository site needs to provide natural isolation of the waste for the hazardous period following maintenance of the site. Studies at existing commercial and federal waste-disposal sites provide information on the problems encountered and the basis for establishing siting guidelines for improved isolation of radioactive waste, engineering design of repository structures, and surveillance needs to assess the effectiveness of the repositories and to provide early warning of problems that may require remedial action. Climate directly affects the hydrology of a site and probably is the most important single factor that affects the suitability of a site for shallow-land burial of low-level radioactive waste. Humid and subhumid regions are not well suited for shallow isolation of low-level radioactive waste in the unsaturated zone; arid regions with zero to small infiltration from precipitation, great depths to the water table, and long flow paths to natural discharge areas are naturally well suited to isolation of the waste. The guiding rationale is to minimize contact of water with the waste and to minimize transport of waste from the repository. The hydrology of a flow system containing a repository is greatly affected by the engineering of the repository site. Prediction of the performance of the repository is a complex problem, hampered by problems of characterizing the natural and man-made features of the flow system and by the limitation of models to predict flow and geochemical processes in the saturated and unsaturated zones. Disposal in low-permeability unfractured clays in the saturated zone may be feasible where the radionuclide transport is controlled by diffusion rather than advection. (Author's abstract)
W91-00347

SUBSURFACE TRANSPORT OF INORGANIC AND ORGANIC SOLUTES FROM EXPERIMENTAL ROAD SPREADING OF OIL-FIELD BRINE.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 5B.
W91-00365

GROUND WATER RECHARGE AND POLLUTION POTENTIAL OF DRY WELLS IN PIMA COUNTY, ARIZONA.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5B.
W91-00367

TRANSPORT OF LOW-CONCENTRATION CONTAMINANTS IN SATURATED EARTHEN BARRIERS.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
Y. B. Acar, and L. Haider.
Journal of Geotechnical Engineering (ASCE) JGENDZ, Vol. 116, No. 7, p 1031-1052, July 1990. 12 fig, 6 tab, 38 ref.

Descriptors: *Landfills, *Liners, *Mathematical models, *Model studies, *Solute transport, *Waste disposal, *Water pollution prevention, Chlorinated hydrocarbons, Earthworks, Groundwater movement, Mathematical analysis.

The need to protect the groundwater against potential contamination has led to the use of containment barrier technology for shallow land disposal facilities under construction, as well as for existing unengineered facilities and/or sites. The objectives of engineering these barriers were to ascertain their structural integrity and to minimize the potential dangers associated with migration of the leachate generated with infiltrating water. Design guidelines are presented for fine-grained earthen barriers based upon the fundamental parameters affecting containment transport, providing a methodology for estimating the time required for the contaminant to breakthrough, and determining the thickness of the earthen barrier for a specified breakthrough concentration and design life. Laboratory tests indicated that a one-dimensional advective-dispersive transport model for reactive solutes provided reasonable estimates of the breakthrough of low-concentration organic contaminants in saturated fine-grained earthen barriers. Based upon this transport model, a design/analysis methodology and respective guidelines were developed for earthen barriers used in waste disposal applications. The fundamental parameters affecting the design are the seepage velocity, retardation factor, and chemical diffusion of the contaminant in the pore fluid. Transport of low-concentration trichloroethylene at a selected study site was selected for illustrating the procedure. (Author's abstract)
W91-00372

HERCULEAN LABORS TO CLEAN WASTEWATER.
Golob's Oil Pollution Bulletin, Cambridge, MA.
For primary bibliographic entry see Field 5D.
W91-00387

GAS-PHASE AND ACTIVATED CARBON MEDIATED THERMAL HYDROGENOLYSIS OF HALOGENATED ORGANICS.
Leiden Rijksuniversiteit (Netherlands). Gorlaeus Labs.
For primary bibliographic entry see Field 5D.
W91-00395

BIOREMEDIATION COMES OF AGE.
Bioscience Management, Inc., Bethlehem, PA.
For primary bibliographic entry see Field 5G.
W91-00400

WATER LEVELS IN PERIODICALLY MEASURED WELLS IN THE YUCCA MOUNTAIN AREA, NEVADA, 1988.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2F.
W91-00441

MACROFAUNA DISTRIBUTIONS AND SEDIMENT ANALYSES FROM THE BRUNSWICK, GEORGIA OCEAN DREDGED MATERIAL DISPOSAL SITE AND ENVIRONS.
Georgia Univ., Savannah. Marine Extension Service.
D. M. Gillespie, J. L. Harding, R. A. Culp, J. E. Noakes, and A. L. Edwards.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-207385/AS. Price codes: A06 in paper copy, A01 in microfiche. Technical Report Series Number 89-1, 1989. 103p, 6 fig, 20 tab, 30 ref.

Descriptors: *Dredging wastes, *Georgia, *Marine animals, *Sediment analysis, *Spoil disposal, *Water pollution effects, *Water pollution sources, Biological samples, Distribution patterns, Environmental effects, Ocean dumping, Statistical analysis.

Sediment samples were obtained from the proposed Ocean Dredged Material Disposal Site and from nearby areas and subjected to chemical and biological analyses. Water samples and trawl tows were also taken over and near the disposal site. Sediment samples were analyzed for grain size distribution, human debris, total organic carbon, oil and grease, high molecular weight hydrocarbons, pesticides, halogenated hydrocarbons, and heavy metals. Trawl macrofauna were also subsampled and analyzed for tissue organics and metals. Sediment was sieved to 0.5 mm, and the macrofauna preserved, identified, and counted. Date were statistically analyzed for possible treatment effects related to the use of the site for disposal of dredged material. Statistical results are presented, along with tables of physical and chemical data. Macrofauna densities are tabulated by station, relative to position over or near the disposal site. No consistent pattern of treatment effect could be discerned from analysis of the data using our sampling regime and analytical techniques. Although ocean dredge spoil dumping undoubtedly disturbs the environment, this study suggests that effects are transient in this area. (Author's abstract)
W91-00444

SUPERFUND RECORD OF DECISION: VELSICOL CHEMICAL CORPORATION, IL.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00445

FIELD EVALUATION OF THE EFFECT OF CHLORINATED TREATED SEWAGE ON SETTLEMENT OF OYSTERS (CRASSOSTREA VIRGINICA GMELIN) AND BARNACLES (BALANUS SP).
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5C.
W91-00511

INACTIVATION OF ENTERIC VIRUSES IN CHLORINATED WASTEWATER SPRAYED ON VEGETABLES.
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5D.
W91-00548

USERS MANUAL FOR THE SLUDGEMAN MODEL FOR THE GROUNDWATER PATHWAY IN THE MONOFILLING OF SEWAGE SLUDGE.
ICF Technology, Inc., Fairfax, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-149322. Price codes: A11 in paper copy, A01 in microfiche. Report No. EPA/SW/DK-89/023a, September 1988. 224p, 27 append. EPA Contract 68-03-3534.

Descriptors: *Computer models, *Groundwater pollution, *Model studies, *Path of pollutants, *SLUDGEMAN model, *Sludge disposal, *Waste disposal, *Water pollution sources, Computer programs, Heavy metals, Landfills, Leaching, Manuals, Municipal wastewater, Risk assessment.

One of the major options actively being considered for the disposal of municipal sewage sludges is landfilling. This option poses a risk to human health and the environment as a result of the presence of heavy metals and other toxic substances in the sludge. In order to reduce the risk to acceptable levels, the EPA has undertaken a regulatory program based on risk management and risk assessment. A set of computer programs called SLUDGEMAN was developed which quantifies the risk associated with landfill options. SLUDGEMAN calculates a reasonable 'worst case' level of human exposure to chemicals leaching from a landfill and being carried by the atmosphere. Exposure levels can be compared to health criteria to determine if they are likely to cause unacceptable impacts. This document is the users manual for the SLUDGEMAN computer programs. (Lantz-PTT)
W91-00575

CONTAMINANT DISSOLUTION AND DIFFUSIONAL TRANSPORT WITH A STATIONARY PRECIPITATION FRONT.
California Univ., Berkeley. Dept. of Nuclear Engineering.
W. B. Light, P. L. Chambre, T. H. Pigford, and

W. W. L. Lee.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1681-1685, July 1990. 3 fig, 10 ref. U.S. Department of Energy Contract DE-AC03-76SF00096.

Descriptors: *Groundwater pollution, *Path of pollutants, *Radioactive waste disposal, *Underground waste disposal, *Waste disposal, *Waste dumps, *Water pollution sources, Diffusion, Dissolution, Mass transport, Mathematical analysis, Numerical analysis, Solubility.

Waste material in a geologic repository will eventually dissolve and migrate away, degrade by chemical reaction or radioactive decay, or become part of the basic rock material. For many waste components these processes will be limited by the dissolution rate of the waste matrix. The precipitation may be due to local geochemical changes such as changes in temperature, pH, or redox potential, caused by nearby geologic features or the waste itself. The effect of contaminant precipitation caused by a drop in the solubility at some specified location away from the waste is analyzed. Transport is by diffusion only; advection is neglected. Analytical solutions are presented for the contaminant concentration in groundwater and the mass transfer rate as functions of space and time for regions on both sides of the precipitation front. At early times the mass transfer rate at the waste surface is controlled by the solid-liquid reaction rate; at later times extending to steady state, the mass transfer rate depends on the location of the precipitation front and on the solubility ratio. Numerical illustrations are made applicable to nuclear waste in a geologic repository. If the U.S. Nuclear Regulatory Commission's (1983) release rate requirement for the engineered barrier system is to be met at the waste package/rock interface, precipitation, which can increase the mass transport rate near the waste package, must be considered. (MacKeen-PTT)
W91-00612

REMARKS ON THE ZOOPLANKTON POPULATION STRUCTURE NEAR WASTEWATER OUTFALLS ON THE ROMANIAN SHORE OF THE BLACK SEA (REMARQUES SUR LA STRUCTURATION DES POPULATIONS ZOOPLANCTONIQUES DANS LES ZONES DES EMISSAIRES D'EAUX USEES DU LITTORAL ROUMAIN DE LA MER NOIRE).
Institutul Roman de Cercetari Marine, Constanta (Romania).
For primary bibliographic entry see Field 5C.
W91-00711

SLUDGE MANAGEMENT SYSTEMS.
Montgomery (James M.) Consulting Engineers, Inc., Pasadena, CA.
For primary bibliographic entry see Field 5D.
W91-00771

STANDARD HANDBOOK OF HAZARDOUS WASTE TREATMENT AND DISPOSAL.
For primary bibliographic entry see Field 5D.
W91-00900

HAZARDOUS-WASTE TREATMENT COMES OF AGE.
Hazardous Waste Treatment Council, Washington, DC.
For primary bibliographic entry see Field 5G.
W91-00901

SUMMARY OF RESOURCE CONSERVATION AND RECOVERY ACT LEGISLATION AND REGULATION.
Tufts Univ., Medford, MA. Center for Environmental Management.
For primary bibliographic entry see Field 6E.
W91-00902

QUANTITIES AND SOURCES OF HAZARDOUS WASTES.
Westat Research, Inc., Rockville, MD.
S. K. Dietz, and M. E. Burns.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 2.3-2.19, 8 fig, 2 tab.

Descriptors: *Environmental protection, *Hazardous materials, *Hazardous wastes, *Regulations, *Resource Conservation and Recovery Act, Data acquisition, Hazardous waste disposal.

Data collected pertaining primarily to hazardous wastes and hazardous-waste handlers subject to regulation under Subtitle C of the Resource Conservation and Recovery Act (RCRA) are presented. There are five main information sources for this data. The purpose of the Hazardous Waste Data Management System is regulatory rather than planning or research. It contains a record for every facility in the U.S. that has applied for an EPA permit to treat, store, or dispose of hazardous wastes regulated under RCRA. The EPA National Survey of Hazardous Waste provided the first statistically reliable estimate of (1) the numbers of facilities generating, treating, storing, and disposing of hazardous waste, (2) the types of processes used, and (3) the characteristics of such facilities. A follow-up survey on hazardous wastes was conducted in 1986 at the request of the EPA. In addition, the EPA is conducting a biennial census of hazardous-waste treatment, storage, and disposal facilities. Information on hazardous waste generation presented includes: (1) the total number of generators; (2) the number of generators by EPA region; (3) the number of generators by industry type; (4) the number of generators shipping waste off-site; and (5) the quantity of hazardous waste generated. The quantity of RCRA-regulated hazardous waste generated at any point in time is essentially affected by two factors: (1) the specific nature and scope of the RCRA hazardous-waste regulatory program at that time; and (2) the nature of the industrial and other activities that actually result in hazardous by-products. (See also W91-00900) (White-Reimer-PTT)
W91-00905

HAZARDOUS-WASTE MANAGEMENT CAPACITY.
MITRE Corp., McLean, VA.
G. A. Vogel.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 2.21-2.31, 4 tab, 13 ref.

Descriptors: *Hazardous materials, *Hazardous waste disposal, *Regulations, *Resource Conservation and Recovery Act, Environmental protection, Permits, Storage capacity.

The capacity of hazardous-waste management units that are operating within the Resource Conservation and Recovery Act (RCRA) regulatory program under interim status on a final permit is emphasized. Capacity data sources include: (1) EPA sources such as permit applications and surveys; and (2) commercial directories and services. Hazardous wastes may be stored in tanks, surface impoundments, containers, or piles. It is estimated that there are 5,455 storage tanks in the RCRA regulatory program, with a total design capacity of 757 million liters. The annual waste-management capacity may be up to 25 time greater than the design capacity. Hazardous wastes are treated in tanks, surface impoundments, incinerators, and other thermal devices such as cement kilns and boilers. It is estimated that there are 3,569 treatment tanks in the RCRA regulatory program with a total design capacity of 90 million liters. The annual waste-treatment capacity of these tanks may be up to 365 times greater than the design capacity. Hazardous wastes can be disposed in landfills, land treatment facilities, injection wells, and surface impoundments. It was estimated in 1984 that there were approximately 130 commercial waste-management facilities in the United States under RCRA. At the beginning of 1985, after two years of full RCRA program operation, approximately 7% of the 4,900 hazardous-waste storage, incineration, and land disposal facilities needing RCRA permits by EPA had been issued permits. Because of the complexity of the RCRA permitting process and limited EPA staff resources, the number of RCRA permits issued is not expected to increase rapidly, despite the regulatory deadlines. (See also W91-00900) (White-Reimer-PTT)
W91-00906

SITING OF HAZARDOUS-WASTE FACILITIES.
North Carolina Univ. at Chapel Hill. Inst. for Environmental Studies.
R. N. L. Andrews, and F. M. Lynn.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 3.3-3.16, 5 fig, 20 ref.

Descriptors: *Hazardous waste disposal, *Hazardous wastes, *Hazardous-waste facilities, *Site selection, Permits, Public participation, Public relations, Regulations.

The siting of hazardous-waste facilities requires a synthesis of two distinct selection procedures: a technical screening process based upon engineering, environmental, and economic suitability; and a public-approval process based upon legality and political acceptability. A technical screening process is used to identify sites that are potentially suitable for a hazardous-waste facility. There are three sets of criteria: characteristics of the facility, characteristics of the site, and economic and legal feasibility. Within the range of technically feasible sites, hazardous-waste facility siting requires at least two forms of regulatory approval: facility approval by a federal or federally approved state agency, and site approval by local or state government. Site approval for hazardous-waste facilities requires not only technical suitability and permit approval, but acceptability of the facility to the host community. At a minimum, public acceptance normally requires two steps of the sponsors beyond technical analysis and state permit approval: substantive information concerning potential impacts, and willingness to engage in an open process of communication and negotiation with the host community. The cornerstone of a successful siting process is early, open, and ongoing communication among all affected parties. The main building blocks of this process include joint fact finding, a community review committee, independent technical assessment, and a fair and open process of negotiation with the host community. (See also W91-00900) (White-Reimer-PTT)
W91-00907

HEALTH EFFECTS OF HAZARDOUS WASTE.
South Carolina State Dept. of Health and Environmental Control, Columbia. Bureau of Preventive Health Services.
For primary bibliographic entry see Field 5C.
W91-00908

ENVIRONMENTAL RISK-ASSESSMENT AND AUDIT PRINCIPLES.
Environmental Strategies Corp., Vienna, VA.
L. M. Miller, and D. E. Gladstone.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 3.29-3.38, 7 ref.

Descriptors: *Hazard assessment, *Legal aspects, *Liability, *Risk assessment, *Water law, Economic aspects, Environmental policy, Resource Conservation and Recovery Act.

Environmental-risk assessment evaluates the potential for liabilities, impairment, or claims resulting from environmental pollution arising from a facility. A useful procedure to evaluate regulatory compliance is an environmental audit, a procedure that determines whether a facility meets appropriate regulatory and nonregulatory standards. For a company with multiple locations, the first step in the risk assessment process involves selection of sites to be assessed, taking into account corporate resources and the objective of the risk-assessment program. The purpose of an environmental audit is to provide corporate management with the assurance that their facilities will not be the source of liabilities for the corporation or its officers and directors. Environmental assessments and audits

can be powerful tools to unite corporate and facility personnel in the struggle against the accrual of environmental liabilities. Since the Resource Conservation and Recovery Act (RCRA) requires certain hazardous-waste facilities to demonstrate financial responsibility for bodily injury and property damage to third parties, these facilities must show evidence of liability coverage for sudden and accidental occurrences at minimum limits of $2 million. Because companies are self-assuming a large portion of their pollution exposures today, the incentive to identify pollution liability has increased greatly. (See also W91-00900) (White-Reimer-PTT)
W91-00909

CASE STUDY OF A SUCCESSFUL FACILITY SITING.
E. E. Kupchanko.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 3.39-3.49, 1 fig, 8 ref.

Descriptors: *Canada, *Hazardous materials, *Hazardous waste disposal, *Public policy, *Site selection, Alberta, Case studies, Project planning, Public participation.

A case study is described in which a private firm proposed to build a disposal plant capable of handling the wastes in western Canada. Over a period of 16 months, the hazardous-waste issue was defined through two bodies: the Hazardous Waste Committee and the Environment Council of Alberta. The implementation structure consisted of two bodies, the Hazardous Waste Team and the Task Force, which were to work closely together. The criteria for site selection were based on environmental and social acceptability. The technical approach to locating a site was based upon criteria by which environmentally unsuitable areas in the province could be eliminated from further investigation, a process known as constraint mapping. The most desirable land parcel would exhibit low capabilities for all land-use possibilities. The experience of the Rural Education and Development Association was utilized for the field program. This organization was deeply involved in public education in rural Alberta. The principal policy in the public-involvement program was that environmental acceptability would be the main criterion for selection and that the siting criteria would be open to public scrutiny. The government would reserve the overall right of final selection. The technique required to communicate a volatile issue requires a well-defined plan with clearly stated objectives. The communications program was based on two distinct strategies: one concerned media relationships, and the other involved the type of material distributed to the public. On March 12, 1984, the Minister of the Environment announced that an area 20 k northeast of Swan Hills was to be the site for the Alberta hazardous-waste facility, making it the only community in North America that had agreed to host a facility in their backyards in the preceding six years. (See also W91-00900) (White-Reimer-PTT)
W91-00910

MINING WASTES.
PEI Associates, Inc., Cincinnati, OH.
R. L. Hoye, and S. J. Hubbard.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 4.47-4.51, 7 ref.

Descriptors: *Mine wastes, *Solid wastes, *Waste disposal, Acid mine drainage, Cyanide, Heavy metals, Pyrite, Regulations.

The U.S. mining industry has generated up to 2 trillion kg of solid waste in a year and accounts for about 40% of the total solid waste generated annually in the United States. The EPA has estimated that about 31 trillion kg of mine waste and 13 trillion kg of tailings were accumulated between 1910 and 1981. Virtually all mine wastes are disposed of on site. In the early 1980's the EPA sponsored waste-characterization studies involving waste sampling at 86 mines in 22 states. Mining wastes contain, with the exception of the product recovered, all constituents present in the ore. The excavation and processing of this native material can expose constituents, such as pyrites, that have acid-forming potential. Heavy metals or potentially toxic elements, such as radionuclides, formerly contained in the ore matrix may become mobile in the environment once exposed. In addition, some process reagents, particularly cyanide, may be mixed with the waste. The EPA's Office of Research and Development and the Office of Solid Waste are actively acquiring and evaluating information germane to the mining-waste issue. (See also W91-00900) (White-Reimer-PTT)
W91-00911

HYDROLYSIS.
BDT, Inc., Clarence, NY.
For primary bibliographic entry see Field 5D.
W91-00915

SOLIDIFICATION AND STABILIZATION TECHNOLOGY.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W91-00929

LIQUID-INJECTION INCINERATORS.
Four Nines, Inc., Plymouth Meeting, PA.
For primary bibliographic entry see Field 5D.
W91-00930

ROTARY KILNS.
Boliden Allis, Inc., Milwaukee, WI. Minerals Systems Div.
For primary bibliographic entry see Field 5D.
W91-00931

FLUIDIZED-BED THERMAL OXIDATION.
Waste-Tech Services, Inc., Golden, CO.
For primary bibliographic entry see Field 5D.
W91-00932

CEMENT KILNS.
General Portland, Inc., Dallas, TX.
For primary bibliographic entry see Field 5D.
W91-00933

WET OXIDATION.
Zimpro, Inc., Rothschild, WI.
For primary bibliographic entry see Field 5D.
W91-00934

PYROLYSIS.
Midland-Ross Corp., Toledo, OH. Surface Div.
For primary bibliographic entry see Field 5D.
W91-00935

OCEANIC INCINERATION.
SITEX Environmental, Inc., Research Triangle Park, NC.
For primary bibliographic entry see Field 5D.
W91-00936

MOLTEN-GLASS PROCESSES.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5D.
W91-00937

DEEP-SHAFT WET-AIR OXIDATION.
Smith (J.M.) and Associates, Cincinnati, OH.
For primary bibliographic entry see Field 5D.
W91-00938

SUPERCRITICAL-WATER OXIDATION.
Modell Development Corp., Framingham, MA.
For primary bibliographic entry see Field 5D.
W91-00939

PLASMA SYSTEMS.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W91-00940

MOBILE THERMAL TREATMENT SYSTEMS.
IT Corp., Knoxville, TN.
For primary bibliographic entry see Field 5D.
W91-00941

CATALYTIC INCINERATION.
Four Nines, Inc., Plymouth Meeting, PA.
For primary bibliographic entry see Field 5D.
W91-00942

LAND TREATMENT OF HAZARDOUS WASTES.
Woodward-Clyde Consultants, Santa Ana, CA.
For primary bibliographic entry see Field 5D.
W91-00945

BIODEGRADATION OF ENVIRONMENTAL POLLUTANTS.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W91-00946

ENZYME SYSTEM AND RELATED REACTIVE SPECIES.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W91-00947

HAZARDOUS-WASTE LANDFILL CONSTRUCTION: THE STATE OF THE ART.
SCS Engineers, Inc., Long Beach, CA.
T. D. Wright, D. E. Ross, and L. Tagawa.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.3-10.23, 13 fig.

Descriptors: *Hazardous waste disposal, *Land disposal, *Landfills, *Waste disposal, Construction, Design criteria, Economic aspects, Operating policies.

An overview of landfill operation and construction is presented. Many but not all hazardous wastes can be disposed of on land in properly designed landfills. In most cases, hazardous wastes are initially deposited below grade in an existing natural or excavated depression or in a pit excavated for that purpose. Hazardous wastes delivered to a landfill site are placed in a manner such that only compatible wastes are disposed of together. To accomplish this objective wastes are placed either in separate areas or in individual control cells within a single, larger landfill. Environmental protection, including control of leachate emissions, gas emissions, and surface-water erosion and waste saturation, is an important aspect of site selection and construction for the hazardous-waste landfill. Pertinent landfill features that must be included in the design are access roads, cover soil, special working areas, buildings and structures, wash rack, landscaping, and monitoring facilities. Heavy equipment used for earth moving, waste handling, and compaction at hazardous-waste landfills includes rubber-tired loaders, vibratory compactors, forklifts and/ or barrel snatchers, scrapers, graders, and water trucks. Upon final closure of the landfill or completion of a cell, a final cover is applied. Postclosure maintenance and monitoring are also conducted. Design considerations include: facility life and size, topography, surface-water drainage, soils, geology, and groundwater. Costs are generally categorized into capital costs and operating costs. Capital costs include all initial expenses required prior to the start-up of landfilling operations. It is common to compute annual operating costs based on a cost per unit of waste received (e.g., dollars per ton). Operating costs for a landfill will vary significantly since local conditions and

labor rates are site-specific. (See also W91-00900) (White-Reimer-PTT)
W91-00948

SYNTHETIC LININGS.
Hovater Engineers, Laguna Hills, CA.
L. R. Hovater.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.25-10.40, 8 fig.

Descriptors: *Hazardous waste disposal, *Landfill linings, *Landfills, *Linings, *Waste disposal, Construction, Design criteria, Land disposal, Materials, Synthetic linings.

Synthetic linings have been used successfully for over 30 years, and most linings used today are of the synthetic type. Synthetic linings are generally known as flexible-membrane linings (FMLs), and are classified as varieties of plastic, rubber, and asphalt. Today plastic and rubber in thin sheets dominate the lining field for disposal of hazardous wastes on land. FMLs are susceptible to damage caused by chemical incompatibility with the contained hazardous waste. Evaluating and testing of the hazardous waste with potential FMLs are necessary to eliminate FMLs that are incompatible. FMLs are generally described by (1) their industry-accepted chemical name, which is usually indicative of their composition, and (2) their physical properties. Factors that contribute to the design criteria include: use; size and shape of the landfill or impoundment; depth; steepness of slope; supporting surface; open vs. closed facilities; accessibility; and life expectancy. Best results of installation are obtained by relying on state of the art design, materials, construction, and inspection. Critical aspects concerning installation are supporting surfaces, layout, field seams, anchors, seals, protective cover, geotextiles and drainage nets, and testing. There is no general rule of thumb pertaining to cost. Costs depend on the type of containment, the selection of FML, the quantity of FML, and the difficulty of installation. (See also W91-00900) (White-Reimer-PTT)
W91-00949

SUBSURFACE INJECTION OF LIQUID HAZARDOUS WASTES.
Missouri Univ.-Rolla. School of Mines and Metallurgy.
D. L. Warner.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.41-10.53, 1 fig, 4 tab, 11 ref.

Descriptors: *Hazardous waste disposal, *Injection wells, *Waste disposal, Design criteria, Monitoring, Regulations, Subsurface injection, Wastewater composition, Wastewater disposal.

An overview is presented of the extent of use of wastewater injection wells, and discussions of injection-well siting, of the evaluation of wastewater characteristics and preinjection treatment, of injection-well design and construction, of injection-system operation, of monitoring, and of regulation. Knowledge of the geologic and hydrologic characteristics of the subsurface environment at an injection-well site and in the surrounding region is fundamental to the evaluation of the suitability of the site for wastewater injection and to the design, construction, operation, and monitoring of injection wells. The characteristics of the untreated wastewater that must be considered in evaluating its suitability for disposal by subsurface injection include: volume, waste type, compatibility, and preinjection treatment. After site selection it is necessary to develop a well-design and construction program. The most common deficiency in well design has been inadequate provision for corrosion protection. The principal means of surveillance of wastewater injection that is presently practiced is monitoring at the injection well of the volume, flow rate, chemistry, and biology of the injected wastewater and of the injection and annulus pressures. The uses of monitoring wells is controversial, but may be used more widely in the future. The principal means of federal regulation of hazardous-waste injection wells is through the Underground Injection Control program, which was mandated in the Safe Drinking Water Act of 1974. Some other regulation of such wells is through the Clean Water Act and the Resource Conservation and Recovery Act. (See also W91-00900) (White-Reimer-PTT)
W91-00950

SURFACE IMPOUNDMENTS.
Brown (K.W.) and Associates, Inc., College Station, TX.
D. C. Anderson.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.55-10.62, 2 fig, 7 ref.

Descriptors: *Hazardous waste disposal, *Impoundments, *Surface impoundments, *Waste disposal, Chemical industry, Food processing industry, Liquid wastes, Regulations.

A surface impoundment (SI) is an excavation or diked area designed to contain an accumulation of liquid wastes or wastes which contain free liquids. There are two basic types of SIs used to manage hazardous waste: those designed for the ultimate disposal and those designed for the temporary storage of hazardous wastes. The largest amounts of hazardous waste placed in SIs were generated by the organic-chemical plants. The largest amounts of general waste placed in industrial SIs were generated by food processors, organic-chemical and inorganic chemical plants, and commercial waste management facilities. Most industrial SIs are at least partially used for treatment of waste. The treatment processes most widely used are neutralization, settling, anaerobic or aerobic digestion, pH adjustment, and polishing. Less than one-third of all industrial SIs were used for the ultimate disposal of wastes. A recent report prepared for the EPA detailed findings from nine case studies and several interviews with experts in the field. Major findings were: (1) land availability is the major criterion for SI site selection; (2) liner selection is based on information provided by the supplier; (3) quality assurance varies widely; and (4) experiences with flexible-membrane liners have generally not been very satisfactory. Subpart K of 40 CFR 264 gives the regulations applicable to owners and operators of new SIs used to manage hazardous wastes. These regulations cover the design, monitoring, and closure of SIs. (See also W91-00900) (White-Reimer-PTT)
W91-00951

SOIL LINERS.
Brown (K.W.) and Associates, Inc., College Station, TX.
D. C. Anderson.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.63-10.71, 5 fig, 1 tab, 23 ref.

Descriptors: *Hazardous waste disposal, *Landfills, *Liners, *Soil liners, *Waste disposal, Clay liners, Clod remnants, Hydraulic conductivity, Soil properties.

Soil liners are a required component of double-liner systems for hazardous-waste disposal facilities. For decades, engineers and scientists have assumed that soil liners constructed with compacted clayey materials would form practically impermeable hydraulic barriers. However, several recent studies have indicated that laboratory tests tend to underestimate the actual hydraulic conductivity obtained in the field. Hydraulic conductivity of a soil liner can be evaluated in the laboratory by either fixed-wall or flexible-wall permeameters. Both methods have shortcomings and advantages but it is not practical to use either method with samples large enough to be representative of field conditions. In a field study conducted on a landfill with a clayey liner, hydraulic-conductivity values obtained in the field were as much as three orders of magnitude greater than the laboratory values. One reason for the discrepancy is the presence of macrofeatures which are common in poorly compacted soil liners and in situ deposits. Macrofeatures tend to be the dominate factor in determining the effective hydraulic conductivity of in situ deposits and compacted soil liners. One of the most prevalent types of macrofeatures found in compacted-soil liners is clod remnants. These remnants are the result of the incomplete remolding of the clods that are an inevitable characteristic of uncompacted clayey borrow material. Even though a given compactor produces a high density, the liner may have a high hydraulic conductivity if clod remnants have not been removed. There is, therefore, need to supplement density tests with field hydraulic-conductivity tests in any construction quality-assurance program for soil liners. (See also W91-00900) (White-Reimer-PTT)
W91-00952

DISPOSAL IN MINES AND SALT DOMES.
GEOMIN, Inc., Tulsa, OK.
R. B. Stone.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.73-10.83, 3 fig, 14 ref.

Descriptors: *Hazardous waste disposal, *Mine disposal, *Salt domes, *Underground waste disposal, *Waste disposal, Case studies, Conventional mines, Solution mines, Technology.

The use of mined underground space for storage and disposal of hazardous materials has a long history of successful application in industrial societies. The current technology for storing hazardous waste in underground openings allows the disposal or storage of a wide range of wastes. Conventional mines can store packaged, dry, nonexplosive, nonflammable, zero-vapor-pressure wastes. Solution mines can store nonreactive liquids and slurries in bulk form; no packages are required. Design considerations for use of conventional mines include mine type, depth, rock mechanics, layout and access, safety, ventilation, and surface facilities. Considerations for solution mines are depth range, rock mechanics, layout and access, safety, cavern discharges, and surface facilities. Case studies and evaluations have been conducted for mines in Germany, Minnesota, Missouri, Ohio, and Canada. Case studies for solution mines were conducted in Canada, Holland, Texas, Louisiana, and New York. Environmental effects of the process are highly variable depending on the mine type, waste, and handling. The EPA has sponsored studies and development projects in recent years covering the fields of encapsulation, storage, and fixation technologies. Present studies, tests, and demonstrations for nuclear-waste storage are continuing in salt, basalt, tuff, and crystalline-rock formations. (See also W91-00900) (White-Reimer-PTT)
W91-00953

ABOVEGROUND DISPOSAL.
Texas A and M Univ., College Station. Center for Trace Characterization.
K. W. Brown, and D. C. Anderson.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.85-10.91, 3 fig, 1 tab, 5 ref.

Descriptors: *Hazardous waste disposal, *Landfills, *Waste disposal, Aboveground disposal, Costs, Design criteria, Leachates, Storage mounds, Warehouse storage.

Even after application of all available waste-reduction and treatment technologies, there is a need for long-term disposal, or storage of the residual solids. Due to the problem of contaminated leachates from underground storage, aboveground storage is recommended in some situations. There are two aboveground options which may be used: (1) warehouse storage, and (2) underdrained, aboveground storage mounds. The essential features of an aboveground storage mound consists of a sloping base which can support the weight of the waste and the cover. The liner system should consist of an upper flexible-membrane liner and a lower composite liner. A drain system consisting of stable aggregates and an appropriate system of

collection pipes should be installed over the liner. Provisions must also be made for collecting and disposing of the leachate. Depending on the nature of the waste and, in particular, the presence of toxic and mobile constituents, it may be desirable to install adsorption layers above the leachate-collection system to remove undesirable constituents leaking from the waste solids. The greatest advantage of aboveground disposal over conventional systems is that the leachate is removed immediately by gravitational drainage. The greatest disadvantage of aboveground disposal is the potential for erosion of the topsoil layer in the cover. The results of a comprehensive cost-comparison study indicated that there is no real cost difference between conventional landfills and aboveground storage mounds. (See also W91-00900) (White-Reimer-PTT)
W91-00954

SAMPLING AND MONITORING OF REMEDIAL-ACTION SITES.
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5A.
W91-00955

TREATMENT AND CONTAINMENT TECHNOLOGIES.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
For primary bibliographic entry see Field 5G.
W91-00956

SITE REMEDIATION.
Science Applications International Corp., McLean, VA.
For primary bibliographic entry see Field 5G.
W91-00957

SAMPLING AND ANALYSIS OF HAZARDOUS WASTES.
Environmental Monitoring Systems Lab., Research Triangle Park, NC.
For primary bibliographic entry see Field 5A.
W91-00958

CONTROL AND DISPOSAL INDICES FOR COMPARING WASTE-MANAGEMENT ALTERNATIVES.
PEER Consultants, Inc., Rockville, MD.
E. Martin, and E. T. Oppelt.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 14.3-14.9, 2 tab.

Descriptors: *Alternative planning, *Hazardous waste disposal, *Hazardous wastes, *Waste management, Destructive treatment, Human health, Incineration, Management planning.

In the context of hazardous-waste management it is necessary to eliminate the hazard potential to the environment and human health, a stated goal of the Resource Conservation and Recovery Act (RCRA). In every case where management of hazardous wastes is being contemplated, a comparison of engineering alternatives should be conducted in detail to assess the potential long-term and short-term effectiveness of available options. A scheme for comparison of management options based on factors other than cost is presented. There are only two objectives possible for hazardous-waste management: (1) control for some period of time; and (2) disposal or elimination of hazard potential. An approach can be used in which each management option is treated as a 'black box.' One must estimate the quantity of expected discharges from the black box and account in some way for the time factor. It is also necessary to deal with the relative degree of disposal of hazardous-waste and toxic-waste components. In the specific engineering analysis of alternatives for specific wastes at an individual site, estimates could be made for each element necessary in the scheme and applied by using this technique. When the technique was applied, incineration and destructive treatment compared favorably to other alternatives considered, but there was a wide disparity in the values of both the control-years index and disposal index. Although 98% removal is considered very high for process treatment efficiency, the 99.9% destruction and removal efficiency for incineration represents three orders of magnitude better control. This difference between control effectiveness of the two options is reflected in the index values. Therefore, it is important to consider and report in detail process removal and destruction efficiencies in future work. (See also W91-00900) (White-Reimer-PTT)
W91-00959

COST PERSPECTIVES FOR HAZARDOUS-WASTE MANAGEMENT.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
G. M. Evans.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 14.11-14.17, 1 tab.

Descriptors: *Cost allocation, *Hazardous waste disposal, *Hazardous wastes, *Waste management, Costs, Disposal alternatives, Economic aspects.

The goal of the hazardous-waste generator is to maximize profits given the constraints imposed by environmental regulation. First and foremost management must develop a set of criteria which reflect the firm's overall goals and objectives. Next, a list of commercially available disposal alternatives must be compiled. Finally, each alternative must be carefully evaluated against the criteria, with this analysis serving as the basis for the final decision. The market for hazardous-waste disposal solutions can be viewed as two distinct submarkets: the on-site waste-disposal market; and the off-site waste-disposal market. In preparing the criteria to be evaluated the following issues must be considered: (1) the waste stream's physical characteristics; waste disposal methods for other similar wastes; corporate attitudes; the nature of the firms product market; in-house expertise; and public reaction to the disposal. In estimating disposal charges a distinction must be made between cost and price. Costs are those identifiable and accountable expenses incurred in the production of a product or service. Price is a result of the interaction of supply and demand forces in a market. For the firm beginning to investigate the range of market prices, the best source of information, short of obtaining vendor quotes, is through published price information. (See also W91-00900) (White-Reimer-PTT)
W91-00960

5F. Water Treatment and Quality Alteration

WATER SUPPLY IN FAST-GROWING CITIES: TOKYO, JAPAN.
Bureau of Waterworks, Tokyo (Japan). Water Supply Operation Centre.
For primary bibliographic entry see Field 6D.
W91-00021

MATHEMATICAL MODELLING OF THE EFFECT OF SIZE DISTRIBUTION ON SUSPENDED PARTICLES IN DEEP-BED FILTRATION.
Chia Nan Junior Coll. of Pharmacy, Tainan (Taiwan).
J. S. Chang, and S. Vigneswaran.
Aqua AQUAAA, Vol. 39, No. 2, p 96-100, April 1990. 8 fig, 7 ref.

Descriptors: *Filtration, *Hydraulics, *Mathematical models, *Particle size, *Suspended solids, *Water treatment, Adsorption, Filter breakthrough, Filter media, Hydraulic gradient, Sedimentation.

Although detailed observation shows that the size of suspended particles is one of the most important physical variables influencing deep-bed filtration, size is not often measured because the techniques available are time-consuming and expensive. A mathematical model for granular-bed filtration is presented. The model incorporates particle-size distribution and is based on the improvement of removal efficiency of finer particles in the presence of coarser particles. To explain this phenomenon, the assumption is made that all retained particles, coarse and fine, act as particle collectors in the removal of finer particles. The concept of detachment of retained particles due to hydraulic gradient is also incorporated to describe the decrease in removal efficiency during the filter breakthrough period of the filter run. The coefficients used in the model can be obtained from a laboratory-scale experiment using the suspension to be filtered. (Stoehr-PTT)
W91-00022

GENOTOXICITY OF DRINKING WATER: SIGNIFICANCE AND FUTURE APPROACH.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 5C.
W91-00023

MICROBIOLOGICAL AND CHEMICAL INVESTIGATIONS ON A BIOLOGICAL, AUTOTROPHIC DENITRIFICATION PLANT USING HYDROGEN AS AN ENERGY SOURCE.
Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Hygiene.
F. Selenka, and R. Dressler.
Aqua AQUAAA, Vol. 39, No. 2, p 107-116, April 1990. 8 fig, 4 tab, 10 ref.

Descriptors: *Biological treatment, *Denitrification, *Hydrogen, *Water treatment, *West Germany, Carbohydrates, Chemical analysis, Coliforms, Groundwater, Humic substances, Microbiological studies, Organic carbon, Organic matter, Pathogens, Pseudomonas, Water treatment facilities.

Besides physicochemical methods, there is increasing interest in biological denitrification. At Rasseln, West Germany, situated between the lower Rhine and the Dutch border, a plant has been built which uses the 'Denitropur' process. Denitrification of groundwater is performed in fixed-bed reactors by chemolithotrophic micro-organisms using hydrogen. Nitrate concentration is reduced significantly--from about 80 mg/L to less than 5 mg/L. Denitrification is accomplished mainly by Pseudomonas species. Prior to using the plant's output directly for drinking water purposes, a one-and-a-half-year experimental phase was carried out in which chemical, physical, and microbiological parameters were measured. Escherichia coli, coliforms, and pathogenic microorganisms, such as Pseudomonas aeruginosa, could not be found in the waters of the reactors or behind the filter, except for a single colony of E. coli found in December 1985 immediately after construction of the plant was completed. Total organic carbon increased only about 0.25 mg/L over the level in the incoming groundwater. The concentration and character of humic substances, mainly fulvic acids, do not change during passage through the plant. The increase in carbohydrate concentration is minimal, but a change in the carbohydrate matrix as a result of microbial activity can be demonstrated. Since July 1987, denitrified water from the Rasseln plant has been used in the common water supply. (Stoehr-PTT)
W91-00024

MEASURING ECONOMIC LOSSES FROM GROUND WATER CONTAMINATION: AN INVESTIGATION OF HOUSEHOLD AVOIDANCE COSTS.
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5C.
W91-00086

DEVELOPMENT OF A WATER AND WASTEWATER SCADA SYSTEM.
Wiley and Wilson, Inc., Lynchburg, VA.
W. H. Clingenpeel, and D. B. Rice.
Public Works PUWOAH, Vol. 121, No. 6, p 60-62, June 1990. 1 fig.

Descriptors: *Computer programs, *Data collections, *Virginia, *Water conveyance, *Water distribution, Municipal wastewater, Municipal water, SCADA, Wastewater facilities, Wastewater management, Water delivery, Water management, Water supply.

Henrico County is urbanizing at a rapid rate and is the second most heavily populated county in Virginia. Henrico is implementing a Supervisory Control and Data Acquisition (SCADA) system that will monitor and control the entire county water system and monitor the county's wastewater system. The SCADA system will completely replace the existing hybrid monitoring and control system and will provide consistency that is currently lacking. Current technology has widened the choices of system architecture available to accomplish the SCADA mission. The computing power necessary to accomplish closed loop control in addition to data communication over leased line, radio, microwave, or satellite link is now available in a package as small as a single control loop or even a single transmitter. With the modern SCADA system, data collected at remote locations serves a two-fold purpose: control of the facility and central monitoring. The sewage pump stations and odor control facility are currently operating under their own local control systems. The new inputs to the SCADA system are designed to give operations personnel more timely information, more flexibility in setting operational alarms, quicker response to problems, and better data for planning operation and improvement strategies. The SCADA system control center will be laid out to promote quick and effective access to critical system information. It is hoped that Henrico's approach to developing its SCADA system will be helpful to others considering the implementation of water and/or wastewater SCADA systems. (Mertz-PTT)
W91-00101

COST SAVINGS THROUGH CHEMICAL ADDITION SEQUENCING.
Texas Univ. at El Paso. Dept. of Civil Engineering.
A. J. Tarquin, and D. D. Rittman.
Public Works PUWOAH, Vol. 121, No. 6, p 74-75, June 1990. 2 fig.

Descriptors: *Chemical treatment, *Cost analysis, *Economic aspects, *Water treatment, Calcium carbonate, Costs, Ferric sulfate, Lime, Mixing, Physicochemical treatment.

Chemicals are major budget items in water treatment operations. For cities treating large volumes of water, small changes in chemical dosages could result in large changes in chemical costs. A study to investigate whether cost savings could be achieved through simple operational changes in full-scale water treatment plant operations was undertaken. After establishing laboratory test conditions, jar test experiments were conducted to determine several variables, including additional flash mixing, longer mixing time, lime treatment without coagulants, and chemical addition sequencing. Laboratory jar tests revealed that a ferric sulfate dosage as low as 6 mg/L (instead of the usual 12-15 mg/L) would be sufficient if the lime were added before the primary settling tank. Changing the lime addition location obviously benefited the required iron dosage. This was probably caused by removal of calcium carbonate precipitate in the primary settling tanks, which reduced the flocculators' turbidity load. The reduction from 13.2 mg/L to 7.0 mg/L in the required coagulant dosage could not be credited solely to changing the lime addition point. However, if only a 2 mg/L reduction is attributed to this change, at a ferric sulfate cost of $187 per ton, the cost savings would be over $15,000 for the 6.5-month river operation season at a 50 million gallon/day flow rate. At 6% per year interest, the present worth of these savings through ten years would exceed $110,000. These savings would be proportionally multiplied for higher flow rates and/or a longer operating season. (Mertz-PTT)
W91-00102

TREATMENT OPTIONS FOR WATER SUPPLIES CONTAMINATED WITH DBCP AND OTHER PESTICIDES.
Brown and Caldwell, Walnut Creek, CA.
J. M. Wong.
Public Works PUWOAH, Vol. 121, No. 6, p 78-81,115, June 1990. 5 fig, 4 tab, 17 ref.

Descriptors: *Pesticides, *Water quality management, *Water treatment, Activated carbon, Air stripping, Decontamination, Groundwater pollution, Herbicides, Oxidation, Reverse osmosis, Ultraviolet radiation, Water pollution.

Contamination of water supplies by pesticides (or herbicides) is a significant public health problem because of the widespread application of pesticides in large-scale agriculture and in forest areas. Contamination can occur through drainage from the surrounding terrain, precipitation from the atmosphere, accidental spills, and leaching into groundwater through fumigated soil. When groundwater used for drinking water supplies is contaminated by pesticides or other organic chemicals, remedial actions by municipalities or water purveyors are required to protect public health and to meet drinking water standards. Remedial alternatives to control the level of contaminants in the water can be nontreatment or treatment methods. Nontreatment alternatives may include changing the groundwater source through well replacement and well rehabilitation, increasing the production of good quality sources with storage, and blending of poor quality water with better quality water. Nontreatment methods are usually less expensive than treatment methods, if they can be technically implemented. Treatment methods include common organic removal processes such as air stripping, activated carbon adsorption, oxidation enhanced by ultraviolet irradiation, and reverse osmosis. Treatment usually occurs at the wellhead or at a central location with a cluster of wells, if feasible. (Mertz-PTT)
W91-00103

COMPUTER-OPERATED TREATMENT PLANT PROVIDES TOP QUALITY WATER.
Bogert (Clinton) Associates, Fort Lee, NJ.
W. Eakins.
Public Works PUWOAH, Vol. 121, No. 6, p 87-89, June 1990. 3 fig.

Descriptors: *Automation, *Computer programs, *Massachusetts, *Water conveyance, *Water distribution, *Water treatment, Computers, Conveyance structures, Pumping plants, Storage tanks, Water storage, Water treatment facilities.

Lynn, Massachusetts faced complicated and extensive water supply issues. A 20-year program culminated in the Lynn Water and Sewer Commission building a new 23-million gallon/day water treatment facility. The water commission supplies water for about 80,000 residents. A water main cleaning and lining program rehabilitated most major water mains over 12 inches in diameter in 125 miles of mains. Two prestressed concrete water storage tanks were built, each storing 3 million gallons of water. The plant's computer system, automatically controls filter backwashing, operates the low service pumping station pumps, and logs and displays operating data. During monitoring, the computer reads and scans through two types of input signals--discrete and analog--wired to it from over 250 pieces of plant equipment. Under the control function, the computer generates output signals to over 100 pieces of equipment and directs valve openings and closings, stopping and starting plumps, and regulating flow rates. As the overall system was designed, the basic components are the network monitor, the remote distributed controllers in the computer cabinet, and the process engineers interface. Lynn's treatment plant computer system gives supervisory personnel or process engineers two extremely powerful and useful tools--centralized and flexible monitoring of process equipment, and automated control of plant processes. (Mertz-PTT)
W91-00106

UPGRADING THE OWL'S HEAD WASTEWATER TREATMENT PLANT.
Metcalf and Eddy of New York, NY.
For primary bibliographic entry see Field 5D.
W91-00107

SUMMERTIME SAMPLING.
Southern Illinois Univ. at Edwardsville. Environmental Resources Training Center.
For primary bibliographic entry see Field 5A.
W91-00111

OPTIMAL VALVE CONTROL IN WATER-DISTRIBUTION NETWORKS.
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Civil Engineering.
P. W. Jowitt, and C. Xu.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 455-472, July/August 1990. 11 fig, 3 tab, 19 ref.

Descriptors: *Flow control, *Leakage, *Water conveyance, *Water distribution, Algorithms, Hydraulic valves, Mathematical equations, Optimization, Water supply.

The primary duty of a water supply undertaking is the consistent provision of water in sufficient quantity, at appropriate pressure, of acceptable quality, as economically as possible. The problem of operational-leakage control has received relatively less attention. It has been reported that leakage from some networks may account for a significant amount of the water put into supply. For some aging urban networks, rates of up to 50% have been reported, with average rates of 25% being quite typical. These high rates of leakage represent a significant economic loss. An algorithm for the determination of flow control valve settings to minimize leakage has been developed. The nonlinear network equations describing nodal heads and pipeflows are augmented by terms that explicitly account for pressure-dependent leakage and by terms that model the effect of valve actions. Successive linearization of these equations using the linear-theory method allows the formulation and solution of a linear program that minimizes leakage. This mathematical representation derives from data collected from a specified set of field experiments, and may not be representative of other circumstances, but it is hoped that the technique will stimulate further interest, both analytical and experimental, in the estimation of leakage in distribution networks. (Fish-PTT)
W91-00180

BEHAVIORAL CHANGES IN GAMMARUS PULEX AND ITS SIGNIFICANCE IN THE TOXICITY ASSESSMENT OF VERY LOW LEVELS OF ENVIRONMENTAL POLLUTANTS.
Reading Univ. (England). Dept. of Physiology and Biochemistry.
For primary bibliographic entry see Field 5C.
W91-00207

WATER RESOURCES OF THE WHITE EARTH INDIAN RESERVATION, NORTHWESTERN MINNESOTA.
Geological Survey, St. Paul, MN. Water Resources Div.
J. F. Ruhl.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4074, 1989. 73p, 30 fig, 8 tab, 35 ref.

Descriptors: *Groundwater data, *Indian reservations, *Minnesota, *Potable water, *Water quality, *Water resources, *Water resources data, Ecology, Esthetics, Recreation, Water use, White Earth Indian Reservation.

Water resources in the White Earth Indian Reservation meet the present (1988) needs for potable supply and other household use and provide valuable ecological, recreational, and aesthetic benefits. Total annual water use in the reservation is about 460 million gallons per year. Domestic supply from

privately-owned wells and municipal systems accounts for roughly 75% of the water use, and irrigation of croplands and nurseries accounts for approximately 25%, depending on rainfall. Glacial-drift aquifers are the source of groundwater in the reservation. Unconfined-drift aquifers consist of two superficial outwash deposits that extend over approximately 20% of the reservation. Confined-drift aquifers are discontinuous lenses of sand and gravel that are poorly connected to each other. The aquifers are 50 to 300 feet below land surface and 5 to 25 feet thick. Yields from these aquifers typically range from 10 to 100 gallons per minute. Surface water in the reservation consists of numerous lakes, wetlands, prairie potholes, and streams. The larger, deeper lakes in the eastern and southern parts of the reservation support game fish and provide recreational opportunities for swimming and boating. The shallower lakes and prairie potholes are used to produce wild rice and also are managed to provide waterfowl habitat. Groundwater is mostly a calcium magnesium bicarbonate type. Dissolved solids concentration of the groundwater generally is greater in the deeper confined-drift aquifers than in the shallower unconfined-drift aquifers. Except for elevated concentrations of iron and manganese, groundwater quality meets Environmental Protection Agency drinking water criteria. Surface water also is a calcium magnesium bicarbonate type. Lake waters are hard and alkaline and mesotrophic to eutrophic. Quality of the lake and stream water is suitable for native forms of freshwater biota, although the concentration of mercury exceeds the 0.012 micrograms per liter maximum contaminant level. Available information, however, indicates that the amount of mercury in edible tissue from fish in alkaline lakes of northwestern Minnesota is within safe limits. The concentrations of phosphorus and nitrate in the streams are below levels that indicate pollution problems. (Author's abstract)
W91-00341

ACCURACY OF HYDRANT FLOW TESTS USING A PITOT DIFFUSER.
Wyoming Valley Sanitary Authority, Wilkes-Barre, PA.
For primary bibliographic entry see Field 7B.
W91-00378

TRANSIENT ANALYSIS OF WATER DISTRIBUTION SYSTEMS.
Toronto Univ. (Ontario). Dept. of Civil Engineering.
B. W. Karney, and D. McInnis.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 7, p 62-70, July 1990. 10 fig, 2 ref.

Descriptors: *Hydraulic models, *Hydraulic transients, *Hydraulics, *Water delivery, *Water distribution, Computer models, Hydraulic loading, Mathematical analysis, Mathematical equations, Mathematical models.

Physical load factors on pressure pipe systems can cause failures such as a break that causes loss of water and pressure or more systemic problems, such as increased fluid friction with its associated reduced flow capacity, increased power costs, or both. One source of loading that is commonly neglected in water distribution system analysis is due to transient (water hammer) conditions. The pressures generated by transient conditions in pipe systems are frequently three or more times the value of normal operating pressures. Thus, transient pressures must be know if the size and strength of the required pipe is to be rationally selected, if surge-suppression equipment is to be logically sized, and if system operating rules are to be intelligently specified. In practice, however, analysts frequently neglect transient conditions, particularly in complex systems such as distribution networks. With modern computer techniques it is possible to analyze distribution systems under a wide range of flow conditions and with relatively few restrictions. (Author's abstract)
W91-00379

SUGGESTED METHODS FOR CALCULATING AND INTERPRETING CALCIUM CARBONATE SATURATION INDEXES.
For primary bibliographic entry see Field 2K.
W91-00380

MEASUREMENT OF BIODEGRADABLE ORGANIC MATTER AND BACTERIAL GROWTH POTENTIAL IN DRINKING WATER.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Huck.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 7, p 78-86, July 1990. 2 fig, 5 tab, 57 ref.

Descriptors: *Biodegradation, *Dissolved solids, *Laboratory methods, *Pollutant identification, *Reviews, *Water analysis, *Water delivery, *Water treatment, Bacteria, Biomass, Dissolved organic carbon, Organic carbon, Water distribution.

The water industry has become increasingly interested in the biodegradability of natural organic matter present in both raw and treated water, due to its role in promoting microorganism growth in such water. A number of methods have recently been developed to measure the biodegradability of aquatic natural organic matter. These techniques measure assimilable organic carbon, biodegradable organic carbon or bacterial growth potential. This article reviews the various methods and summarizes their application to the assessment of treatment processes and bacterial growth in distribution systems. Biomass-based methods are the subject of a major philosophic difference as to whether the most appropriate inoculum is one or more known bacterial strains or an indigenous bacterial population. The biodegradability methods have been successfully applied to measure the effects of treatment processes. Limited use has been made thus far of the methods in the design of treatment processes and optimization of their operation. Further research quantifying the relationship between biodegradability and bacterial growth in distribution systems is required before biodegradability can be effectively used as a design parameter. Currently, none of the methods can be considered ready for routine use in water treatment practice, although efforts to develop a procedure that could be more widely used are in progress. (Hoskin-PTT)
W91-00381

DISINFECTING BIOFILMS IN A MODEL DISTRIBUTION SYSTEM.
American Water Works Service Co., Inc., Belleville, IL. Belleville Lab.
M. W. LeChevallier, C. D. Lowry, and R. G. Lee.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 7, p 87-99, July 1990. 17 fig, 9 tab, 34 ref.

Descriptors: *Biofilms, *Chlorination, *Disinfection, *Water delivery, *Water distribution, *Water treatment, Bacteria, Chlorine, Copper, Corrosion, Iron, Laboratory methods, Model studies, Physical models, Pipes.

Maintenance of a chlorine residual does not eliminate all bacteria in a water distribution system. The study examined the disinfection efficiency of free chlorine and monochloramine for controlling biofilm organisms in a model pipe system. The composition of the pipe material was found to be a major influence on disinfection efficiency. Bacteria grown on galvanized copper, or polyvinylchloride pipe surfaces were readily inactivated by a 1-mg/L residual of free chlorine or monochloramine. Biofilms grown on iron pipes treated with free chlorine doses as high as 4 mg/L (3-mg/L residual) for two weeks did not show significant changes in viability, but if treated with 4 mg/L of monochloramine for two weeks, these biofilms exhibited a more than 3-log die-off. Accumulation of corrosion products on iron pipes was found to interfere with free chlorine disinfection. (Author's abstract)
W91-00382

DISINFECTION OF DRINKING WATER BY FILTRATION THROUGH SILVER IMPREGNATED ALUMINA.
Industrial Toxicology Research Centre, Lucknow (India).
R. K. Sharma, S. Kumar, P. W. Ramteke, and P. K. Ray.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 5, p 479-486, July 1990. 3 tab, 18 ref.

Descriptors: *Coliforms, *Disinfection, *Drinking water, *Filtration, *Silver, *Water treatment, Alumina, Bacteria, Escherichia coli, Water supply.

A system for the disinfection of drinking water by silver ions was devised. Immobilized metallic silver ion on alumina was found to be effective in the removal and inactivation of thermotolerant Escherichia coli within 10 to 15 seconds of contact time. In the process, bacteria are not only adsorbed on the solid support but are also inactivated due to the bactericidal and bacteriostatic effects of silver ions. This filter material may potentially be useful for the disinfection of potable water for individual and community water systems. (Author's abstract)
W91-00391

SPECIFER'S GUIDE TO POLYMER FEED SYSTEMS.
For primary bibliographic entry see Field 5D.
W91-00402

CORROSION AND WATER QUALITY.
Wisconsin Dept. of Natural Resources, Spooner. Northwest District.
For primary bibliographic entry see Field 5B.
W91-00411

WHAT TO CONSIDER WHEN SELECTING YOUR WATER SUPPLY.
Ernst and Young.
Water Well Journal WWJOA9, Vol. 44, No. 6, p 55-63, June 1990. 10 fig.

Descriptors: *Domestic water, *Water conveyance, *Water supply, *Wells, Costs, Rural areas, Water quality, Water quality standards, Well testing.

When a homeowner has the opportunity to select his or her water supply, there are certain questions that need to be answered in order to make an informed decision. To help decide between a rural public water provider and a well water system, the homeowner must consider the availability and safety of the water supply, the short-term and long-term costs, as well as the ability to receive adequate amounts of water when needed. These factors can be determined by discussing with the rural water provider their plans to meet demand as the area develops, whether current water quality meets standards set by the federal government, and the connection costs to obtain service and operating costs. By considering and comparing these aspects of using a rural water provider to the same concerns applied to a well water system, the homeowner should be able to make an informed decision. Worksheets for determining and comparing these costs for both options are provided. (Fleishman-PTT)
W91-00414

COST AND PERFORMANCE OF MEMBRANES FOR ORGANIC CONTROL IN SMALL SYSTEMS: FLAGLER BEACH AND PUNTA GORDA, FLORIDA.
University of Central Florida, Orlando. Dept. of Civil Engineering and Environmental Sciences.
J. S. Taylor, L. A. Mulford, W. M. Barrett, S. J. Duranceau, and D. K. Smith.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-190367/AS. Price codes: A12 in paper copy, A01 in microfiche. Report No. EPA/600/2-89/022, May 1989. 272p, 115 fig, 95 tab, 16 ref. Cooperative Agreement No. CR 813199.

Descriptors: *Costs, *Filtration, *Florida, *Membrane processes, *Water treatment, Capital costs,

Fouling, Operating costs, Performance evaluation, Pilot plants.

The performance and cost of low pressure membrane technology to remove THM precursors from drinking water is documented. A 12,500 gpa membrane pilot plant was operated for one year at both groundwater and surface water source test sites in Florida. At the groundwater site, the pilot plant was operated for over 5,000 hr and produced a permeate with an average THMFP of 20 microg/L from a source water with an average THMFP of 400 microg/L. Permeate production was consistent throughout the operating period. There were no significant operational problems. A preliminary cost estimate showed that the cost of a low pressure membrane treatment facility was essentially equal to that of the existing lime softening treatment and produced drinking water of generally superior quality. At the surface water site, the pilot plant was operated for over 6,600 hr and produced a permeate with an average THMFP of 37 microg/L from a source water with an average THMFP of around 600 microg/L. Consistent permeate production was not achieved at this location, however, as a significant problem with fouling of the membranes by the highly organic surface water was encountered. Use of this type of membrane technology on such surface water will require lower membrane flux, lower recovery, more frequent membrane cleaning and extensive pretreatment. Capital costs for such an application will be significantly higher than conventional treatment. (Author's abstract)
W91-00448

SOC (SYNTHETIC ORGANIC COMPOUNDS) REJECTION BY NANOFILTRATION.
University of Central Florida, Orlando. Dept. of Civil Engineering and Environmental Sciences.
J. S. Taylor, S. J. Duranceau, L. M. Mulford, D. K. Smith, and W. M. Barrett.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-194245/AS. Price codes: A07 in paper copy, A01 in microfiche. Report No. EPA/600/2-89/023, May 1989. 142p, 56 fig, 58 tab, 13 ref. Cooperative Agreement No. CR 813199.

Descriptors: *Filtration, *Fumigants, *Membrane processes, *Pesticides, *Synthetic compounds, *Water treatment, Adsorption, Mass balance, Membranes, Molecular structure, Pilot plants.

A study was conducted to evaluate the rejection of six synthetic organic compounds (SOCs) from a potable water source by a nanofiltration membrane process. The SOCs were ethylene dibromide (EDB), dibromochloropropane (DBCP), chlordane, heptachlor, methoxychol and alachlor. To investigate SOC rejection, a membrane pilot plant was constructed that utilized a single, 4-in by 40-in FilmTec N 70 spiral wound, thin film composite membrane with a molecular weight cutoff of 300. The effects of different operating pressures and membrane feed stream velocities on membrane rejection of SOCs are reported. Trihalomethane formation potential (THMFP) and total organic halide formation potential (TOXFP) and general water quality in and out of the membrane are also reported. Accurate organic and inorganic mass balances were conducted in solutes. The percent rejection of the SOCs varied from 0% for EDB to 100% for chlordane, methoxychlor, heptachlor and alachlor. DBCP was the only partially rejected SOC in the group. Mass balances conducted during each SOC test indicated that adsorption could have occurred within the membrane system for the three highest molecular weight SOCs tested; methoxychlor, heptachlor and chlordane. Although breakthrough of adsorbed SOCs did not occur during these short-term tests, it could occur if the adsorption capacity of the membrane is reached. (Author's abstract)
W91-00449

SUPERFUND RECORD OF DECISION: BEACHWOOD/BERKELEY, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00451

WATER CHLORINATION: CHEMISTRY, ENVIRONMENTAL IMPACT AND HEALTH EFFECTS. VOLUME 6.
Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. 1023p.

Descriptors: *Chemical analysis, *Chlorination, *Environmental effects, *Public health, *Water treatment, Conferences, Disinfection, Epidemiology, Toxicology.

This book represents the proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects held May 3-8, 1987 in Oak Ridge, Tennessee. Most of the research that occurred between the fifth and sixth conferences was documented at this meeting. Chapters in this volume fall into ten section headings: The Stage, The Mutagen/Carcinogen, The Toxicology, The Epidemiology, The Environment, The Water, The Other By-Product/Compound, The Chemistry, The Disinfection, and The Perspective. (See W91-00477 thru W91-00551) (Lantz-PTT)
W91-00476

INTERIM: SELECTED CHEMICAL RESEARCH REPORTED BETWEEN CONFERENCES FIVE AND SIX.
Oak Ridge National Lab., TN.
R. L. Jolley, and J. D. Johnson.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 3-19, 1 tab, 55 ref.

Descriptors: *Chlorination, *Literature review, *Research priorities, *Water pollution effects, *Water treatment, Chemical analysis, Chlorine compounds, Measuring instruments, Organic compounds, Oxidation, Water quality control.

In this brief literature review, an attempt is made to summarize the research on water chlorination that was published in the interval between 1984-1987. Four commercial on-line total residual chlorine analyzers for wastewater were bench tested. The analyzers were representative of the major instrument types: amperometric, colorimetric, and potentiometric. Although some deficiencies were noted, all had acceptable accuracy spans. Artifact problems in analytical chemistry are presented, specifically with respect to cyclohexene which is used as a preservative in methylene chloride. Consequently, use of methylene chloride to extract water samples containing free or active chlorine residuals commonly produces the following artifacts at micro g/L levels: chlorocyclohexenes, dichlorocyclohexane, chlorocyclohexanone, and chlorocyclohexanol. Diethyl ether extracts comprise nearly 100% of the mutagenic activity from aqueous solutions of chlorinated humic acids. Diacetone alcohol was found to be an artifact of processes involving acetone extraction and weakly basic Florisil (magnesium silicate) adsorbents. The effect of permanganate oxidation and chlorination on the mutagenic activity of recharged groundwater processed from humic-rich surface water was studied in Kuopio, Finland. The mutagenic activity of chlorinated water in this area is very high and attributable to the high organic content of the lake that is the raw water source. (See also W91-00476) (Lantz-PTT)
W91-00477

WATER CHLORINATION: THE CHALLENGE.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. D. Johnson, and R. L. Jolley.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 21-27, 22 ref.

Descriptors: *Chlorination, *Disinfection, *Public health, *Water treatment, Human diseases, Standards, Water quality, Water quality control.

The challenge of modern day water chlorination is to reap the benefits of chlorine's excellent disinfection efficacy while minimizing its environmental impacts and by-product toxicity. Waterborne diseases such as typhoid, cholera, dysentery, amebiasis, salmonellosis, shigellosis, and hepatitis A have greatly decreased in the U.S. in the last 80 years, in part, due to chlorination. Only recently has data become available on the efficacy of chlorine against some of the more difficult to disinfect waterborne disease microorganisms such as hepatitis A virus and Giardia lamblia parasitic cysts. There is a large effort currently being mounted to use the laboratory-determined concentration, C, times time, t, or the C X t dose required for a constant fraction of disinfection, to meet the drinking water disinfection requirements of the filtration and disinfection rule promulgated by the EPA as part of the 1986 amendments to the Safe Water Drinking Act. Disinfectants must gain access to the sensitive sites of organisms through protective layers of reducing agents and other organisms aggregated or on surfaces. These protective layers not only slow down, but also exert a demand on the disinfectant, reducing it to an ineffective chemical form. (See also W91-00476) (Lantz-PTT)
W91-00478

CURRENT STATUS OF DISINFECTANT RESIDUAL MEASUREMENT METHODS FOR FREE AND COMBINED CHLORIDE AND OXYCHLORINE SPECIES.
Miami Univ., Oxford, OH. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-00479

SOUTH AUSTRALIAN WATER: A DISINFECTION PROBLEM.
South Australian Health Commission, Adelaide.
C. C. Baker, and D. B. Bursill.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 47-59, 9 tab, 43 ref.

Descriptors: *Australia, *Chlorination, *Disinfection, *Public health, *Trihalomethanes, *Water quality, *Water treatment, Chlorine, Human diseases, Toxicity.

Australia is the driest inhabited continent in the world with the largest proportion of the continent receiving < 300 mm of rainfall annually. The population of South Australia is about 1.4 million, with the majority (73%) living in and around Adelaide. In a state with such small amounts of this rainfall, water is a precious resource to the community. To conserve this resource, rainwater tanks and irrigation systems are used extensively. The available groundwater is generally unsuitable for water supply purposes because of high salinity. Consequently, the generation of trihalomethanes (THMs) from surface waters containing relatively high levels of naturally occurring organic material is a problem affecting most of the state's population. A second problem arises from the need to pipe the water over long distances where the ambient temperatures are high. Water at elevated temperatures preferentially encourages the growth of an amoeba, Naegleria fowleri, the organism that causes an often fatal meningitis. To combat the growth of this organism and to adequately disinfect the water require large amounts of chlorine. Chlorine is added at various dosing stations along these pipelines and levels of up to 25 mg/L chlorine have been used to ensure effective disinfection. A review of the literature revealed that the strongest evidence was for an association between chlorinated organic contaminants and cancers of

the rectum, and to a lesser degree, cancers of the colon and bladder. A case-control interview study of 2982 incident cases of bladder cancer and 5782 randomly selected population-based controls was undertaken. In addition, results from long-term feeding experiments show that an increased incidence of tumors was only seen at high doses and often at levels which were clearly toxic to the liver and kidney. Most of the chronic studies used high doses to produce tumors, but unfortunately, sufficient lower doses were not included to allow establishment of no-effect levels (NELs). A program for the construction of water filtration facilities for the major South Australian water supplies has been in progress since the early 1970s. (See also W91-00476) (Lantz-PTT)
W91-00480

CHLORINATED HYDROCARBONS AND WATER QUALITY ISSUES IN THE NEW YORK CITY MUNICIPAL WATER SUPPLY.
Lamont-Doherty Geological Observatory, Palisades, NY.
R. F. Bopp, B. L. Deck, H. J. Simpson, and S. D. Warren.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 61-74, 5 fig, 4 tab, 18 ref.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Disinfection, *Municipal water, *New York, *Trihalomethanes, *Water quality, *Water treatment, Chlorine compounds, Chloroform, Delaware River, Hudson River, Organic carbon, Raw water.

Two groups of laboratory incubation experiments were performed on NYC raw water sources. The first, included (1) unfiltered Chelsea raw water, (2) filtered Chelsea raw water, and (3) unfiltered Rondout raw water. Over the course of 100 h, the total trihalomethane (TTHM) levels in the tree sample sets reached 191, 165, and 33 ppb respectively. Thus, both the Chelsea sample sets were five to six times higher in THM production than the Rondout samples. THM levels in filtered Chelsea samples were generally lower than, but within 15% of, corresponding values in the unfiltered Chelsea set. All three sets had monotonically increasing chloroform (CHCL3) levels with time since chlorination began. The Hudson River water during late fall 1985 had two to three times the dissolved organic carbon (DOC) levels of water in the Delaware watershed reservoirs and streams. Hudson River samples produced about 35 ppb TTHMs/mg/L DOC, while Delaware System water yielded about 15 ppb TTHMs/mg/L DOC. Water withdrawn from the Hudson at Chelsea contains PCBs originally discharged to the river far upstream of tidal waters over a period of several decades. Even undiluted treated Hudson River water does not exceed federal or state standards for dissolved PCBs in drinking water. The limited TTHM data available for NYC drinking water show the TTHM levels in the water generally average <50% of the level currently permitted in the US for large municipal water supplies. (See also W91-00476) (Lantz-PTT)
W91-00481

HEALTH EFFECTS OF DISINFECTANTS AND DISINFECTION BY-PRODUCTS: A REGULATORY PERSPECTIVE.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
J. Orme, C. S. Mullin, and E. V. Ohanian.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 75-86, 56 ref.

Descriptors: *Chlorination, *Disinfection, *Public health, *Water pollution effects, *Water treatment, Chloramines, Chlorine, Chlorine compounds, Drinking water, Toxicity, Trihalomethanes.

The Safe Drinking Water Act (SDWA) requires the EPA to specify drinking water contaminants that may have any adverse effect on public health. For each of these contaminants, the EPA must set a maximum contaminant level (MCL). Chlorine is the most widely used disinfectant in the US and does not appear to be acutely toxic. In short-term toxicity studies, the liver and kidney appear to be target organs. Chlorine dioxide has often been used in conjunction with chlorine during drinking water disinfection to control phenolic tastes and odors. It has also proven to be an effective disinfectant with nearly 2.5 times the oxidizing power of chlorine. Chlorine dioxide degrades into chlorite and chlorate. Chloramines are also used as an alternative to chlorine for drinking water disinfection. Human studies were negative for chloramines in volunteers receiving 0.2 mg/L in drinking water for 84 d. The trihalomethanes, consisting of chloroform, bromoform, bromodichloromethane, and dibromochloromethane, are formed from the reaction of chlorine with organic matter in the water during the disinfection process. A number of other substances or treatment practices have been used in drinking water disinfection, including ozone, iodine, bromine, potassium permanganate, silver, ferrate, high pH, ionizing radiation, and ultraviolet light. The available health effects information on these substances is extremely limited. (See also W91-00476) (Lantz-PTT)
W91-00482

REGULATORY EFFECTS ON THE PRACTICE OF DRINKING WATER TREATMENT.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
S. W. Clark, and J. A. Contruvo.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 87-100, 1 tab, 6 ref.

Descriptors: *Chlorination, *Disinfection, *Drinking water, *Public health, *Regulations, *Standards, *Water treatment, Filtration, Maximum contaminant level, Protozoa, Viruses, Water quality, Water quality control.

The Safe Drinking Water Act (SDWA) offers two options for regulating drinking water contaminants. The first is to set technology-based maximum contaminant levels (MCLs) as close to a health-based MCL goal (MCLG) as is feasible. Contaminants for which monitoring is not technically or economically feasible may be regulated by setting treatment technique requirements. The second option involves the treatment of surface waters, and disinfection of all waters through filtration for microbial contaminants, a number of which can not be measured. The primary distinction between an MCL and a treatment technique requirement is the ability to monitor for a particular contaminant. The practice of water treatment will be impacted by the new drinking water standards in several areas: (1) establishing new treatment systems; (2) providing technologies that are cost-effective and simple to operate; (3) increased emphasis on microbiological safety. Agents of concern will include viruses, Giardia, and other protozoans, bacteria and Legionella; and (4) improving microbiological safety while reducing human exposure to disinfectants and their by-products. (See also W91-00476) (Lantz-PTT)
W91-00483

TRIHALOMETHANES: IS SWIMMING POOL WATER HAZARDOUS.
J. Copaken.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 101-104, 2 tab, 7 ref.

Descriptors: *Chlorination, *Disinfection, *Public health, *Swimming pools, *Trihalomethanes, *Water treatment, Chlorinated hydrocarbons, Organic compounds, Path of pollutants, Recreation, Volatile organic compounds.

Trihalomethanes (THMs), carcinogenic compounds formed through the chemical reaction of chlorine and organic materials in aqueous solution, are problems in some drinking water. However, the formation of THMs and other choroorganic compounds during the chlorination of swimming pool waters has received scant attention. Previous research indicated the following: the average concentration of THMs in chlorinated freshwater swimming pools is 150 microgram/L; THMs are volatile, and an equilibrium is established in indoor pools between THMs present in the swimming pool water and those in the surrounding atmosphere; THMs enter the body through inhalation, adsorption, and the gastroenteric system (drinking of the water), although inhalation is the predominant mechanism; once in the body, THMs bond with fat, blood, and brain tissues; and the depuration rate for THMs in the human body is greater than 24 hr. The goal of the research reported in this paper is to measure the concentrations of chloroform in a chlorinated swimming pool's water and to determine whether chloroform (and therefore THMs) enters the bodies of swimmers in the pool or is inhaled by workers exposed to the atmosphere surrounding the pool. After a 2-hr exposure to chlorinated water containing 37.9 microgram/L chloroform, the average increase in the blood chloroform concentration in five volunteers was 0.61 microgram/L. A similar study with two volunteers in an electronically purified swimming pool containing 3.6 microgram/L chloroform resulted in a 0.48 microgram/L decrease in the blood chloroform level. It is concluded that THMs may present a hazard to lifeguards or occupationally exposed persons and to competitive swimmers exposed for long periods to chlorinated swimming waters. (See also W91-00476) (Lantz-PTT)
W91-00484

PRODUCTION OF ORGANIC CHEMICALS AND MUTAGENS DURING CHLORINATION OF AMINO ACIDS IN WATER.
Water Research Centre, Medmenham (England). Medmenham Lab.
H. Horth, M. Fielding, H. A. James, M. J. Thomas, and P. Wilcox.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 107-124, 15 ref.

Descriptors: *Amino acids, *Chlorination, *Disinfection, *Organic compounds, *Water pollution sources, *Water treatment, Chlorine compounds, Chloroform, Hydrogen ion concentration, Mutagens, Tyrosine.

Bacterial mutagenicity assays on concentrated extracts of drinking water have shown the presence of chemical mutagens. It has also been shown that mutagenic activity is produced during drinking water disinfection as a result of the reaction of chlorine with naturally occurring compounds such as humic and amino acids. Some amino acids produce mutagenic activity on aqueous chlorination similar in character to that generated during chlorination of natural waters. However, the low amounts of free amino acids present in such waters are likely to account for only a small portion of the mutagenic activity generated. Different mutagens can be extracted by altering the pH of the aqueous chlorinated solution. Chlorination of tyrosine produced considerable mutagenic activity, but when examined by the pH 6.2/XAD method the primary mutagens could not be identified; pH 2/XAD extracts of tyrosine, 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) accounted for much of the mutagenicity. Tyrosine appears to be an interesting model compound for studying the production of mutagenic compounds during water treatment by chlorination. Not only is tyrosine a precursor of potent mutagenic activity of similar characteristics to that observed in drinking water,

but many of the products so far identified in chlorinated tyrosine have been found in drinking water and in chlorinated humic acid. These include E-MX, MX, chloroform, chloral, dichloroacetonitrile, hydroxybenzlcyanide, and chlorophenols. (See also W91-00476) (Lantz-PTT)
W91-00485

FORMATION AND PROPERTIES OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE, A POTENT MUTAGEN IN CHLORINATED WATERS.
Abo Akademi, Turku (Finland). Lab. of Forest Products Chemistry.
For primary bibliographic entry see Field 5B.
W91-00486

IDENTIFICATION OF THE STRONG MUTAGEN 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE AND ITS GEOMETRIC ISOMER E-2-CHLORO-3-(DICHLOROMETHYL)-4-OXOBUTENOIC ACID IN MUTAGENIC FRACTIONS OF CHLORINE-TREATED HUMIC WATER AND IN DRINKING WATERS.
Environmental Protection Agency, Cincinnati, OH.
L. Kronberg, B. Holmbom, and L. Tikkanen.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 137-146, 7 fig, 2 tab, 13 ref.

Descriptors: *Chlorination, *Disinfection, *Drinking water, *Organic compounds, *Water pollution sources, *Water treatment, Ames test, Mutagens.

Many studies have demonstrated that concentrates of drinking waters exhibit mutagenicity in the Ames test. The practice of water chlorination has been shown to be responsible for the formation of mutagenicity. The mutagenic activity in extracts of chlorine-treated water seemed to be derived quantitatively from the strong Ames mutagen MX. In drinking water extracts, the compound was estimated to account for 20% to 50% of the total TA100 activity. The geometric isomer of MX, E-MX, has been tentatively identified in a mutagenic fraction of chlorine-treated humic water. The compound exhibited at most 10% of the MX mutagenicity. EX-MX was found in extracts of chlorinated humic and drinking waters at approximately the same concentration levels as MX and thus accounted only for marginal proportions of the activity in the extracts. Under the acid conditions, E-MX has the ability to isomerize to MX, but the isomerization rate seems to be too slow to cause any significant increase in the activity of consumed water. Although these results indicate that E-MX is not an important mutagen, the properties of E-MX have to be further evaluated until the compound can be excluded from discussions concerning drinking water mutagens. (See also W91-00476) (Lantz-PTT)
W91-00487

COMPARISON OF MUTAGENIC ACTIVITY OF CHLORINATED AQUATIC AND COMMERCIAL HUMIC SUBSTANCES.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W91-00488

IMPORTANCE OF GLUTATHIONE IN THE IN VITRO DETOXIFICATION OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE, AN IMPORTANT MUTAGENIC BY-PRODUCT OF WATER CHLORINATION.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W91-00489

CHLORINATION OF AQUATIC FULVIC ACID AND NATURAL WATERS: ADDITIONAL BY-PRODUCTS.
ENVIRON Corp., Washington, DC.
G. P. Thompson, R. F. Christman, and J. D. Johnson.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. 171-178, 6 fig, 3 tab, 8 ref.

Descriptors: *Chlorination, *Disinfection, *Fulvic acids, *Natural waters, *Water pollution sources, *Water treatment, Chlorine compounds, Chloroform, Organic compounds, Trihalomethanes, Volatile organic compounds.

Since the initial findings of chloroform and other trihalomethanes (THMs) in chlorine-treated drinking water, a large number of by-products have been observed. The by-products may be divided into the following classes: (1) chloroform and other THMs; (2) other purgeable chlorinated organic by-products; (3) trichloroacetic acid (TCAA), dichloroacetic acid (DCAA), and other short-chain chlorinated acids; (4) chlorohydroxyfuranones (CHFs) and chloroform precursors; and (5) recalcitrant by-products. Research was performed to determine if additional purgeable (volatile) by-products and extractable nonvolatile by-products could be isolated from chlorinated natural waters and fulvic acid solutions. Analyses of chlorinated high humic water and fulvic acid solutions yielded several significant results. Many volatile (purgeable) chlorinated organic compounds are produced by chlorination. But the concentrations of these compounds indicate that they do not account for a preponderance of the total organic halides (TOX). Short chain chlorinated acids are the predominant extractable by-products under the conditions used. The extremely important mutagen MX has been detected as a by-product of chlorination of both a pristine natural surface water and an aquatic prepared fulvic solution. The quantities of MX observed are very small; concentrations of < 2ng/L were observed. There is mass spectral evidence for additional chlorohydroxyfuranones or straight-chained analogs, but insufficient concentrations were obtained to confirm structures by mass spectral analysis. (See also W91-00476) (Lantz-PTT)
W91-00490

MUTAGENICITY OF THE NONVOLATILE REACTION PRODUCTS OF AQUEOUS CHLORINATION OF L-TRYPTOPHAN.
Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
For primary bibliographic entry see Field 5C.
W91-00491

CARCINOGENICITY OF CHLORINATED ACETIC ACIDS.
Health Effects Research Lab., Cincinnati, OH. Toxicology and Microbiology Div.
For primary bibliographic entry see Field 5C.
W91-00492

COMPARISON OF DRINKING WATER DISINFECTANTS USING MUTAGENICITY TESTING.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
W. B. Anderson, P. M. Huck, S. A. Daignault, G. A. Irvine, and D. W. Rector.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 201-225, 6 fig, 4 tab, 38 ref.

Descriptors: *Chlorination, *Disinfection, *Drinking water, *Mutagens, *Water pollution effects, *Water treatment, Ames test, Chloramination, Chloramines, Chlorine, Chlorine dioxide, Filtration, Granular activated carbon, Ozonation, Ozone.

Studies involving drinking water disinfectants have shown that chlorine produces high levels of mutagenic activity while chloramines and chlorine dioxide generally produce much less. Research was conducted using the Ames Salmonella typhimurium and yeast (Saccharomyces cerevisiae) mutagenic assays in parallel with chemical identification by gas chromatography/mass spectrometry (GC/MS), to assess the reaction products formed by the addition of the disinfectants chlorine, chloramine, chlorine dioxide, and ozone during drinking water treatment. Throughout the study, chlorination produced mutagenicity far more frequently in the Ames test than did chloramination, ozonation, or chlorine dioxide disinfection. Mutagenicity was observed occasionally in the chloramine post-filter. The chlorine dioxide post-filter position was examined and mutagenicity was never observed. Ozone was examined on five occasions and mutagenicity was observed once. Post granular activated carbon (GAC) disinfection with chlorine, chloramine, or chlorine dioxide did not produce mutagenicity in any of the salmonella strains examined, regardless of the oxidant which had been used prior to GAC. The results obtained with the Ames assay are generally consistent with the findings of other investigators, although some have reported mutagenicity following post GAC disinfection with chlorine, when chlorine or ozone were used as primary disinfectants. (See also W91-00476) (Lantz-PTT)
W91-00493

ORGANIC REACTIONS OF CHLORINE DIOXIDE IN DRINKING WATER-A MUTAGENIC ASSESSMENT.
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
R. Acha, E. Choshen, R. Bilts, M. Alburquerque, and N. Bass.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 227-238, 5 fig, 2 tab, 25 ref.

Descriptors: *Chemical reactions, *Chlorination, *Chlorine dioxide, *Disinfection, *Drinking water, *Mutagens, *Water pollution sources, *Water treatment, Ames test, Bacteria, Organic compounds, Oxidation, Potable water.

Chlorine dioxide (ClO2) primarily reacts with organic model compounds, such as an electron transfer oxidant, with the formation of oxygenated products such as diols, aldehydes, ketones, and carboxylic acids. Some aldehydes have been shown to react with native DNA and are suspected carcinogens. Such compounds have not been found in potable water to date; however, it is possible that toxic aldehydes as well as other carcinogenic compounds are produced during the course of water disinfection. The objectives of this investigation were to determine whether ClO2 disinfection produces unknown oxygenated products in drinking water, and to assess the possible mutagenic activity of disinfection products using the new Ames tester strain, TA104, which is particularly sensitive to oxidative mutagens. The quinones found as reaction products of ClO2 in natural waters can be rationalized in view of the partially polyphenolic nature of the humic substances. Benzoquinone has been described as an inhibitor of bacterial growth, and some quinones were found to be cytotoxic and to interact with native DNA. This can explain the reduced number of revertants in both S. typhimurium strains found after ClO2 treatment for both natural water and solutions of humic acid. The main finding of this study is that ClO2 markedly decreases the number of revertants, either because of a decrease in mutagenicity or because of cytotoxic effects. (See also W91-00476) (Lantz-PTT)
W91-00494

MUTAGENIC ACTIVITY OF CONCENTRATED WATER EXTRACTS IN CULTURED MAMMALIAN CELLS AND DROSOPHILA MELANOGASTER.
Research Ltd., Ware (England). Genetic Toxicology Section.
For primary bibliographic entry see Field 5C.
W91-00495

EVALUATION OF PROTOCOL FOR PREPARING DRINKING WATER SAMPLES FOR AMES MUTAGENICITY TESTING.
California Dept. of Health Services, Berkeley.
For primary bibliographic entry see Field 5A.
W91-00496

TOXICOLOGICAL EFFECTS ASSOCIATED WITH DRINKING WATER DISINFECTANTS AND THEIR BY-PRODUCTS.
Dugway Proving Ground, UT.
For primary bibliographic entry see Field 5C.
W91-00497

ASSOCIATION BETWEEN CHLORINATED DRINKING WATER AND DECREASED SERUM HDLC IN TWO MONKEY SPECIES DURING DIETARY ATHEROGENIC STRESS.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W91-00498

EFFECTS OF DRINKING WATER CHLORINE ON HUMAN LIPID AND THYROID METABOLISM.
Cincinnati Univ., OH. Coll. of Medicine.
For primary bibliographic entry see Field 5C.
W91-00499

EFFECT OF DRINKING WATER CONTAINING CHLORINE AND MONOCHLORAMINE ON CHOLESTEROL AND TRIGLYCERIDE LEVELS IN THE LIVER OF THE PIGEON AND RABBIT.
Oak Ridge Research Inst., TN.
For primary bibliographic entry see Field 5C.
W91-00500

LONG-TERM EFFECTS OF CHLORINE-CONTAINING DISINFECTANTS ON PLASMA LEVELS OF CHOLESTEROL AND THYROXINE IN RABBITS AND PIGEONS.
Oak Ridge Research Inst., TN.
For primary bibliographic entry see Field 5C.
W91-00501

BIOCHEMICAL MECHANISMS OF IN VITRO CHLOROPROPANONE TOXICITY.
Health Effects Research Lab., Cincinnati, OH. Toxicology and Microbiology Div.
For primary bibliographic entry see Field 5C.
W91-00502

FISH HEPATOCYTE MODEL FOR INVESTIGATION OF THE EFFECTS OF TRIHALOMETHANES.
Environmental Research Lab., Narragansett, RI.
For primary bibliographic entry see Field 7B.
W91-00503

CHLORINE DIOXIDE DEPRESSES T3 UPTAKE AND DELAYS DEVELOPMENT OF LOCOMOTOR ACTIVITY IN YOUNG RATS.
Miami Univ., Oxford, OH. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-00504

REVIEW OF RECENT EPIDEMIOLOGICAL STUDIES REPORTING ASSOCIATIONS BETWEEN DRINKING WATER DISINFECTION AND CANCER.
Environmental Protection Agency, Cincinnati, OH.
P. A. Murphy, and G. F. Craun.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 361-372, 1 tab, 35 ref.

Descriptors: *Cancer, *Chlorination, *Epidemiology, *Literature review, *Public health, *Water pollution effects, *Water treatment, Disinfection, Human diseases.

The process of water disinfection creates a variety of potential exposures for the general public. Concern about the health problems created by these exposures has led to a research agenda that attempts to define exactly what these health risks are and the extent to which they might contribute to the overall cancer burden in the population. Analytical case control studies have shown a modest increase in the risk of bladder cancer and colon cancer in populations with relatively long-term exposure to chlorinated drinking water. Attributable fraction estimates indicate approximately 28% of nonsmoking, low risk bladder cancer cases in one study may be attributed to exposure to chlorinated drinking water if the association is known to be a causal one. This figure should be interpreted very cautiously because there is very likely a high degree of error associated with it, such as misclassification of exposure and confounding factors which may be responsible for different findings among epidemiological studies. The issue of whether a causal relationship exists between certain cancers and chlorinated drinking water exposure will not be decided easily and must await the results of several ongoing investigations in this area. (See also W91-00476) (Lantz-PTT)
W91-00505

CASE-CONTROL STUDY OF COLON CANCER AND VOLATILE ORGANICS IN WISCONSIN MUNICIPAL GROUNDWATER SUPPLIES.
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5C.
W91-00506

CASE-CONTROL STUDY OF MULTIPLE CANCER SITES AND WATER CHLORINATION IN IOWA.
Iowa Univ., Iowa City. Dept. of Preventive Medicine and Environmental Health.
For primary bibliographic entry see Field 5C.
W91-00507

CASE-CONTROL STUDY OF BLADDER CANCER IN MASSACHUSETTS AMONG POPULATIONS RECEIVING CHLORINATED AND CHLORAMINATED DRINKING WATER.
Brown Univ., Providence, RI. Dept. of Community Health.
For primary bibliographic entry see Field 5C.
W91-00508

BLADDER CANCER, TAP WATER CONSUMPTION, AND DRINKING WATER SOURCE.
National Cancer Inst., Bethesda, MD.
For primary bibliographic entry see Field 5C.
W91-00509

SERUM LIPID LEVELS IN NEIGHBORING COMMUNITIES WITH CHLORINATED AND NONCHLORINATED DRINKING WATER.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5C.
W91-00510

DEVELOPMENT AND CALIBRATION OF A MODEL FOR PREDICTING OPTIMUM CHLORINATION SCENARIOS FOR BIOFOULING CONTROL.
Miami Univ., Coral Gables, FL. Dept. of Civil and Architectural Engineering.
For primary bibliographic entry see Field 5C.
W91-00516

MEASUREMENT OF CHLORINE RESIDUALS IN CHLORINATED COOLING WATERS: EFFECT OF ORGANIC NITROGEN.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00517

MANGANESE DEPOSITION IN CHLORINATED POWER PLANT COOLING WATER.
Public Service Electric and Gas Co., Newark, NJ.
R. Sugam, J. F. Garey, and J. M. White.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 545-554, 2 tab, 8 fig.

Descriptors: *Biofouling, *Chlorination, *Electric powerplants, *Manganese, *Scaling, *Water pollution effects, *Water treatment, Ammonia, Chlorine compounds, Cooling water, New Jersey, Salem.

Studies of biological fouling carried out at the Public Service Electric and Gas Company (PSE and G) Salem (New Jersey) Generating Station between 1984 and 1985 showed that continuous chlorination at a level of 0.3 to 0.5 ppm total residual chlorine (TRC) effectively controlled macrofouling in a mock-up of the plants service water system. However, this treatment promoted scale deposits of iron and manganese, which increased the risk of corrosion and an expected decline in heat exchanger efficiency. In 1986, follow-up studies based on our 1984-1985 findings were carried out at the Salem Station to explore the effects of several variables on scale deposition and to test some control methods. Preliminary results of this work (principally for manganese) are presented here. Manganese was deposited as a direct result of continuous chlorination. With no chlorination there was little deposition. Although previous macrofouling studies at the site indicated that intermittent chlorination caused deposition, it was evident only at very high TRC levels. Manganese scaling at the Salem site is a direct consequence of continuous chlorination of the source water. Monochloramine, produced in a reaction between abundant ammonia and free chlorine, prevented scale deposition over the duration of the tests in the season when they were conducted. Proprietary compounds tested were less effective. (See also W91-00476) (Lantz-PTT)
W91-00518

MICROBIOFOULING ON PLASTIC PACKING IN COOLING TOWERS: A CASE FOR CHLORINE TREATMENT.
Central Electricity Generating Board, Leatherhead (England). Technical Planning and Research Div.
J. W. Whitehouse, and J. Coughlan.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 555-563, 2 fig, 5 tab, 5 ref.

Descriptors: *Biofouling, *Chlorination, *Cooling towers, *Water treatment, Biological treatment, Chlorine, Plastics.

The buildup of fouling on cooling tower splash packs is limited by the relatively small surface area of the packs and by the incessant impact of water droplets. By contrast, the labyrinthine construction of the alternative film-forming type of pack encourages the growth of bacterial slimes and the codeposition of silt and scales. This leads to large increases in pack weight that can pose a threat to the structural integrity of the packs and its supports, and can also impair thermal performance. There are three interrelated problems here. Initially, the weight of the pack must be controlled to avoid damage to the packs and its supports. Second, there are indications from full size towers

that fouling build-up is reducing the predicted savings. Third, the only immediately available control strategy appears to be a resumption of biocide (specifically chlorine) dosing. Adoption of continuous low-level chlorination at prevailing demands resurrects problems of transport and storage and discharge to the waterway. If the rate of makeup were to be reduced by operating the cooling circuits at a higher CF, there would be a reduction in the input of sediment, nutrients and chlorine demand, and the volume of chlorinated water purged to the waterway also would be reduced. Comparisons of plastic tower packings from wastewater treatment plants show that while nutrient loading on the latter is far higher, overall weight gains are similar. (See also W91-00476) (Lantz-PTT)
W91-00519

TARGETED CHLORINATION SCHEDULES AND EFFECTS ON HEAT TRANSFER.
Stone and Webster Engineering Corp., Boston, MA.
Y. Mussalli, W. Chow, S. Sengupta, and T. Waite.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 565-576, 11 fig, 1 tab, 5 ref.

Descriptors: *Biofouling, *Chlorination, *Heat transfer, *Water treatment, Chlorine, Chlorine compounds, Condensers.

Biofouling is a major cause of reduced heat transfer in condensers: it leads to diminished plant performance and availability. Chlorination, the conventional method of biofouling control, has become less effective since the EPA lowered the allowable discharge concentrations of chlorine residuals to 0.2 mg/L total residual chlorine and restricted discharge to 2-hr/plant. The Electric Power Research Institute (EPRI) has sponsored research on a number of alternative biofouling control techniques. Targeted chlorination involves the application for short periods of time (10-15 min) of a high dose chlorine solution (1 to 5 ppm) to selected fractional areas of the inlet tube sheet of the condensor. The objectives of targeted chlorination are to: (1) use chlorine more efficiently; (2) improve the thermal performance of condensors; and (3) meet regulatory requirements for chlorine effluents. The preliminary targeted chlorination investigations sponsored by EPRI were successful in demonstrating effective chlorination schedules to maintain the cleanliness of condensor tubes. The chlorination predictive model can aid in minimizing chlorine use while achieving clean tubes and high heat transfer coefficients. The targeted chlorination schedules of 0.5 to 2 ppm require about 10 to 15 min duration and two applications per day. These schedules may require the chlorination of only two to six fractional sections of the tube sheet at a time and will result in only minor water box modifications. A full scale demonstration is being conducted at the Brayton Point Station Unit 2 Condensor to evaluate the effect of several targeted chlorination schedules on thermal performance. (See also W91-00476) (Lantz-PTT)
W91-00520

BY-PRODUCTS OF CHLORINATION AT TEN OPERATING UTILITIES.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W91-00521

ORGANIC HALIDE FORMATION DURING WATER TREATMENT UNDER FREE CHLORINE VERSUS CHLORAMINATION CONDITIONS.
Arizona Univ., Tucson. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00522

EFFECT OF PREOZONATION ON TRIHALOMETHANE AND TOTAL ORGANIC HALOGEN FORMATION AT THE LOUISVILLE WATER COMPANY.
Louisville Water Co., KY.
S. A. Hubbs, and J. C. Smith.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 623-631, 5 fig, 4 ref.

Descriptors: *Chlorination, *Louisville, *Ozonation, *Pretreatment of water, *Trihalomethanes, *Water pollution sources, *Water treatment, Chloramines, Halides, Kentucky.

One of the more promising treatment techniques investigated for trihalomethanes (THM) control used ozone as an oxidant prior to the application of free chlorine. This treatment process may be applicable where maintenance of a free chlorine residual is required by state regulating agencies. For the Louisville Water Company (LWC), the accomplishment of breakpoint chlorination has been required to minimize taste and odor problems resulting from subsequent oxidation with chlorine dioxide or chloramines. Data on the application of ozone prior to free chlorine were collected at a pilot plant scale for a range of raw water conditions at LWC, with the intention of evaluating how this combination of oxidants might work in the LWC disinfection process. The use of ozonation prior to chlorination might be effective in a treatment scheme incorporating conventional coagulation and sedimentation, ozonation with the appropriate reaction time (20 min), free chlorination with an appropriate reaction time (30 min), ammoniation and pH adjustment from 8.0 to 8.5 for the formation of chloramines and corrosion control, and conventional filtration. Such a treatment scheme at LWC might be expected to reduce total THM (TTHM) and total organic halide levels in the distribution system by about 50% as compared with a similar treatment scheme without ozonation. For conditions experienced at LWC, the resultant TTHM levels would be expected to fall in the range of 10 to 15 micrograms/L as an annual average. (See also W91-00476) (Lantz-PTT)
W91-00523

TRIHALOMETHANE FORMATION POTENTIAL AND ORGANIC CONTENT: A NEW ANALYTICAL APPROACH.
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
A. Bruchet, C. Anselme, J. P. Duguet, and J. Mallevialle.
Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 633-648, 14 fig, 17 ref.

Descriptors: *Chemical reactions, *Chlorination, *Humic acids, *Pollutant identification, *Trihalomethanes, *Water pollution sources, *Water treatment, Lignin, Organic carbon, Pyrolysis, Tannins.

Studies have shown that chlorination by-products are widespread throughout the world and that polyhydroxyaromatic structures present in humic substances are probably the main trihalomethane (THM) precursors. The concentration of THMs formed during chlorination has been correlated with various nonspecific parameters such as raw water dissolved organic carbon (DOC), UV absorbance, and chlorine demand. A method based on a degradative technique, pyrolysis-gas chromatography/mass spectrometry (GC/MS), was developed to further understanding of the relationship between THM formation potential (THMFP) and DOC. This method was applied to various standard compounds such as lignins, tannins, and humic substances, and to several selected waters, to characterize the THMFP of the waters as a function of their macromolecular content. Investigation of several high-molecular weight substances in groundwater and surface waters has shown an important variation in their THMFP. The use of a degradative technique, pyrolysis-GC/MS, has revealed the capability to precisely determine the organic content of the samples, thus leading to a better understanding of THM precursors. It is also possible to determine the approximate proportion of the different types of biological macromolecules, such as polyhydroxyaromatics, carbohydrates (neutral sugars and N-acetylaminosugars), and peptidic material. Using this method, a good relationship was found between the THMFP, the origin, and the macromolecular content of various waters. (See also W91-00476) (Lantz-PTT)
W91-00524

CHLOROFORM FORMATION BY THE TRANSFER OF ACTIVE CHLORINE FROM MONOCHLORAMINE TO PHLOROACETOPHENONE.
RPC Environmental Management, Inc., Chicago, IL.
For primary bibliographic entry see Field 5B.
W91-00525

TRIHALOMETHANE FORMATION AND DISTRIBUTION IN BROMIDE-RICH AND AMMONIA-CONTAINING LAKE WATER.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00526

CHLORINATION OF SURFACE WATERS: EFFECTS OF BROMIDE CONCENTRATION ON THE CHLOROPICRIN FORMATION POTENTIAL.
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5B.
W91-00527

CORRELATIONS BETWEEN MEASUREMENTS OF ORGANIC HALIDE AND SPECIFIC HALOGENATED VOLATILE ORGANIC COMPOUNDS IN CONTAMINATED GROUNDWATER.
Arizona Univ., Tucson. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00528

EFFECTS OF COPPER (II) ON THE PRODUCTION OF TRIHALOMETHANES IN MODEL AND NATURAL WATERS.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
For primary bibliographic entry see Field 5B.
W91-00529

DEVELOPMENT OF CHLORINE DEMAND KINETICS IN A DRINKING WATER TREATMENT PLANT.
Compagnie Generale des Eaux, Paris (France).
C. Ventresque, G. Bablon, B. Legube, A. Hecart, and M. Dore.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 715-728, 8 fig, 6 tab, 28 ref.

Descriptors: *Chlorination, *Chlorine, *Drinking water, *Kinetics, *Water treatment, Chemical reactions, Filtration, France, Odors, Potable water, Seine River, Taste, Total organic carbon.

Numerous researchers have identified and quantified several haloorganics including trihalomethanes (THMs), chloroacetic acids, dihaloacetonitriles, and chloroaromatic acids. Extensive studies have shown that this type of organic compound accounts for only 50% of the total organic halogens (TOX) in chlorinated humic solutions. Chloro-

phenols have long been known as precursors to an unpleasant taste in chlorinated drinking water. However, the identities of other chlorination by-products responsible for tastes and odors are generally not well known. The general purpose of this study is to try to identify the organic components (that react with chlorine) of the Seine River water coming to the final treatment step at the Choisy-le-Roi potable waterworks near Paris. Chlorine consumption kinetics are presented from samples of water taken after sand filtration and ozone/granular activated carbon filtration treatment steps, and of treated water after laboratory ultrafiltration. The kinetics profiles of treated drinking water (before and after ultrafiltration) indicates that the initial chlorine demand (after 4-h of chlorination) of disturbed water was 0.6-1.0 mg/L (initial dosage of 2 mg Cl2 per mg total organic carbon (TOC), with TOC = 2 mg/L). The long-term chlorine demand of distributed water was interpreted in terms of second order kinetic constants (k = 0.1/M/s) and the potential for long-term chlorine demand (b = 2.5 to 4.5 X 0.00010 mol/L. The initial chlorine demands and the kinetic constants of ozone/GAC-treated waters were always lower than those obtained from sand-filtered water, demonstrating the well known effect of activated carbon on the removal of organic matter. (See also W91-00476) (Lantz-PTT)
W91-00530

FURTHER STUDIES OF HYPOCHLORITE ION PAIR CHEMISTRY AND DISINFECTION EFFICIENCY.
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. Haas, C. D. Trivedi, and J. R. O'Donnell.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 729-740, 5 fig, 2 tab, 15 ref.

Descriptors: *Chemical reactions, *Chlorination, *Disinfection, *Hypochlorite, *Water treatment, Anions, Cations, Chlorine, Ion transport.

Previous studies have shown that lithium, sodium and potassium cations can form ion pairs with hypochlorite that are titratable potentiometrically, and that enhance the disinfection efficiency of free chlorine to coliforms. A report on investigations that were conducted to measure the ion pair formation using a different experimental methodology and to determine whether enhancement of biocidal efficiency by ion pairs would also occur when ammonia was present, (thus resulting in a stable combined residual) is presented. The effect of ionic environment on the spectrophotometric absorbance of hypochlorite anion was used to study the chemistry of ion pairing. Escherichia coli was used in the disinfection microbiology studies. Results indicate that the alkali cations (lithium, sodium, and potassium) produce measureable changes in the physical-chemical properties of hypochlorite consistent with the formation of a 1:1 ion pair with the hypochlorite anion. The dissociation constants measured spectrophotometrically are somewhat greater than those previously obtained from titration. Data obtained in this work suggest that the ion-pairing phenomenon may also influence the reaction rate with ammonia, and that there may be some nonadditivity of the inactivation rates of free chlorine and monochloramine during dynamic chlorination. (See also W91-00476) (Lantz-PTT)
W91-00531

INFLUENCE OF ORGANIC NITROGEN COMPOUNDS ON THE PRODUCTION OF ORGANOCHLORINE COMPOUNDS IN THE CHLORINATION OF HUMIC MATERIAL.
Technische Hogeschool Delft (Netherlands). Lab. for Analytical Chemistry.
E. de Leer, C. Erkelens, and L. de Galan.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 763-781, 10 fig, 5 tab, 20 ref.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Nitrogen compounds, *Water pollution sources, *Water treatment, Amino acids, Chemical reactions, Chloroform, Humic acids.

The production of chloroform in the chlorination of humic acid is strongly influenced by the presence of nitrogen compounds. Compounds with free amino groups, such as primary amines and amino acids, react preferentially with chlorine almost completely suppress the production of chloroform until the breakpoint reaction. Less reactive nitrogen compounds, such as urea and uracil, show no marked influence when low amounts of chlorine are added. However, they do suppress chloroform production at higher chlorine concentrations, due to oxidation reactions. The chlorination of humic materials is known to give several by-products that cannot be explained on the basis of aromatic-type precursors, such as resorcinol derivatives. Amino acids, purine, or pyrimidine residues, which form an integral part of the humic acid structure, may explain the production of chlorinated compounds such as di-chloropropanedioic acid and 2,2-dichlorobutanedioic acid. (See also W91-00476) (Lantz-PTT)
W91-00534

INACTIVATION OF E. COLI SUSPENSION BY CHLORINE: IMPLICATION OF CHLORINATION OF ALPHA-AMINO ACIDS AND URACIL.
Ecole Nationale Superieure de Chimie de Rennes (France). Lab. de Chimie des Nuisances et Genie de l'Environnement.
H. L. Benabdesselam, J. Poncin, and G. Martin.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 783-794, 6 fig, 2 tab, 16 ref.

Descriptors: *Amino acids, *Chlorination, *Escherichia coli, *Uracil, *Water treatment, Bacteria, Bacterial physiology, Chloramines, Disinfection.

During water chlorination, different substances can react with oxidizing agents, especially nitrogenic substances. Free chlorine reacts rapidly with ammonia to generate gas phase chloramines and nitrogen. With some aliphatic amino acids, the effect of chlorine is known to lead to the formation of aldehydes and nitriles. The very presence of several chlorine derivatives in drinking water shows the existence of several other possible reactions with other substances. This work describes experiments in chlorination of a suspension of E. coli under conditions comparable with those used for water disinfection with chlorine. The phenomenon of cell membrane permeability alteration of inactivated bacteria is apparently enhanced by exposure to chlorine. Exposure of E. coli to chlorine results in the leakage of substances such as amino acids, uracil and phosphates. The large presence of phosphates in the membrane led the authors to theorize that the bacteria have been actually damaged, and that such damage causes leakage of internal constituents of the cell. The nitro-organic substances ejected by bacteria are quickly eliminated by reaction with free chlorine. Thus, schemes or reactive mechanisms of the chlorination process are suggested. (See also W91-00476) (Lantz-PTT)
W91-00535

CHLORINE AND MONOCHLORAMINE MEASUREMENTS USING A PULSED SILVER IODIDE ELECTRODE.
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-00536

CHLORAMINE INTERFERENCE IN THE MEASUREMENT OF FREE CHLORINE BY THE AMPEROMETRIC MEMBRANE ELECTRODE.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W91-00537

CHLORINATED ORGANIC BY-PRODUCTS OF THE REACTION OF N-CHLOROPIPERIDINE WITH STOMACH FLUID FROM LABORATORY ANIMALS.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
For primary bibliographic entry see Field 5B.
W91-00538

SOME PHYSICAL AND CHEMICAL CHARACTERISTICS OF AN UNIDENTIFIED PRODUCT OF INORGANIC CHLORAMINE DECOMPOSITION.
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
R. L. Valentine, and G. G. Wilber.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 819-832, 9 fig, 2 tab, 11 ref.

Descriptors: *Chloramines, *Chlorination, *Path of pollutants, *Water pollution sources, *Water treatment, Chemical analysis, Chemical properties, Chemical reactions, Chlorides, Chlorine, Physical properties, Polarity, Pollutant identification.

Chloramine solutions are inherently unstable at neutral pH and slowly decompose via a complex series of chlorine transfer and redox reactions, ultimately leading to the oxidation of ammonia-nitrogen and reduction of chlorine to chloride. Several studies have reported spectrophotometric evidence of the formation of another unknown product. The product, which exhibits a peak absorbance near 240 nm, has been shown to accumulate as chloramine species decompose. This study was undertaken to further characterize some physical and chemical properties of the unidentified species that may be of value in helping to isolate and identify its structure, and in determining its significance and fate under conditions encountered during water treatment. The unidentified product is very polar and ionic, since it could not be extracted into several common organic solvents. The species does not appear to be a cation. Its reactivity with activated carbon and two common amine based anion resins suggests that it may be reactive toward organic compounds found in drinking water. The equivalent absorptivity values indicate that the unidentified product was a minor product relative to nitrogen gas and chloride ion in these studies. (See also W91-00476) (Lantz-PTT)
W91-00539

CHEMISTRY OF BROMINE TRANSFER: DISPROPORTIONATION AND HYDROLYSIS IN BROMAMINE SYSTEMS.
Hartford Univ., West Hartford, CT. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W91-00540

PROPOSED MECHANISM FOR THE REACTIONS OF CHLORINE DIOXIDE WITH AQUATIC ORGANIC MATERIALS.
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
R. Acha, E. Choshen, R. Blits, and O. Grafstein.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 849-857, 5 fig, 2 tab, 21 ref.

Descriptors: *Chemical reactions, *Chlorine dioxide, *Organic matter, *Path of pollutants, *Water treatment, Alkenes, Chlorination, Chlorine, Disin-

fection, Drinking water, Hydrocarbons, Olefins, Styrene.

Chlorine dioxide is becoming a viable alternative to chlorine for disinfecting drinking water and for the treatment of effluents. One of the main reasons for this is that it does not produce trihalomethanes and that it produces much smaller amounts of chlorinated compounds. It is clear that being an active chemical, chlorine dioxide may react with aquatic organic materials to produce other products of a largely unknown nature. A better understanding of the mechanisms by which ClO2 reacts may provide an important basis for the prediction of it's by-products and their health effects. It is quite natural that radical mechanisms have been postulated for the reactions of ClO2 with various hydrocarbons in light of its electronic structure and odd number of electrons. Thus, its reactions with alkenes possessing allylic hydrogens have been viewed as proceeding via the abstraction of allylic hydrogen. Styrene clearly reacts with ClO2 by an electron transfer process. However, the question still exists about whether other olefins possessing allylic hydrogens will also react by a similar pathway, or whether they might also react by a hydrogen abstraction process. Indene and allylbenzene that contain very active allelic (or benzoic) hydrogens react similarly to styrene. Reactivities of various alkenes with ClO2 correlate with their ionization potentials. The order of reactivities of the various olefins with ClO2 is at variance with either the radical mechanism or the hydrogen abstraction process. A regular acid-catalyzed addition reaction is also very unlikely. (See also W91-00476) (Lantz-PTT)
W91-00541

HYDROLYSIS CONSTANTS OF CHLORINE MONOXIDE AND BROMINE CHLORIDE IN WATER.
Stanford Univ., CA.
For primary bibliographic entry see Field 5B.
W91-00542

OZONATION OF ALACHLOR: EFFECTS AND SUITABILITY AS A TREATMENT TECHNOLOGY.
F. L. Mink, and J. R. Rickabaugh.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 871-882, 8 fig, 1 tab, 4 ref.

Descriptors: *Alachlor, *Chemical reactions, *Ozonation, *Water treatment, Disinfection, Herbicides, Ozone, Toxicity.

Alachlor (2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl) acetamide) is a widely used preemergence herbicide. Concern has been shown by the EPA because alachlor has been found in ground and surface waters in concentrations > 100 ppm. A study was initiated to determine the mechanism and suitability of ozonation of alachlor as a treatment technology. Reports have shown a high destruction rate of alachlor by ozone, but the by-product formation and mechanism rate of this reaction (or reactions) was previously uninvestigated. One major stable reaction product was formed upon ozonation of alachlor (> 100 ppb). The reaction itself is rapid (<2.5-15 min) and driven to a low rate of completion depending on concentration (8-10%). The methoxyl group of the methoxymethyl moiety on alachlor can act as an electron-donating group. Ozone can act as a nucleophilic agent. Ozone rapidly attacks the more negative pole of terminal hydrogens of the methoxymethyl group on alachlor and replaces the hydrogens with oxygen molecules. Carbon-hydrogen bonds have been shown to be susceptible to attack by ozone. Alachlor was oxidized by ozone dehydrogenation of the N-methyl group. The drawback of alachlor ozonation is the production of a by-product of unknown toxicity at higher levels (0.100 ppb). Since these levels are rarely if ever encountered in environmental samples (natural groundwater and surface waters) this is of little concern. Ozone at reasonable contact times and low doses is an efficient treatment technology for the removal of alachlor from drinking water. (See also W91-00476) (Lantz-PTT)
W91-00543

FACTORS THAT CHANGE BACTERIAL RESISTANCE TO DISINFECTION.
California Univ., Irvine.
B. H. Olson, and M. Stewart.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 885-904, 6 fig, 8 tab, 44 ref.

Descriptors: *Bacteria, *Bacterial physiology, *Disinfection, *Microbiological studies, *Water treatment, Biological studies, Growth, Nutrients.

Data is presented in this paper from previously published and current research suggesting that a number of factors influence an organism's susceptibility to a disinfectant. These factors include: differential disinfection resistance; distribution in the water; differential genera response; environmental strain variation; growth condition effects; nutrient effects of noncarbon constituents; and selection for disinfection resistance. Primary among these is the organism's ability to withstand exposure to disinfection. This is mediated through physiological changes in the organism itself or through its association with physical factors in the environment that enhance survival. The data generated to date indicate that this is a complex set of interacting variables that will require detailed experimentation before complete understanding is achieved. Currently, better laboratory models can be developed by testing organisms from a variety of environments or hosts as opposed to relying on one test strain. Testing those organisms that grow outside the host after exposure to nutrient conditions will provide bacterial tolerance to disinfection more closely resembling that occurring in water distribution systems. (See also W91-00476) (Lantz-PTT)
W91-00544

DISINFECTION OF BACTERIAL BIOFILMS.
American Water Works Service Co., Inc., Belleville, IL. Belleville Lab.
M. W. LeChevallier.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 905-915, 5 fig, 2 tab, 27 ref.

Descriptors: *Bacteria, *Biofilms, *Disinfection, *Water treatment, Chloramines, Chlorine, Hypochlorous acid.

An investigation was conducted in order to examine the disinfection of biofilm bacteria and to characterize the interaction of biocides with microbial interfaces. The results suggest that penetration of the disinfectant to the biofilm surface may be a major rate limiting step. Data indicated that monochloramine, despite being a weaker disinfectant, was better able to penetrate and inactivate biofilms growing on a variety of surfaces. The attachment of bacteria to surfaces interferes with disinfection efficiency; ie., attachment of bacteria to a glass surface decreased the disinfection efficiency of free chlorine over 75 fold. Complex biofilms also decreased free chlorine disinfection efficiency by more than 600 fold. Of the compounds tested, monochloramine showed the greatest ability to penetrate and inactivate biofilm bacteria. For biofilm grown on granular activated carbon, 1 mg/L monochloramine showed the same disinfection efficiency as 1 mg/L hypochlorous acid. Additional research is necessary to model the interaction of disinfectants with microbial biofilms. (See also W91-00476) (Lantz-PTT)
W91-00545

NEW HALAMINE WATER DISINFECTANTS.
Auburn Univ., AL. Dept. of Chemistry.
S. D. Worley, D. E. Williams, S. B. Barnela, and L. J. Swango.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 931-942, 7 fig, 1 tab, 14 ref. Army Medical Research and Development Command Contract DAMD 17-82-C-2257.

Descriptors: *Disinfection, *Halamines, *Wastewater treatment, *Water treatment, Bromine, Bromine compounds, Chlorine, Chlorine compounds, Organic compounds, Potable water.

The evaluation of three new N-halamine biocides in the imidazolidinone class is reported. These biocides were recently synthesized and are more stable and efficacious as disinfectants than are their oxazolidinone counterparts. It is expected that they will receive considerable attention in the commercial sector in the near future. The three new N-halamine disinfectants are: Compound A (1,3-dichloro-4,4,5,5-tetramethyl-2-imidazolidinone); Compound AB (1,3-dibromo-4,4,5,5-tetramethyl-2-imidazolidinone) and; Compound ABC (1-bromo-3-chloro-4,4,5,5-tetramethyl-2-imidazolidinone).
There are a number of possible applications for the new N-halamine disinfectants. Compound A could be used in applications for which long-term disinfection is required, but contact time is relatively unimportant (e.g., cooling towers, air conditioning systems, and swimming pool winterization). It could also be used in hot tubs because of its great stability at elevated temperatures. Compound AB would be useful in applications requiring fairly rapid disinfection with more stability than afforded by free chlorine or free bromine (potable water in remote locations). Compound ABC may be the most useful of the new compounds because the bromine moiety causes rapid disinfection, while the chlorine moiety contributes long-term disinfection. All of the new compounds are considerably less corrosive than free halogen toward materials. It should be emphasized that toxicology testing has not been completed for the new compounds, but is in progress in the industrial sector. (See also W91-00476) (Lantz-PTT)
W91-00547

WATER CHLORINATION: IS THERE ENVIRONMENTAL RISK.
Virginia Inst. of Marine Science, Gloucester Point.
M. H. Roberts.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 969-970.

Descriptors: *Chlorination, *Water pollution effects, *Water treatment, Aquatic environment, Chlorine, Disinfection, Environmental effects.

Awareness of chlorination as a significant environmental problem has led to better control of chlorination, to a considerable degree abating, though certainly not eliminating, acute environmental impacts. Clearly, there are complex chlorination by-products that are not removed by dechlorination. Nevertheless, while the biological significance of these compounds at ambient concentrations is unknown, no research is being funded to fill this data gap. The detection limit for chlorine residuals remains essentially unchanged over the past decade. Chronic exposure to low-level residual or by-product concentrations never received much attention, largely because of limitations in analytical chemistry. During the period that interest in environmental impacts of chlorine residuals has declined, there have been two significant findings that have focused attention on other chlorine-related issues: first, efforts to identify chlorination by-products led to the discovery of a variety of exotic reactive chemical species that might be expected to have ominous human health impacts; second, a relationship has been established between the incidence of

certain cancers and use of chlorinated drinking water. Research work is still needed in at least three areas: (1) To determine whether there are any significant effects of highly reactive compounds such as MX on individual aquatic organisms, and whether these compounds pose a threat to aquatic communities; (2) To determine whether by-products of chlorination, such as MX, accumulate in food chains, eventually reaching man; and (3) What type, if any, tumerogenic impacts exist against fish exposed to chlorination by-products. (See also W91-00476) (Lantz-PTT)
W91-00550

MICROBIOLOGICAL PERSPECTIVE ON RISKS FROM WATER CHLORINATION.
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 971-972, 1 tab, 5 ref.

Descriptors: *Chlorination, *Microbiology, *Water pollution effects, *Water treatment, Disinfection, Human diseases, Potable water, Public health, Water quality.

It is apparent that some risks, particularly from carcinogenicity of chlorine and/or its by-products, exist. However, it is important that environmental professionals not lose sight of the potential risks for increase in infectious disease if, in the process of 'optimizing' chlorination practice, the microbial quality of finished potable water supplies is allowed to deteriorate. Waterborne disease outbreaks arise through a variety of causes, including insufficient treatment other than disinfection. For example, inadequate filtration was one cause for a waterborne outbreak of rotavirus in Colorado. Similarly, cross-connections, possibly coupled with inadequate disinfection residuals at the consumer's tap, may have been responsible for a massive waterborne outbreak of Norwalk Agent in Georgia. Even at present, the risk of cancer from chlorine by-products may balance out the risks from disease associated with waterborne pathogens. For example, assuming that 15% of the bladder cancers in the United States may be attributable to water chlorination, an annual mortality rate of about 0.65/100,000 can be computed. On the other hand, the overall mortality from intestinal infectious diseases, meningitis, and hepatitis A is about 0.5/100,000 per year. There are also a substantial number of illnesses from reportable diseases that might plausibly arise from a variety of exposures, including drinking water. However, the fraction of the deaths and illnesses that may be attributable to drinking water exposure is uncertain at present. (See also W91-00476) (Lantz-PTT)
W91-00551

REMOVAL OF DBCP (1,2-DIBROMO-3-CHLOROPROPANE) FROM GROUNDWATER. VOLUME 1. POE/POU (POINT OF ENTRY/POINT OF USE) TREATMENT DEVICES INSTITUTIONAL AND JURISDICTIONAL FACTORS.
California State Univ., Fresno.
K. E. Longley, G. P. Hanna, and B. H. Gump.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-198808. Price codes: A07 in paper copy, A01 in microfiche. Report No. EPA/600/2-89/029, June 1989. 51p, 14 fig, 2 tab, 18 ref, 3 append. EPA Cooperative Agreement CR-812227.

Descriptors: *Granular activated carbon, *Water quality management, *Water treatment, Drinking water, Filters, Filtration, Institutional constraints, Maintenance, Monitoring, Performance evaluation, Potable water, Quality control, Water quality.

The results obtained from evaluating ten granular activated carbon (GAC) point-of-entry (POE) devices show that while these GAC units generally function satisfactorily, their performance can change markedly over short periods of time. These results require conscientious, periodic monitoring. This monitoring appears to be a significant shortcoming in the application of this technology. During the course of the study, operation and maintenance problems were encountered with three of the ten units monitored. A potential health risk exists for those individuals who unwittingly drink contaminated water that is inadequately treated using point-of-entry/point-of-use (POE/POU) technology due to monitoring or operation and maintenance shortfalls. A third party evaluation of POE/POU treatment equipment to verify the manufacturers' claims is an important mechanism for providing consumer protection. Such an equipment testing program could be established by legislation and implemented through a state laboratory. Or, one or more independent testing facilities could be designated by the state and financed by fees from equipment vendors who wish to market their products within the state certification of specific types of POE/POU Treatment Devices that can have an adverse effect on consumer health if they do not function properly. (Lantz-PTT)
W91-00558

POINT-OF-ENTRY DRINKING WATER TREATMENT SYSTEMS FOR SUPERFUND APPLICATIONS.
PEI Associates, Inc., Cincinnati, OH.
C. D. Chambers, and T. A. Janszen.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-195010. Price codes: A05 in paper copy, A01 in microfiche. Report No. EPA/600/2-89/027, June 1989. 69p, 4 fig, 5 tab, 8 ref, 3 append. EPA Contract No. 68-03-3413.

Descriptors: *Drinking water, *Point-of-entry water treatment, *Potable water, *Superfund, *Water treatment, Air stripping, Filtration, Granular activated carbon, Maintenance, Monitoring, Performance evaluation.

The EPA and State Superfund agencies need a technical assistance manual to assist their personnel in the selection of an effective drinking water treatment system for individual households in areas where the drinking water has been adversely affected by superfund site contaminants, and no other alternative water supply is available or feasible. Commercially available water treatment systems for individual households are of two basic types: (1) point-of-use (POU) and point-of-entry (POE). A POU device consists of equipment applied to selected water taps to reduce contaminants at each tap. A POE device consists of equipment to reduce the contaminants in the water distributed throughout the entire structure of a house. This study was initiated to collect monitoring, operation and maintenance, performance and design data on existing Superfund POE water treatment systems. Evaluation of the collected data showed that the existing data are not sufficient for the preparation of a technical assistance document to meet the objectives of EPA and State Superfund personnel. Therefore, additional studies are needed to develop the technical assistance document. Because most of the existing data and field experience related to POE water treatment is concerned with granular activated carbon filters and air strippers for the treatment of organic contaminants, further detailed study should center around these two technologies. (Author's abstract)
W91-00572

REDUCTION OF PHOSPHORUS AND CHLOROPHYLL A CONCENTRATIONS FOLLOWING CACO3 AND CA(OH)2 ADDITIONS TO HYPEREUTROPHIC FIGURE EIGHT LAKE, ALBERTA, CANADA.
Alberta Univ., Edmonton. Dept. of Zoology.
E. E. Prepas, T. P. Murphy, J. M. Crosby, D. T. Walty, and J. T. Lim.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1252-1258, August 1990. 8 fig, 3 tab, 43 ref.

Descriptors: *Algal control, *Calcium, *Chlorophyll a, *Eutrophic lakes, *Figure Eight Lake, *Lake restoration, *Liming, *Phosphorus removal, *Water quality control, Canada, Chemical treatment, In situ treatment, Limiting nutrients, Phytoplankton.

Lime (CaCO3 or Ca(OH)2) was added a total of four times to hard-water, hypereutrophic, Figure Eight Lake, Alberta, Canada. Within 14 days of treatment, chlorophyll a concentrations (Chla) decreased to less than half the values measured just prior to treatment; there was no short-term trend in total phosphorus concentrations, (P) sub T. Chla returned to pretreatment concentrations within 35 days of treatment. Although dissolved oxygen concentrations were very low in the autumn and first winter following lime treatments, under-ice (P) sub T were less than half pretreatment values. During the summer following the first lime treatments, under-ice (P) sub T, (Chla), and water clarity improved relative to the other five summers on record; average (P) sub T decreased to 30% and (Chla) decreased to 12% of the previous summer's values. The following winter, dissolved oxygen depletion rates were 59% of pretreatment rates. The short-term reduction in (Chla) was likely related to precipitation of growth-limiting nutrients other than phosphorus, such as iron, with the calcite. In contrast, improvements in (Chla) the year following the first lime treatments could be related to lower (P) sub T in the water column, as a consequence of increased P-binding capacity of bottom sediments. Lime treatments can enhance water quality in eutrophic hard-water lakes by suppression of growth-limiting nutrients for phytoplankton. (Author's abstract)
W91-00625

EMERGING ISSUES FOR THE MICROBIOLOGY OF DRINKING WATER.
University of South Florida, Tampa. Dept. of Environmental and Occupational Health.
J. B. Rose.
Water Engineering and Management WENMD2, Vol. 137, No. 7, p 23-26,29, July 1990. 3 tab, 5 ref.

Descriptors: *Disinfection, *Drinking water, *Microorganisms, *Pathogenic bacteria, *Viruses, *Water quality control, *Water treatment, Biofilms, Diseases, Giardia, Heterotrophic bacteria, Legionella, Protozoa.

In order to achieve the quality of drinking water at the tap which is now expected--and mandated by law--microbial issues will have to be addressed. A better understanding of microbiology of drinking water will lead to appropriate treatment approaches for maintaining and improving water quality. Since 1970 common waterborne diseases such as cholera and typhoid have been adequately controlled in the US; however, newly recognized waterborne agents have emerged. Between 1970 and 1985, 52% of the outbreaks were due to Giardia, whereas 38% were an unidentified acute gastrointestinal illness. Cryptosporidium is another new enteric protozoan disease of concern. Recent outbreaks and their causes and future prevention are discussed in this article. Enteric viruses, another major cause of waterborne disease, were first isolated from sewage. These include polioviruses, coxsackieviruses and echoviruses. Besides the enteric organisms, a naturally occurring aquatic bacterium, Legionella pneumophila has been responsible for major outbreaks of disease in the US. Factors involving their growth and contamination of water systems are detailed. Other organisms able to grow in water supply distribution systems are heterotrophic plate count bacteria, commonly used as an indicator of water treatment and water quality. These HPC bacteria are associated not only with opportunistic infections but are partly responsible for biofilm development within the distribution systems. There are a number of drinking water treatment rules which have been or will be promulgated by the EPA which are partly directed at the microbial quality of drinking water. These include the 'Surface Water Treatment Rule' to control Giardia, the 'Ground Water Disinfection Rule' mandating disinfection of groundwaters to control viruses and the 'Disinfection By-Products Rule' aimed at decreasing the potential cancer risks from compounds produced during the disinfection process. This risk must be balanced with

the risk of microbial pathogens from inadequate disinfection. (VerNooy-PTT)
W91-00627

REDUCING MAINTENANCE IN A WATER TREATMENT PLANT.
Denver Water Dept., CO.
J. Swenson.
Water Engineering and Management WENMD2, Vol. 137, No. 7, p 34-35, July 1990.

Descriptors: *Construction materials, *Corrosion control, *Maintenance, *Plastics, *Sedimentation basins, *Wastewater facilities, *Water treatment facilities, Denver, Flytes, Friction, Mechanical equipment, Underwater.

In 1988, the Denver Water Department expanded and upgraded its Marston Treatment Plant to increase finished treated water production. The new facility, treating 220 million gallons per day, includes six flocculation and sedimentation basins. In each of the sedimentation bays, long fiberglass scraper blades (flytes) move along on railroad rails imbedded in the concrete floor. A system of plastic chain and sprockets move the flytes. Use of special industrial-grade ultra-high molecular weight (UHMW) plastic is enabling maintenance to be cut to a minimum. Industrial-grade UHMW plastic is used to create a system of plastic on plastic, acting as an interface between blades and the steel rails. This reduces the coefficient of friction when wet to 0.05 (versus 0.30 to 0.40 for steel on steel), thus requiring less energy to move the entire system. The plastic wear rails are shaped to allow for expansion of the steel underneath, providing a flexible joint to prevent any buckling and to prevent the flytes from hanging up as they pass over. (VerNooy-PTT)
W91-00629

MICROCOMPUTER ANALYSIS OF PIPE NETWORKS.
Broward County Office of Environmental Services, Pompano Beach, FL. Wastewater Management Div.
J. M. Chansler, and D. R. Rowe.
Water Engineering and Management WENMD2, Vol. 137, No. 7, p 36,38-39, July 1990. 2 tab, 8 ref.

Descriptors: *Computer models, *Computer-aided design, *Microcomputers, *Network design, *Pipes, *Water conveyance, Model testing, Water demand.

Today most water distribution systems are designed and analyzed by using computer programs. In the design of a water distribution system, consideration must be given to several factors, including average daily per capita water consumption, city size, presence of industries, water quality, cost of water, climate, population characteristics and whether the water supply is metered. The hydraulic computations involved in designing a water distribution system can only be approximated, as it is impossible to consider all the factors affecting loss of head in a complicated network of pipes. Here a computer program using the Hardy Cross method of network analysis is considered; it is compared to conventional analysis used in the past. The program is presented on a demonstration disk and is limited to no more than 10 pipes, 8 nodes, and 4 loops. Three textbook examples are illustrated for a 1, 2, and 3-loop water distribution system. The microcomputer and conventional solutions are compared, and agreement was very good. For an example of an actual field situation, the demonstration disk was used to evaluate modifications to a water distribution system in Bowling Green, KY. The 5-pipe, 5-node single loop system was evaluated under average water consumption conditions. The microcomputer program is a powerful tool that can be used to analyze water distribution systems. This particular program can be used as a simple tool for solving day-to-day problems in network analysis. Much larger programs are available for more extensive analyses. (VerNooy-PTT)
W91-00630

EFFICACY OF A SMALL-QUANTITY WATER TREATMENT METHOD FOR INACTIVATING GIARDIA CYSTS IN RAW WATER.
Research Inst. for Diseases in a Tropical Environment, Congella (South Africa).
H. D. Hamilton, and T. F. H. G. Jackson.
Water SA WASADV, Vol. 16, No. 3, p 201-204, July 1990. 1 tab, 22 ref.

Descriptors: *Chlorination, *Clarification, *Disinfection, *Giardia, *Raw water, *Water treatment, Chemical treatment, Flocculation, Performance evaluation, Temperature effects.

Chlorfloc is a commercial product developed for clarifying and disinfecting small quantities of raw water. It consists of a mixture of sodium dichloro-s-triazinetrione dihydrate as a source of chlorine for disinfection and a proprietary flocculant to clarify raw water. The efficacy of the disinfecting process was investigated with regard to Giardia muris cysts. The ability of viable G. muris trophozoites to excyst under defined conditions was used as the criterion for viability before and after treatment. Experiments were performed using artificially polluted water at 25, 15, 10 and 5 C. In each of these temperature regimens, the time and dosage required to effect a 99.9% reduction in the number of viable cysts was determined. At 25 C one tablet/L was effective after 7 minutes, whereas at 15 and 10 C the exposure time had to be extended to 15 minutes. At 5 C, two tablets/L and a 15 minutes exposure time were required. Results of this study indicate that the Chlorofloc treatment process is highly effective in disinfecting Giardia cysts in a high demand water over a wide range of temperatures. It would be a useful water treatment aid to rural communities as well to the military forces and the weekend hiker. (Author's abstract)
W91-00637

USE OF UV RADIATION FOR DISINFECTING WATER IN FIRST STAGE GROWTH TANKS STOCKED WITH RAINBOW TROUT LARVAE (ZASTOSOWANIE PROMIENIOWANIA UV DO DEZYNFEKCJI WODY W PODCHOWALNI WYLEGU PSTRAGA).
Instytut Rybactwa Srodladowego, Piaseczno (Poland). Zaklad Rybactwa Stawowego.
For primary bibliographic entry see Field 8I.
W91-00786

IMPLICATIONS OF HEAVY METAL TOXICITY RELATED TO EDTA EXPOSURE.
Bundesgesundheitsamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W91-00792

EXPERIMENTAL INVESTIGATION OF SIZE DISTRIBUTION OF SUSPENDED PARTICLES IN GRANULAR BED FILTRATION.
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
S. Vigneswaran, J. S. Change, and J. G. Janssens.
Water Research WATRAG, Vol. 24, No. 7, p 927-930, July 1990. 4 fig, 2 tab, 4 ref.

Descriptors: *Filters, *Filtration, *Granular bed filtration, *Particle size, Experimental design, Filter media, Pollen, Sand filters, Suspended solids, Water treatment.

Although from observation and theory, it has been found that the size of suspended particles is one of the most important physical variables influencing deep bed filtration, size is not often measured because the techniques available are time consuming and expensive. Laboratory-scale experimental studies were conducted to show the effect of size distribution of particles in granular bed filtration. Detailed experiments were conducted with pollen grain particles of two and three different sizes in suspension with sand as the filter medium. The results showed that the investigation of granular bed filtration based merely on the mean size is inadequate as particles of different size have different removal efficiencies. It was also shown that there is an improvement in fine particle removal efficiency when they are present with particles in polydispersed suspension. The improvement was greater when the ratio of coarse particles to fine particles increased. Improvement was greater when the size of the coarse particles increased. (Author's abstract)
W91-00819

N-CARBOXYMETHYLCHITOSAN: ALGISTATIC AND ALGICIDAL PROPERTIES.
Prairie View A and M Univ., TX.
R. G. Cuero, and E. B. Lillehoj.
Biotechnology Techniques BTECE6, Vol. 4, No. 4, p 275-280, July/August 1990. 2 fig, 2 tab, 11 ref.

Descriptors: *Algal control, *Algicides, *Chitin, *Cyanophyta, *Water treatment, Biomass, Dose-response relationships, Microscopic analysis, N-carboxymethylchitosan, Nuisance algae.

Anabaena (Cyanophyceae) are among the most common algae in fresh water environments such as swimming pools, aqueducts, sewages and natural water sources. Algae in aqueous environments modify the environment by their growth and metabolite production and can produce undesirable consequences. A water soluble agent made from waste crustacean shells that controls the growth of algal cells was identified. Growth of an Anabaena species was inhibited in the presence of 12 to 39 nM N-carboxymethylchitosan (NCMC) as determined by the reduction of algal biomass and chlorophyll production. Application of dilute water solutions of NCMC prevented algal multiplication, enhanced aggregation of cells and assured clearing of algal suspensions by filtration. A potential role for NCMC in algal control strategies is suggested. (MacKeen-PTT)
W91-00837

INCIDENCE OF BDELLOVIBRIO SPP. IN MAN-MADE WATER SYSTEMS: COEXISTENCE WITH LEGIONELLAS.
Newcastle Public Health Laboratory, Institute of Pathology, General Hospital, Westgate Road, Newcastle upon Tyne NE4 6BE, United Kingdom.
I. R. Richardson.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 1, p 134-140, July 1990. 1 fig, 3 tab, 34 ref.

Descriptors: *Legionella, *Microbiological studies, *Public health, *Vibrio, *Water conveyance, Bdellovibrios, Laboratory methods, Microorganisms, Pathogenic bacteria, Water distribution.

Bdellovibrios have been isolated from surface waters but there are no reports of its occurrence in main water supplies. One hundred and thirty five water samples from 81 sources were examined for the presence of Bdellovibrio bacteriovorus and Legionella species. Bdellovibrios were isolated by a double-layer agar technique with two strains of Legionella pneumophila serogroup I as the host organisms. Bdellovibrio species were isolated from 57.8% and Legionella species from 9.5% of the samples. The two species occurred together in 4.4% of samples. The incidence of Bdellovibrio species and its occurrence with legionellas in man-made water systems may have several explanations. As Bdellovibrios are ubiquitous in aquatic environments and natural soils they may, like legionellas, be transferred to these systems by mains water and aerosol. The role bdellovibrios play in the reduction or removal of Legionella species from water systems is difficult to assess. Although it is unlikely that bdellovibrios could be actively used in control of Legionella species, they may act as natural inhibitors to multiplication in man-made water systems. (Author's abstract)
W91-00876

5G. Water Quality Control

INPUT AND DEPLETION OF WOODY DEBRIS IN ALASKA STREAMS AND IMPLICATIONS FOR STREAMSIDE MANAGEMENT.
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
For primary bibliographic entry see Field 4C.
W91-00011

IMPLICATIONS OF ENVIRONMENTAL PROGRAM PLANNING FOR SITING A NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA, USA.
Department of Energy, Carson City, NV. Nevada Nuclear Waste Project Office.
For primary bibliographic entry see Field 5E.
W91-00026

LATERALLY AVERAGED HYDRODYNAMICS MODEL FOR RESERVOIR PREDICTIONS.
Toronto Univ. (Ontario). Dept. of Physics.
For primary bibliographic entry see Field 2H.
W91-00062

TARGETING REMEDIAL MEASURES TO CONTROL NONPOINT SOURCE POLLUTION.
Guelph Univ. (Ontario). School of Engineering.
W. T. Dickinson, R. P. Rudra, and G. J. Wall.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 499-507, June 1990. 4 fig, 3 tab, 34 ref.

Descriptors: *Agricultural watersheds, *Erosion control, *Model studies, *Nonpoint pollution sources, *Sediment control, *Soil erosion, *Water pollution control, Cropland, Ontario, Sediment yield, Soil management.

The watershed model GAMES was used for the evaluation of a targeting approach to control fluvial sedimentation arising from soil erosion in agricultural areas. The data considered for the analysis consists of output from the application of the model to existing and hypothetical soil and crop management systems in two small watersheds of southern Ontario, one in the rolling uplands and the other in a very flat lowland area. The model output includes estimates of spring sediment yield from field-size cells to the stream outlet for existing agricultural management conditions, and estimates of sediment yield resulting from the successive implementation of two levels of soil erosion controls under four remedial measures strategies. The results reveal that, for the rolling upland watershed exhibiting a wide range of soil erosion and sediment yield rates, targeted control programs can be expected to provide an extremely effective approach to sediment control. For flat lowland watersheds, exhibiting relatively uniform soil erosion and sediment yield rates, the strategy of targeting controls may be somewhat more effective than a random approach to control, but not as efficient as in the case of watersheds in more rolling terrain. The study shows that a screening model such as GAMES provides a very useful tool for the planning and evaluation of erosion and sediment control programs. (Author's abstract)
W91-00090

TREATMENT OPTIONS FOR WATER SUPPLIES CONTAMINATED WITH DBCP AND OTHER PESTICIDES.
Brown and Caldwell, Walnut Creek, CA.
For primary bibliographic entry see Field 5F.
W91-00103

USE OF STATISTICAL METHODS IN INDUSTRIAL WATER POLLUTION CONTROL REGULATIONS IN THE UNITED STATES.
Environmental Protection Agency, Washington, DC.
H. D. Kahn, and M. B. Rubin.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 129-148, November 1989. 7 fig, 3 tab, 5 ref.

Descriptors: *Compliance, *Environmental protection, *Industrial wastewater, *Statistical analysis, *Statistical methods, *Water pollution control, Pollution load, Regulations, Statistics, Wastewater disposal, Water pollution sources.

The process of developing regulations to limit the discharge of pollutants from industrial sources includes studies and surveys of the industry to define products, processes, wastewater sources and characteristics, and appropriate subcategorization and control technologies in use. Developing effluent limitations is accomplished by first identifying and characterizing the various industrial point source categories. Limitations on the amount of pollutants that may be discharged in treated wastewater are based on the statistical analysis of physical and chemical analytical data characterizing the performance capability of technologies currently in use. Pollutants regulated include conventional pollutants such as biochemical oxygen demand and pH, toxic pollutants identified on the priority pollutant list, and nonconventional pollutants such as radioactivity, color, and chemicals not on the priority pollutant list. Effluent limitations are numerical values which act as boundaries on measures that indicate how well an industrial process is operating. The statistical procedures used to determine limitations involve the fitting of effluent data to distributions and the use of estimated upper percentiles of the distributions as the basis of the limitations. In the majority of cases, the lognormal distribution, or a straightforward extension of the lognormal distribution, provides a reasonable fit to effluent data. The determination of regulatory discharge limitations, based on estimates of percentiles of lognormal distributions of measured pollutant concentrations in treated wastewater, has resulted in the formalization of engineering 'rules of thumb' into variability factors determined from ratios of high effluent to average levels. Regulatory efforts then rely on statistical measures such as daily maximum and maximum monthly averages. Modifications are made to account for different averaging periods and detection limit observations. (Tappert-PTT)
W91-00125

CONTINUOUS EFFLUENT CONSENTS: MODELLING AND COMPLIANCE TESTING.
WRc Engineering, Swindon (England).
R. W. Crabtree, C. P. Crockett, and J. C. Ellis.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 149-164, November 1989. 8 fig, 5 tab, 13 ref.

Descriptors: *Compliance, *England, *Environmental protection, *Frequency distribution, *Industrial wastewater, *Regulations, *Statistical analysis, *Water pollution control, Legal aspects, Probabilistic process, Statistical methods, Statistics, Wastewater disposal, Water pollution sources.

The control of continuous polluting discharges in the U.K. was placed in a framework of statistically based legislation nearly 10 years ago. Both discharge standards and desired river quality class objectives are assessed within a probabilistic system of pollution control, whereby a minimum level of 95 percent compliance with standards has to be achieved. The use of such a statistical framework permits occasional infringements of what would otherwise be fixed standards. The change to a statistically based system has been a slow process carried out in stages; (1) the introduction of a river quality classification; (2) setting long-term river quality objectives; (3) setting discharge consents to achieve these objectives; and (4) monitoring compliance with the consents and objectives. A pass-fail compliance monitoring scheme has been implemented, which utilizes a non-parametric benefit-of-doubt approach. Several catchment-scale consent setting models were utilized to simulate the probability distribution of stream quality parameters and the interaction between several significant polluting discharges. One fundamental component of these models was the choice of a suitable probability distribution to describe the various model inputs in terms of flow and quantity. Different parameters require different parametric distributions to achieve an acceptable data fit, and in some cases, such as chloride, a non-parametric fit was most appropriate. The use of the wrong distribution to estimate the 95th percentile can lead to large errors. While current efforts at compliance monitoring focus on the catchment basin level, a national approach is likely to be devised for procedures such as setting discharge consents and assessing compliance. (Tappert-PTT)
W91-00126

AUDITING THE QUALITY OF EFFLUENT DISCHARGES.
Anglian Water Authority, Peterborough (England).
A. E. Warn.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 165-181, November 1989. 2 fig, 5 tab, 7 ref, 2 append.

Descriptors: *Compliance, *Environmental protection, *Industrial wastewater, *Monitoring, *Statistical analysis, *Wastewater disposal, *Water pollution control, England, Probabilistic process, Regulations, Sampling, Statistical methods, Statistics.

For many rivers, the achievement of good water quality is a matter of regulating the discharges from wastewater treatment plants. The effective audit of the quality of such discharges is a good basis for measuring progress in controlling pollution. To prove that control is effective, the techniques which underpin the following tasks must be sound and consistent: (1) the standards for rivers must be devised so that the environmental objectives are met with the required reliability. The form of the standards will be constrained by the procedures available to monitor compliance; (2) the standards worked out for effluents must have the correct mathematical relation with the river targets, and must be consistent with the options available for auditing performance; (3) the assessment of compliance must be objective; and (4) the statistics used to summarize the performance of a region must be simple, stable, clear, and consistent with the results for individual sites. Sampling procedures and statistical analysis of sample data is critical to monitoring effluent quality. Concepts such as the Pessimistic Confidence Limit, Optimistic Confidence Limit, Confidence of Failure, and Confidence of Compliance statistics are used to help guide regulatory actions based upon effluent test results. (Tappert-PTT)
W91-00127

SOME COMMENTS ON ANALYSIS TECHNIQUES FOR CENSORED WATER QUALITY DATA.
Waterloo Univ. (Ontario). Dept. of Health Studies.
V. T. Farewell.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 285-294, November 1989. 2 fig, 3 tab, 8 ref.

Descriptors: *Monitoring, *Statistical analysis, *Statistical methods, *Water quality, Comparison studies, Data interpretation, Niagara River, Statistics, Trace levels, Water quality control, Water quality management.

When investigating trace substances in ambient water, a proportion of water sample concentrations is usually below the limits of detection. In medical and industrial reliability studies, comparisons are often made of time to event data, which includes right censored observations indicating only that an observation is greater than a specified value. Non-parametric procedures, widely used in the analysis of time to event data, can be applied to water quality data which is left censored. A non-parametric estimate of the cumulative distribution function for left censored water quality data can be generated quite easily. For the comparison of levels of trace substances it is necessary to combine an unconditioned likelihood for the proportion of observations below a detection limit with a partial likelihood for the proportion of the distribution above the detection limit, in order to make use of regression methodology. Levels of toxic substances at the head and mouth of the Niagara River can be compared using a model that corresponds to a Lehmann family of distributions. When comparisons are based on matched pair data, further modifications are necessary. A model can developed that parallels that for time to event data, and consideration is also given to model extensions which allow for a dependence between observations at the same location over a period of time. Other non-parametric methodologies may also be appropriate. (Author's abstract)
W91-00131

STATUS OF THE NIAGARA RIVER POINT SOURCE DISCHARGE INFORMATION: SAMPLING DESIGN AND ESTIMATION OF LOADING.
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W91-00134

MEASURES OF FLOW VARIABILITY FOR GREAT LAKES TRIBUTARIES.
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 2E.
W91-00136

ROBUST GRAPHICAL METHODS FOR DIAGNOSING TREND IN IRREGULARLY SPACED WATER QUALITY TIME SERIES.
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
For primary bibliographic entry see Field 5B.
W91-00138

DEVELOPMENT OF A SOFTWARE PACKAGE FOR TREND DETECTION IN TEMPORAL SERIES: APPLICATION TO WATER AND INDUSTRIAL EFFLUENT QUALITY DATA FOR THE ST. LAWRENCE RIVER.
INRS-Eau, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W91-00139

WATER AND NITROGEN MANAGEMENT IN CENTRAL PLATTE VALLEY OF NEBRASKA.
Nebraska Univ., Clay Center. South Central Research and Extension Center.
For primary bibliographic entry see Field 3F.
W91-00173

STREAMFLOW SIMULATION USING DETERMINISTIC MODEL.
Dames and Moore, Park Ridge, IL.
For primary bibliographic entry see Field 2E.
W91-00174

RAINFALL-REAERATION EFFECTS.
Florida Inst. of Tech., Melbourne. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W91-00175

GROUND-WATER-MANAGEMENT AREAS IN UNITED STATES.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 4B.
W91-00182

TWO-STAGE GROUND-WATER REMEDIATION DESIGN.
Connecticut Univ., Storrs. Environmental Research Inst.
D. Ahlfeld.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 517-529, July/August 1990. 5 fig, 2 tab, 15 ref.

Descriptors: *Economic aspects, *Groundwater pollution, *Model studies, *Site remediation, *Water pollution treatment, Design criteria, Groundwater management, Hydraulic engineering, Numerical analysis, Optimization, Pumping.

Although available technology may be inadequate for the complete remediation of certain contaminated groundwater sites, hydraulic control can be used to reduce the extent of, and contain, groundwater contaminants until adequate technology can be developed. The design of such a remediation system can be viewed as a two-stage process. A first stage is the achievement of a reduction of the extent of the contaminant, and a second stage is the maintenance of the contaminant at this reduced areal extent. Viewed in this light, alternative pump staging criteria can be considered within the design process. These criteria can include allowing the well location and pumping rate to change during the remediation effort. The economic significance of incorporating increasing complexity of pump-stage criteria into the design process was conducted using numerical simulation and a new multistage optimization formulation. The analysis concludes that while different pumping strategies should be used in each stage of remediation, it is generally unnecessary to consider the impact of the pumping strategy in the first stage on the remediation cost in the second stage. (Author's abstract)
W91-00184

FIVE WORST SUPERFUND DESIGN MISTAKES.
Geraghty and Miller, Inc., Tampa, FL.
E. K. Nyer.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 76-81, Summer 1990. 1 fig, 2 tab.

Descriptors: *Cleanup operations, *Design standards, *Superfund, *Water pollution treatment, Groundwater management, Groundwater pollution, Iron, Performance evaluation, Wells.

Criticism of the Superfund program has been leveled by both congressional and press sources. The opinion has been expressed that the main problem with the Superfund program is that it has been inadequate in educating the public as to what can be accomplished and in what time frame. The five worst Superfund project designs encountered in reviewing Superfund projects are: (1) a contaminated well clean-up site where lack of experienced personnel to review that data forced a relatively simple treatment system to be designed as a complicated, expensive system; (2) a case of iron removal from groundwater where improper laboratory analysis of water samples was performed and the lack of experience of EPA reviewers to understand the significance of these errors resulted in design flaws; (3) a case of improper modeling of flow selection where a lack of knowledge of new technology also contributed to a too-costly system; and, (4) another iron-removal project where lack of practical experience by designers led to a high cost solution where less expensive methodologies were available. These design mistakes were ultimately due to the system by which the low-bid contractor was given design responsibility. This led to less experienced personnel including recent college graduates being used on these contracts. Experienced designers should be used in all final process design and review of projects to in order to avoid mistakes such as those discussed here. (Hoskin-PTT)
W91-00363

HIGH WATER LEVEL INSTALLATION OF MONITORING WELLS FOR UNDERGROUND STORAGE TANKS.
C. Treadway.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 82-83, Summer 1990. 2 fig.

Descriptors: *Groundwater level, *Groundwater pollution, *Monitoring, *Monitoring wells, *Underground storage, *Water pollution prevention, Drilling, Florida, Oil, Storage tanks.

Most states throughout the United States have guidelines and requirements concerning the installation of monitoring wells. The most common monitoring well installation would perhaps be for the detection of fuel leaking from an underground storage tank. The 'ideal' geological formation to detect leakage from an underground storage fuel tank through a monitoring well system would have a water table below the bottom of the tank and a confining layer within the next 10 to 20 feet. The standard monitoring well construction method in this case would be to auger down using a 4 1/4-inch I.D. hollow-stem auger to some point above the confining layer but more than 5 feet below the water table. A 2-inch inside diameter screen and riser is placed inside the hollow-stem augers. The screen would be placed to allow at least 2 feet above the high water table 5 feet or more below the low water table. In areas such as Central Florida, where water tables are high, heaving sands become the driller's enemy. Area hydrological conditions can call for special drilling techniques to handle difficult formations such as the heaving sands. The first and probably most important item is to keep a head of water on the formation, reducing the tendency of sand to run into the augers. Drillers should be careful not to overdrill the hole. If a contract calls for sampling through the augers using split spoons, special care must be taken to avoid sand running up the augers when pulling the split spoons. A problem facing drillers in high water areas is meeting state guidelines for vadose zone monitoring in well construction. Obtaining samples through the pumping of the sample well may also be complicated under high groundwater levels. (Hoskin-PTT)
W91-00364

TRANSPORT OF LOW-CONCENTRATION CONTAMINANTS IN SATURATED EARTHEN BARRIERS.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W91-00372

DISTRIBUTIONS AND POPULATION STRUCTURES OF TWO INTERTIDAL ESTUARINE POLYCHAETES IN THE LOWER ST. LAWRENCE ESTUARY, WITH SPECIAL REFERENCE TO ENVIRONMENTAL FACTORS.
Quebec Univ., Rimouski. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W91-00383

BIOREMEDIATION COMES OF AGE.
Bioscience Management, Inc., Bethlehem, PA.
T. G. Zitrides.
Pollution Engineering PLENBW, Vol. 22, No. 5, p 57-62, May 1990.

Descriptors: *Bioremediation, *Cleanup operations, *Hazardous wastes, *Toxic wastes, *Waste treatment, *Water pollution prevention, *Water pollution treatment, Aerobic bacteria, Anaerobic bacteria, Bacteria, Biodegradation, Groundwater pollution, Organic wastes, Process control, Site remediation, Sludge treatment, Soil treatment.

Bioremediation offers a cost-effective technology to rectify hazardous waste sites. The acceptance of bioremediation by industry in the United States and in the European Economic Community has been due to its relatively low cost compared to incineration or safe landfilling, its effectiveness in dealing with a wide variety of organic compounds, and its provision of a final, ecologically sound solution to toxic waste problems. Bioremediation began at least 20 years ago with the relatively haphazard application of bacterial strains originally developed for the production of enzymes used in detergents. The selection of a bioremediation method is governed by the local situation, contaminant type, concentration and location within the site. Three general bioremediation techniques are in use today: biostimulation, used primarily for cleanup of contaminated groundwaters and soils; bioslurry, used for sludges and highly contaminated soils; and biofarming, applied to lightly contaminated soils, usually less than 1% organics. The development of rapid techniques for determining biokinetics as a function of substrate, such as electrolytic respirometry, has turned bioremediation from an art into a science. The future offers the application of biodegradation to a wider range of materials as new strains of microorganisms, both aerobic and anaerobic, are developed. (MacKeen-PTT)
W91-00400

CHANNEL CHANGES AT CROSS SECTIONS OF THE POWDER RIVER BETWEEN MOORHEAD AND BROADUS, MONTANA, 1975-88.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2J.
W91-00436

SUPERFUND RECORD OF DECISION: VELSICOL CHEMICAL CORPORATION, IL.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-196703/AS. Price codes: A05 in paper copy, A01 in microfiche. Report No. EPA/ROD/R05-88/081, September 1988. 98p, 3 fig, 5 tab.

Descriptors: *Administrative decisions, *Illinois, *Site remediation, *Superfund sites, *Volatile organic compounds, *Water pollution treatment, Costs, Injection wells, Land disposal, Soil contamination, Velsicol Chemical Corporation Site.

The Velsicol Chemical Corporation (VCC) is a manufacturing facility located in east-central Illinois, approximately one mile north of the City of Marshall, Clark County, Illinois. The site is bordered by a railroad on the south and by an unnamed tributary on the southwest. A total of 334 acres onsite are leased for crop farming. VCC was in operation between the mid-1930s and August 1987, and occupied an area of approximately 420 acres, 172 of which were used for production or disposal practices for petroleum derivatives including resins, solvents, and pesticides, including chlordane manufacturing. All process wastewater has been deep-well injected onsite since 1965 and the majority of the waste solids and sludges generated at the facility were disposed of in Pond 5/6 until 1980 when the firm ceased operations. Accidental and intentional offsite releases of wastes were noted during the period the ponds were in operation. In the 1980s, all contaminated soil and visually contaminated sediments were consolidated and stabilized with cement and fly ash, and covered with a temporary clay cap and vegetation. The primary contaminants of concern affecting the soil, sediments, surface water and groundwater are VOCs including benzene and other organics including PAHs and pesticides. The selected remedial action for this site includes: excavation of 10,200 sq yd of contaminated stream and pond sediments and 87,900 sq yd of contaminated soil and backfilling with clay, and revegetation; and consolidation of all excavated material onsite with in-place stabilization followed by construction of a RCRA cap; construction of groundwater collection drain with disposal via onsite deep well injection or treatment using granular activated carbon prior to offsite discharge; groundwater and surface monitoring; and implementation of land use and deed restrictions. The estimated present worth cost for this remedial action including O&M is $9,080,910. (Author's abstract)
W91-00445

SUPERFUND RECORD OF DECISION: INDEPENDENT NAIL, SC.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-209829/AS. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R04-88/040, August 1988. 69p, 4 fig, 4 tab.

Descriptors: *Administrative decisions, *Metal-finishing wastes, *Site remediation, *South Carolina, *Superfund sites, Endangered species, Groundwater quality, Independent Nail Site, Infiltration, Wastewater lagoons.

The Independent Nail site, occupying 24.6 acres, is located near the town of Beaufort, South Carolina. The site is surrounded by fields, woodlands, and wetlands. The United States Fish and Wildlife Service in 1987 indicated that endangered and threatened species may exist in the area of influence of the site, however, these species have not been confirmed to be inhabiting areas that may be impacted by the operations at the site. An estimated 25 residents live within one quarter mile of the site. The Black & Johnson Company, previous owners of the site, manufactured metallic screws and fasteners. As part of the manufacturing process, the company discharged approximately 33,000 gal/day of plating wastewater into a unlined infiltration lagoon. The discharge rate may have been as high as 75,000 gal/day. The lagoon was in use from approximately 1969 to 1980. The South Carolina Department of Health and Environmental Control reported that wastewater contained some organic cleaning solvents and metals. In April 1980, the Black & Johnson Company ceased operation. Two months later, the Independent Nail Company purchased the plant and currently operates a panelling-nail coating process, but does not discharge wastewater to the lagoon. The first remedial action at this site addressed the contaminants in the soil and lagoon sediments. This remedial action at this site addresses groundwater contamination. The primary contaminants of concern include chromium, zinc, and cyanide. The selected remedial action for this site addressing groundwater is a no action remedy. The source control remedial action conducted at the site was determined to have little or no impact on groundwater quality in the area of the site. This remedial action has no costs associated with it. (Author's abstract)
W91-00446

SUPERFUND RECORD OF DECISION: FRENCH LIMITED, TX.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-204788/AS. Price codes: A05 in paper copy, A01 in microfiche. Report No. EPA/ROD/R06-88-030, March 1988. 96p, 4 fig, 7 tab.

Descriptors: *Administrative decisions, *Cleanup, *Groundwater pollution, *Site remediation, *Superfund sites, *Texas, *Water pollution treatment, Costs, Flooding, French Limited Site, Industrial wastes, Wastewater lagoons.

The French Limited, Inc. (FLI) site, a 22.5-acre tract of land, is located in Harris County, Texas. The site is situated one mile east of the San Jacinto River. The entire site is within the 100-year flood plain of the River and has flooded frequently in the past. Between 1966 and 1972, approximately 300,000 sq yd of industrial wastes from area petrochemical companies were deposited in an unlined 7.3-acre pit, formerly an active sand pit. The disposal site operated under a temporary permit issued by the Texas Water Quality Board. In 1973, the permit was revoked after extensive public hearings and legal proceedings, and FLI was ordered to cease operations. As part of the settlement, FLI was ordered to remove all the structures, tankage, and process equipment. The tract of land was ultimately deeded to the State. During a flood event, the dike surrounding the waste pit was overtopped and breached, and contaminated sludges were discharged into an adjacent slough. In 1982, the U.S. EPA conducted an Immediate Removal Action (IRA). The dike was repaired and the majority of discharged sludges were pumped back into the pit. The floating portion of the sludges was removed and disposed of in July of 1983 during another U.S. EPA IRA. Groundwater has been heavily contaminated by the leaching action of organic wastes deposited in the pit. Sludge and soil from the waste pit and adjacent slough include the following primary contaminants: PCBs, PCP, organics, VOCs, metals, and arsenic. The selected remedial action for this site includes: in-situ biodegradation of sludges and contaminated soils with aeration of the lagoon waste for degradation enhancement; stabilization of residues followed by onsite disposal; groundwater pumping and treatment; surface water discharge to the San Jacinto River with treatment, as necessary; backfilling of the lagoons to grade and contour; and groundwater monitoring. The estimated present worth for this remedial action is $47,000,000. (Author's abstract)
W91-00447

SUPERFUND RECORD OF DECISION: BEACHWOOD/BERKELEY, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-189484/AS. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/R02-88/062, June 1988. 45p.

Descriptors: *Administrative decisions, *Drinking water, *Lead, *New Jersey, *Superfund sites, Beachwood/Berkeley Site, Groundwater quality, Plumbing, State jurisdiction, Wells.

The Beachwood/Berkeley Well site, encompasses Beachwood Borough and Berkeley Township in central-east Ocean City, NJ. The total population of the two municipalities is approximately 23,000. In response to a public complaint of possible aluminum contamination of drinking water, the New Jersey Department of Environmental Protection (NJDEP) sampled four potable wells and discovered the presence of lead in exceedance of the Federal Interim Primary Drinking Water Standard. Subsequent sampling confirmed the presence of lead at approximately 4 times the standard. The Ocean County Health Department, collected additional samples in the two municipalities. Results of analyses indicated that 15% of the total wells sampled in the Borough and 3% of the residential wells sampled in the Township exceeded the regulatory standard for lead in drinking water, however, there was no distinct geographical pattern to the occurrence of the lead contamination. By order of the NJDEP, an alternate supply of water was provided to the affected residents. After extensive investigation of lead levels in residential tap water, surface water, groundwater, sediments, soil, and lead concentrations in, and dissolution from plumbing systems, it was concluded that elevated concentrations of lead in drinking water were not caused by man-made or industrial sources. Rather, the sources of lead include; a minor contribution from native area groundwater, lead packers used in well construction, and dissolution of lead from lead-bearing materials of home plumbing systems, particularly lead/tin solder. Remediation under the Superfund program of the documented existence of lead in drinking water is precluded by law. The State of New Jersey is proceeding independently of Federal Superfund financing to address the presence of and the problems posed by lead in drinking water. (Author's abstract)
W91-00451

METHOD FOR DETERMINING THE COMPLETENESS OF DECHLORINATION WITH SULFITE.
Maryland Univ., College Park. Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W91-00532

FIVE YEAR PROGRAM STRATEGY FOR THE GREAT LAKES NATIONAL PROGRAM OFFICE, FY 1989-1993.
Environmental Protection Agency, Chicago, IL. Great Lakes National Program Office.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-206023. Price codes: A05 in paper copy, A01 in microfiche. Report No. EPA/905/9-89/001, GLNPO-89/1, December 1988. 84p, 6 fig, 4 tab.

Descriptors: *Great Lakes National Program, *Regulations, *Water quality, Ecosystems, Environmental protection, Federal jurisdiction, Great Lakes, Management planning, Project planning, State jurisdiction, Water quality control, Water quality management.

A five year strategy for the EPA's Great Lakes National Program Office (GLNPO) has two principle purposes: (1) to inform other EPA programs, Federal agencies, the Great Lakes States, and the public of GLNPO's goals and how they will be addressed; and (2) To provide a long term strategic framework for GLNPO, within which annual budget and workplan priorities can be established. Chapter one provides an overview of the Great Lakes Program office and its role in relation to the governmental organizations that influence environmental management decisions within the Great Lakes Basin, both in the US and Canada. Chapter two provides an overview of the great lakes ecosystem. Chapter three describes water quality problems within the Great Lakes Basin. Chapter four summarizes Federal and State environmental programs that work in the Great Lakes Basin with

a review of significant accomplishments. Chapter five describes the 1987 amendments to the Clean Water Act that define GLNPO's statutory charter to coordinate the US response to the Great Lakes Water Quality Agreement. Chapter six provides an overview of the Great Lakes Water Quality Agreement. Chapter seven presents GLNPO's five year strategy for addressing the priorities defined in the Agreement and for fulfilling its statutory mandate. (Lantz-PTT)
W91-00552

MOSES LAKE CLEAN LAKE PROJECT. FINAL STAGE 3 REPORT.
R. C. Bain.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-209126. Price codes: A16 in paper copy, A01 in microfiche. May 1987. 363p, 47 fig, 30 tab, 15 append.

Descriptors: *Algal blooms, *Eutrophication, *Lake restoration, *Moses Lake, *Water pollution control, *Water pollution sources, *Water quality, Agricultural runoff, Irrigation practices, Nonpoint pollution sources, Nutrients, Washington, Water quality control, Water quality management.

The Moses Lake Clean Lake Project represents a five year effort designed to identify and control nonpoint pollution sources affecting Moses Lake water quality. Moses Lake is a large freshwater lake located near the geographic center of Washington State. The lake is shallow and over-fertilized with nutrients from an extensive watershed encompassing over 1.5 million acres, and from urban development around the lake, and has experienced extensive blue-green algae blooms for over two decades, resulting in a diminished recreational use of the lake. Although a dilution program was successful in reducing algal blooms, it was also desirable to reduce the nutrient load entering the lake. In March 1982, a grant was obtained to conduct an investigation of agricultural and other nutrient sources in the Moses Lake watershed and the potential impact of these sources on Moses Lake water quality. The project was carried out in three stages: the stage one goal was to determine sources of nutrients within the Moses Lake watershed; stage 2 involved development of demonstrations of the best agricultural management processes and water quality control plans for implementation of stage 3; stage 3 emphasized implementation of a major agricultural cost share program that upgraded irrigation systems in the project area and off-farm projects involving urban wastewater disposal and construction of detention pond structures. (Lantz-PTT)
W91-00554

SUPERFUND RECORD OF DECISION, BRODERICK WOOD PRODUCTS COMPANY.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-188742. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/ROD/RO8-88/021, June 30, 1988. 116p 10 fig, 7 tab.

Descriptors: *Broderick Wood Products, *Cleanup operations, *Colorado, *Superfund, *Waste disposal, *Water pollution sources, Adsorption, Evapotranspiration, Incineration, Industrial wastes, Monitoring, Sludge, Soil contamination, Wastewater treatment.

Between 1947 and 1981, Broderick Wood Products operated a wood treatment facility in Adams County, CO, to treat power poles, fence posts, railroad ties and other wood products. Process wastes from the plant were conveyed through a clay pipe to two onsite, unlined surface impoundments, referred to as the main and secondary impoundments, located in the northwest corner of the facility. Records indicate that waste seepage was apparent just north of the site and became so extensive that the waste was burned off, starting in 1955. Site investigations conducted by the EPA in April 1981, and July 1982 noted several violations of Resource Conservation and Recovery Act requirements. Another site inspection in December 1982 revealed the possibility of serious contamination at a trench in the vicinity of the surface impoundments that reportedly had only been used for the disposal of solid waste. Wood treating chemicals were detected in a groundwater monitoring well located immediately downgradient of the surface impoundments. The main and secondary impoundments have been identified as the major sources of site contamination. The selected remedial action for this site includes: installation of access restrictions, excavation and onsite mobile incineration of the sludge and oil in the main and secondary impoundments, with offsite disposal of the residual ash; treatment of contaminated impoundment wastewater using carbon adsorption with disposal through onsite evapotranspiration or use as incinerator quench water; and excavation of the visibly contaminated soil beneath the impoundments, and onsite incineration if the volume is < 2500 cu yd, or onsite storage for further studies. (Lantz-PTT)
W91-00555

SUPERFUND RECORD OF DECISION MIDWEST MANUFACTURING, IO.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-188726. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/RO7-88/019, September 30, 1988. 62p, 4 fig, 7 tab.

Descriptors: *Cleanup operations, *Iowa, *Metal-finishing wastes, *Midwest Manufacturing Site, *Superfund, *Water pollution sources, Cadmium, Cyanide, Excavation, Heavy metals, Management planning, Soil contamination, Surface runoff, Vegetation, Waste disposal.

The North Farm operable unit is one of two subsites of the Midwest Manufacturing site located in a rural area east of Kellogg, Jasper County, Iowa. The subsite consists of an unlined disposal cell containing approximately 200 cubic yards of soil contaminated with electroplating wastes. The disposal cell is located on the lower slope of a rolling hill adjacent to the valley of Bear Creek, which is an intermittent stream located 500 feet east and 50 feet lower than the site. Records indicate that electroplating activities took place at this site until June 1981, when the facility ceased operations. The start date for activities at the site is unknown. Activities involved the use of heavy metals. In 1977, a wastewater treatment plant was installed at the facility to treat effluent before it was discharged into the local river. Solids generated at the plant were temporarily stored in an onsite tank and periodically transferred to the disposal cell. The disposal tank was unlined. Analysis of soil samples in the area revealed that soil contamination had occurred via surface runoff. Cadmium and cyanide were the primary contaminants found. The selected remedial action for this operable unit includes: excavation of the contaminated soil within and around the disposal cell and either onsite or offsite treatment using stabilization, with offsite disposal of the treated soil at a permitted Resource Conservation and Recovery Act disposal facility; and backfilling and grading of the excavated area with clean soil to support a vegetative cover. The estimated total present worth cost for this remediation is $140,000-$170,000. (Lantz-PTT)
W91-00556

HYDROGEOLOGIC INVESTIGATIONS SAMPLING PLAN.
For primary bibliographic entry see Field 7A.
W91-00557

SUPERFUND RECORD OF DECISION, JOHN DEERE DUBUQUE WORKS, IA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-188718. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/RO7-88/021, September 29, 1988. 48p, 5 fig, 3 tab.

Descriptors: *Cleanup operations, *John Deere Dubuque Work Site, *Site remediation, *Superfund, Acids, Aquifers, Bases, Fuel, Groundwater pollution, Groundwater quality, Iowa, Landfills, Solvents, Waste disposal, Wastewater treatment.

The John Deere Dubuque Works (JDDW) site is located approximately 2.5 miles north of the City of Dubuque, Iowa. Prior to 1968, wastes were placed in the low areas of the landfill and combustible materials were burned. Wastes included caustics (sodium or potassium hydroxide), acids (hydrochloric and sulfuric), petroleum distillates (solvents, grinding oils), heavy metals (chromium, lead, zinc), cyanide and paint sludges. Another area of concern at the facility is the site of a 1980, 200,000-gallon diesel fuel spill. The primary contaminants of concern affecting the groundwater are volatile organic compounds including benzene, tetrachloroethylene, trichloroethane, and toluene. The selected remedial action for this site includes: development of an alternative potable water supply for the plant; extraction and offsite discharge of water from the contaminated alluvial aquifer using the existing production wells to maintain drawdown around the plant and landfill areas; continuation of extraction and treatment of non-aqueous phase liquids (NAPLs) from production well number 3 with offsite discharge of treated groundwater and offsite disposal of collected NAPLs; imposition of deed restrictions to prevent inappropriate use of the plant property in the future; and development of a contingency plan to insure that contaminants do not migrate offsite in the event of a plant shutdown (which would result in the loss of drawdown from production wells). The estimated present worth cost for this remedial action is $5,151,800 with annual operations and maintenance costs of $276,600. (Lantz-PTT)
W91-00559

SYLVAN LAKE RESTORATION PROJECT.
Utility Engineering Corp., Rapid City, SD.
G. Wierenga, and F. Payne.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-209118. Price codes: A07 in paper copy, A01 in microfiche. July 1987. 138p, 44 fig, 11 tab, 13 ref. EPA Grant No. S008293-01.

Descriptors: *Cleanup operations, *Eutrophic lakes, *Lake restoration, *South Dakota, *Sylvan Lake, Algal blooms, Eutrophication, Lakes, Nutrients, Phosphates, Phosphorus, Recreation, Sedimentation, Water quality, Water quality management.

Sylvan Lake is a small man-made lake (7.5 hectares) located in Custer State Park, SD. A focal point of intense recreational activity, the lake has experienced severe aesthetic and water quality problems. Shoreline and watershed areas were denuded of vegetation and active erosion of the unprotected soils resulted in accelerated sedimentation to the lake. The reduction in depth of the lake from sedimentation and nutrient loadings associated with the sedimented particles had resulted in undesirable aesthetics (algal blooms), limited access, and reduced fish habitat. The Sylvan Lake Restoration Project was initiated by the South Dakota Department of Game, Fish, and Parks in 1979 with the general objectives of correcting watershed and in-lake problems, and controlling activities detrimental to the recreational experience provided by the lake and its surroundings. Construction activities included: (1) partial removal of lake sediment deposits; (2) paving existing gravel surface access roads and parking areas; (3) construction of new hard surface access roads and parking areas; (4) surface restoration and revegetation; and (5) construction of sediment control structures. In addition to the construction activities, the project included changes in management practices and land uses by Custer State Park to enhance and accommodate restoration activities. During construction activities, the lake showed an increase in total phosphorous, dissolved orthophosphate, suspended solids and ammonia as nitrogen concentrations. With the exception of orthophosphate, all concentrations were about the same level

before the project began and after the construction activities ceased. (Lantz-PTT)
W91-00562

LAKE RESTORATION PROJECT, NORTH HUDSON PARK LAKE, BERGEN, NEW JERSEY.
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-209043. Price codes: A03 in paper copy, A01 in microfiche. Final Report, January 1985. 14p, 2 ref, append.

Descriptors: *Cleanup operations, *Eutrophic lakes, *Eutrophication, *Lake restoration, *New Jersey, *North Hudson Park Lake, *Water quality, Algae, Algal blooms, Fish populations, Nutrients, Phosphorus, Sedimentation.

North Hudson Park Lake is a small urban water body which exhibited classic signs of cultural eutrophication. Suffering from neglect and intense watershed development, the lake was filling with silt, supported unpleasantly high algal populations, had a declining fisheries and was generally aesthetically unacceptable. A proposed restoration plan was approved in 1981, which included dredging 85,000 cu yd of bottom sediments, shoreline stabilization, repair of storm sewers, revegetation of adjacent park land, and outlet repair and modification. After project completion, analysis of water quality data of the in-lake stations showed measured improvement. Prior to restoration, the mean total phosphorous in lake value was 0.26 mg/L, with a minimum value of 0.04 mg/L, and a maximum of 0.49 mg/L. After-project monitoring values for mean total phosphorous were 0.12 mg/L, with a minimum of 0.03 mg/L and a maximum of 0.22 mg/L. This is an approximate 53% reduction in total phosphorous values in-lake. There was a substantial decline in algal populations by approximately 3,000%, and a substantial decrease in ammonia concentrations. Prior to dredging, the in-lake mean concentration of ammonia was 0.20 mg/L. After dredging, the mean concentration was reduced to 0.065 mg/L. North Hudson Lake has been restored to a much higher quality recreation facility. (Lantz-PTT)
W91-00563

DREDGING OF NORTH PARK LAKE, COUNTY OF ALLEGHENY, PENNSYLVANIA.
Pennsylvania Dept. of Environmental Resources, Harrisburg.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-208714. Price codes: A04 in paper copy, A01 in microfiche. Final Report, September 1988. 67p, 5 fig, 3 append. EPA Grant No. S-003250-01.

Descriptors: *Dredging, *Ecological effects, *Lake restoration, *North Park Lake, *Pennsylvania, *Sedimentation, *Water quality, Cleanup operations, Costs, Lake sediments, Water resources development.

North Park Lake is located approximately 10 miles north of the City of Pittsburgh. The lake was created by the construction of Pine Creek Dam in the early 1930s and had an original surface area of 75 acres. The maximum water depth as constructed was 15 feet; the average depth of the water prior to dredging was 5 feet. Upstream development has increased the sediment load entering North Park Lake. Prior to dredging, the buildup of sediment within the lake had reduced the surface area by approximately 5 acres. This created a loss of habitat for fish and a decrease in lake area available for recreation. The dredging project is designed to reestablish the original surface area and maintain an average water depth of 5 feet, and was divided into the following phases: (1) Silt trap cleaning and repair; (2) purchase of the dredge; (3) construction of sediment containment area; and (4) dredging of the lake. The total amount of material dredged between April 1984 and November 1986, is estimated at 30,500 cu yd at a cost of approximately $69,450.00. The dredging activity performed to date has noticeably increased the surface area of the lake. This has created new fishing and boating areas. The removal of sediment and plant life above the surface of the lake has improved the appearance of the lake. (Lantz-PTT)
W91-00564

RESPONSE OF THE US EPA REGION V STATES TO THE NONPOINT SOURCE REPORTING REQUIREMENTS OF THE 1987 CLEAN WATER ACT AMENDMENTS.
Wisconsin Univ.-Madison. Inst. for Environmental Studies.
N. Houtman.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-188528. Price codes: A05 in paper copy, A01 in microfiche. EPA Report No. 600/9-89/031, January 1989. 28p, 4 tab.

Descriptors: *Clean Water Act, *Legislation, *Nonpoint pollution sources, *Regulations, *Water pollution control, Federal jurisdiction, Groundwater quality, State jurisdiction, Water pollution sources, Water quality management, Wetlands.

The Clean Water Act Amendments of 1987 passed Congress in February, 1987. Section 319 requires the states to submit reports on the assessment and management of nonpoint source pollution within their borders. Six nonpoint pollution source (NPS) assessment efforts are discussed in these reports which use six different strategies for addressing these requirements. These reports discuss water quality degradation as reflected in three kinds of use levels: fishing, swimming, and aquatic life. Section 319 also asks for identification of the extent of NPS impacts to navigable waters. To do that, the reports need to address three types of water bodies: streams, wetlands and lakes. All states address lakes and streams. Nonpoint impacts to groundwater are also discussed in detail, by each state. However, only Minnesota provides details on wetlands. To the extent that wetlands are accurately defined and impacts assessed, these waterbodies can provide valuable clues about NPS effects on physical and biotic systems (e.g., cycling of nutrients, trapping of sediment, or species changes). Their absence from the reports represents a major gap and needs to be addressed in the 1990 reports. Although the reports differ in standards and assessment levels, they all give varying information on each state's NPS pollution. (Lantz-PTT)
W91-00565

ROLE OF STANDARDS IN IOWA'S GROUNDWATER PROTECTION PROGRAM: A REPORT TO THE IOWA GENERAL ASSEMBLY.
Iowa Dept. of Environmental Quality, Des Moines.
J. Combs, D. Koch, R. Kelley, L. Smith, and M. Wnuk.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-219612. Price codes: A04 in paper copy, A01 in microfiche. January 1989. 49p, 2 tab, 2 append.

Descriptors: *Groundwater pollution, *Groundwater protection, *Groundwater quality, *Iowa, *Regulations, *Water pollution control, *Water quality control, Legislation, Water quality management.

An analysis of the role of groundwater standards in Iowa's overall groundwater protection effort is presented. The analysis addresses the historical use of standards for environmental protection, current federal and state programs which use standards, Iowa's current groundwater protection program, and the potential role of standards for groundwater in Iowa. The report makes three specific recommendations on the role of groundwater standards: (1) to continue and enhance the current program of preventing contamination through research; (2) demonstration and education; (3) to adopt cleanup guidelines, based on current EPA lifetime health advisories (for contaminants in drinking water), to direct cleanup of existing areas of contamination, and to require development and implementation of a control strategy for nonpoint source contamination, in the event that voluntary efforts are unsuccessful. (See also W91-00567) (Lantz-PTT)
W91-00566

ROLE OF STANDARDS IN IOWA'S GROUNDWATER PROTECTION PROGRAM: A REPORT TO THE IOWA GENERAL ASSEMBLY, APPENDIX 2 - WRITTEN COMMENTS.
Iowa Dept. of Environmental Quality, Des Moines.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-219620. Price codes: A05 in paper copy, A01 in microfiche. January 1989. 338p.

Descriptors: *Groundwater protection, *Groundwater quality, *Iowa, *Regulations, *Water pollution control, *Water quality control, Groundwater pollution, Legislation, Water quality management.

This report, an appendix to the Report to the Iowa General and Assembly, contains copies of all written comments and letters received by the Department of Natural Resources during the public comment period on groundwater standards. Multiple copies of the same letter received were reproduced only once. (See also W91-00566) (Lantz-PTT)
W91-00567

PESTICIDES AND WETLANDS OVERSEAS: A FRAMEWORK FOR MITIGATING ADVERSE IMPACTS.
California Univ., Berkeley. Graduate School of Public Policy.
G. Goldenman.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-189732. Price codes: A05 in paper copy, A01 in microfiche. EPA Report No. 600/9-89/014, 1988. 76p, 5 fig, 127 ref, 4 append.

Descriptors: *Developing countries, *Pesticides, *Water pollution control, *Wetlands, Africa, Agriculture, Ecological effects, Environmental protection, Literature review, Water pollution prevention, West Germany.

Pesticides can enter wetlands through direct spraying, as in vector control, or indirectly, through agricultural runoff, industrial contamination, or airborne deposition. A valuable function of wetlands is their ability to act as a sink for hazardous chemicals. Conversely, chemicals can overload a wetland's ability to break down pollutants, therefore adversely effecting the biota of the wetland ecosystem. In looking at how pesticides affect fragile ecosystems like wetlands, it is important to assess both acute and long-term impacts. Wetland destruction and pesticide misuse are examples of environmental problems that have been exacerbated by economic development at the expense of the environment. A study examined pesticide affected wetlands globally, and reviewed the scientific literature to determine some preliminary steps toward devising effective policies for safeguarding wetlands in developing countries. Three case studies were examined which include: African tsetse fly control with respect to African Trypanosomiasis; examination of a 20 year old orchard drainage ditch in West Germany and species diversity; and rice cultivation in Southeast Asia with regard to the effects of pesticide use. (Lantz-PTT)
W91-00570

MEASUREMENT OF IN SITU RATES OF SELENATE REMOVAL BY DISSIMILATORY BACTERIAL REDUCTION IN SEDIMENTS.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W91-00620

CREATING CONDITIONS FOR CHANGES IN PREY COMMUNITY STRUCTURE BY CHAOBORUS SPP. IN A LAKE IN SWEDEN.
Goeteborg Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00697

EVALUATING THE PROBABILITY OF VIOLATING DISSOLVED OXYGEN STANDARD.
Wyoming Water Research Center, Laramie.
Y.-K. Tung.
Ecological Modelling ECMODT, Vol. 51, No. 3/4, p 193-204, June 1990. 1 fig, 3 tab, 18 ref.

Descriptors: *Dissolved oxygen, *Mathematical models, *Standards, *Water pollution control, *Water quality control, *Water quality standards, Comparison studies, Estimating equations, Mathematical equations, Probabilistic process, Streeter-Phelps equation.

One of the main concerns in water quality control and regulation is the assurance of compliance of the specified water quality standard. Due to the existence of various uncertainties in a stochastic stream environment, such compliance cannot be guaranteed at all times. Methodologies are discussed for evaluating the risk of violating a specified water quality standard using the Streeter-Phelps equation. A numerical example was prepared using the Streeter-Phelps dissolved oxygen (DO) model. Because of the existence of various uncertainties in stream environments, the impact of water quality decisions should be assessed using probabilistic methodologies. These techniques can be applied to other water quality indicators along with appropriate mathematical models. Comparisons of two first-order methods, mean-value first-order second moment (MFOSM) and advanced first-order second-moment (AFOSM), were made in terms of their accuracy for computing the risk of violating the DO standard. It was found that, when the risk level is high, the two methods yield rather compatible results, but as the risk level decreases the AFOSM method is superior to the MFOSM method. In places where water quality management decisions are made carefully, the risk of having negative events happen usually is small. To estimate such risk accurately, it is recommended that the more sophisticated AFOSM be used. The use of the MFOSM method based on the Streeter-Phelps equation overestimates the risk of violating the water quality standard. This might lead to over-conservative water management decisions. (Rochester-PTT)
W91-00715

HYDROGEN SULFIDE TREATMENT SYSTEMS IN SANITARY SEWERS.
HDR Engineering, Inc., Denver, CO.
For primary bibliographic entry see Field 5D.
W91-00769

COMMERCIAL OXYGEN USE IN WATER-QUALITY MANAGEMENT.
Vanderbilt Univ., Nashville, TN.
For primary bibliographic entry see Field 5D.
W91-00770

STATE AGRICULTURAL POLLUTION REGULATION: A QUANTITATIVE ANALYSIS.
Harvard School of Public Health, Boston, MA. Dept. of Health Policy and Management.
A. Rosenthal.
Water Environment & Technology WAETEJ, Vol. 2, No. 8, p 51-57, August 1990. 2 fig, 3 tab.

Descriptors: *Agricultural runoff, *Agricultural watersheds, *Farm wastes, *Nonpoint pollution sources, *Water pollution control, *Water pollution sources, Conservation, Erosion control, Florida, North Carolina, Pennsylvania, Regression analysis, Regulations, Statistical analysis, Water law.

Water pollution in the U. S. may be attributed principally to agricultural nonpoint sources (NPS). The objectives of NPS policies are generally the same. There are several best management practices (BMPs) that reduce runoff and the concentration of nutrients, pesticides, and sediment. These practices include traditional erosion-control measures such as terraces, waterways, and conservation tillage; and other water quality practices such as animal-waste storage and application, fertilizer management, and integrated pest management (IPM). The effectiveness of agricultural NPS programs in North Carolina, Florida, and Pennsylvania was assessed through a telephone survey of over 700 farmers. The survey was designed on the basis of several interviews and in consultation with the U. S. Department of Agriculture's (USDA) National Agricultural Statistical Service. Chi-square tests and a variety of logistic-regression analyses suggest that Florida's NPS intervention has succeeded in changing farmer behavior with respect to BMP implementation. Upward trends in BMP use before intervention were noted for all three states. It may be argued that without the cost-share program in North Carolina, county enforcement in Pennsylvania, and the powerful effect of regulations in Florida, BMP implementation would have leveled off, or not improve as much as it did. The study also confirmed the ability of a permitting system to dramatically change the practices of a farming population. (Korn-PTT)
W91-00801

ENVIRONMENTAL RUSSIAN ROULETTE: COMPLIANCE AT OR NEAR THE DETECTION LEVEL.
Nixon, Hargrave, Devans and Doyle, Rochester, NY.
L. Ford, R. Henrichs, and D. Spadacene.
Water Environment & Technology WAETEJ, Vol. 2, No. 8, p 58-63, August 1990. 5 tab.

Descriptors: *Analytical methods, *Detection limits, *Environmental policy, *Measuring instruments, *Pollutant identification, Compliance, Environmental protection, Judicial decisions, Legal aspects, Regulations.

Although analytical capabilities continue to improve, compliance has not kept pace with the public's goal to restore sites to virtually pristine levels. In attempting to track mandated cleanup standards or permit limits, analytical capabilities are being pushed to, and beyond, their limits. Measurement of contaminants at the minute levels of some standards is subject to substantial uncertainty. While the U. S. Environmental Protection Agency (EPA) has formally recognized this uncertainty in other contexts, the agency has yet to be consistent in its process of setting, monitoring, and enforcing cleanup requirements or permit limits. Because of the minute detection limits of some contaminants, new measurement methods have been developed that detect contaminants at lower concentrations. Unfortunately, quantification at these minute levels is not exact. EPA has recognized the uncertainty of some analytical methods and has incorporated an acceptable amount of error in its regulations (as much as 40%) when concentrations are below 10 micro g/L. The issue of reliability of analytical results is often raised when results are challenged by a measurement device or a sophisticated measurement method. However, before a court will admit such evidence or rule that it is sufficient to support a conviction, the court requires some some evidence confirming the reliability of the measurement device or method and the competence or qualifications of the individual doing the analysis. A hypothetical case study is presented that demonstrates the advisability of including the potentially responsible party (the discharges) in the design of the monitoring program and setting of realistic compliance levels. (Korn-PTT)
W91-00802

DECHLORINATION OF FOUR COMMERCIAL POLYCHLORINATED BIPHENYL MIXTURES (AROCLORS) BY ANAEROBIC MICROORGANISMS FROM SEDIMENTS.
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5B.
W91-00827

TOXICITY OF 1,1,1-TRICHLOROETHANE AND TRICHLOROETHENE ON A MIXED CULTURE OF METHANE-OXIDIZING BACTERIA.
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
K. Broholm, B. K. Jensen, T. H. Christensen, and L. Olsen.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2488-2493, August 1990. 6 fig, 1 tab, 27 ref.

Descriptors: *Water pollution treatment, *Soil treatment, *Cleanup, *Chlorinated hydrocarbons,*Toxicity, *Bacteria, Methane bacteria, Degradation, Trichloroethene, Trichloroethane, Model studies, Inhibition, *Site remediation, Soil contamination, Groundwater pollution.

Aerobic biodegradation of chlorinated aliphatics by methane-oxidizing bacteria is a possible way to remediate contaminated soil and groundwaters. However, the applicability of this technique may be hampered by the toxicity of high concentrations of chlorinated aliphatics to the methanotrophic bacteria. The influence of trichloroethene (TCE: 0 to 65 mg/L) and 1,1,1-trichloroethane (1,1,1-TCA: 0 to 103 mg/L) on methane consumption of a mixed culture of methane-oxidizing bacteria was studied in laboratory batch experiments. Increasing concentrations of TCE or 1,1,1-TCA resulted in decreasing methane consumption. Methane consumption was totally inhibited at a concentration of 13 mg/L TCE, while methane consumption was still observed at the upper studied concentration of 103 mg/L 1,1,1-TCA. The inhibition of methane consumption by TCE depended on the initial concentration of methane. A model accounting for competitive inhibition between methane and TCE or 1,1,1-TCA was used to simulate methane consumption at various concentrations of TCE or 1,1,1-TCA. The simulations indicated that competitive inhibition may be the mechanism causing the inhibitory effect of TCE on methane consumption, while this does not seem to be the case for 1,1,1-TCA. (Author's abstract).
W91-00832

TETRACHLOROETHENE TRANSFORMATION TO TRICHLOROETHENE AND CIS-1,2-DICHLOROETHENE BY SULFATE-REDUCING ENRICHMENT CULTURES.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W91-00833

CLOSURE OF AN UNLINED EVAPORATION POND: A CASE HISTORY.
Army Engineer District, Fort Worth, TX.
M. G. Green, and A. J. Marr.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 27, No. 2, p 235-243, May 1990. 7 fig, 4 tab, 9 ref.

Descriptors: *Cleanup, *Evaporation ponds, *Hazardous wastes, *Munitions wastes, *Sludge disposal, *Waste disposal, *Water pollution control, Case studies, Groundwater pollution, Permits, Resource Conservation and Recovery Act, Sludge, Soil contamination, Texas, Underground waste disposal, Wastewater disposal.

In 1985, the Fort Worth District, Corps of Engineers, successfully permitted and executed the closure of an unlined evaporation pond at the Longhorn Army Ammunition Plant in east Texas. The pond, constructed in 1963 at the site of an active explosive waste-burning ground area, had been used to store explosive wastes resulting from the washout of rock motor casings and solvent residues from operations involving pyrotechnic material preparation and mixing. Because operation of the unlined evaporation pond appeared to be primarily responsible for locally contaminating the groundwater, the Army ceased operation of the pond in 1984 and began formal closure activities for the unit as a Resource Conservation and Recovery Act (RCRA) interim status surface impoundment. Under Phase I of the closure contract, a total of 1,877,113 gal of wastewater was removed and shipped via tank truck to a permitted disposal well some 80 mi from the site. The Phase II contract consisted of removing and transporting contaminated sludges and soils to a permitted hazardous waste disposal site, backfilling the pond, installing a filter drain system, and turfing. A total of 8,116 cubic yd of material was excavated and

shipped from the site. An increasing number of closures of hazardous waste facilities are anticipated in the future. A detailed project summary of the case history on each project should be documented and published so that planners of similar projects may benefit. (Author's abstract)
W91-00855

MATHEMATICAL MODELLING OF SEA WATER INTRUSION, NAURU ISLAND.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
For primary bibliographic entry see Field 2L.
W91-00865

EFFECTS OF CATCHMENT LIMING AND AFFORESTATION ON THE CONCENTRATION AND FRACTIONAL COMPOSITION OF ALUMINUM IN THE LOCH FLEET CATCHMENT, SW SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
I. C. Grieve.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 385-396, July 1990. 3 fig, 2 tab, 27 ref.

Descriptors: *Acid rain, *Acid rain effects, *Acidic water, *Aluminum, *Forest watersheds, *Liming, *Scotland, *Water pollution treatment, *Watershed management, Acid streams, Chemical analysis, Dissolved organic carbon, Forest hydrology, Iron, Neutralization, Sulfates.

The most rapid method of neutralizing excess acidity due to acid deposition is the application of neutralizing materials such as limestone powder or fragments either directly to streams and lakes, or indirectly to the surface of catchment soils. Concentrations of total, total monomeric and organic monomeric forms of aluminum and of iron, anions and dissolved organic carbon (DOC) in streams draining one forested and two moorland catchments in southwest Scotland were measured over a 3-year period. Catchments were limed during the study and comparisons of stream chemistry were made before and after liming under the two land-use types. Within individual events, DOC and anion concentrations increased with increasing discharge, and aluminum concentrations showed little change with discharge. In the pre-liming phase as a whole, organic monomeric Al was strongly correlated with DOC and inorganic monomeric Al was strongly correlated with anions, particularly Cl. The forested catchment had higher mean DOC and SO4, but lower mean Al. After liming, Al concentrations were reduced, by up to 80% for monomeric forms, and these low levels prevented observation of correlations with DOC and anions. Liming treatments were effective in both forested and moorland catchments, lasted for at least 2.5 years after treatment, and low rates of application to bog areas were as effective as entire catchment treatments. (Author's abstract)
W91-00897

HAZARDOUS-WASTE TREATMENT COMES OF AGE.
Hazardous Waste Treatment Council, Washington, DC.
R. C. Fortuna.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 1.3-1.7.

Descriptors: *Environmental protection, *Hazardous waste disposal, *Legal aspects, *Resource Conservation and Recovery Act, *Superfund, *Waste disposal, *Wastewater treatment, Cleanup operations, Environmental policy, Land disposal, Legislation.

The enactment of the Superfund Amendments and Reauthorization Act (SARA) in 1986 and the Hazardous and Solid Waste Amendments (HSWA), which amend the Resource Conservation and Recovery Act (RCRA), in 1984, represents both the culmination of the 10-year flirtation with failure and a commitment to prevent the propagation of future problem sites and uncontrolled management practices. The process of implementing the Superfund and RCRA laws throughout the early eighties reinforced many of the fundamental lessons that were emerging for those responsible for congressional oversight. In the area of hazardous-waste cleanup it was learned that simply attempting to cap, pump, and treat or dispose wastes was more of a shell game than a solution. As a result very specific restrictions on land disposal and surface impoundments were imposed and many regulatory loopholes were closed. However, the most enduring and fundamental reform issuing from this legislation was a restructuring of the regulatory decision-making process itself. The legislation: (1) establishes a national policy which states that land disposal is to be the method of last resort in the management of hazardous wastes; (2) institutes presumptive prohibitions against the land disposal of all hazardous wastes; and (3) supports the presumptions with a statutory set of minimum controls and self-implementing total prohibition in the event that the EPA does not act to override or modify them by a specified date. The new demand and the changes it brings with it pose their own set of challenges, primarily in the permitting of RCRA facilities and timely expansion of capacity. It is necessary to ensure that new capacity is permitted on a timely bases, and that there is sufficient flexibility to modify facilities in order to meet the demands of the new laws. (See also W91-00900) (White-Reimer-PTT)
W91-00901

SUMMARY OF CERCLA LEGISLATION AND REGULATIONS AND THE EPA SUPERFUND PROGRAM.
Weston (Roy F.), Inc., Washington, DC.
For primary bibliographic entry see Field 6E.
W91-00903

UNDERGROUND STORAGE TANKS.
Clean Site, Inc., Alexandria, VA.
D. C. Ammon, and S. R. Cochran.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 1.47-1.59, 3 fig, 1 ref.

Descriptors: *Cleanup operations, *Hazardous materials, *Storage tanks, *Underground storage, *Water pollution sources, Design criteria, Emergency planning, Environmental protection, Legislation, Monitoring, Public health, Regulations.

An estimated 3 to 5 million underground tanks in the United States are used to store liquid petroleum and chemical substances. Concern for the status of underground storage tanks has resulted in the development of legislation regarding the registration and monitoring of existing tanks, design and installation of new tanks, and corrective actions for releases. Leaks can occur from storage tanks and associated piping and pumping via leaks from corrosion; from system rupture due to overloading, external stresses, or puncture; and from faulty construction or installation. Overfilling is another source of a tank-system release. The four classes of methods for detecting leaks in underground storage tanks are: (1) volumetric leak testing and leak-rate measurement; (2) nonvolumetric leak testing, (3) inventory controls; and (4) monitoring of environmental effects. Corrective-action responses for leaking underground storage tanks can be divided into two categories. Initial responses are directed at controlling the immediate impacts resulting from newly discovered or sudden releases. If an emergency situation exists, immediate responses may include notification of fire departments, evacuation, removal of ignition sources, and venting of flammable vapors. Permanent corrective measured are directed at cleanup of the releases to some acceptable level for protection of human health and the environment. (See also W91-00900) (White-Reimer-PTT)
W91-00904

QUANTITIES AND SOURCES OF HAZARDOUS WASTES.
Westat Research, Inc., Rockville, MD.
For primary bibliographic entry see Field 5E.
W91-00905

HAZARDOUS-WASTE MANAGEMENT CAPACITY.
MITRE Corp., McLean, VA.
For primary bibliographic entry see Field 5E.
W91-00906

SITING OF HAZARDOUS-WASTE FACILITIES.
North Carolina Univ. at Chapel Hill. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5E.
W91-00907

TREATMENT AND CONTAINMENT TECHNOLOGIES.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
S. C. James, and P. J. Rogoshewski.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 12.35-12.50, 2 fig, 1 tab, 24 ref.

Descriptors: *Hazardous waste disposal, *Waste containment, *Waste disposal, *Waste treatment, *Water pollution control, *Water pollution prevention, Groundwater pollution, Groundwater pumping, Low-permeability barriers, Sludge treatment, Subsurface drains.

Containment technologies are used to contain waste or contaminated groundwater or to keep uncontaminated water from entering the waste. This is accomplished by three commonly used methods: (1) groundwater pumping, (2) subsurface drains, and (3) low-permeability barriers. One alternative to waste excavation and removal and conventional pump-and-treat methods is to treat wastes in situ. In situ treatment entails the use of chemical or biological agents or physical manipulations which degrade, remove, or immobilize contaminants; methods for delivering solutions to the subsurface; and methods for controlling the spread of contaminants and treatment reagents beyond the treatment zone. In situ treatment processes are generally divided into three categories: biological, chemical, and physical. Other techniques include aqueous-waste treatment, solids treatment, solidification and stabilization, and thermal processes. Potential solutions for site remediation will almost always include a variety of technologies. Containment technologies and treatment technologies will invariably be used together. In addition, various technologies will be used to solve problems associated with the treatment of liquids, solids, and sludges at the same site. However, in addition to containment and treatment technologies, other aspects such as materials handling, worker safety, protection from accidental releases, and protection from future financial liability must be incorporated into the complete plan for site remediation. (See also W91-00900) (White-Reimer-PTT)
W91-00956

SITE REMEDIATION.
Science Applications International Corp., McLean, VA.
R. S. Wetzel.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 12.51-12.61, 4 fig, 3 tab, 6 ref.

Descriptors: *Cleanup, *Hazardous waste disposal, *Site remediation, *Waste disposal, Closure, Monitoring, Regulations, Water pollution control.

Site remediation incorporates the use of specific technologies such as capping, slurry trenching, and groundwater treatment to address specific problems identified in the site-investigation process. The currently accepted practices and U.S. EPA guidelines include remedial investigation (RI), feasibility study (FS), corrective action, and closure. The ultimate goal of the RI and FS is to develop data to support the selection of an approach for site remediation and then to use this data in a structured procedure that results in a well-supported recommended approach. The remedial investi-

gation must establish site characteristics such as media contaminated, the extent of contamination, and the physical boundaries of the contamination. The purpose of the feasibility study is to document the problem(s) identified in the RI, determine the range of possible solutions, and select the best solution to waste-site problems. Criticisms of past RI/FS projects by the EPA have been that they take too much calendar time to complete, supporting data is insufficient or minimally adequate, key alternatives are not evaluated, and evaluation and rational for the alternatives presented are insufficient. The corrective-action program under the Resource Conservation and Recovery Act (RCRA) goes into effect when the RCRA groundwater-monitoring program (for the uppermost aquifer) identifies contaminants significantly above permitted levels. Waste-site closure consists of final design of the remedial action, implementation, and postclosure monitoring and maintenance. Postclosure monitoring and maintenance must be conducted as long as the site is considered a threat. (See also W91-00900) (White-Reimer-PTT)
W91-00957

CONTROL AND DISPOSAL INDICES FOR COMPARING WASTE-MANAGEMENT ALTERNATIVES.
PEER Consultants, Inc., Rockville, MD.
For primary bibliographic entry see Field 5E.
W91-00959

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

PRESENT AND FUTURE PERSPECTIVES OF WATER RESOURCES IN DEVELOPED COUNTRIES.
Politecnico di Milano (Italy). Inst. of Hydraulics.
U. Maione.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 2, p 101-115, 1988. 3 fig, 5 tab, 36 ref.

Descriptors: *Comprehensive planning, *Future planning, *History, *Hydrology, *Planning, *Systems analysis, Consumptive use, Flood control, Water cycle, Water quality, Water resources management.

Based upon some present and past features of water resources in developed countries, some future trends are outlined towards the development of water sciences. The reduction of specific consumption use, the amelioration of water quality, increasing water resources, and the improvement of flood control measures should dictate innovation of water resources technology. Decision analysis will hopefully play a larger role in water resources analysis and planning than it does at present. Systems analysis for water resources applications has suffered due to insufficient reliability of basic data, inadequacy of models, and the marked insensibility of many models to variation of design parameters. Interdisciplinary cooperation is critical to future progress in hydrology. These trends will also introduce new perspectives in the development of hydrological sciences, thus indicating a route to overcome the present crisis. (Tappert-PTT)
W91-00067

PRINCIPLES OF A GROUND-WATER STRATEGY.
Greeley-Polhemus Group, Inc., West Chester, PA.
W. Whipple, and D. J. Van Abs.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 503-516, July/August 1990. 2 tab, 3 ref.

Descriptors: *Groundwater management, *Legal aspects, *State jurisdiction, *Water law, *Water policy, *Water quality management, *Water resources management, Alternative planning, Legislation, New Jersey, Nonpoint pollution sources, Water supply.

A groundwater strategy is a policy document that outlines how a state can best manage its groundwater, consistent with budgetary limitations and with provisions of federal and state law. Such a strategy has been adopted in New Jersey which establishes policies for water supply and water quality protection. The strategy includes two new directions critically important to successful groundwater management. First, a state program was proposed to control nonpoint sources of groundwater pollution. Second, the strategy corrected the lack of coordination among state programs that provide alternative water supplies to replace contaminated wells and among programs requiring cleanup of hazardous water pollution. Alternative water supplies that are constructed without regard to pollution mitigation may allow the party responsible for the pollution to escape liability for full remedial costs. Due to such circumstances, water supply remedies in severe cases may be delayed, even where sufficient public funds exist. The strategy solved this problem through a common priority system for both water supply and pollution mitigation remedies, and by addressing first those portions of cases that pose major public health risks and afterward, the remaining portions of these cases. (Author's abstract)
W91-00183

COMBINED SEWER OVERFLOW: A MANAGEMENT STUDY.
Environmental Protection Agency, Washington, DC. Office of Marine and Estuarine Protection.
For primary bibliographic entry see Field 5D.
W91-00568

FUZZY REGRESSION IN HYDROLOGY.
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
For primary bibliographic entry see Field 7C.
W91-00596

ENVIRONMENTAL RISK-ASSESSMENT AND AUDIT PRINCIPLES.
Environmental Strategies Corp., Vienna, VA.
For primary bibliographic entry see Field 5E.
W91-00909

HYDROLOGY AND MANAGEMENT OF DROUGHT IN THE UNITED STATES.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00991

GENERALIZED COMPONENTS OF COMPLEX DECISION SUPPORT SYSTEMS FOR WATER RESOURCES MANAGEMENT IN RIVER BASINS.
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 4A.
W91-00997

OBJECT-ORIENTED HYDROLOGICAL MODELLING (MODELISATION HYDROLOGIQUE ORIENTEE OBJECT).
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural.
For primary bibliographic entry see Field 2A.
W91-00999

6B. Evaluation Process

ENDPOINTS FOR REGIONAL ECOLOGICAL RISK ASSESSMENTS.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 6G.
W91-00025

HYDROLOGY PAST AND PRESENT.
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
For primary bibliographic entry see Field 2A.
W91-00066

PRESENT AND FUTURE PERSPECTIVES OF WATER RESOURCES IN DEVELOPED COUNTRIES.
Politecnico di Milano (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 6A.
W91-00067

DECISION-MAKING PROCESS ON THE DANUBE AND THE PLATTE.
Nebraska Dept. of Water Resources, Lincoln.
A. Bleed, H. P. Nachtnebel, I. Bogardi, and R. J. Supalla.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 479-487, June 1990. 2 fig, 17 ref. NSF Grant No. INT 8620200 and Austrian Research Council Grant No. P6502B.

Descriptors: *Danube River, *Decision making, *Platte River, *Political aspects, *Public policy, *River basin development, Conflict resolution, Institutional constraints, Policy making, Public participation, Regional planning, Water allocation.

Two case studies highlighting the institutional arrangements and decision-making processes used to attempt to allocate water on large scale river systems in two countries are presented. In both cases the implementation of river plans has been blocked by conflicts between those who wish to use water for irrigation, hydropower, or municipal purposes and those who wish to maintain instream flows for fish and wildlife. To date conflict has blocked the implementation of a large hydropower scheme on the Danube River, downstream from Vienna, Austria, and the construction of municipal and agricultural projects, as well as the relicensing of an existing hydropower facility on the Platte River in Nebraska. Analysis of the decision-making processes and institutional settings of both cases led to the identification of problem areas and development of recommendations that would support the achievement of compromise solutions for management. In order to arrive at sound conflict resolution, the decision-making system needs to be improved by (1) using project evaluation that is able to handle a full range of alternatives with conflicting objectives, and (2) establishing an institutional setting that promotes a transparent and rational negotiation process. Both the Platte and Danube experiences suggest that the major institutional requirements for effective decision making include: (1) extensive and well-defined procedures for securing and responding to public input throughout the planning and development process; (2) a lead organization that has the authority to address the full range of options, to engage all affected parties in negotiation, and to implement the politically chosen solution; and (3) a political coalition that is powerful enough to secure the resources and implement the negotiated solution. (Peters-PTT)
W91-00088

DYNAMICS OF SIMULATED EFFECTS OF IRRIGATION OVER DRYLAND FARMING IN SASKATCHEWAN.
Saskatchewan Univ., Saskatoon. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3F.
W91-00091

SIMULATION OF LAND USE CHANGES AND IMPACTS ON THE WATER BALANCE: A CASE STUDY FOR BELGIUM.
Institut Royal Meteorologique de Belgique, Brussels.
For primary bibliographic entry see Field 4C.
W91-00162

TRENDS IN IRRIGATION DEVELOPMENT, AND THEIR IMPLICATIONS FOR HYDROLOGISTS AND WATER RESOURCES ENGINEERS.
For primary bibliographic entry see Field 3F.
W91-00377

TOWARD EMPIRICAL ESTIMATION OF THE TOTAL VALUE OF PROTECTING RIVERS.
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
L. D. Sanders, R. G. Walsh, and J. B. Loomis.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1345-1357, July 1990. 3 fig, 7 tab, 57 ref.

Descriptors: *Management planning, *Recreation demand, *Statistical analysis, *Water resources management, *Water use, *Watershed management, Colorado, Cost-benefit analysis, Environmental protection, Instream water use, Public opinion, Resource allocation, River protection, Rocky Mountains, Social values.

A study was conducted to develop and apply a procedure to estimate a statistical demand function for the protection of rivers in the Rocky Mountains of Colorado. Other states and nations around the world face a similar problem of estimating how much they can afford to pay for the protection of rivers. The demand for rivers was measured using the contingent valuation method recommended by federal guidelines (U.S. Water Resources Council, 1979; 1983) on a sample of 241 households. Nearly all of the households surveyed favored protection of rivers. Annual benefits of the three most valuable rivers in Colorado (Cache la Poudre, Elk, and Colorado at Westwater Canyon) were estimated as $40 per household, including about $8 onsite recreation use value and $32 offsite preservation value. Consideration of the offsite values of rivers in addition to the onsite recreation values is recommended in determining the total value of rivers to society. (MacKeen-PTT)
W91-00584

BENEFITS OF AN IRRIGATION WATER RENTAL MARKET IN A SALINE STREAM-AQUIFER SYSTEM.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 3F.
W91-00586

WATER BANKING THROUGH ARTIFICIAL RECHARGE, LAS VEGAS VALLEY, CLARK COUNTY, NEVADA.
Las Vegas Valley Water District, NV.
For primary bibliographic entry see Field 4B.
W91-00880

CASE STUDY OF A SUCCESSFUL FACILITY SITING.
For primary bibliographic entry see Field 5E.
W91-00910

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER AUCTIONS AS AN ALLOCATION MECHANISM IN VICTORIA, AUSTRALIA.
Department of the Interior, Washington, DC. Office of Program Analysis.
B. Simon, and D. Anderson.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 387-395, June 1990. 1 fig, 6 tab, 14 ref.

Descriptors: *Australia, *Licensing, *Water allocation, *Water auctions, *Water costs, *Water resources management, *Water rights, Auctions, Highest value use, Irrigation water.

During recent years many countries have moved to rationalize the management of state owned or state controlled resources. Victoria, Australia, has taken the unusual step of using auctions to allocate new irrigation water entitlements. The six water auctions that took place during 1988 and early 1989 were perceived as an efficient and equitable mechanism to allocate limited water supplies to their highest value use. While the agricultural areas where the different auctions occurred were similar, there was substantial variation in the prices paid, which reflects varying demands for additional irrigation water. The auctions demonstrated that the water had an annual value to license holders of at least $Aus 15/megaliter above existing charges. However, by excluding irrigation district members and urban areas, competition was constrained and the chances of selling greater volumes to higher value uses were reduced. Allowing irrigators in irrigation districts to participate would have greatly increased the number of potential bidders. Limiting the amount of water any individual could purchase and the staging procedure also introduced an degree of inefficiency into the auction process. While the auctions represent a major change in Victoria's water allocation procedures, they only provide a portion of the flexibility that modern water management systems require. By making water entitlements transferable, individuals who were not able to acquire water in an auction could purchase or lease it from those who were able to acquire it. (Peters-PTT)
W91-00080

EFFECT OF SYSTEM LAYOUT ON SUBSURFACE DRAINAGE COST IN FLAT IRRIGATED LAND.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Center for Drainage Studies.
For primary bibliographic entry see Field 4B.
W91-00081

MEASURING ECONOMIC LOSSES FROM GROUND WATER CONTAMINATION: AN INVESTIGATION OF HOUSEHOLD AVOIDANCE COSTS.
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5C.
W91-00086

BRIDGES AND CULVERTS REDUCED IN SIZE AND COST BY USE OF CRITICAL FLOW TRANSITIONS.
Shire of Stawell (Australia).
For primary bibliographic entry see Field 8B.
W91-00100

COST SAVINGS THROUGH CHEMICAL ADDITION SEQUENCING.
Texas Univ. at El Paso. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-00102

COST IMPACTS OF SEDIMENTS IN SOUTH AFRICAN RIVERS.
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 2J.
W91-00295

COST EFFECTIVENESS OF THE STREAMFLOW-GAGING PROGRAM IN WEST VIRGINIA.
Geological Survey, Charleston, WV.
For primary bibliographic entry see Field 2E.
W91-00331

COST AND PERFORMANCE OF MEMBRANES FOR ORGANIC CONTROL IN SMALL SYSTEMS: FLAGLER BEACH AND PUNTA GORDA, FLORIDA.
University of Central Florida, Orlando. Dept. of Civil Engineering and Environmental Sciences.
For primary bibliographic entry see Field 5F.
W91-00448

COMPETITIVE ASSESSMENT OF THE U.S. WATER RESOURCES INDUSTRY.
International Trade Administration, Washington, DC.
For primary bibliographic entry see Field 6D.
W91-00561

SIMULATING PHYSICAL PROCESSES AND ECONOMIC BEHAVIOR IN SALINE, IRRIGATED AGRICULTURE: MODEL DEVELOPMENT.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 3C.
W91-00585

COST PERSPECTIVES FOR HAZARDOUS-WASTE MANAGEMENT.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5E.
W91-00960

6D. Water Demand

WATER SUPPLY FOR MEXICO CITY.
Universidad Autonoma Metropolitana, Mexico City. Unidad Iztapalapa.
For primary bibliographic entry see Field 3D.
W91-00020

WATER SUPPLY IN FAST-GROWING CITIES: TOKYO, JAPAN.
Bureau of Waterworks, Tokyo (Japan). Water Supply Operation Centre.
Y. Sekine.
Aqua AQUAAA, Vol. 39, No. 2, p 86-95, April 1990. 7 fig, 8 tab.

Descriptors: *Human population, *Japan, *Metropolitan water management, *Tokyo, *Water demand, *Water resources development, *Water supply, Economic aspects, Urbanization, Water pollution, Water quality management, Water rates, Water supply management.

Tokyo, the center of politics and economy in Japan, has produced large numbers of water consumers, reaching almost 12 million. Consequently, the following problems have occurred: (a) shortage of water resources; (b) pollution of raw water; (c) ceaseless expansion of facilities; (d) financial problems. Recently, in accordance with the steady growth in the economy, the water demand has levelled off. The capacity of production is sufficient for the current water demand. It is now time to renovate the facilities and, therefore, reconstruction work becomes more important. As one of the lifelines supporting urban activities, the waterworks should respond to various metropolitan needs, such as reliability and stability. Future financial, administrative, and research plans of the waterworks are presented. (Author's abstract)
W91-00021

WATER FLOWS TOWARD MONEY: THE COMPLICATED STORY OF RENO, NEVADA'S WATER SUPPLY PROBLEMS.
C. Ross.
Water Well Journal WWJOA9, Vol. 44, No. 4, p 55-59, April 1990. 1 fig.

Descriptors: *Groundwater, *Nevada, *Water demand, *Water law, *Water resources development, *Water use, Economic aspects, Groundwater basins, Political aspects, Water quality, Water supply.

The Reno/Sparks/Carson City urban area on the western edge of the Great Basin desert in Nevada has always suffered from water problems. In many areas, precipitation is less than 8 inches per year. According to the major water provider, customers have increased by 30% in the last 10 years and other sources cite a 4% annual growth rate for the area. Yet Reno remains one of the last western cities not using water meters. Users are charged a flat rate based on the diameter of their hookup. Not only is the source of water to fuel this growth in serious doubt, but there are problems with the bacterial and metal content of the water. Unfortunately, these water systems were built to sell houses, not to provide lasting quality, cost-effective water. The use of Nevada's tiny, uncertain desert rivers and lakes by an incredibly complex set of upstream and downstream agricultural, recreational, environmental, domestic, and industrial interests has created problems not only for maintaining its increasing human population but also in preserving its parks and wildlife population. Al-

though the use of groundwater, which is legally apportioned in Nevada, has helped alleviate the situation, the reality exists of a finite water supply against an uncontrolled growth, creating additional problems. This is especially true in western Nevada, where groundwater basins are shared with neighboring California. There have been a series of protests and legislative actions by both states regarding appropriation and allocation of groundwater. (Medina-PTT)
W91-00054

EFFECT OF DROUGHT ON URBAN WATER SUPPLIES. I: DROUGHT ANALYSIS.
Resource Consultants, Inc., Fort Collins, CO.
D. M. Frick, D. Bode, and J. D. Salas.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 733-753, June 1990. 6 fig, 8 tab, 39 ref.

Descriptors: *Climatology, *Drought, *Drought effects, *Model studies, *Stochastic models, *Trees, *Water deficit, *Water shortage, *Weather patterns, Planning, Water resources management, Water supply.

Communities in arid areas, where total annual surface-water withdrawals approximate and in some years exceed average overall water availability, are faced with difficult and urgent problems concerning water policy and management approaches. The City of Fort Collins, Colorado has conducted studies to determine the effects of prolonged droughts on the city's water supplies. As a result of the analysis, various water-supply strategies were developed to be used by the city for handling the problems associated with extreme droughts. The study utilized stochastic modeling coupled with water-resource-system modeling to evaluate drought effects on the water supplies of the city. A stochastic model was developed for the five river basins that account for the city's water supplies. The stochastic model was verified with 400 years of tree-ring data obtained for the area. Periods of records were then generated to determine potential droughts that could occur. Representative 1-in-20, 1-in-50, 1-in-100, and 1-in-500 year droughts were selected for analysis. These droughts are designated 'design' droughts for use in the water supply analysis. The analysis indicated that historically experienced droughts such as those of the 1930s and 1940s do not represent as severe a drought as previously thought. (See also W91-00060) (Tappert-PTT)
W91-00059

EFFECT OF DROUGHT ON URBAN WATER SUPPLIES. II: WATER-SUPPLY ANALYSIS.
Resource Consultants, Inc., Fort Collins, CO.
D. M. Frick, D. Bode, and J.D. Salas.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 754-764, June 1990. 3 fig, 2 tab, 5 ref.

Descriptors: *Climatology, *Drought, *Drought effects, *MODSIM model, *Metropolitan water management, *Model studies, *Planning, *Stochastic models, *Water deficit, *Water requirements, *Water shortage, Water resources management, Water rights, Water supply.

Using a water resource system model, the water supply system of the City of Fort Collins, Colorado, which consists of five river basins, was simulated for selected drought periods to determine the yield of the city's existing water supplies and for other potential water supply sources. The Cache le Poudre River basin is the major water supply for the city. Several approaches were used to estimate the yields of various water supply sources imported from adjacent basins during a 500-year period. A water-rights model (MODSIM) was used to simulate allocations of water supplies based on existing and future water-rights ownership scenarios for the city. The program was run to simulate conditions basin-wide and also to simulate conditions for the city water supply only. Safe demand levels were determined to assure adequate water availability during extreme drought events. Five different scenarios were simulated, ranging from the existing supply system to projected conditions in 2035. The results of the study indicated that although water supplies for the city are adequate at the present time, policies should be adopted to assure that supplies are adequate to meet future demands during drought periods. The study provided a tool to use in evaluating the drought sensitivity of new water sources for meeting future water demands. The approach presented has widespread application to evaluation of droughts on western urban water supplies. (See also W91-00059) (Author's abstract)
W91-00060

ESTIMATED RUNOFF FROM MAN-MADE SNOW.
Wright Water Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 2C.
W91-00092

OPTIMAL PLANNING AND OPERATION OF MULTIAQUIFER SYSTEM.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Earth Sciences.
For primary bibliographic entry see Field 4B.
W91-00179

OPPORTUNITIES FOR RESERVOIR-STORAGE REALLOCATION.
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 6E.
W91-00186

SOURCES OF WATER-USE INFORMATION IN MAINE.
Maine Geological Survey, Augusta. Dept. of Conservation.
D. H. Tepper, and E. M. Lanctot.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report No. 84-4. 38p, 8 ref.

Descriptors: *Data collections, *Databases, *Information systems, *Maine, *Water use, Environmental impact, Groundwater, Resource allocation, Surface water, Water quality.

The nation's water supplies are undergoing stress as a result of increasing demands for water from agricultural, industrial, domestic, and other uses accompanied by demands for greater protection of water quality. Although some detailed information is available on the quantity and quality of surface water and groundwater, data are lacking on the amount of water used, where it is used, and how it is used. Water use information is necessary for definition and efficient resolution of many critical water-related problems involving water quality, environmental impact, energy development, and resource allocations. In order to address the growing national concern about adequacy of water supplies, the U S Geological Survey (USGS) began a cooperative state/federal water-use information program in 1977. As an outgrowth of the national program, the Maine Geological Survey, in cooperation with the USGS, has initiated the development of a comprehensive water-use data program, the Maine Water-Use Data System (MWUDS). A summary of data appropriate for central filing, and anticipated future water-use information needs are included in this source booklet. The sections are arranged by water-use categories. Each category is defined and the appropriate standard industrial classification codes for the category are listed. Descriptions of data elements which will be stored in the national system and optional data to be included in the Maine system are presented. A tentative approach for MWUDS data collection is summarized, sources of information are listed, and where appropriate, a bibliography is given at the end of each section. (Shidler-PTT)
W91-00443

COMPETITIVE ASSESSMENT OF THE U.S. WATER RESOURCES INDUSTRY.
International Trade Administration, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-200687. Price codes: A07 in paper copy, A01 in microfiche. October 1985. 118p, 10 fig, 31 tab, 30 ref, 2 append.

Descriptors: *Economic aspects, *Management planning, *Water resources development, Desalination, Irrigation, Legislation, Marketing, Regulations, Wastewater treatment, Water resources management, Water supply, Water treatment.

A study of the water resources industry was completed in June 1985, and examines developments as they relate to demand and markets in the six subsectors of the water resources industry: water desalination and reuse; water and wastewater treatment; irrigation; groundwater exploration and development; point of use water treatment; and water supply and distribution. In 1983, there were approximately 1500 water resource equipment manufactures in the US employing 516,000 workers. In 1983, the US industry shipments were $22 billion. The US market is served primarily by US firms but import penetration is increasing. Twenty percent of US shipments in 1983 were exported to more than 75 countries. However, US exports peaked in 1981 and have been declining since then. This decline is attributed to the high value of the dollar, the global recession, and intensified foreign competition. This study identifies a number of areas in which the US government might consider supporting water resource firms' competitiveness, including: improved competitive financing, greater coordination in export promotion, increased research and development support, elimination of certain tariff and non-tariff barriers, and support of specific legislation which would enhance the water resource markets. (Lantz-PTT)
W91-00561

TOWARD EMPIRICAL ESTIMATION OF THE TOTAL VALUE OF PROTECTING RIVERS.
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W91-00584

SLIPS AHOY.
Johnson, Johnson and Roy, Inc., Ann Arbor, MI.
For primary bibliographic entry see Field 8A.
W91-00677

6E. Water Law and Institutions

IMPROVING THE EFFECTIVENESS OF FISHERIES AGENCIES IN DEVELOPING HYDROPOWER MITIGATION.
Oak Ridge National Lab., TN. Environmental Sciences Div.
S. F. Railsback, C. C. Coutant, and M. J. Sale.
Fisheries (Bethesda) FISHDN, Vol. 15, No. 3, p 3-8, 1990. 1 fig, 7 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Environmental protection, *Fisheries, *Hydroelectric power, *Regulations, *Water resources development, Information exchange, Institutions, Legislation, Licensing, Mitigation.

New legislation and Federal Energy Regulatory Commission (FERC) regulations increase the responsibilities of state and federal fisheries management agencies for developing mitigation for hydropower projects. Having participated in some of the first major licensing cases since these changes, observations are presented on how agencies can be more effective in recommending mitigation measures that protect fisheries. Fisheries agencies need access to expertise in fields outside traditional fisheries management to address diverse hydropower impacts. Agencies need effective policies that can be applied to the specific conditions at each project. Coordination and communication between regulatory and resource agencies and with project applicants are important to establish agreement on mitigation recommendations and to share expertise. Agencies will often need to make recommendations on issues for which complete information is not available; if carefully designed, such recommendations can be defensible and conservative. A

thorough understanding of current FERC procedures and policies is essential. Many of these same recommendations for effective mitigation are included in the Fish and Wildlife Service's hydropower mitigation policy. (Author's abstract)
W91-00008

WATER FLOWS TOWARD MONEY: THE COMPLICATED STORY OF RENO, NEVADA'S WATER SUPPLY PROBLEMS.
For primary bibliographic entry see Field 6D.
W91-00054

DECISION-MAKING PROCESS ON THE DANUBE AND THE PLATTE.
Nebraska Dept. of Water Resources, Lincoln.
For primary bibliographic entry see Field 6B.
W91-00088

OPPORTUNITIES FOR RESERVOIR-STORAGE REALLOCATION.
Hydrologic Engineering Center, Davis, CA.
W. K. Johnson, R. A. Wurbs, and J. E. Beegle.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 550-566, July/August 1990. 9 fig, 3 tab, 7 ref.

Descriptors: *Governmental interrelations, *Kansas, *Operating policies, *Reservoir operation, *Reservoir storage, *Resource allocation, *Water allocation, *Water resources management, Dams, Economic aspects, Feasibility studies, Flood control, Hydrologic aspects, Legal aspects, Political aspects, Regulations, State jurisdiction, Water conservation, Water storage, Water supply.

When a reservoir is constructed, water storage volumes are authorized for different purposes, and operating policies are established to control water releases. A review of studies on reallocation of reservoir storage capacity for reservoirs in the U.S. Army Corps of Engineers and state of Texas has identified eight general cases of reallocation: (1) use of water supply storage not under contract; (2) temporary use of storage allocated for future conservation purposes and sediment; (3) storage made available by change in conservation demand or purpose; (4) seasonal use of flood-control space during dry seasons; (5) reallocation of flood-control space; (6) modification of reservoir-water-control plan and method of regulation; (7) raising existing dams; and (8) system regulation of Corps and non-Corps reservoirs. While these general cases suggest a variety of opportunities for reallocation, feasibility must be evaluated for each specific site. A memorandum of understanding between the state of Kansas and the Department of the Army illustrates the different hydrologic, economic, environmental, legal, and institutional considerations required in reallocation investigations and the value and necessity of cooperation between responsible parties. (Author's abstract)
W91-00186

PROFESSIONAL CERTIFICATION AND REGISTRATION FOR WATER-RESOURCES AND RELATED DISCIPLINES.
American Water Resources Association, Bethesda, Maryland. 1989. 69 p. Edited by A. Ivan Johnson.

Descriptors: *Professional certification, *Professional personnel, *Standards, Institutions, Licensing, Professional societies, Workshops.

Certification and registration of professional specialists in water resources and related disciplines has been a question on the minds of many people this past decade or two. Hearing the frequent questions and the frequently uninformed speculations that followed, the editor decided to organize several seminar-type sessions where knowledgeable specialists could discuss the procresses for professional certification and registration. The papers contained in this publication describe certification programs for the Association of Ground Water Scientists and engineers, American Institute of Hydrology, American Institute of Professional Geologists, American Society for Agronomy, American Society for Photogrammetry and Remote Sensing, National Association of Environmental Professionals, and The Society of American Foresters. In addition there are papers: (1) describing the philosophy of the Association of Engineering Geologists, (2)discussing experiences with registration of geologists and geophysicists in California, (3) explaining the efforts in Arizona to develop professional registration of hydrologists, and (4) discussing new thoughts on certification of engineering specialties. Some of the reasons for certification or registration are described in several papers in this publication. A basic similarity in requirements of certification programs will be seen: a list of basic qualifications of education, experiences and publications; a written or oral examination, which frequently is dropped for people of special eminence in the field; agreement to a specified code of ethics, a system for acting on complaints of unethical practice; and a need for maintaining competence and renewing certification. (See W91-00268 thru W91-00279)
W91-00267

CASE FOR STATE CERTIFICATION OF WATER EXPERTS.
National Water Well Association, Dublin, OH.
J. H. Lehr.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 3-6.

Descriptors: *Professional personnel, *Standards, *State jurisdiction, Association of Ground Water Scientists a, Education, Licensing, Regulations, Training.

All states should consider the development of a certification exam in concert with the professional societies which govern these disciplines in the same manner as certified public accountants assist the states in their certification program. Reliance on voluntary certification programs developed by professional societies such as the Association of Ground Water Scientists and Engineers (AGWSE), a division of the National Water Well Association, appears to be the best approach. They introduced their own certification program in 1985 in response to a significant demand from their membership. Successful applicants who become Certified Ground Water Professionals earn the right to use CGWP after their name. To earn CGWP, an applicant must have at least seven years of progressively more responsible professional experience, following receipt of a baccalaureate degree, during which competence has been demonstrated in the application of scientific or engineering principles and methods to the execution of work involving: (1) the understanding of the occurrence, movement and composition of groundwater, or (2) the development, management or regulation of groundwater, (3) the teaching and research of groundwater subjects at the university level. Education may be substituted for this experience. Explicit descriptions of the qualifying work experience must be presented. A two (2) three-person certification committee decides for or against an applicant. Individuals denied certification may petition for a personal hearing before a review committee that denied his or her original application. To date, over 3000 persons have submitted applications for certification, with nearly 150 becoming certified. (See also W90-00267) (Lantz-PTT)
W91-00268

AMERICAN INSTITUTE OF HYDROLOGY.
Environmental Strategies Corp., Vienna, VA.
J. E. Moore.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 7-10, 1 fig.

Descriptors: *American Institute of Hydrology, *Professional personnel, *Standards, Education, Licensing, Professional societies, Training.

The American Institute of Hydrology (AIH) was formed in 1981 to provide a certification procedure for professionals in all fields of hydrology. The objective of the AIH certification is to strengthen the standing of hydrology as a science and a profession by: establishing standards to certify qualified hydrologists; establishing and maintaining ethical standards to protect the public from irresponsible work; and providing education and training in hydrology. The Institute adheres to the principle of responsible professional conduct and public service. In 1989 the Institute had 756 members, 16 associate members, and 14 corporate members. AIH has established chapters in 40 states and 4 countries. AIH is an organization whose principle aim is to enhance and strengthen the science of hydrology. It achieves this objective by certifying hydrologists, holding technical meetings, assisting state and federal agencies, and cooperating with hydrologic professional organizations. (See also W90-00267) (Lantz-PTT)
W91-00269

PROFESSIONAL REGISTRATION FOR GEOLOGISTS AND ENGINEERING GEOLOGISTS.
Santa Clara Valley Water District, San Jose, CA.
R. E. Tepel.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 11-18, 1 fig, 1 tab, 6 ref.

Descriptors: *Engineering, *Geology, *Professional personnel, *Standards, Education, History, Licensing, Training.

As sciences and professions, engineering and geology share a history of development in which each interacted with the other for many centuries. Water resources development has been a prime factor in the growth of each field. Early civil engineers were forced to invent the geology they needed to build their canals, tunnels and aqueducts. By the late 19th century it was not uncommon for civil engineers in charge of major water supply projects to retain a geologist (usually a college professor) as a consultant. In terms of sheer numbers, the professional registration of geologists and engineering geologists got its biggest boost with the passage of the California Registration Act in 1968. The Association of Engineering Geologists was instrumental in passing the California Act, and continues to support state-by-state registration of geologists, with recognition of the specialty of engineering geology. Engineering geologists almost always, but other geologic specialties on occasion, practice an applied science that directly impacts the public health, welfare, and safety. Professional registration imposes a responsibility on engineering geologists commensurate with the importance of their contribution to the safe design and construction of engineering works. (See also W91-00267) (Lantz-PTT)
W91-00270

AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS: COMPETENCE, INTEGRITY, ETHICS.
American Inst. of Professional Geologists, Arvada, CO.
W. V. Knight.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 19-21.

Descriptors: *American Institute of Professional Geol, *Professional personnel, *Standards, Geology, Licensing, Professional societies, Public relations.

Geology is both a science and a profession. In taking the title of geologist, members identify themselves as part of an established scientific discipline. The American Institute of Professional Geologists (AIPG) is founded on the premise that the strengthening of geology as a profession likewise strengthens geology as a science. The AIPG, a voluntary individual membership association, was organized in 1963 to deal with the professional concerns of all geologists. Since its inception, the Institute has grown to a membership of 4500 certified professional geologists. AIPG membership in-

cludes representatives from all geological disciplines, including engineering geology, geohydrology, minerals and petroleum. All activities of the Institute are directed and funded by geologists themselves. AIPG is the sole organization whose major purpose is to strengthen geology as a profession. The professional practice of geology involves economics, business practices, governmental functions, policy decisions, and competition. Therefore, much of AIPG's work involves interaction between member geologists and the public domain. The seal of AIPG carries the terms: competence, integrity, and ethics. It is these words which guide AIPG's major activities in certification, representation, information and education. (See also W90-00267) (Lantz-PTT)
W91-00271

CERTIFICATION IN THE AMERICAN METEOROLOGICAL SOCIETY.
National Oceanic and Atmospheric Administration, Rockville, MD. Federal Coordinator for Meteorological Services and Supporting Research.
R. L. Carnahan.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 23-25.

Descriptors: *American Meteorological Society, *Professional personnel, *Standards, Licensing, Meteorology, Professional societies, Training.

The Certified Consulting Meteorologist Program of the American Meteorological Society is more than 30 years old. Approximately 425 meteorologists have been certified and the program is growing at the rate of 15-25 certificates being granted each year. There are currently 60 candidates under consideration for certification. The American Meteorological Society will soon be 70 years old. Its objective is the development and dissemination of knowledge of the atmospheric and related oceanic and hydrologic sciences and the advancement of their professional applications. Today it has approximately 10,000 members. This figure represents 80% of the professional meteorologists in the nation. While the Society concentrates heavily on the sciences, which are its principle focuses, it also attempts to address professional applications in a number of ways. In addition to the Society's program for Certified Consulting Meteorologists, it also operates a program to award seals of approval to radio and television weathercasters. The qualifications for certification are: knowledge, experience, and character. Lack of a college degree is not a bar to certification. Qualification on the basis of experience requires a minimum of five years of work at the professional level. To provide a basis for qualification on the basis of character, the application requires the naming of at least three professional references. The certification program is administered by the Board of Certified Consulting Meteorologists consisting of five certified members who contribute their time and interest to the program. Unsuccessful candidates are allowed to reapply for certification two years from the date of denial of their application. Applicants not approved by the board may appeal within 90 days from the receipt of notice to the Executive Committee of the Society. (See also W90-00267) (Lantz-PTT)
W91-00272

AGRONOMISTS: EVALUATION OF PROFESSIONAL COMPETENCE.
American Society of Agronomy, Madison, WI.
J. M. MacCubbin.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 27-36, 2 fig, 3 tab, 2 ref.

Descriptors: *Professional personnel, *Standards, Agronomy, American Society of Agronomy, Education, Licensing, Professional societies.

Society has long demanded professional competence of members of various professions; it was in the 1960's that members of the American Society of Agronomy and the Soil Society of America requested a means for recognizing professional competence. This certification program ARCPACS (American Registry of Certified Professionals in Agronomy, Crops and Soils) was established by the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America in 1977 to evaluate the educational experience and ethical credentials of individuals whose activities are with public and private agencies. In the initial stages of development of the program, it was the intent of the Society to provide a service which would recognize professionals at education levels other than PhD. The certification program has met its primary intent. About 2/3 of the Registry are professionals with baccalaureate or masters degrees. The certification program was initiated at a time when professionals of other disciplines were also requesting a means of professional recognition in their respective areas of expertise. The ARCPACS program has become more viable and recognized since the enactment of various state and federal rules, which require some standard of competence of individuals in the agronomic sciences. As ARCPACS certification continues to be recognized in courts of law and by government regulatory agencies and employers, the program should experience continued growth. The future should include added programs and services, particularly for consultants and practicing professionals with baccalaureate and masters degrees. (See also W90-00267) (Lantz-PTT)
W91-00273

AMERICAN SOCIETY FOR PHOTOGRAMMETRY AND REMOTE SENSING VOLUNTARY CERTIFICATION PROGRAM.
Coyote (E.) Enterprises, Inc., Eugene, OR.
R. Chamard.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 37-39, 1 tab.

Descriptors: *American Society for Photogrammetry and, *Professional personnel, *Standards, Aerial photography, Licensing, Photogrammetry, Professional societies, Remote sensing.

A program was developed for certifying photogrammetrists which was approved by the Board of Directors of the American Society for Photogrammetry on March 13, 1975. The program is entirely voluntary. The Board felt that certification was one way for an individual to be recognized by colleagues and peers as having truly demonstrated professional integrity and competence in one or more subdivisions of photogrammetry. It also felt that the program would encourage members to improve their skills and promote professional practice. Photogrammetry and remote sensing are the art and science of obtaining reliable information about physical objects and the environment through the process of recording, measuring and interpreting imagery and digital representations of energy patterns derived from noncontact sensor systems. Conventional photogrammetry includes the compilation of topographic and other maps from information obtained from aerial photographs. (See also W90-00267) (Lantz-PTT)
W91-00274

NATIONAL ASSOCIATION OF ENVIRONMENTAL PROFESSIONALS--CERTIFICATION PROGRAM.
National Association of Environmental Professionals, Alexandria, VA.
C. F. Zirzow, and R. F. Ehrhardt.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 41-43.

Descriptors: *National Association of Environmental P, *Professional personnel, *Standards, Education, Licensing, Professional societies, Training.

The Certification Program of the National Association of Environmental Professionals (NAEP) is designed to recognize those members of the environmental community who are specially qualified by a combination of education, experience and proven accomplishment. Certification requires submittal of educational transcripts, summaries of work experience, and written answers to essay questions focused on an applicant's particular field or discipline. NAEP's Certification Review Board reviews the documentation and contacts professional references with a knowledge of the applicant's qualifications. Following a favorable finding by the Review Board and action by the Board of Directors of the Association, the applicant is accorded the status of 'C.E.P.', Certified Environmental Professional. (See also W91-00267) (Lantz-PTT)
W91-00275

CREDENTIALING IN THE FORESTRY PROFESSION.
P. G. Smith.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 45-46.

Descriptors: *Forestry, *Licensing, *Professional personnel, *Standards, *State jurisdiction, Alabama, Arkansas, California, Georgia, Legislation, Maine, Maryland, Michigan, Mississippi, North Carolina, Oklahoma, South Carolina, Training, West Virginia.

Results from a 1988 survey of 50 states show that only 12 have active registration or licensing programs for foresters. They include: Alabama, Arkansas, California, Georgia, Maine, Maryland, Michigan, Mississippi, North Carolina, Oklahoma, South Carolina, and West Virginia. Of these 12, only California and Maine require mandatory licensing in order to practice forestry. The others comprise voluntary registration programs. This finding represents no change in numbers of registration and licensing programs since the last survey results in 1983. Five additional states are now actively pursuing enacting forester registration legislation. Others are expected to follow suit. Credentialing is governed by a hierarchy beginning with accreditation, and moves through certification, registration and licensing. Certification is similar to accreditation in that it is a voluntary process but it differs in registration in that a nongovernmental organization attests to the professional qualifications of the individual. Registration is similar to certification, it requires an individual to meet specified standards of education and/or professional experience. Qualifying exams must also be passed. Licensing is a compulsory procedure by which a state grants qualified individuals the right to practice their occupation. Currently, California and Maine license foresters. (See also W91-00267) (Lantz-PTT)
W91-00276

HISTORY OF REGISTRATION OF GEOLOGISTS AND GEOPHYSICISTS IN CALIFORNIA.
Law Environmental, Inc., Burbank, CA.
G. A. Browm.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 47-49.

Descriptors: *California, *Professional personnel, *Standards, Civil Engineers Registration Act, Geology, Geophysics, History, Legislation.

The first registration attempts for geologists and physicists were made through the efforts of the California Association of Engineering geologists. There are two types of registration: (1) protection of the practice act which signifies that those professionals working in a given field of practice cannot sell their services to the public without being registered; and (2) protection of the title act which reserves the use of the title 'geologist' or 'geophysicist' to those qualified.The history began with the enactment of the Civil Engineers Registration Act in 1930 which was ammended in 1947 to include professional engineers in the chemical, electrical, petroleum, and mechanical fields. The

first registration bill for geologists was introduced in 1963, and a grandfathering process was started in 1969 for preventing those qualified through experience from being legislated out of business. The profession of geology in California has been spurred on by disasters. The mandates of the Clean Water Act have also added new dimensions to the need for qualified professionals. (See also W91-00267) (Lantz-PTT)
W91-00277

PROFESSIONAL REGISTRATION FOR HYDROLOGISTS IN ARIZONA: A PROPOSAL PREPARED BY THE ARIZONA HYDROLOGICAL SOCIETY.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
E. S. Simpson, and D. Young.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 51-56.

Descriptors: *Arizona, *Licensing, *Professional personnel, *Standards, *State jurisdiction, Regulations.

In recent years Federal and State laws have been enacted designed to conserve the quantity and protect the quality of public water supplies, and to reduce the adverse impacts of flooding and public expenditures for flood control works and post-disaster assistance. These laws and the public's awareness of the need to conserve and protect water supplies has resulted in an explosive market for professionals trained in the hydrological sciences. In Arizona the need for well trained hydrologists is acute. The population influx continues to promote new housing developments, many of which require the development of new water sources resulting in an increase in competition for water supplies. A summary of the need for the professional registration of hydrologists in Arizona emphasizes that: (1) the practice of hydrology is distinct and different from either civil engineering or geology; (2) the explosion in demand for hydrologists requires state registration for quality assurance; (3) hydrologic conditions and water law in Arizona are unique. State registration will ensure that hydrologists practicing in Arizona will be qualified to deal with problems particular to the state; (4) registered engineers should be relieved of the need to sign reports prepared by hydrologists when the report requires a state seal; (5) hydrologists must be held responsible for the quality of their work; and (6) the exclusion of professional hydrologists from protection offered registered professionals for the recovery of fees through mechanic's lien rights (House Bill 2229), is not fair to hydrologists and can be corrected by offering state registration to hydrologists. (See also W91-00267) (Lantz-PTT)
W91-00278

ENGINEERING SPECIALTY CERTIFICATION.
National Inst. for Certification in Engineering Technologies, Alexandria, VA.
J. D. Antrim.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 57-60.

Descriptors: *Engineering, *Professional personnel, *Standards, Licensing, Regulations.

Although broad engineering disciplines such as civil, electrical, and mechanical engineering are still important, the complexities of present-day technology has led to the creation of engineering specialties. The expertise needed to practice competently in a specialty area has brought many practioners to believe that special credentialing is needed to verify that the claimed expertise is real. A national effort to bring order and consistency to engineering specialty credentialing is underway and a proposed entity to provide the needed coordination could be operational early in 1990. This entity must accommodate certification efforts which address different populations such as licensed professional engineers, graduate engineers, engineering technologists, engineering technicians, and professionals whose area of practice falls in what is typically referred to as engineering-related, and that the entity must operate in a manner which spreads control among the populations. Engineering specialty certification will succeed only if there are no 'turf battles' and all of the programs are quality programs meeting uniform minimum standards. (See also W91-00267) (Lantz-PTT)
W91-00279

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, L987 - NOVEMBER 30, 1988.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W91-00344

ANNUAL YIELD AND SELECTED HYDROLOGIC DATA FOR THE ARKANSAS RIVER BASIN COMPACT ARKANSAS--OKLAHOMA 1989 WATER YEAR.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-00360

REGULATORY EFFECTS ON THE PRACTICE OF DRINKING WATER TREATMENT.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5F.
W91-00483

RESPONSE OF THE US EPA REGION V STATES TO THE NONPOINT SOURCE REPORTING REQUIREMENTS OF THE 1987 CLEAN WATER ACT AMENDMENTS.
Wisconsin Univ.-Madison. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5G.
W91-00565

OPERATION AND MAINTENANCE ACTIVITIES OF AN IRRIGATION SYSTEM IN JAVA (IN JAPANESE).
For primary bibliographic entry see Field 3F.
W91-00767

SUMMARY OF RESOURCE CONSERVATION AND RECOVERY ACT LEGISLATION AND REGULATION.
Tufts Univ., Medford, MA. Center for Environmental Management.
J. R. Reinhardt.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 1.9-1.27, 2 tab, 5 ref.

Descriptors: *Environmental protection, *Hazardous waste disposal, *Legal aspects, *Regulations, *Resource Conservation and Recovery Act, Hazardous wastes, Incineration, Land disposal, Legislation.

An overview of existing legislation and regulation, and a context in which to evaluate current and future regulatory activity is presented. The Resource Conservation and Recovery Act (RCRA) of 1976 is the primary legislation controlling hazardous-waste management. RCRA originated as a law with a comprehensive scope; it instituted 'cradle to grave' control of hazardous waste requiring massive and complex regulation due to the diversity of industrial and commercial operations under its purview. The scope of RCRA is discussed in regard to: (1) the framework of regulations in regard to generator responsibilities and waste identification; transporter responsibilities; and treatment, storage, and disposal facility owner and operator responsibilities; (2) its relation to the Comprehensive Environmental Response Compensation and Liability Act (CERLA); (3) the 1984 administrative, financial, enforcement, solid-waste, and reports amendments; and (4) the amendments dealing with hazardous-waste regulations for permits, underground storage tanks, technology, mining, small-quantity generators, and waste oil. The policy of shunning land disposal in favor of incineration and other methods gives rise to a complex process subject to many influences. ONe factor is the complexity of the permitting process for land disposal facilities, with closure and post-closure costs, that encourages more incineration and other treatment facilities. Depending on how the regulations or promulgated and enforced, hazardous-waste management in the United States could change dramatically over the next ten years. (See also W91-00900) (White-Reimer-PTT)
W91-00902

SUMMARY OF CERCLA LEGISLATION AND REGULATIONS AND THE EPA SUPERFUND PROGRAM.
Weston (Roy F.), Inc., Washington, DC.
R. Stanford, and E. C. Yang.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 1.29-1.45, 3 fig.

Descriptors: *Cleanup, *Comprehensive Environmental Response Co, *Hazardous materials, *Legal aspects, *Regulations, *Superfund, *Waste disposal, Emergency planning, Environmental protection, Public health, Remedies.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) gives the federal government broad authority to respond to releases or the threats of releases of hazardous substances, and to pollutants or contaminants that may present an imminent and substantial danger to the public health or welfare or to the environment. A 'release' is defined to include not only the spilling or leaking of a substance into the environment, but also the abandonment or discarding of barrels, containers, or other closed receptacles that are considered hazardous. The Act provides for long-term actions that are consistent with permanent remedy, known as remedial-response actions, and shorter-term actions in response to immediate danger, known as removal actions. The key provisions of CERLA provide for emergency response, remedial response, and research, development, and demonstration. The two areas of response for the CERCLA Superfund program are: (1) removal response, which is administered by the Emergency Response Division of the Office of Emergency and Remedial Response (OERR); and (2) remedial response which is administered by the Hazardous Site Control Division of OERR. The Superfund removal program provides response to immediate threats to public health, welfare, and the environment. The remedial-response program addresses the releases of hazardous material, pollutants, or contaminants that require complex, long-term response. The Superfund Innovative Technology Evaluation (SITE) program distinguishes between an alternative technology that is currently available, one that is innovative, and one that is emerging. The SITE demonstration program consists of two parts: (1) searching for and identifying prospective innovative alternative technologies, and (2) evaluating the performance of those technologies through demonstration. (See also W91-00900) (White-Reimer-PTT)
W91-00903

6G. Ecologic Impact Of Water Development

ENDPOINTS FOR REGIONAL ECOLOGICAL RISK ASSESSMENTS.
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. W. Suter III.
Environmental Management EMNGDC, Vol. 14, No. 1, p 9-23, January/February 1990. 4 tab, 44 ref.

Descriptors: *Ecology, *Ecosystems, *Environmental policy, *Population dynamics, *Regional planning, *Risk assessment, Air pollution, Environmental effects, Productivity, Water pollution, Water quality standards.

Ecological risk assessments must have clearly defined endpoints that are socially and biologically relevant, accessible to prediction and measurement, and susceptible to the hazard being assessed. Most ecological assessments do not have such endpoints, in part because the endpoints of toxicity tests or other measurements of effects are used as assessment endpoints. This article distinguishes assessment and measurement endpoints in terms of their roles in risk assessments and explains how the criteria for their selection differ. It then presents critical discussions of possible assessment and measurement endpoints for regional ecological risk assessments. Finally, the article explains how endpoint selection is affected by the goal of the assessment. Generic goals for regional risk assessment include explanation of observed regional effects, evaluation of an action with regional implications, and evaluation of the state of a region. Currently, population level assessment endpoints such as abundance and range are the most generally useful. For ecosystems and regions, data are generally not available and the validity of models has not been demonstrated. Physiological and organismal effects are not relevant. However, landscape descriptors, material export, and other regional-scale measurement endpoints show promise for regional assessments. (Author's abstract)
W91-00025

ROLE OF GROUND WATER IN CONTROLLING ECOLOGY OF AREA: A CASE STUDY OF GHANA BIRD SANCTUARY - DISTRICT BHARATPUR, RAJASTHAN.
M. Mehta.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 179-181, 1 fig, 1 tab.

Descriptors: *Ecosystems, *Ghana Bird Sanctuary, *Groundwater management, *India, *Surface-groundwater relations, *Water level, Aquifers, Case studies, Flow discharge.

The Ghana Bird Sanctuary district, in Bharatpur, Rajasthan, is one of the most famous bird sanctuaries in the world. A number of migratory birds travel to the sanctuary each winter. In 1979, the sanctuary suffered from an acute water shortage which effected the ecology of the area and possibly the migration of the birds. The average annual rainfall is 670 mm. The rainfall is also very erratic with a variability of approximately 40%. This has resulted in acute water shortages in the area lake, and the ecology of the area has suffered. To study the lake level with regard to groundwater level, an observation well was put in the sanctuary. Confirmation of a groundwater/lakewater relationship was made through observation. The lake level is marginally higher than the groundwater level. The average loss of water in the lake from 10/77-5/78 was 120 mm/month with a seepage loss of around 40 mm. Any supply scheme to maintain the lake water level over 1 sq km will require about 0.12 million cu m (4000 cu m/day) in addition to the quantity required to fill the lake. It was estimated that around 0.3 million cu m/day would be required to maintain the lake level in limited areas of the sanctuary. In order to augment water in the lake the deeper aquifers should be developed (90-140 m). The deeper aquifer is under artesian pressure and the piezometric head is about 2 to 3 meters above ground level within the entire sanctuary area. The expected free flow discharge from tube wells tapping this aquifer is about 30 cu m/hour. If the wells are pumped the discharge will be about 150 cu m/hour. Consequently, 3 high capacity wells with free flowing conditions were constructed in the lake bed. This has helped continue the present agricultural environment of the lake. (See also W91-00215) (Lantz-PTT)
W91-00234

GEOMORPHIC DESIGN AND MANAGEMENT OF DISTURBED LANDS.
Denver Univ., CO. Dept. of Geology and Geography.
For primary bibliographic entry see Field 4C.
W91-00296

WATER RESOURCES DATA COLLECTED DURING WATER YEAR 1988 AT SELECTED JAMES RIVER BASIN SITES IN NORTH DAKOTA AND SOUTH DAKOTA.
Geological Survey, Huron, SD. Water Resources Div.
S. K. Sando, K. G. Guttormson, and T. A. Gleich.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 90-101, 1990. 230p, 3 fig, 41 tab, 9 ref.

Descriptors: *Dam effects, *Environmental impact, *North Dakota, *South Dakota, *Water resources data, *Water resources development, Discharge measurement, Garrison Diversion Unit, Hydrologic data, Interbasin transfers, James River Basin.

Operation of the proposed Garrison Diversion Unit will supply water from the Missouri River in North Dakota to the upstream part of the James River basin. The U S Bureau of Reclamation initiated a monitoring program in 1984 to aid in determining whether the potential impacts resulting from Garrison Diversion Unit operation will be compatible with the operational objectives of the three national wildlife refuges located on the James River in North Dakota and South Dakota. The report presents water resources data collected by the U S Geological Survey during water year 1988 in the James River basin as part of the Garrison Diversion Unit monitoring program. Water discharge records for 12 stations, reservoir elevation and contents records for one station, stream gage-height records for three stations, and water-quality records for 23 stations are presented. (Author's abstract)
W91-00342

VEGETATIVE CHANGES IN A WETLAND IN THE VICINITY OF A WELL FIELD, DADE COUNTY, FLORIDA.
Geological Survey, Tallahassee, FL.
R. H. Hofstetter, and R. S. Sonenshein.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4155, 1990. 16p, 9 fig, 37 ref. Prepared in cooperation with the South Florida Water Management District.

Descriptors: *Environmental effects, *Florida, *Vegetation, *Wells, *Wetlands, Aerial photography, Ecosystems, Introduced species, Species diversity, Succession.

Plant communities present in 1978 and 1986 were analyzed at 250 random points on stereoscopic pairs of aerial photographs for four study sites in the vicinity of the Northwest Well Field in Dade County, Florida. Sites NW and NE lie northwest of the well field beyond the cone of depression. Site SW lies in the outer part of the cone, and site SE lies within the cone of depression. Relative frequency values for several plant types including herbs, shrubs-small trees, and trees were analyzed by the Heterogeneity G-Test to determine heterogeneity among sites in 1978 and 1986. In 1978, all four sites were dominated by plant communities having herbs, shrubs, or a mixture thereof. The communities at sites NW and NE were similar, and those at SE and SW were somewhat similar. In 1986, sites NW, NE and SE were dominated by a mixture of shrubs and trees. Only at site SW was the relative frequency of occurrence of herbaceous plants still high. At each site, there was a decrease in herbaceous vegetation and an increase in woody vegetation during this period, with the increase in trees being greatest at site SE. Time between the start of the well-field operation in May 1983 and January 1986 photographs was insufficient to allow determination of any direct effects of the well field on the vegetation. Ground-level observations in 1987 and 1988 indicate a trend toward continued increase in dominance of woody plants and a decrease in herbaceous wetland vegetation. Development of a forest of the exotic pest tree Melaleuca is occurring at all four sites, but especially at site SE. Vegetative changes between 1978 and 1986 are attributed to an invasion of Melaleuca, a shortened hydroperiod, and natural succession within the plant communities. (Author's abstract)
W91-00352

DREDGING OF NORTH PARK LAKE, COUNTY OF ALLEGHENY, PENNSYLVANIA.
Pennsylvania Dept. of Environmental Resources, Harrisburg.
For primary bibliographic entry see Field 5G.
W91-00564

EFFECT OF TOSTON DAM ON UPSTREAM ICE CONDITIONS.
Cold Regions Research and Engineering Lab., Hanover, NH.
G. D. Ashton.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A210-119. Price codes: A03 in paper copy, A01 in microfiche. May 1989. 11p, 3 fig, 1 tab, 4 ref.

Descriptors: *Dam effects, *Environmental effects, *Ice formation, *Missouri River, *River ice, *Toston Dam, *Water resources development, Flooding, Ice pressure, Seasonal variation, Water level.

A study was conducted to evaluate the effect of raising the winter period reservoir level at Toston Dam on the Missouri River to an elevation of 3952.6 feet above sea level. At present, the dam is operated as an overflow dam with crest elevation of 3941.6 ft during winter. A proposal to install hydropower at the dam would require replacement of the existing flashboard system with radial gates and maintenance of a higher water level at the dam during winter periods. Under this proposed plan of operation, there is concern about the possible effects of the Crow Creek pumping plant located about two miles upstream, with possible ice related flooding of the Burlington Northern railroad track, which extends along the east side of the reservoir, with the effects of ice on existing islands in the reservoir, and with ice effects at the dam and proposed hydropower facility. The effect of raising the reservoir level of Toston Dam on the Missouri River on water levels upstream during winter periods is assessed. The analysis used the HEC-2 program with the ice option to estimate water levels under present and future raised dam elevations. Ice thicknesses were estimated using a trial and error procedure based on existing ice jam theory. Results of the analysis were validated using field observations from two winters. (Lantz-PTT)
W91-00574

EFFECT OF REGULATION ON 0+ FISH RECRUITMENT IN THE GREAT OUSE, A LOWLAND RIVER.
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
G. H. Copp.
Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 251-263, June/July 1990. 3 fig, 4 tab, 41 ref.

Descriptors: *Dam effects, *England, *Fish establishment, *Fish populations, *Ouse River, *Regulations, *River systems, *Stream regulation, *Water management, Correspondence analysis, Electrofishing, Flow rates, Spatial distribution.

The recruitment of 0+ fishes in the River Great Ouse, East Anglia, England was investigated using electrofishing by point abundance sampling, in order to compare the distribution and extent of fish reproduction in the river and its annexes (side channels, backwaters, etc.) with similar but unregulated lowland rivers of Europe. In all, 44 sites were sampled during three weeks in August 1989. Correspondence analysis of the site-by-species matrix (44 x 17) in density (fishes per square meter) revealed a slight but notable longitudinal zonation of fish reproduction, unusual for lowland rivers, with the limnophils Blicca bjoerkna, Scardinus erythrophthalmus and Abramis brama limited to lentic downstream sites and the rheophil Barbus

barbus restricted to a few upstream sites. Thus, compared with unregulated rivers of Europe, the River Great Ouse differs by: (1) the absence of pelagic spawners, e.g. Lota lota, which were historically reported as abundant; (2) the reduced range and abundance of both rheophilic and limnophilic cyprinids, e.g. Barbus barbus, Alburnus alburnus, and Blicca bjoerkna, Scardinus erythrophthalmus, Abramis brama, Tinca tinca; and (3) the predominance of generalists throughout the system, Rutilus rutilus downstream and Phoxinus phoxinus with Gasterosteus aculeatus upstream, probably to the additional detriment of the localized specialists, both limnophilic and rheophilic. (Author's abstract)
W91-00777

ENHANCEMENT OF BENTHIC MACROINVERTEBRATES BY MINIMUM FLOW FROM A HYDROELECTRIC DAM.
Versar, Inc., Columbia, MD.
S. B. Weisberg, A. J. Janicki, J. Gerritsen, and H. T. Wilson.
Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 265-277, June/July 1990. 8 fig, 1 tab, 33 ref.

Descriptors: *Benthic fauna, *Flow rates, *Hydroelectric plants, *Instream flow demand, *Invertebrates, Minimum flow, Population dynamics, Temporal distribution, Water currents.

The biological consequences of instituting a summer minimum flow from the Conowingo Hydroelectric Dam were investigated by comparing invertebrate abundance in the Susquehana River during 1980, when flow shutdowns were frequent, to that in 1982, when the minimum flow (142 cubic m per sec) was maintained. The minimum flow was only maintained from April 15 to September 15, and additional investigations compared invertebrate abundance before and after the minimum flow was terminated in the fall of 1982 and 1983. There was a large difference in summer invertebrate density in the between-year comparison, with an almost 100-fold increase in the year when the minimum flow was maintained. Most of this difference was exhibited by two taxa, chironomids and net-spinning trichopterans. These results were consistent with findings from the fall of 1982 and 1983, when cessation of the minimum flow in September led to the decline of more than three orders of magnitude in both of these taxa. The rate of decline was faster in the shoal habitat (areas dewatered at low flow, but submerged when the minimum flow is released) suggesting that dewatering was the predominant mechanism of effect. Declines were also evident in the channel habitat (always submerged) which suggests that maintenance of current velocity is also an important beneficial component of the minimum flow. (Author's abstract)
W91-00778

MARGINAL ZOOBENTHOS OF A SOUTHERN BRAZILIAN DAM (ZOOBENTHOS LITORANEOS DE UM ACUDE SUL-BRASILEIRO).
Museu de Ciencias Naturais de Fundacao Zoobotanica do Rio Grande do Sul, Porto Alegre (Brazil).
I. L. Veitenheimer-Mendes, V. L. P. Pitoni, R. M. Lanzer, and M. C. P. DaSilva.
Revista Brasileira de Biologia RBBIAL, Vol. 50, No. 1, p 7-14, February 1990. 6 fig, 1 tab, 15 ref. English summary.

Descriptors: *Benthic fauna, *Dam effects, *Limnology, *River systems, Caddisflies, Midges, Oligochaetes, Seasonal variation, Sediment chemistry, Sediment type, Species composition, Species diversity.

A qualitative, quantitative and seasonal study on the marginal zoobenthos was conducted in a small dam at Morro Santana, Porto Alegre, Rio Grande do Sul, Brazil (30 deg 03 min 45 sec and 30 deg 03 min 50 sec south; 51 deg 08 min 06 sec and 51 deg 08 min 15 sec west). Samples were collected monthly from May 1979 to April 1980, in six marginal stations (942 sq cm/station). Sediment characteristics and physical and chemical data measured during the collections are also provided. The marginal zoobenthos is low in number of organisms (1917), but the species diversity is high (23 taxa). The Chironomidae larvae were dominant in the faunal composition with Pisidium punctiferum, Pisidium forense, and Gundlachia concentrica secondarily dominant. Other important faunal components were oligochaetes and trichopteran larvae. (Author's abstract)
W91-00780

SPOT AND ENVIRONMENTAL STUDIES: AN ADVANCED SYSTEM TO COLLECT UP TO DATE GEOGRAPHIC INFORMATION.
SPOT Image Corp., Toulouse (France).
For primary bibliographic entry see Field 7B.
W91-00793

CONCEPTUAL BASIS FOR ENVIRONMENTAL MONITORING PROGRAMS.
Idaho National Engineering Lab., Idaho Falls.
For primary bibliographic entry see Field 7A.
W91-00794

7. RESOURCES DATA

7A. Network Design

RESEARCH ON AGRICHEMICALS IN WATER RESOURCES.
Geological Survey, Iowa City, IA.
For primary bibliographic entry see Field 5B.
W91-00417

BASIS OF HYDRO-CLIMATIC TIME SERIES IN GREENLAND.
Greenland Technical Organization, Copenhagen (Denmark). Section of Hydro-Technical Investigation.
For primary bibliographic entry see Field 7C.
W91-00469

HYDROGEOLOGIC INVESTIGATIONS SAMPLING PLAN.
Available from the National Technical Information Service, Springfield, VA 22161, as DE-89005720. Price codes: A13 in paper copy, A01 in microfiche. Report No. DOE/OR/21548--020, November 1988. 276p, 62 fig, 25 tab, 72 ref, append. DOE Contract DE-AC05-86OR21548.

Descriptors: *Geohydrology, *Missouri, *Network design, *Path of pollutants, *Project planning, *Sampling, *Weldon Spring Site, Hydraulic properties, Quality control, Risk analysis, Water quality control, Water sampling.

The goal of the sampling plan is to identify and develop specific plans for those investigative actions necessary to: (1) characterize the hydraulic regime; (2) define the extent and impact of contamination; and (3) predict future contaminant migration for the Weldon Spring Site (WSS), Missouri and vicinity. This sampling plan is intended to supplement the Quality Assurance Plan (QAPP). The plan describes objectives, work tasks, quality assurance/quality control (QA/QC) procedures and the level of effort required for site characterization and to support a feasibility study. Data developed through this sampling plan will also be used in the risk assessment evaluation. (Lantz-PTT)
W91-00557

HEURISTIC CLOSED-LOOP CONTROLLER FOR WATER DISTRIBUTION IN COMPLEX IRRIGATION SYSTEMS.
Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung.
For primary bibliographic entry see Field 3F.
W91-00582

REGIONAL WATER QUALITY: EVALUATION OF DATA FOR ASSESSING CONDITIONS AND TRENDS.
Geological Survey, Menlo Park, CA. Water Resources Div.
J. Hren, C. J. Oblinger Childress, J. M. Norris, T. H. Chaney, and D. N. Myers.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1122-1127, August 1990. 12 ref, 4 fig.

Descriptors: *Colorado, *Data interpretation, *Groundwater data, *Hydrologic data collections, *Network design, *Ohio, *Regional analysis, *Surface water data, *Water quality, *Water quality trends, Aquifers, Data collections, Data requirements, Laboratory methods, Streams, Water analysis, Water sampling.

In 1986, a pilot National Water Quality Assessment Program (NAWQA) was begun by the US Geological Survey (USGS). The goals of the NAWQA program are to describe the status and trends in the water quality of the nation's streams and aquifers, and to provide an understanding of the natural and human causes of the observed conditions and trends. In the pilot study, water sampling programs in Colorado (CO) and Ohio (OH) were examined to determine characteristics of data collection activities of government agencies and universities, and to determine the adequacy of resulting data. In Phase I, USGS compiled an inventory of 48 data collection organizations with 115 programs in CO, and 42 organizations with 88 programs in OH. Most samples were from surface water sources, and only a fraction (34% for CO and 5% for OH) met Phase I screening criteria. In the Phase II screen, the 8 criteria used fall into one of two major categories, field practices or laboratory practices. Most of the data passing both the Phase I and Phase II screening were pH, alkalinity, specific conductance, and dissolved oxygen data--factors that broadly characterize water quality. Few acceptable analyses were for trace constituents. Phase III evaluated the extent to which this ambient water quality data can be used to answer major regional and national questions on current water quality conditions, water quality trends, and the relationship of trends to natural versus anthropogenic factors. Both surface and groundwater data collected during 1977 to 1984 were used in Phase III, and the number of measurements at each data collection site was analyzed, as well as the areal distribution of sites. Problem areas included the limited effort directed toward the determination of potentially toxic constituents, lack of areas where samples had been collected over a long period of time, and the lack of standards in field procedures when sampling. (VerNooy-PTT)
W91-00619

CONCEPTUAL BASIS FOR ENVIRONMENTAL MONITORING PROGRAMS.
Idaho National Engineering Lab., Idaho Falls.
G. B. Wiersma.
Toxicological and Environmental Chemistry TXECBP, Vol. 27, No. 4, p 241-249, 1990. 5 fig, 10 ref.

Descriptors: *Chile, *Environmental monitoring, *Experimental design, *Network design, *Risk assessment, *Wyoming, Atmosphere, Comprehensive planning, Ecosystems, Lichens, Mosses, Path of pollutants, Pollutant identification, Sampling.

For the past several years, the Marine Board of the National Research Council, National Academy of Sciences, has been working on a study of a systems analysis of marine environmental monitoring programs. As a result of that study, a set of general technical criteria for designing and evaluating monitoring programs has been proposed and a set of questions was derived to assist in the evaluation of an existing or proposed monitoring network. These questions are set against a pilot study in southern Chile and/or a Wind River Mountain, Wyoming study and are: have the information needs been clearly stated; does the monitoring design reflect cause and effect; will the data sets support a multi-media risk assessment; have preliminary studies been identified, including what data

are already available and how will they be used; is the monitoring program designed for ecosystem level analysis; can the design support large space and time scales; are the study boundaries clearly defined; and how will the information be disseminated; monitoring programs should be set up to reveal pathways of exposure, the distribution of potential compounds, exits from a system, and identification of the most sensitive and critical ecological receptors. In Chile, atmospheric sampling was completed, as well as sampling of streams, lakes, and soil. Mosses and lichens were sampled for trace elements. This variety of test sites reflect the attempt to design a multi-media monitoring program. Both pilot sites experienced extensive preliminary sampling which was extremely useful in the eventual study design. To accommodate ecosystem level analysis, a site inventory is essential. In Chile, this inventory included an analysis of vegetation types and distribution, overstory sampling, dead and down log measurements, estimates of litter mass, tree ring analysis for growth rate, and mapping of stand features. The sampling site in both sites was carefully established, and personnel were trained to support longterm sampling. The principle established are applicable to the development of all monitoring programs. (Brunone-PTT)
W91-00794

ASSESSMENT OF THE US CONSERVATION SERVICE METHOD FOR ESTIMATING DESIGN FLOODS.
Brawijaya Univ., Malang (Indonesia). Fakultas Teknik.
For primary bibliographic entry see Field 2E.
W91-00989

7B. Data Acquisition

FOURIER AND MOMENT METHODS APPLIED TO TWO-DIMENSIONAL RAINDROP IMAGES.
Alabama Univ. in Huntsville.
For primary bibliographic entry see Field 2B.
W91-00055

MEASUREMENT OF RAINDROP SIZE DISTRIBUTIONS USING A SMALL DOPPLER RADAR.
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W91-00056

MODELLING LONG-TERM RAINFALL PATTERNS IN NORTH-EAST ENGLAND.
For primary bibliographic entry see Field 2B.
W91-00099

DIFFERENTIAL REFLECTIVITY RADAR HAIL MEASUREMENT TECHNIQUE: OBSERVATIONS DURING THE DENVER HAILSTORM OF 13 JUNE 1984.
Pennsylvania State Univ., University Park. Communications and Space Sciences Lab.
For primary bibliographic entry see Field 2C.
W91-00140

EFFECT OF IRREGULARITIES IN THE DIAMETER CLASSIFICATION OF RAINDROPS BY THE JOSS-WALDVOGEL DISDROMETER.
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W91-00141

RADAR RAINFALL FORECASTING METHOD DESIGNED FOR HYDROLOGICAL PURPOSES.
Ecole Nationale des Ponts et Chaussees, Paris (France).
T. Einfalt, T. Denoeux, and G. Jacquet.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 229-244, May 1990. 14 fig, 2 tab, 37 ref.

Descriptors: *Model studies, *Radar, *Rainfall forecasting, *Rainfall-runoff relationships, *Runoff forecasting, *Storm water management, *Urban hydrology, Computer models, Flood forecasting, France, Hydrologic models, Infrared imagery, Rainfall simulators.

Advanced techniques in sewer management need a reliable rainfall forecasting methodology to satisfy the urban hydrologist. Frequent flooding of a Paris, France, suburb caused a need for a real-time control scheme. Studies directed toward the use of radar rainfall forecasts considered three hierarchical control goals: flood prevention, pollution reduction, and cost minimization. A proposed computerized forecasting method is based on recent advances of pattern recognition and image processing. Its user-defined hydrological features focus on heavy rainfall and on accuracy at a small time-area scale. The reliability of the actual forecast is calculated and issued in real-time. One of the typical problems of the 'structured' (pattern recognition) approach has been solved (splitting and merging of echoes), and the same technique has allowed a basis to be established for future development of a simple growth and decay forecast. By comparison with earlier forecasting methods, the proposed method proves to be slightly superior in hydrological terms. However, the appropriate quality criteria always depend on the application. Further research is being undertaken in this direction. The method has been in operation since May 1988. (Fish-PTT)
W91-00156

EVALUATION OF HYDROGEOCHEMICAL PARAMETERS WITH SPONTANEOUS POTENTIAL LOGS.
National Geophysical Research Inst., Hyderabad (India).
I. Radhakrishna, and T. G. Rao.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 245-257, May 1990. 8 fig, 4 tab, 9 ref.

Descriptors: *Borehole geophysics, *Geochemistry, *Geohydrology, *Groundwater quality, *Logging (Recording), *Spontaneous potential logging, *Water chemistry, *Well logs, Aquifer characteristics, Coastal aquifers, Electric potential, Resistivity, Sedimentary basins, Water quality management.

The estimation of groundwater quality for individual aquifers in a multi-aquifer system is beset with many problems. An attempt has been made to quantify the hydrogeochemical parameters using self potential logs for different aquifers in a major coastal sedimentary basin. This involved establishing a relationship between the resistivity of formation water and the 'equivalent formation water resistivity' for the system and then using analytical scatter diagrams between dissolved solids and various individual cations and anions. The results obtained through these trend analyses and scatter plots for a multi-layered coastal system were compared with the chemical analyses of water samples and were found to be in close agreement. This approach would reduce drill-stem tests, which are costly and risky, and also minimize uncertainties in the assessment of quality variations for individual zones in multi-aquifer systems. (Author's abstract)
W91-00157

REMOTE-SENSING APPLICATION TO WELL MONITORING.
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W91-00169

MODELING THE EFFECT OF ALGAL BIOMASS ON MULTISPECIES AQUATIC MICROCOSMS RESPONSE TO COPPER TOXICITY.
Washington Univ., Seattle. Applied Physics Lab.
For primary bibliographic entry see Field 5C.
W91-00197

RURAL WATER SUPPLY INVESTIGATIONS IN SCARCITY VILLAGES IN BHANDARA DISTRICT, MAHARASHTRA.
Central Ground Water Board, Nagpur (India). Central Region.
P. R. Subramanian.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 71-74, I fig.

Descriptors: *Data collections, *Developing countries, *Geohydrology, *Groundwater resources, *Water resources development, *Water yield, Bhandara District, Geology, Gneiss, Granites, India, Mica, Well drilling.

Recurrent failure of monsoons since 1982 culminated in alarming drought condition in many parts of Maharashtra, India, especially in the Vidarbha region. Bhandra district was severely affected. Most of the district is underlain by rocks of Pre-Cambrian age belonging to Sausar and Sakoli series, comprised of mica-schists, quartz-mica-granualites and gneisses. The Sakoli group of rocks occur in a triangular fashion and are comprised essentially of agillaceous sediments with arenaceous intercalations, metamorphosed to varying degrees. Granites, granitic gneisses and basic intrusives and extrusives occurring and associated with the above rocks. The Central Ground Water Board carried out geohydrological surveys in 315 scarcity villages and selected sites for borewells, and tubewells. Drilling that has been carried out so far has indicated good yields ranging from 500 to 28,000 L/hr. (See also W91-00215) (Lantz-PTT)
W91-00222

APPLICATION OF RADIOACTIVE TRACER TECHNIQUES FOR DETERMINING GROUNDWATER VELOCITY AND DIRECTION.
Bhabha Atomic Research Centre, Bombay (India).
K. Shivanna, U. P. Kulkarni, S. V. Navada, and A. C. Eapen.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 75-88, 7 fig, 2 tab, 4 ref.

Descriptors: *Flow velocity, *Groundwater movement, *India, *Radioactive tracers, *Saline water intrusion, *Tracers, Aquifers, Case studies, Developing countries, Wells.

Single well tracer techniques for groundwater velocity measurement and multiple well techniques for determining the direction of groundwater flow were employed in the following groundwater studies. (1) Leakage of reservoir water in a lateritic area in Sawantvadi in Maharashtra: radiotracer studies were carried out at the Poip Dam site to investigate the seepage of reservoir water. It was observed that most of the seepage occurred from under the dam through the laterite soil in the direction of the natural stream at the dam's location. (2) Seawater intrusion in the Minjur aquifer near Madras in Tamil Nadu: A radiotracer study was carried out on the coastal Minjur aquifer to determine the intrusion of saltwater toward the well field. The inland intrusion of the saltwater was found to be a few centimeters per day near the coast. (3) Impact of paper mill effluent on the groundwater body at Erode in Tamil Nadu: A radio tracer carried out near M/s. Seshasayee Paper Mill in Erode helped in determining the rate at which effluents move toward the groundwater body. (See also W91-00215) (Lantz-PTT)
W91-00223

ENVIRONMENTAL CHLORIDE METHOD FOR GROUNDWATER RECHARGE STUDIES: POTENTIALITIES AND LIMITATIONS.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-00226

SPECIFIC YIELD ESTIMATIONS BY RADIOACTIVE TRACER IN INDO-GANGETIC PLAIN.
Uttar Pradesh Irrigation Research Inst. Roorkee (India).
For primary bibliographic entry see Field 2F.
W91-00227

MANAGEMENT AND CONSERVATION OF GROUND WATER RESOURCE THROUGH POINT DILUTION TECHNIQUE USING RADIOTRACER - SOME CASE HISTORIES.
For primary bibliographic entry see Field 4B.
W91-00229

SUBMERSIBLE PUMP TESTS CONDUCTED ON BORES DRILLED BY D.T.H. COMPRESSOR RIGS AND THE COMPARISON OF TWO DISCHARGES.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
For primary bibliographic entry see Field 2F.
W91-00232

INSTRUMENTATION AND TECHNIQUE OF GROUNDWATER EXPLORATION (WITH NATURE OF AQUIFER) IN UNCONSOLIDATED SEDIMENTS (GANGETIC PLAINS) OF UTTAR PRADESH, NORTHERN INDIA.
Lucknow Univ. (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00235

MORE ACCURATE DETERMINATION OF AQUIFER PARAMETERS USING THE IP SOUNDING METHOD.
University of Science, Penang (Malaysia).
S. Arafin, and C. Y. Lee.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 221-228, 5 fig, 1 tab, 14 ref.

Descriptors: *Aquifers, *Data acquisition, *Electrical studies, *Geohydrology, *Geophysical surveys, *Induced polarization, Geologic fractures, Groundwater movement, Hydraulic conductivity, Limestone, Resistivity, Transmissivity.

Unlike the DC resistivity method, the induced polarization (IP) method for the determination of the fractured limestone zones is seldom used in groundwater prospecting. A literature search shows that the IP method has been used intermittently over the last thirty years. An estimate of geohydrological parameters is based on the assumption that the so-called saturated layer contains clean sand and that there is no clay in the aquifer. In practice, such a situation is rarely encountered while prospecting for groundwater. The author attempts to show that the IP method can be used to identify the fractured limestone zones and separate the saturated layer from the clay layer. This is usually determined from the DC resistivity method. Therefore, the saturated thickness determined from the IP sounding curve is very likely to be more accurate. Consequently the estimate of the geohydrological parameter is close to the true representative value. This information can be used to estimate the transmissivity of limestone aquifers in the northwestern Peninsular Malaysia, from longitudinal conductance. (See also W91-00215) (Lantz-PTT)
W91-00238

INTEGRATED GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS FOR DELINEATING KARSTIC ZONES IN CARBONATE FORMATIONS OF ANANTAPUR DISTRICT, A.P., INDIA.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-00239

DECIPHERING GROUNDWATER USING REMOTE SENSING TECHNIQUES.
Roorkee Univ. (India). Dept. of Civil Engineering.
O. Prakash Dubey, S. Niwas, and P. Ahmed.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 269-272, 2 ref.

Descriptors: *Data acquisition, *Groundwater management, *Groundwater resources, *Remote sensing, Groundwater budget, Landsat, Model studies, Satellite technology, Water resources management.

For the optimal management of resources, an accurate and timely information system is required. Conventional data collection systems are often uneconomical, difficult, and slow. Remote sensing techniques can be organized in near real-time for the evaluation of water resources. An analysis is presented for the evaluation of groundwater resources in a part of the Indogangetic Plain in India. A linear mathematical model of a land cover system operator matrix has been developed for the evaluation of groundwater recharge. The operator has been estimated from the Landsat SST, band 5 and band 7, with imagery blowup at a scale of 1:250,000. The operator can be singular or nonsingular, square or rectangular. The model was calibrated using conventional Generalized Linear Inversion (GLI) and Moore Pen Rose Inverse (MPI) techniques; MPI gives better results. The model was used to predict the groundwater level fluctuations for 1977. The data generated from the model is consistent with actual observations. (See also W91-00215) (Lantz-PTT)
W91-00243

PROSPECTING GROUNDWATER IN PUSHKAR LAKE REGION THROUGH REMOTE SENSING - A CASE STUDY.
Roorkee Univ. (India). Dept. of Civil Engineering.
R. Sinha, and R. S. Tiwari.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 273-285, 4 fig, 13 ref.

Descriptors: *Case studies, *Data acquisition, *Data interpretation, *Groundwater resources, *India, *Pushkar Lake, *Remote sensing, Digital map data, Satellite technology.

The Puskar Lake Valley region of India was assessed for groundwater potential using remote sensing equipment, such as Landsat imagery. As a result of this investigation it was determined that useful information for delineating the potential zones for groundwater can be obtained using remote sensing techniques. The MSS data is good for extracting qualitative and quantitative information. Digital processing techniques have great potential for mapping the surface manifestations of groundwater occurrence to facilitate faster analysis. The interpretation also aids in inferring subsurface features. A detailed investigation of major zones identified through satellite data analysis is required before selecting sites for drilling wells. The analysis of areal photographs and the use of digital processing of the high resolution data are strongly recommended for obtaining concrete results. (See also W91-00215) (Lantz-PTT)
W91-00244

RADIAL VERTICAL ELECTRICAL SOUNDINGS: A CASE STUDY IN GROUNDWATER EXPLORATION.
Karnatak Univ., Dharwad (India). Dept. of Studies in Geology.
For primary bibliographic entry see Field 2F.
W91-00246

DEEP GEOELECTRICAL SOUNDINGS AND SHAPES OF CURVES USED FOR RECOMMENDATIONS OF BORE SITES IN BASALTIC TERRAIN.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
H. N. Parikh, A. J. Merh, and S. B. Singh.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 307-310, 1 fig, 8 ref.

Descriptors: *Boreholes, *Data acquisition, *Geoelectrical soundings, *Geophysical surveys, *Site selection, *Sounding, *Well drilling, Groundwater resources, Resistivity.

Geophysical methods provide an indirect picture of subsurface formations by measuring the various physical parameters of the earths' crust. These parameters are: density, magnetic susceptability, electrical conductivity and elasticity. An Electrical Resistivity Survey (ERS) is by far the most suitable method for groundwater investigation . The geoelectrical resistivity method used to collect resistivity values of surface to depth in a rock mass at a particular point is called Vertical Electrical Sounding (VES). The true resistivity values and thickness of layers are obtained from the interpretation of the sounding curves. The Schlumberger configuration was used in the VES that was conducted in the Jamnager district to select borehole sites in basaltic terrain. From this study the following recommendations were made: (1) Deep soundings are necessary for deep scanning of basalt rocks; (2) For deep scanning, the electrode should be placed 1000 m apart; (3) Cable wires and battery packs must be strong and leak proof; (4) Shapes of curves depend on various factors and do not guarantee large quantities of fresh water; (5) The resistivity meter should be accurate and fast working; and (6) A clear correlation of different data and observations should improve the drilling results. (See also W91-00215) (Lantz-PTT)
W91-00247

DESCRIPTION OF LINEAMENTS FOUND IN KALAVAD TALUKA OF JAMNAGAR DISTRICT AND DRILLING DRILLED FOR WATER SUPPLY.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
For primary bibliographic entry see Field 2F.
W91-00248

BRISK GROUND WATER INVESTIGATION FOR LOCATING BORE HOLE SITE IS BASALTIC TERRAIN.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
For primary bibliographic entry see Field 2F.
W91-00249

ELECTRICAL RESISTIVITY SURVEY FOR GROUND WATER IN VARAHA RIVER BASIN, A.P., INDIA.
Andhra Univ., Waltair (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00251

STUDY OF SOIL MOISTURE MOVEMENT IN THE VADOSE ZONE USING NEUTRON PROBE.
National Geophysical Research Inst., Hyderabad (India).
R. Chand.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 359-369, 5 fig, 5 ref.

Descriptors: *Borehole geophysics, *Data acquisition, *Groundwater movement, *Neutron logging, *Neutron probes, *Soil water, *Vadose zone, Evaporation, Groundwater recharge, Infiltration, Infiltration rate, Rainfall-runoff relationships.

Neutron probing of soils is useful for assessing the soil moisture variation in the vadose zone. Results from field studies in alluvial soils probed to a depth of 250 cm during the pre-monsoon, monsoon, and post-monsoon periods, under both naturally and artificially ponded conditions, are addressed. Soil moisture data was plotted against the depth probed. Information rates and evaporation losses were calculated under different conditions. During the dry periods, the neutron probe provided data to compute actual evaporation. The studies also show that drainage losses for the soil studied are relatively small in the zones below 120 cm depth, and there is not much variation in moisture content below this depth. The velocity of infiltration and the velocity of drainage discharge in the profile varied with time. But the velocity of vertical flow over the distance between the centers of consecutive layers was found to be constant during one time interval. The infiltration rate was about 9.8 mm/hr immediately after ponding, and increased to 23.3 mm/hr within 3 to 4 hours, remaining about 18.7 mm/hr until the ponding height reduced to zero. During this period of four hours after ponding, the soil moisture storage increased by 15.35 cm and absorbed 98% ponded water. Evaporation during the period April 22 to May 22, and May 22 to June 21, 1985 was estimated to be 5 cm and 1.9 cm, respectively. (See also W91-00215) (Lantz-PTT)
W91-00256

SOIL MOISTURE STUDIES IN SOILS OF DELHI TERRITORY USING THE RESISTIVITY METER.
Indian Agricultural Research Inst., New Delhi. Nuclear Research Lab.
For primary bibliographic entry see Field 2G.
W91-00258

BOREHOLE RESISTIVITY LOGGING IN PVC SCREENED WELL.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-00264

CROSS-SECTIONAL VARIABILITY IN SUSPENDED SEDIMENT AND ASSOCIATED TRACE ELEMENT CONCENTRATIONS IN SELECTED RIVERS IN THE US.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2J.
W91-00287

CASE STUDY OF APPROACHES FOR DETERMINING DIFFUSE SUSPENDED SEDIMENT SOURCES AND PROCESSES.
Alberta Research Council, Edmonton. Resource Technologies Dept.
For primary bibliographic entry see Field 2J.
W91-00290

SEDIMENT STORAGE AND MOVEMENT ON THE SOUTHERN HIGH PLAINS OF TEXAS AS INDICATED BY BERYLLIUM-TEN.
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2J.
W91-00299

APPLICATION OF GEOPHYSICAL METHODS TO HYDROGEOLOGICAL PROBLEMS IN DINARIC KARST OF YUGOSLAVIA.
Geophysical Institute, Belgrade, Yugoslavia.
D. Arandelovic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 143-159, 10 fig, 7 ref.

Descriptors: *Aquifer systems, *Borehole geophysics, *Data acquisition, *Engineering geology, *Geohydrology, *Geophysical methods, *Geophysical surveys, *Karst, *Regional Aquifer-Systems Analysis, *Yugoslavia, Dinaric Karst, Field tests, Geologic formations, Groundwater, Groundwater movement, Karst hydrology.

Geophysical methods applied in the Yugoslavian karst areas include electrical sounding, electrical mapping, mise a la masse, seismic refraction, ultrasonic impulse, GEOBOMB, and well-logging. The following problems in the Dinaric Karst Region were solved using geophysical methods: (1) determination of depth of the karstified base; (2) determination of the position of intensively karstified and tectonically broken zones in karstified limestone; (3) delimitation of the intrusion of saline water and its water table; (4) recognition of boundaries of the fresh water zone in brackish karst areas; (5) study of the intensity of karstification and position of water bearing zones in boreholes; (6) detection of potential or existing groundwater flows; (7) determination of direction and rate of groundwater flow by a single well; and (8) estimation of porosity and permeability of karstic rocks. Field examples illustrating the role of geophysical methods included identification of groundwater supply for the Marina-Stupin Valley, determination of groundwater flow in the Oko Spring area, determination of the karstified base and the thickness of sediments in the Fatnicko Polje in Herzegovina, a study of the karstified base and the position of intensively karstified and tectonically damaged zones in the area of the Bileca Storage Reservoir, and exploration of the Grancarevo and Mratinje Dam sites. (See also W91-00318) (MacKeen-PTT)
W91-00326

COST EFFECTIVENESS OF THE STREAMFLOW-GAGING PROGRAM IN WEST VIRGINIA.
Geological Survey, Charleston, WV.
For primary bibliographic entry see Field 2E.
W91-00331

SELECTED QUALITY ASSURANCE DATA FOR WATER SAMPLES COLLECTED BY THE U.S. GEOLOGICAL SURVEY, IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO, 1980 TO 1988.
Geological Survey, Idaho Falls, ID. Water Resources Div.
S. J. Wegner.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4168, October 1989. 91p, 4 fig, 24 tab, 12 ref.

Descriptors: *Chemical analysis, *Data quality control, *Idaho, *Laboratories, *Quality assurance, *Water analysis, *Water quality data, Groundwater quality, Statistical analysis, Surface water data, Water quality, Water sampling, Well water.

Multiple water samples from 115 wells and 3 surface-water sites were collected between 1980 and 1988 for the ongoing quality assurance program at the Idaho National Engineering Laboratory. The reported results from the six laboratories involved were analyzed for agreement using descriptive statistics. The analytical constituents and properties included: tritium, plutonium-238, plutonium-239, -240 (undivided), strontium-90, americium-241, cesium-137, total dissolved chromium, selected dissolved trace metals, sodium, chloride, nitrate, selected purgeable organic compounds, and specific conductance. Agreement could not be calculated for trace metals, some nitrates, purgeable organic compounds, and blank-sample analyses because analytical uncertainties were not consistently reported. However, differences between results for most of these data were calculated. The blank samples were not analyzed for differences. The laboratory results analyzed using descriptive statistics showed a median agreement of 95% between all usable data pairs. (Author's abstract)
W91-00334

COMPARISON OF TRACER-DILUTION AND CURRENT-METER DISCHARGE MEASUREMENTS IN A SMALL GRAVEL-BED STREAM, LITTLE LOST MAN CREEK, CALIFORNIA.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-00337

EVALUATION OF METHODS USED FROM 1965 THROUGH 1982 TO DETERMINE INORGANIC CONSTITUENTS IN WATER SAMPLES.
Geological Survey, Reston, VA.
L. C. Friedman, and M. J. Fishman.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Supply Paper 2293. 126p, 83 fig, 27 ref.

Descriptors: *Chemical analysis, *Inorganic compounds, *Laboratory methods, *Water analysis, *Water chemistry, *Water samples, Analytical methods, Comparison studies, Hydrologic data, Performance evaluation, Precision.

Since 1962, the U S Geological Survey has prepared and distributed standard Reference Water Samples (SRWS) to participating laboratories in order to alert them to possible analytical deficiencies. This report marks the first time that a concentrated effort has been made to examine and compare the SRWS data for each constituent by the analytical method that was used to obtain the data. Unlike laboratories that participate in interlaboratory studies that are designed to determine the precision and accuracy of a particular analytical method, laboratories that participate in the SRWS program are allowed to select the method used to analyze a reference sample and are requested to report the method used. Data for a particular method could not be compared with a 'true' value because the data were obtained from analyses of reference samples that were prepared using natural waters; however, where possible a comparison was made between the mean concentrations obtained by the various analytical methods that were used to determine each constituent. Where enough information is available, models for predicting the precisions of the methods have been developed, and the precisions have been compared. In addition to the data presented in the reports, this evaluation provides a good indication of methods that were used routinely to analyze water samples during the 18 years of study. (Author's abstract)
W91-00350

RESULTS OF QUALIFICATION TESTS ON WATER-LEVEL SENSING INSTRUMENTS, 1987.
Geological Survey, Stennis Space Center, MS.
T. E. Olive.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-397, 1989. 37p, 8 fig, 11 tab, 9 ref.

Descriptors: *Instrumentation, *Measuring instruments, *Performance evaluation, *Water level, Test facilities, Testing procedures.

The U S Geological Survey's Hydrologic Instrumentation Facility (HIF) at the Stennis Space Center, Mississippi, conducts qualification tests on water-level sensing instruments. Instrument systems, which meet or exceed the Survey's minimum performance requirements, are placed on a Qualified Products List. The qualification tests conducted in the environmental chamber at the HIF's Test and Evaluation Laboratory in 1987 added two instrument systems to the Qualified Products List. The Leupold and Stevens water-level sensing system, consisting of the PG-III pulse generator, Telemark II encoder, and an environmental modem met or surpassed the requirements for use at a daily-discharge station. The Endeco model 1029 solid-state memory water-level recorder systems met or surpassed the requirements for a special-case station. These systems have been added to the Qualified Products List for water-level sensing instrument systems as a result of these tests. The laboratory qualification tests were conducted by the HIF's Test and Evaluation Section Section, using one model of each system. The first test on each system was made at prevailing room tempera-

ture and humidity conditions. This was a bench test to familiarize personnel with system operation and to test instrument output at a constant input. The calibration of each instrument was checked in the second test, using procedures appropriate for that type of system. Environmental tests were run to establish the system performance under simulated field conditions. The last test was a calibration check for drift in the instrument's output over the qualification testing period. (Author's abstract)
W91-00356

SOIL-GAS SURVEYING FOR SUBSURFACE GASOLINE CONTAMINATION USING TOTAL ORGANIC VAPOR DETECTION INSTRUMENTS: PART I. THEORY AND LABORATORY EXPERIMENTATION.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5A.
W91-00368

REMOTE DATA COLLECTION AND CONTROL FOR HYDROGEOLOGIC MONITORING.
CH2M Hill Engineering, Waterloo (Ontario).
M. Adomait, and R. W. Gillham.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 138-142, Summer 1990. 6 fig, 10 ref.

Descriptors: *Data acquisition, *Data storage and retrieval, *Geohydrology, *Groundwater movement, *Hydrologic data, *Microcomputers, *Monitoring, *Telemetry, Computers, Data transmission, On-site data collections.

The use of microcomputers for remote control applications is well established in industry. This technology was adaptated for experiment control and data collection for hydrologic monitoring at remote sites. A hydrogeologic field experiment, conducted at a research site some 125 miles (200 km) from the home base, used commercially available computer controller technology for data collection and experimental control. A telephone line connected to the equipment facilitated the downloading of data, provided a means of remotely monitoring the operating performance, and made it possible to adjust the monitoring procedures. This experiment demonstrated the benefits of a remotely controlled data acquisition system for a long-term investigation. Identification of problems and the adjustment of the sampling algorithm by telephone reduced costly travel time. The considerable amount of data collected, the data evaluation techniques, and the continuous monitoring provided a high degree of confidence in the results. (Author's abstract)
W91-00370

ACCURACY OF HYDRANT FLOW TESTS USING A PITOT DIFFUSER.
Wyoming Valley Sanitary Authority, Wilkes-Barre, PA.
T. M. Walski, and T. L. Lutes.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 7, p 58-61, July 1990. 6 fig, 4 ref.

Descriptors: *Diffusers, *Flow equations, *Flow measurement, *Flow models, *Hydrants, *Hydraulics, *Water distribution, Hydraulic models, Mathematical analysis, Mathematical equations, Mathematical models, Rapid flow, Water delivery.

Hydrant flow tests are important for collecting data for pipe network model calibration and assessing the general strengths and weaknesses of a water distribution system. The method of choice for measuring discharge from a hydrant is the hydrant Pitot gauge. However, the strong, directed flow from such a gauge can result in damage because of erosion, flooding or impact. Several devices, referred to as Pitot diffusers, have been developed to divert and diffuse the flow to minimize such damage and disruption. Attempting to apply formulas developed for freely discharging streams to Pitot diffusers can give poor estimates of discharge because flow in the throat of the diffuser tested more closely corresponded to closed conduit flow. With total and static pressure readings, Pitot diffuser devices can give good results using the formulas developed in this work. If only total pressure is measured, somewhat more complicated formulas are needed for the same accuracy. Numerical values for coefficients given here are only applicable to identical Pitot diffusers. (Hoskin-PTT)
W91-00378

DETERMINATION OF CHLOROANILINE TRACES IN ENVIRONMENTAL WATERS BY SELECTIVE EXTRACTION WITH TWO TRAPS IN TANDEM AND LIQUID CHROMATOGRAPHY.
Rome Univ. (Italy). Dipt. di Chimica.
For primary bibliographic entry see Field 5A.
W91-00389

AUTOMATED HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY FOR THE DETERMINATION OF PESTICIDES IN WATER USING SOLID PHASE EXTRACTION.
Brock Univ., St. Catharines (Ontario). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-00390

PERFORMANCE EVALUATION MATERIALS FOR THE ANALYSIS OF VOLATILE ORGANIC CONTAMINANTS IN SOIL: A PRELIMINARY ASSESSMENT.
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W91-00393

PRELIMINARY ASSESSMENT OF THE POTENTIAL FOR USING CESIUM-137 TO ESTIMATE RATES OF SOIL EROSION IN THE LOESS PLATEAU OF CHINA.
Xian Lab. of Loess and Quaternary Geology (China).
For primary bibliographic entry see Field 2J.
W91-00405

SPATIAL ALLOCATION FACTOR PROCEDURES FOR THE 1980 NAPAP (NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM) EMISSIONS INVENTORY DOCUMENTATION.
Alliance Technologies Corp., Bedford, MA.
For primary bibliographic entry see Field 5B.
W91-00453

REMOTE SENSING AND LARGE-SCALE GLOBAL PROCESSES.
IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. 191 p. Edited by Albert Rango.

Descriptors: *Climatology, *Meteorology, *Remote sensing, *Satellite technology, Evapotranspiration, Ice, Instrumentation, Precipitation, Snow, Symposium.

Twenty-one papers presented at a symposium held during the Third Scientific Assembly of the International Association of Hydrological Sciences in 1989 are included in this proceedings. The papers are divided into five areas as follows: (1) large-scale processes (5 papers); (2) evapotranspiration (4 papers); (3) precipitation (4 papers); (4) ice, snow, and climate (4 papers); and (5) remote sensing (4 papers). (See W91-00455 thru W91-00475) (Peters-PTT)
W91-00454

HYDROLOGICAL REMOTE SENSING RESEARCH WITH LARGE-SCALE APPLICATIONS IN WESTERN EUROPE.
Zurich Univ. (Switzerland). Remote Sensing Labs.
H. Haefner.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 3-12, 40 ref.

Descriptors: *Europe, *Rainfall-runoff relationships, *Remote sensing, *Satellite technology, *Snow cover, *Snowmelt, Alps, Finland, Glaciers, Glaciohydrology, Greenland, Hydroelectric plants, Instrumentation, Mapping, Microwaves, Norway, Optical properties, Surface water availability, Switzerland.

Water which was taken for granted and as existing in infinite abundance has become one of our most precious natural resources. Accordingly the need to assess and forecast water supplies increases rapidly. Remote sensing methods are being used more and more to overcome these problems and to acquire near-real-time data in regular temporal sequences to measure, monitor and model the complex hydrological processes in the environment. Hydrological properties are strongly interlinked with processes at the surface of the earth and in the atmosphere, influencing environment and climate. Within this wide spectrum of research topics and practical applications, the main emphasis is given to the specific requirements of Western Europe, dealing exclusively with processes in which land surfaces and inland waters are involved. Consequently large-scale applications, requiring high standards of accuracy, predominate in this review. Examples are provided for runoff forecasting of rainfall and from the snow cover. Operational applications are dominant in the field of snow hydrology; preference is being given to optical data and low-cost (PC based) classification systems. Snow mapping for runoff forecasting to optimize hydroelectric power generation is undertaken for example in the Swiss Alps, in Norway and in Greenland. Extensive research activities on the possibilities and applications of microwave sensors are being carried out in the Alps and Finland. The results indicate that the prospects for an adequate microwave system for snow hydrology, especially for large-scale mapping, are not too promising. Efforts need to be undertaken to develop integral models considering all sources of precipitation and capable of simulating and forecasting the entire runoff regime of a basin. (See also W91-00454) (See also W91-00454) (Peters-PTT)
W91-00455

HAPEX-MOBILHY: RESULTS FROM A LARGE-SCALE FIELD EXPERIMENT.
Centre National de Recherches Meteorologiques, Toulouse (France).
J. C. Andre, J. P. Goutorbe, T. Schmugge, and A. Perrier.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 13-20, 2 fig, 2 tab, 9 ref.

Descriptors: *Evapotranspiration, *Infrared imagery, *Remote sensing, *Thermal radiation, Aircraft, Cropland, Instrumentation, Microwaves, Soil moisture, Temperature, Transpiration.

The HAPEX-MOBILHY program is aimed at studying the hydrological budget and evapotranspiration flux at the scale of the GCM grid, i.e., 10000 sq km. For the program several surface and subsurface networks operated from mid 1985 to early 1987 to measure and monitor soil moisture, surface energy budget, and surface meteorological parameters. During the Special Observing Period (SOP) from May 7 to July 15 1986, there were additional measurements including detailed observation of atmospheric fluxes and remote sensing of the surface using two well instrumented aircraft: the NCAR King-Air for flux measurements and the NASA C-130 aircraft for remote sensing observations. The NASA aircraft carried a thermal infrared multispectral scanner (TIMS) for surface temperature observations. Surface temperature maps were created using the TIMS data to study the representativeness of the surface flux measurements stations (SAMER). The SAMER stations were located in cultivated fields which at the time of the aircraft overflights were mostly bare. The histograms of the total scenes ranged from 25-30 C for the freely transpiring vegetated surfaces to

more than 40 C for the bare soils; most of the temperatures for the SAMER stations were in the 40 C category. While the proportions of vegetated and bare surfaces varied from scene to scene, they typically were about evenly split. These results have implications for the comparison of aircraft and surface flux measurements. In the situation examined, the majority of the area had a surface temperature typical of the forest, the flux measured by the King-Air would be close to that measured by a forest tower. (See also W91-00454) (Peters-PTT)
W91-00456

USE OF SATELLITE MICROWAVE RADIOMETERS FOR LARGE-SCALE HYDROLOGY.
Innsbruck Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
H. Rott, and J. Aschbacher.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 21-30, 3 fig, 22 ref. Austrian Fonds zur Forderung der Wissenschaftlichen Forschung, Project No. S3801.

Descriptors: *Microwaves, *Remote sensing, *Satellite technology, *Snow cover, *Soil water, Instrumentation, Mapping.

Microwave radiometers on earth-orbiting satellites are able to make significant contributions to large-scale observations of hydrological parameters. Promising applications include rainfall mapping, soil moisture monitoring, and mapping of snow areal extent and water equivalent. Constraints for retrievals of these parameters result from complex interactions of microwave radiation with various physical properties of targets and from limited spectral capabilities and spatial resolution of existing microwave sensors. These constraints can partly be overcome by utilizing support information from other sensors. The capabilities of satellite microwave sensors for soil moisture and snow cover sensing are illustrated using examples of Nimbus-7 Scanning Multichannel Microwave Radiometer data. Due to complex interactions of microwave radiation with physical properties of the targets, the retrieved information from microwave sensors will not be able to cope with detailed in situ measurements for small scale applications. The strength of microwave radiometry is the repetitive coverage of large areas. (Peters-PTT)
W91-00457

FIRST ISLSCP FIELD EXPERIMENT: EXPERIMENT EXECUTION AND PRELIMINARY ANALYSES.
Maryland Univ., College Park.
P. J. Sellers, J. L. Dorman, C. Walthall, F. G. Hall, and D. E. Strebel.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 49-58, 8 fig, 13 ref.

Descriptors: *Evaporation, *Remote sensing, *Satellite technology, *Transpiration, *Vegetation effects, Canopy, Data acquisition, Data interpretation, Grasslands, Instrumentation, Kansas, Radiometry, Soil moisture, Temperature.

Progress in the First ISLSCP Field Experiment (FIFE) is reviewed. FIFE was executed in May-October 1987 and involved the detailed study of land surface-atmosphere exchanges over a 15 x 15 km grassland area in Kansas. The objective of the experiment was to determine the extent to which surface parameters could be quantified from remotely sensed data. The analysis of data is underway: It appears that the use of radiometric surface temperature has a limited capability for the calculation of surface sensible heat fluxes. Vegetation index data, on the other hand, shows some promise for the calculation of surface latent heat fluxes and photosynthetic rates. Additionally, many of the biophysical relationships linking photosynthesis to transpiration appear to show little variation across a wide range of measurement scales. (See also W91-00454) (Author's abstract)
W91-00460

RELATING NIMBUS-7 GHZ DATA TO LAND SURFACE EVAPORATION.
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
B. J. Choudhury.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 59-66, 3 fig, tab, 13 ref.

Descriptors: *Evaporation, *Remote sensing, *Satellite technology, *Temperature effects, Air temperature, Data acquisition, Data interpretation, Hydrologic budget, Instrumentation, Vegetation effects.

Land surface evaporation links the heat and the water balances, and this process has been shown to have a significant impact on the regional and global atmospheric circulation patterns. An attempt was made to relate the 37 GHz brightness temperatures observed from the Nimbus-7 satellite to the land surface evaporation. The spatial resolution of the global 37 GHz data is 0.25 degrees x 0.25 degrees (latitude x longitude), gridded on a Mercator projection. The data have been processed for 84 consecutive months, January 1979 to December 1985. Limited field observations and radiative transfer modeling for agricultural crops show that the temporal variation of these data could be related to crop phenology (leaf growth and senescence). A radiative transfer model and empirical data were used to investigate the relationship between the 37 GHz observations and evaporation. A logarithm relation provided a good correlation between the annual evaporation and the annual mean change in temperature. (See also W91-00454) (Author's abstract)
W91-00461

RELATIONSHIPS BETWEEN THE HYDROLOGIC BALANCE OF A SMALL WATERSHED AND REMOTELY SENSED SOIL MOISTURE.
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2A.
W91-00463

POTENTIAL APPLICATION OF SATELLITE DATA FOR RAINFALL ESTIMATION.
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2B.
W91-00465

RADAR DATA PROCESSING FOR HYDROLOGY IN THE CEVENNES REGION.
Laboratoire Central des Ponts et Chaussees, Bouguenais (France).
H. Andrieu, J. D. Creutin, G. Delrieu, J. Leoussoff, and Y. Pointin.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 105-115, 5 fig, 2 tab, 16 ref.

Descriptors: *Alpine regions, *Flood forecasting, *Instrumentation, *Mountains, *Radar, *Rainfall-runoff relationships, Cevennes, Data interpretation, Data processing, Errors, Flash floods, France, Rain gages.

An experiment called 'Cevennes 86-88' was designed to evaluate weather radar capabilities for a flash flood early warning system in a mountainous area. A dual polarization radar was set up, during the Autumn seasons from 1986 to 1988, in the heart of the mountain ridge in Barre des Cevennes at a 1030 m elevation. At the same time, hydrological and meteorological data from 45 recording rain gages covering 6,000 sq km were analyzed and archived. Radar data processing procedures were developed to detect and correct for anomalies (ground clutter and underdetection) caused by the mountainous relief in order to provide suitable rainfall estimates for hydrological applications. The preliminary results obtained indicate the important role of radar data processing in mountainous terrain. On-going research efforts are being devoted to the validation of radar assessments on the complete database and the introduction of radar information in flow forecasting models. (See also W91-00454) (Peters-PTT)
W91-00466

MONITORING OF WEATHER CONDITIONS ON MESOSCALE TO IMPROVE A PRECIPITATION WARNING SYSTEM FOR HYDROLOGIC PURPOSES.
Kozponti Elorejelzo Intezet, Budapest (Hungary).
A. Takacs.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 117-123, 5 fig, 10 ref.

Descriptors: *Hungary, *Meteorology, *Radar, *Rainfall, *Weather forecasting, Data processing, Model studies, Nowcasting, Rainfall intensity, Rainstorms.

Extreme rainfall over a small area and during a very short time can be predicted up to 2 hr ahead by extrapolation using radar and satellite measurements and conventional meteorological data. For prediction, large amounts of observational data have to be processed and the resulting products distributed to the users very quickly because of the nature of the information. The meteorological considerations for developing a precipitation warning system for hydrological purposes in Hungary were examined. Because of the short time available for prediction a method was developed for making preliminary estimations based on conventional meteorological data. First guess estimations are made more exact by monitoring of weather conditions on mesoscale by use of hourly surface measurements and manually digitized radar data. The precipitation warming system is being developed on a personal computer by the use of a displaying technique. (See also W91-00454) (Author's abstract)
W91-00467

SATELLITE DETERMINATION OF COAST RANGE, ALASKAN GLACIER MASS BALANCE RELATED TO ATMOSPHERIC CIRCULATION.
Maine Univ. at Orono. Inst. for Quaternary Studies.
For primary bibliographic entry see Field 2C.
W91-00468

DETERMINATION OF SNOW WATER EQUIVALENTS BY USING NOAA-SATELLITE IMAGES, GAMMA RAY SPECTROMETRY AND FIELD MEASUREMENTS.
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).
For primary bibliographic entry see Field 2C.
W91-00470

MULTISPECTRAL SNOW AREA ALGORITHM FOR OPERATIONAL 7-DAY SNOW COVER MONITORING.
Bristol Univ. (England). Remote Sensing Unit.
For primary bibliographic entry see Field 2C.
W91-00471

HYDROLOGICAL EFFECTS OF CATCHMENT CHARACTERISTICS AND LAND USE CHANGES DETERMINED BY SATELLITE IMAGERY AND GIS.
Ruhr Univ., Bochum (Germany, F.R.). Inst. for Hydrology, Water Resources and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W91-00472

MONITORING LAKE NASSER BY SPACE SENSING.
Boston Univ., MA. Center for Remote Sensing.
E. B. Farouk.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 177-181, 1 fig, 4 ref.

Descriptors: *Lake Nasser, *Landsat images, *Nile River, *Remote sensing, *Satellite technology, *Water level, Drought, Egypt, Groundwater potential, Irrigation water, Monitoring, Reservoirs, Water conservation, Water resources management.

The level of Lake Nasser is a good indicator of the cycles of wet climate followed by droughts in East Africa. The dam has already saved Egypt from two cycles of dangerous floods in 1964 and 1975 and droughts in 1973 and 1984, and most perilously in 1987-1988. Recent changes in the water levels of Lake Nasser were clearly indicated by Landsat images and photographs obtained by the Space Shuttle astronauts and the Large Format Camera. Regular monitoring from space of the Lake's water level would constitute an early warning system of the conditions in the upper reaches of the Nile. In addition to monitoring that would allow better forecasting of Nile water levels several steps could be taken to help control the water situation in Egypt: (1) enforce water conservation measures; (2) pump and utilize the vast amounts of near-surface groundwater; and (3) search for and develop deep groundwater resources for use during time of need. Images obtained from Landsat and SPOT satellites can be used for future monitoring of the flow of the Nile into Lake Nasser. Since such satellites provide digital data, these can be processed in a nearly automated way to emphasize short-term changes. These data could also be used in long-term forecasting which is essential to the economic stability of the countries in East Africa. (See also W91-00454) (Peters-PTT)
W91-00473

FLOOD MONITORING FROM SPACE IN CHINA.
Ministry of Water Resources, Beijing (China). Remote Sensing Application Center.
J. Yang.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 183-185, 1 tab, 2 ref.

Descriptors: *China, *Flood forecasting, *Remote sensing, *Satellite technology, Flood damage, Historic floods, Land use, Runoff, Snowmelt, Snowpack, Soil erosion.

Flooding and soil erosion are problems in the fertile flood plains of eastern China. Remote sensing offers the opportunity to monitor floods and to identify land-use policies which exacerbate flooding conditions. Meteorological satellites and earth resources satellites are now being utilized to make areal measurements on a repetitive basis in flood prone regions. One of China's largely untapped resources is its unparalleled historical record collection; historical records of flooding events are available for the past 2200 years. These records are being examined to determine if trends or cycles are evident. Conventional observations should be continued and enhanced by employing spaceborne observations which sample entire areas rather than single points. This will result in an increase in agricultural productivity and a decrease in loss of life. (See also W91-00454) (Peters-PTT)
W91-00474

SATELLITE TELETRANSMISSION: TECHNOLOGY APPLIED TO HYDROLOGICAL FORECASTING. AN EXAMPLE OF THE FIGHT AGAINST ONCHOCERCOSIS (LA TELETRANSMISSION PAR SATELLITE: UNE TECHNOLOGIE ADAPTEE A LA PREVISION HYDROLOGIQUE. EXEMPLE DE LA LUTTE CONTRE L'ONCHOCEROSE).
Institut International de Recherche Scientifique pour le Developpement d'Adiopodoume, Abidjan (Cote d'Ivoire). Lab. d'Hydrologie.
E. Servat.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 187-191, 3 ref.

Descriptors: *Data acquisition, *Data transmission, *Public health, *Rapid flow, *Satellite technology, *Telemetry, *Tropical regions, *Water level, Africa, Hydrologic data, Larvicides, Onchocercosis, Parasites.

River blindness (onchocercosis) which is transmitted to man by the bite of a small fly, Simulium damnosum, is endemic in many areas of West Africa. A program was launched in 1974 by the World Health Organization to fight onchocercosis by destroying the larva of the simulium. Larvae develop in rivers, particularly in reaches with a rapid current, and are most susceptible to the effects of the larvicide when the water level is high. In 1985 a project was undertaken to optimize the application of the larvicide by applying it during periods of high river level and in areas having a fast current. Because of the large area to be covered, it was decided to obtain the required data by installing hydrological platforms fitted with transmitting devices. The collected data is transmitted every 220 seconds and picked up by a satellite that makes several passes each day over the area. The satellite, in turn, relays the data to a receptor station where the messages are stored and can be accessed by a human operator. This method has the following advantages: (1) access to the hydrological data regardless of season; (2) transmission of data on the water level in real time because the satellites relay the data a few times each day; and (3) fast centralization of data by communication among the receptor stations. The use of this data resulted in saving $2 million in 1987 through more efficient dosage of larvicide with respect to both quantity and timing. The program is being expanded by completing the installation of the hydrological platforms. At its completion, the network should include 100 platforms. This method of data collection and transmission by satellite can be used in the case of networks extended over substantial areas and could provide better management and automated surveillance of water resources. (See also W91-00454) (Peters-PTT)
W91-00475

CURRENT STATUS OF DISINFECTANT RESIDUAL MEASUREMENT METHODS FOR FREE AND COMBINED CHLORIDE AND OXYCHLORINE SPECIES.
Miami Univ., Oxford, OH. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-00479

FISH HEPATOCYTE MODEL FOR INVESTIGATION OF THE EFFECTS OF TRIHALOMETHANES.
Environmental Research Lab., Narragansett, RI.
S. M. Baksi.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 341-346, 4 tab, 5 ref.

Descriptors: *Bioindicators, *Biological studies, *Chlorination, *Laboratory methods, *Toxicology, *Trihalomethanes, *Water pollution effects, *Water treatment, Culturing techniques, Data acquisition, Hepatocytes, Model studies, Tissue analysis.

There is currently great concern over the potential health and environmental effects of the water chlorination reaction by-products, of which little is known toxicologically. A new application is presented for the isolated teleost hepatocyte culture system for examining the toxicity of these substances in aquatic species. The system holds great potential because of its sensitivity. Additionally, several endpoints (e.g. enzyme leakage, protein synthesis, and levels of specific proteins of interest) can be measured simultaneously. The hepatocyte culture system can potentially be used to investigate genetic effects and metabolism. In these preliminary experiments, a dose response relationship for trihalomethanes (THMs) was established, as well as the measurement of a cellular response--inhibition of protein synthesis--in response to exposure to THMs. The effect of bromine substitution on toxicity was clearly demonstrated. These types of experiments can be utilized to determine structure-activity relationships and further characterize the effect of bromine substitution on the mode of action and metabolism of chlorination reaction by-products. (See also W91-00476) (Lantz-PTT)
W91-00503

IDENTIFICATION OF ORGANIC N-CHLORAMINES IN WASTEWATER.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5A.
W91-00533

CHLORINE AND MONOCHLORAMINE MEASUREMENTS USING A PULSED SILVER IODIDE ELECTRODE.
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-00536

CHLORAMINE INTERFERENCE IN THE MEASUREMENT OF FREE CHLORINE BY THE AMPEROMETRIC MEMBRANE ELECTRODE.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
J. N. Jenson, C. Le Cloirec, and J. D. Johnson.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 801-808, 1 fig, 3 tab, 17 ref. EPRI Grant No. RP2300-7.

Descriptors: *Amperometry, *Chlorination, *Electrodes, *Measuring instruments, *Pollutant identification, *Wastewater treatment, *Water analysis, *Water treatment, Chloramines, Chlorine, Performance evaluation.

Chlorine reacts with water, ammonia and nitrogenous organics to form free available chlorine (FAC = HOCl + OCl), inorganic chloramines (mono, di and trichloramine), and organic chloramines (for example, N-chloramino acids). Chlorine is continually discharged in large quantities into the environment, after use in wastewater and drinking water treatment, as well as biofouling control in powerplant cooling towers. Interference by organic chloramines in the measurement of free available chlorine by an amperometric membrane electrode are addressed here. This study suggests that interference is significant with several chloramines, and instrument responses are 1 to > 50 times the true HOCl concentrations. Comparisons between the hydrolysis constants calculated here with literature values indicates that in some instances, previously determined hydrolysis constants may be too large due to interferences in the free chlorine measurements. Results with model compounds were found to be consistent with the amperometric membrane electrode performance in the field. (See also W91-00476) (Lantz-PTT)
W91-00537

ENHANCEMENT OF THE HWRIC DATABASE, YEAR 2. WITH AN EVALUATION OF DATABASE CONTENT.
Illinois State Water Survey Div., Champaign. Ground-Water Section.
For primary bibliographic entry see Field 7C.
W91-00571

MECA WORKSHOP ON ATMOSPHERIC H2O OBSERVATIONS OF EARTH AND MARS.
Available from the National Technical Information Service, Springfield, VA 22161, as N89-25790. Price codes: A05 in paper copy, A01 in microfiche. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. 95p. Edited by Stephen M. Clifford and Robert M. Haberle.

Descriptors: *Atmospheric water, *Data acquisition, *Remote sensing, *Soil water, *Workshops,

Astronomy, Hydrologic budget, Physical properties, Regoliths.

On September 25-27, 1986, a three-day MECA workshop on 'Atmospheric H2O Observations of Earth and Mars: Physical Processes, Measurements, and Interpretation' was held at the Lunar and Planetary Institute. The purpose of the workshop was to investigate and discuss a variety of ideas related to the detection and cycling of atmospheric H2O. Among ideas discussed were possible factors governing the storage and exchange of H2O between planetary surfaces and atmospheres; the instruments that may be best suited for measuring and mapping atmospheric H2O; the question of whether regolith sources and sinks of H2O have uniquely identifiable column abundance signatures; the degree of time and spatial resolution in column abundance data that may be necessary to determine dynamic behavior; and, whether or not current understanding of how atmospheric H2O is cycled on Earth provides any insight for the interpretation of Martian atmospheric data. These questions were addressed by researchers from fields as diverse as soil physics, atmospheric dynamics, atmospheric H2O instrumentation, and Martian volatiles. The interdisciplinary approach gave scientists from traditionally isolated disciplines a unique opportunity to meet and discuss issues of common interest. Of particular importance was the participation of scientists from the terrestrial community, whose perspective contributed to an improved understanding of the Mars water cycle. This technical report is the final product of that discussion. (See W91-00581 thru W91-00581) (Lantz-PTT)
W91-00576

OBSERVATIONS OF ATMOSPHERIC WATER VAPOR WITH THE SAGE II INSTRUMENT.
SASC Technologies, Inc., Hampton, VA.
J. C. Larson, M. P. McCormick, L. R. McMaster, and W. P. Chu.
IN: MECA Workshop on Atmospheric H2O Observations of Earth and Mars. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. p 62-66, 3 fig, 8 ref. NASA Contract NASI-17022.

Descriptors: *Atmospheric water, *Data acquisition, *Measuring instruments, *Remote sensing, *Satellite technology, *Stratospheric Aerosol and Gas Experiment, Climatology, Meteorology, Nitrogen compounds, Ozone, Spectrometry.

The Stratospheric Aerosol and Gas Experiment II (SAGE II) is a multiwavelength spectrometer which infers the vertical distribution of atmospheric aerosols, ozone, nitrogen dioxide and water vapor from the extinction of solar radiation measured during space craft sunrise/sunset. Each day, 15 sunrise and 15 sunset profiles are obtained with successive measurements separated by 24 degrees in longitude at similar latitudes. Since this is the first measurement of water vapor with the SAGE II observational technique, and the first use of the water vapor band to infer H2O from space, an extensive validation program has been undertaken that incorporates correlative measurements and comparisons to other global data sets. This paper presents preliminary zonal means for November 1985 and compares them to tropospheric water vapor and the LIMS stratospheric water vapor. Correlative measurements from a frost-point hygrometer are also compared to individual SAGE II profiles. The quality and consistency of the SAGE II water vapor will lead to an improved understanding of the global water vapor climatology, aerosol formation mechanisms, and tropospheric/stratospheric exchange processes. (See also W91-00576) (Lantz-PTT)
W91-00579

MEASUREMENTS OF H2O IN THE TERRESTRIAL MESOSPHERE AND IMPLICATIONS FOR EXTRA-TERRESTRIAL SOURCES.
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W91-00580

NIMBUS 7 LIMS WATER VAPOR MEASUREMENTS.
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 2B.
W91-00581

EVALUATION OF AUTOMATED TECHNIQUES FOR BASE FLOW AND RECESSION ANALYSES.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W91-00593

AUTOMATED PRECONCENTRATION OF TRACE METALS FROM SEAWATER AND FRESHWATER.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
A. van Geen, and E. Boyle.
Analytical Chemistry ANCHAM, Vol. 62, No. 15, p 1705-1709, August 1990. 3 fig, 4 tab, 10 ref. ONR Contract N00014-86-K-0325.

Descriptors: *Automation, *Chemical analysis, *Heavy metals, *Metal complexes, *Preconcentration, *Separation techniques, *Trace metals, *Water analysis, Adsorption, Freshwater, Ion exchange, Resins, Seawater.

A reliable method capable of processing a large number of samples was required for work on the distribution of trace metals in coastal waters. The separation and concentration of trace metals from sample matrices by solvent extraction is a labor-intensive procedure that is not easily automated. An alternative method is described based on the adsorption of complex metals onto a resin column. A previous version of this method was modified in key aspects to allow for analyses at typical natural dissolved metal concentrations (less than 0.01 mM). Sodium bis(2-hydroxyethyl) dithiocarbamate (NaHEDC) was shown to form water-soluble hydrophobic complexes with several metals (cadmium, cobalt, copper, nickel, lead and zinc). These complexes adsorbed quantitatively on XAD-4 resin when seawater or distilled water, spiked at concentrations on the order of 1 mM, was passed through a column. With this procedure, ten 30 ml samples can be preconcentrated with only 1 hour of operator attention; the complete procedure is completed in less than 4 hours. The nonautomated manipulations include preparations for a set of extractions and sample loading. The sample throughput rate (samples preconcentrated per hour) is not higher than could be achieved by an experienced worker using solvent extraction, but the analyst's productivity is much higher with the present method since other work can be done while preconcentration is underway. The device is constructed for the most part from commercially available components and could be adapted easily to other column separation techniques requiring trace metal-clean conditions. (VerNooy-PTT)
W91-00615

FLUORESCENT POLYCYCLIC AROMATIC HYDROCARBONS AS PROBES FOR STUDYING THE IMPACT OF COLLOIDS ON POLLUTANT TRANSPORT IN GROUNDWATER.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5B.
W91-00623

PO210 AND PB210 REMOBILIZATION FROM LAKE SEDIMENTS IN RELATION TO IRON AND MANGANESE CYCLING.
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00624

PALAEOFLOOD HYDROLOGY: A TOOL FOR SOUTH AFRICA--AN EXAMPLE FROM THE CROCODILE RIVER NEAR BRITS, TRANSVAAL, SOUTH AFRICA.
Geological Survey, Pretoria (South Africa). Regional Geology Div.
For primary bibliographic entry see Field 2E.
W91-00636

AUTOMATED DETERMINATION OF SILICA IN SURFACE AND GROUND WATER (DIE OUTOMATIESE BEPALING VAN SILIKA IN OPPERVLAK EN GRONDWATER).
Pretoria Univ. (South Africa). Dept. of Chemistry.
J. F. van Staden, J. J. Pauer, H. R. van Vliet, and P. L. Kempster.
Water SA WASADV, Vol. 16, No. 3, p 205-210, July 1990. 4 fig, 10 tab, 15 ref. English summary.

Descriptors: *Autoanalyzers, *Chemical analysis, *Colorimetry, *Measuring instruments, *Silica, *Water analysis, Automation, Dyes, Groundwater, Ions, Metal complexes, Surface water.

An automated flow-injection procedure for the determination of silica in surface and ground water was developed. The reduced heteropoly molybdenum blue-formed complex from molybdosilicic acid was used as the detection product at 660 nm. Ascorbic acid was used as reductant and oxalic acid was used to decompose the formed molybdophosphoric acid complex eliminating the interference of phosphate. Interferences of a number of ions, i.e., phosphate, fluoride, chloride, sulfate, nitrate, sodium, potassium, calcium and magnesium, were evaluated and the results given. The proposed method was evaluated in the range of 0.07 to 20 mg/cu dm Si. At a sample frequency of 90 samples per hour a good precision and accuracy were achieved and the carry-over between samples was less than 1%. (Author's abstract)
W91-00638

SYNCHRONOUS FLUORESCENCE SPECTROSCOPY OF DISSOLVED ORGANIC MATTER IN SURFACE WATERS: APPLICATION TO AIRBORNE REMOTE SENSING.
Cornell Univ., Ithaca, NY. Cornell Lab. for Environmental Applications of Remote Sensing.
For primary bibliographic entry see Field 5A.
W91-00639

STRIDES IN NONDESTRUCTIVE TESTING.
Olson Wright NDT and E, Inc., Lakewood, CO.
For primary bibliographic entry see Field 8G.
W91-00676

LITTORAL BENTHIC FAUNA OF LAKE MANAGUA, NICARAGUA: A STUDY COMPARING ARTIFICIAL AND NATURAL SUBSTRATA.
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
For primary bibliographic entry see Field 2H.
W91-00681

DETERMINATION OF THE ENVIRONMENTAL CAPACITY OF HAIFA BAY WITH RESPECT TO THE INPUT OF MERCURY.
National Inst. of Oceanography, Haifa (Israel).
For primary bibliographic entry see Field 5B.
W91-00706

TWO HYDRODYNAMICALLY STABLE SELF-SUSPENDED BUOYANT SEDIMENT TRAPS.
Stockholm Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 2J.
W91-00721

USE OF CHLOROFORM IN SEDIMENT TRAPS: CAUTION ADVISED.
Bergen Univ. (Norway). Dept. of Marine Biology.
K. Gundersen, and P. Wassmann.
Marine Ecology Progress Series MESEDT, Vol. 64, No. 1/2, p 187-195, June 28, 1990. 7 fig, 2 tab, 48 ref.

Descriptors: *Chloroform, *Experimental design, *Sample preservation, *Sampling, *Sediment sam-

pler, Chlorophyll a, Oceanography, Organic carbon, Organic matter, Performance evaluation, Zooplankton.

Experiments were conducted to study the effect of chloroform addition to sediment traps in the laboratory and in the field. Chloroform gave rise to extensive leaching of pigments and probably also other soluble organic compounds when fresh organic matter entered sediment traps. Droplets of chloroform suppressed microbial degradation of organic matter in the traps for few days, but did not stop it. The presence of chloroform resulted in anesthesia of 'swimmers' such as cladocerans and copepods and their subsequent death. Thus, chloroform led to accumulation and disintegration rather than exclusion or preservation of 'swimmers.' The field and laboratory experiments suggested that loss of organic matter in unpoisoned traps was due more to 'swimmers,' which entered, grazed, and left the trap than to microbial degradation per se. Chloroform does not increase significantly the accuracy of vertical flux data. On the contrary, it gives rise to significant undesirable side-effects, e.g., overestimation and underestimation of particulate organic carbon and chlorophyll a sedimentation rates, respectively. (Author's abstract)
W91-00731

LARGE-SCALE PATTERNS OF NODULARIA SPUMIGENA BLOOMS IN PYRAMID LAKE, NEVADA, DETERMINED FROM LANDSAT IMAGERY: 1972-1986.
Arizona State Univ., Tempe. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00749

SPOT AND ENVIRONMENTAL STUDIES: AN ADVANCED SYSTEM TO COLLECT UP TO DATE GEOGRAPHIC INFORMATION.
SPOT Image Corp., Toulouse (France).
J. C. Rivereau, and M. Pousse.
Toxicological and Environmental Chemistry TXECBP, Vol. 27, No. 4, p 197-200, 1990.

Descriptors: *Data acquisition, *Mapping, *Remote sensing, *SPOT satellite, *Satellite technology, Civil engineering, Desertification, Groundwater pollution, Hydrography, Land degradation, Multiobjective planning, Repeat imaging, Stereoscopy, Urban planning, Water resources management.

SPOT 1, the first Earth observation satellite of the SPOT program, has been in orbit for more than three years and has currently gathered one million images of the Earth. SPOT is a technologically advanced system to gather geographic updated information and to monitor Earth surface phenomena. SPOT presents some unique features: 10 m and 20 m ground resolution, repeat imaging capability and stereoscopy associated with more conventional advantages of space remote sensing such as synoptic and global coverage. It is therefore an efficient tool to study and monitor a variety of environmental phenomena. Land use maps and inventories of natural, cultivated and urban areas are rapidly completed with SPOT data. In addition to current status assessment and monitoring, SPOT data are used to foresee and anticipate consequences of planned modification. Impact studies in civil engineering such as roads, railways, power lines, dams, and urban projects can be simulated in 3D perspective views and different scenarios investigated in a global context. The high revisit capability of SPOT allows monitoring of coastal evolution, shoreline modification, sediment transport, current studies, and siltation behavior of river water discharge. Land degradation and desertification problems are aided by SPOT analysis in ways such as hydrographic mapping; slope and exposure measurements; morphological, geological and soil mapping; and vegetal cover mapping. Fresh water availability and groundwater pollution concerns, such as catchment area protection; studies of erosion and siltation; and protection of groundwater recharge perimeters from waste in fracture zones; can all be aided by the accurate mapping of results is obtained with SPOT high precision imagery. The data extracted from analysis are easily introduced into Geographic Information Systems or any digital georeferenced data bank to be merged with other sources of information. (Brunone-PTT)
W91-00793

DEVELOPMENT OF A NEW METHODOLOGY FOR THE ASSESSMENT OF SPECIFIC METHANOGENIC ACTIVITY.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-00805

RESPIRATION INHIBITION KINETIC ANALYSIS.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 5D.
W91-00810

MICROBIAL SENSOR FOR BOD.
Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Molekularbiologie.
For primary bibliographic entry see Field 5A.
W91-00812

USE OF A GEL-FORMING BIOPOLYMER DIRECTLY DISPENSED INTO A LOOP FLUIDIZED BED REACTOR TO RECOVER DISSOLVED COPPER.
California State Univ., Long Beach. Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W91-00813

ISOLATION OF DISSOLVED ORGANIC MATTER FROM THE SUWANNEE RIVER USING REVERSE OSMOSIS.
Georgia Inst. of Tech., Atlanta. School of Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 5B.
W91-00816

DETECTION AND ANALYSIS OF TWO SEROTYPES OF AMMONIA-OXIDIZING BACTERIA IN SEWAGE PLANTS BY FLOW CYTOMETRY.
ORPEGEN, Medizinisch-Molekularbiologische Forschungsgesellschaft mbH, Heidelberg, Germany.
For primary bibliographic entry see Field 5D.
W91-00831

COMPARISON OF TWO CLOUDWATER/FOGWATER COLLECTORS: THE ROTATING ARM COLLECTOR AND THE CALTECH ACTIVE STRAND CLOUDWATER COLLECTOR.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
J. L. Collett, B. C. Daube, J. W. Munger, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1685-1692, July 1990. 5 fig, 1 tab, 23 ref. California Air Resources Board Contract A4-075-32.

Descriptors: *Cloud chemistry, *Cloud liquid water, *Fog, *Measuring instruments, *Precipitation gages, *Rain gages, *Sampling, *Water sampling, Calcium, California, Chemical analysis, Chlorides, Clouds, Comparison studies, Data acquisition, Fogwater, Liquid water content, Magnesium, Nitrates, Nitrites, Santa Barbara Channel, Sodium, Sulfates.

A side-by-side comparison of the Rotating Arm Collector (RAC) and the Caltech Active Strand Cloudwater Collector (CASCC) was conducted at an elevated coastal site near the eastern end of the Santa Barbara Channel in southern California. The CASCC was observed to collect cloud water at rates of up to 8.5 ml/min. Collection rates for the RAC as high as 2 ml/min have been observed in previous studies. The ratio of cloud water collection rates was found to be close to the theoretical prediction of 4.2:1 (CASCC:RAC) over a wide range of liquid water content (LWC). At low LWC, however, this ratio climbed rapidly, possibly reflecting a predominance of small droplets under these conditions, coupled with a greater collection efficiency of small droplets by the CASCC. Cloud water samples collected by the RAC had significantly higher concentrations of Na(+), Ca(2+), Mg(2+), and Cl(-) than those collected by the CASCC. These higher concentrations may be due to differences in the chemical composition of large versus small droplets. No significant differences were observed in concentrations of NO3(-), SO4(2-), or NH4(+) in samples collected by the two instruments. (Author's abstract)
W91-00844

RADIOMETRIC STUDIES OF CLEAR AIR ATTENUATION AND ATMOSPHERIC WATER VAPOR AT 22.235 GHZ OVER CALCUTTA (LAT. 22 DEGREES 32 MINUTES N, LONG. 88 DEGREES 20 MINUTES E).
Calcutta Univ. (India). Inst. of Radiophysics and Electronics.
For primary bibliographic entry see Field 2B.
W91-00852

FURTHER DISCUSSION ON THE INTERCOMPARISON OF THE TRACE METAL CONCENTRATIONS AND PARTICLE SIZE OF FLUVIAL SEDIMENT RECOVERED FROM TWO CENTRIFUGE SYSTEMS.
Geneva Univ. (Switzerland). Inst. F.-A. Forel.
For primary bibliographic entry see Field 5A.
W91-00866

TRANSPIRATION OF PLANTATION PINUS RADIATA ESTIMATED BY THE HEAT PULSE METHOD AND THE BOWEN RATIO.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 2D.
W91-00867

NOTE ON THE ANALYSIS OF MOISTURE-DEPTH CURVES OBTAINED BY THE HOT-AIR METHOD FOR THE DETERMINATION OF SOIL MOISTURE DIFFUSIVITY.
Botswana Univ., Gaborone. Dept. of Geology.
For primary bibliographic entry see Field 2G.
W91-00889

USING RN222 TO EXAMINE GROUNDWATER/SURFACE DISCHARGE INTERACTION IN THE RIO GRANDE DE MANATI, PUERTO RICO.
Florida Univ., Gainesville. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00893

EFFECT OF OBLIQUE RAIN ON INCLINED SURFACES: A NOMOGRAPH FOR THE RAIN-GAUGE CORRECTION FACTOR.
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
J. L. M. P. de Lima.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 407-412, July 1990. 2 fig, 7 ref, append.

Descriptors: *Error analysis, *Nomographs, *Rain gages, *Rainfall, Correction factors, Mathematical analysis, Measuring instruments, Slopes, Wind.

Inclined rainfall leads to errors in the assessment of effective precipitation in areas with rugged relief. This affects many hydrological studies such as hydrologic forecasts, water erosion, determination of conditions for flash flood formation, determination of cropping conditions, etc. A nomograph is presented for the rain-gage correction factor (C-gau), by which rainfall measured in a standard horizontal rain-gage (P-gau) may be corrected to obtain the rainfall flux actually received on the inclined surface under study (P-act = C-gau x P-gau). The correction factor is assumed to be a

function of wind (with constant wind velocity), type of rainfall, and inclination and orientation of the sloping surface with respect to the oblique rain. Care should be taken in the use of the nomograph and in the interpretation of the results. In the construction of the nomograph, drop size and wind velocities are assumed constant in time and no allowance is made for the local turbulence created by the rain gage, or for its exposure. In addition, the effects of topography on local variations in rainfall may cause an error in the utilization of the nomograph. (Hoskin-PTT)
W91-00899

SAMPLING AND ANALYSIS OF HAZARDOUS WASTES.
Environmental Monitoring Systems Lab., Research Triangle Park, NC.
For primary bibliographic entry see Field 5A.
W91-00958

STUDY ON SHORT-TERM RAINFALL PREDICTION BY RADAR RAINGAUGE.
Public Works Research Inst., Tsukuba (Japan).
For primary bibliographic entry see Field 2B.
W91-00962

7C. Evaluation, Processing and Publication

MATHEMATICAL MODELLING OF THE EFFECT OF SIZE DISTRIBUTION ON SUSPENDED PARTICLES IN DEEP-BED FILTRATION.
Chia Nan Junior Coll. of Pharmacy, Tainan (Taiwan).
For primary bibliographic entry see Field 5F.
W91-00022

TIDES IN THE ENGLISH CHANNEL AND SOUTHERN NORTH SEA. A FREQUENCY DOMAIN ANALYSIS USING MODEL TEA-NL.
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 2L.
W91-00045

COMPARISON OF TWO FINITE ELEMENT MODELS OF TIDAL HYDRODYNAMICS USING A NORTH SEA DATA SET.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2L.
W91-00046

TIDAL FLOW SIMULATION IN THE ENGLISH CHANNEL AND SOUTHERN NORTH SEA.
Katholieke Univ. Leuven (Belgium). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W91-00047

SIMULATION OF THE TIDAL FLOW IN THE ENGLISH CHANNEL AND THE SOUTHERN NORTH SEA BY A CURVILINEAR FINITE DIFFERENCE MODEL.
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
For primary bibliographic entry see Field 2L.
W91-00048

ONE-DIMENSIONAL MODEL FOR THE TRANSPORT OF A SEDIMENT MIXTURE IN NON-EQUILIBRIUM CONDITIONS.
Trento Univ. (Italy).
For primary bibliographic entry see Field 2J.
W91-00070

ESTIMATING STATISTICAL PARAMETERS FOR AN N-SEGMENT DISCRETE HYDROLOGIC DATA SERIES.
Clark Univ., Worcester, MA. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-00074

GROUNDWATER MODELLING AS A TOOL FOR WATER MANAGEMENT: WAIMEA PLAINS, NELSON.
Nelson Catchment Board (New Zealand).
For primary bibliographic entry see Field 2F.
W91-00075

VARIABLE LAPSE RATE SNOWLINE MODEL FOR THE REMARKABLES, CENTRAL OTAGO, NEW ZEALAND.
Department of Scientific and Industrial Research, Christchurch (New Zealand). Land and Soil Science Div.
For primary bibliographic entry see Field 2C.
W91-00076

HYDROCLIMATIC APPLICATION STRATEGY FOR THE POISSON PARTIAL DURATION MODEL.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00084

ERRORS IN ESTIMATED STREAMFLOW PARAMETERS AND STORAGES FOR UNGAUGED CATCHMENTS.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W91-00085

DEVELOPMENT OF A WATER AND WASTEWATER SCADA SYSTEM.
Wiley and Wilson, Inc., Lynchburg, VA.
For primary bibliographic entry see Field 5F.
W91-00101

COMPUTER-OPERATED TREATMENT PLANT PROVIDES TOP QUALITY WATER.
Bogert (Clinton) Associates, Fort Lee, NJ.
For primary bibliographic entry see Field 5F.
W91-00106

SPATIAL AND TEMPORAL VARIABILITY OF PRECIPITATION ACROSS KENTUCKY.
Louisville Univ., KY. Dept. of Geography.
For primary bibliographic entry see Field 2B.
W91-00110

PCG SOLUTIONS OF FLOW PROBLEMS IN RANDOM POROUS MEDIA USING MIXED FINITE ELEMENTS.
California Univ., Irvine. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-00117

MODELING INFILTRATION IN HYSTERETIC SOILS.
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W91-00118

NUMERICAL MODEL FOR AREAL MIGRATION OF WATER AND LIGHT HYDROCARBON IN UNCONFINED AQUIFERS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5B.
W91-00120

PROPAGATION OF PERIODIC WAVES IN THE LIDO CHANNEL OF THE VENICE LAGOON.
For primary bibliographic entry see Field 2L.
W91-00121

VARIATIONAL PRINCIPLE METHOD WITH VARIABLE DOMAIN IN THE FLOW PROBLEM WITH FREE SURFACE.
Shanghai Inst. of Mechanical Engineering (China).
For primary bibliographic entry see Field 8B.
W91-00122

TIME SERIES ANALYSIS OF UNEQUALLY SPACED OBSERVATIONS-WITH APPLICATIONS TO COPPER CONTAMINATION OF THE RIVER GAULA IN CENTRAL NORWAY.
Norsk Regnesentral, Oslo.
For primary bibliographic entry see Field 5B.
W91-00128

STATISTICS-BASED SYSTEM FOR TREATMENT PLANT OPERATION.
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W91-00129

STATE ESTIMATION IN WASTEWATER ENGINEERING: APPLICATION TO AN ANAEROBIC PROCESS.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
For primary bibliographic entry see Field 5D.
W91-00130

SOME COMMENTS ON ANALYSIS TECHNIQUES FOR CENSORED WATER QUALITY DATA.
Waterloo Univ. (Ontario). Dept. of Health Studies.
For primary bibliographic entry see Field 5G.
W91-00131

ESTIMATION OF PHOSPHORUS FROM THE NIAGARA RIVER TO LAKE ONTARIO.
Waterloo Univ. (Ontario).
For primary bibliographic entry see Field 5E.
W91-00133

INFERENCES ABOUT POINT SOURCE LOADING FROM UPSTREAM/DOWNSTREAM RIVER MONITORING DATA.
International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 5B.
W91-00135

MEASURES OF FLOW VARIABILITY FOR GREAT LAKES TRIBUTARIES.
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 2E.
W91-00136

ROBUST GRAPHICAL METHODS FOR DIAGNOSING TREND IN IRREGULARLY SPACED WATER QUALITY TIME SERIES.
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
For primary bibliographic entry see Field 5B.
W91-00138

DEVELOPMENT OF A SOFTWARE PACKAGE FOR TREND DETECTION IN TEMPORAL SERIES: APPLICATION TO WATER AND INDUSTRIAL EFFLUENT QUALITY DATA FOR THE ST. LAWRENCE RIVER.
INRS-Eau, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W91-00139

ONE-DIMENSIONAL INTERACTIVE SOIL-ATMOSPHERE MODEL FOR TESTING FORMULATIONS OF SURFACE HYDROLOGY.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2A.
W91-00145

STABILITY LIMITS FOR PREISSMANN'S SCHEME.
Hydraulics Research Ltd., Wallingford (England).
For primary bibliographic entry see Field 2E.
W91-00150

NONPARAMETRIC FLOOD-FREQUENCY ANALYSIS WITH HISTORICAL INFORMATION.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00152

SIMULATION OF DISPERSION IN LAYERED COASTAL AQUIFER SYSTEMS.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00155

RAINFALL INTERCEPTION IN THE TAI FOREST, IVORY COAST: APPLICATION OF TWO SIMULATION MODELS TO A HUMID TROPICAL SYSTEM.
Groningen Rijksuniversiteit (Netherlands). Dept. of Physical Geography.
For primary bibliographic entry see Field 2B.
W91-00158

SOME FUNDAMENTAL WEAK SPOTS OF KRIGING TECHNIQUE AND THEIR CONSEQUENCES.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Soil and Groundwater.
J. W. De Kwaadsteniet.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 277-284, May 1990. 1 fig, 8 ref.

Descriptors: *Data interpretation, *Kriging, *Mapping, *Monitoring wells, *Observation wells, *Statistical methods, Analysis of variance, Geostatistics, Noise, Optimization, Spatial distribution.

The spatial interpolation technique known as 'kriging' has become a significant technique in the Earth sciences, making up the bulk of what is called 'geostatistics.' The kriging technique is also applied in groundwater hydrology. This technique is not only used for interpolation but for optimization purposes as well. Kriging owes much of its popularity to its combination of properties: (1) each estimate is supplied with confidence information; (2) an estimated spatial picture of a variable links up continuously with the observations at the observation points; and (3) the technique is mathematically elegant and can easily be programmed. However, insufficient attention has been paid to a number of fundamental weak spots of the kriging technique, in spite of their serious practical consequences. At the basis of kriging, the spatial variable studied is split into a deterministic part and a noise part while in the usual context (one observed realization at each observation point) such a division is impossible without making assumptions unconnected with the data considered. As a consequence, kriging results are highly artificial in the usual context. The artificiality can be removed if several realizations from each observation point are available, as for example, in the case of a monitoring network of groundwater head, since a specification of the noise part can be given, particularly of its variance/covariance structure. First results point to a large inhomogeneity of variance and a large autocorrelation in groundwater head on a regional scale. Some attention must be paid to the consequences of these specific properties, also with regard to the optimization of monitoring networks. (Author's abstract)
W91-00159

ESTIMATING GROUNDWATER RECHARGE USING A SURFACE WATERSHED MODEL: SENSITIVITY ANALYSES.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
F. H. S. Chiew, and T. A. McMahon.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 305-325, May 1990. 14 fig, 2 tab, 9 ref, append.

Descriptors: *Groundwater recharge, *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Sensitivity analysis, *Surface-groundwater relations, Australia, Groundwater management, Model testing, Parametric hydrology, Simulation analysis, Streamflow data, Watersheds.

A surface watershed modeling approach was used to obtain groundwater recharge as an output from the rainfall-runoff process model HYDROLOG by calibrating HYDROLOG against streamflow records. The parameters in HYDROLOG were fitted to minimize a streamflow objective function. The model can thus provide accurate recharge estimates only if the parameters to which the recharge estimates are sensitive are also those to which the streamflow objective function is sensitive, otherwise recharge estimates will remain unchanged as the parameters which influence the streamflow objective function are progressively altered to reduce the value of the objective function. Analyses were carried out in a catchment area in northern Victoria, Australia, to guide further improvements in the model and to investigate the sensitivity of the objective function and the recharge estimates to the parameters in HYDROLOG, using NLFIT (an optimization package) and sensitivity plots. The analyses indicated that this approach was promising. The streamflow objective function was sensitive to the parameters in the model which influenced the recharge estimates, thus calibrating the model against streamflow records appears to be a reasonable way to obtain the parameters influencing recharge. The sensitivity analyses also indicated that the objective function and the recharge estimates were not sensitive to some parameters and some parameters were strongly correlated to another parameter. Only a few simulation runs were required to obtain appropriate estimates for the less important parameters, reducing the number of parameters to be optimized during the subsequent simulation runs. (See also W91-00160) (Fish-PTT)
W91-00161

EVALUATION OF THREE EVAPOTRANSPIRATION MODELS IN TERMS OF THEIR APPLICABILITY FOR AN ARID REGION.
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
For primary bibliographic entry see Field 2D.
W91-00165

DRIP IRRIGATION NONLINEAR OPTIMIZATION MODEL.
Concepcion Univ. (Chile). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W91-00168

2-D BED EVOLUTION IN NATURAL WATERCOURSES: NEW SIMULATION APPROACH.
Energoprojekt, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 2J.
W91-00177

REGIONAL FLOW-DURATION CURVES FOR UNGAUGED SITES IN MASSACHUSETTS.
Massachusetts Div. of Water Supply, Boston.
For primary bibliographic entry see Field 2E.
W91-00185

OPTIMIZATION OF FRESHWATER INFLOW TO ESTUARIES.
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 2L.
W91-00187

PUMPING TEST IN A LOW PERMEABILITY CLAYSTONE AQUIFER EXECUTED WITH HIGH-RESOLUTION ELECTRONIC WATER LEVEL RECORDERS AND EVALUATED WITH THE VERSATILE COMPUTER PROGRAM HYDROPAR.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
For primary bibliographic entry see Field 2F.
W91-00216

ANALYSIS OF PUMPING TEST DATA FROM BOREWELLS IN FRACTURED ROCKS OF KARNATAKA.
Roorkee Univ. (India). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W91-00217

ANALYSIS OF TEST PUMPING DATA FROM UNCONFINED AQUIFERS BY SIMULATION.
Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 2F.
W91-00218

CRITICAL EVALUATION OF PUMPING TEST DATA FROM FRACTURED CRYSTALLINE FORMATION.
Madras Univ. (India). Dept. of Applied Geology.
For primary bibliographic entry see Field 2F.
W91-00219

COMPUTATION OF TRANSMISSIVITY FROM STEP-DRAWDOWN TESTS.
Action for Food Production (AFPRO), Geohydrological Investigation Team, Hyderabad-500 007.
For primary bibliographic entry see Field 2F.
W91-00220

JOINT SYSTEM ANALYSIS FOR THE EVALUATION OF FLOW IN FRACTURED AQUIFER.
Central Ground Water Board, Bhubaneswar (India).
P. K. Das, and S. B. Mallik.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 131-141, 6 fig, 1 tab, 8 ref.

Descriptors: *Data interpretation, *Geohydrology, *Geologic fractures, *Geology, *Groundwater movement, *Joint systems analysis, Aquifers, Developing countries, Graphical analysis, Groundwater budget, Groundwater level, India, Kasai River, Maps, Permeability, Resistivity.

An intensive study has been made of Joint System of Precambrian Crystalline rocks occurring at the township of Khatra in Bankura District, West Bengal. The area is mantled by saprolite derived from weathering of phyllites, micaschist, granite, amphibolites and quartzites. The saprolite aquifer is considered to be isotropic in nature which may be evidence from the water table contour maps which were prepared from close observation of the wells. The saturated fractured rocks occurring just below the saprolite aquifer can be determined from electrical resistivity studies and borehole data. Analysis of the joint system of this aquifer can be made from the exposed rocks. The predominant joint sets have been determined by graphical techniques from the central tendencies of all the joint planes giving rise to a characteristic joint geometry of different sectors in the area. Study of different sets of dispersion shows that the medium is largely anisotropic and that the principle permeability direction of joint sets is contained in the southeastern direction. It can be shown that the course of streams and creeks appear to bear some relation to the major permeability direction, and that the base flow of the Kasai River is maintained by the fractured aquifer. (See also W91-00215) (Lantz-PTT)
W91-00228

APPROACH IN DETERMINATION OF AQUIFER GEOMETRY AND ESTIMATION OF AQUIFER PARAMETERS OF AN AREALLY EXTENSIVE UPPER KAMTHI SANDSTONE AQ-

UIFER IN PARTS OF GODAVARI VALLEY, ANDHRA PRADESH.
For primary bibliographic entry see Field 2F.
W91-00231

AQUIFER PARAMETER ESTIMATION AND GROUNDWATER POTENTIALITY IN GRANITE-BASALT TERRAIN NEAR HYDERABAD, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00233

PARAMETER ESTIMATION FOR A QUASI-THREE-DIMENSIONAL FLOW MODEL.
Asian Inst. of Tech., Bangkok (Thailand).
A. Das Gupta, and A. S. Srikanthan Herath.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 197-208, 6 fig, 2 tab, 7 ref.

Descriptors: *Data interpretation, *Groundwater movement, *Mathematical models, *Model studies, Hydrologic models, Mathematical equations, Mathematical studies, Piezometric head, Sensitivity analysis.

Parameter estimation for 3-dimensional groundwater flow is based on the sensitivity of the analysis approach. Flow models consist of a two dimensional partial differential equations representing flow in individual layers and vertical leakage terms coupling the layers with transmissivities, storativities and leakage factors as unknown parameters of the model. An alternative, direction implicit method is used to solve the equation numerically with specified initial and boundary conditions. The parameters are identified by improving on a set of initial parameters using the square of the difference between the observed and computed piezometric head values. Initially the model responses were evaluated by applying the algorithm for a hypothetical two-layer aquifer system. The possibility of application to a multi-layer aquifer system underlying the city of Bangkok was then investigated. Sensitivity analysis could be used to identify a set of parameters in a hydrologic model. However, the main drawback with this method is the extensive computation time involved. (See also W91-00215) (Lantz-PTT)
W91-00236

KRIGED ESTIMATES OF WATER-LEVELS FROM THE SPARSE MEASUREMENTS IN A HARD ROCK AQUIFER.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-00245

FRACTURE PATTERN MODELLING FOR GROUNDWATER TARGETTING IN HARD ROCK TERRAIN: A STUDY AIDED BY REMOTE SENSING TECHNIQUE.
Indian Inst. of Tech., Madras.
K. Usha, S. M. Ramasamy, and S. P. Subramanian.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 319-328, 6 fig, 2 ref.

Descriptors: *Data interpretation, *Geohydrology, *Groundwater resources, *Model studies, *Remote sensing, Data acquisition, Digital map data, Geologic fractures, Groundwater level, Groundwater movement, Heterogeneity, Maps.

The groundwater conditions in hard rock terrain are multivariate due to the heterogeneous nature of the aquifer. This is due to the varying composition, compaction, density of fracturing and degree of weathering. As a result, targeting of groundwater in such terrain has proven to be complex. In the present model, the lithologic and deformational fabrics have been brought out in detail using digital enhancement and enlarged formats of the Thematic Mapper Data. From these surface signatures, subsurface configuration of the folded structure, and the nature and morphology of the fractured system have been analyzed. Various fracture density diagrams were drawn and the information integrated with water level and water table maps. Thus, the exact controls of groundwater mobility and stability have been identified. Analysis of structural trends and water level contour diagrams suggest that the synclinal areas have more potential for groundwater targeted in hard-rock terrain. (See also W91-00215) (Lantz-PTT)
W91-00250

DIGITAL ENHANCEMENT OF SURFACE GEOLOGIC FEATURES IN A PART OF BANAS RIVER CATCHMENT FOR GROUND WATER POTENTIAL CHARACTERIZATION.
Central Ground Water Board, Jaipur (India).
O. N. Tiwari.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 333-336, 1 fig, 6 ref.

Descriptors: *Data interpretation, *Digital map data, *Groundwater resources, *Remote sensing, *Well yield, Geomorphology, Groundwater budget, India, Landsat, Mount Abu, Satellite technology.

For two decades, machine processing techniques for remotely sensed data have steadily advanced. Pattern recognition and enhancement techniques are application oriented operations. Digital enhancement of images and their interpretation has established itself as significant for lithological, structural, and geomorphological studies. These criteria are necessary for establishing evidence for the presence of groundwater potential. An attempt to assess groundwater availability in the semi-arid catchment area of Mt. Abu is made. Materials and methods that were employed included Landsat MSS data interpreted along with Indian Remote Sensing Satellite (IRS) simulated imagery; a sub-image of Landsat MSS bands 4,5,6, and 7, and separate maps on lithology, lineament, drainage, and geomorphology. This study has highlights a linear contrast stretched image containing better geological details that can be integrated to define areas in terms of their potential for groundwater. Potential areas demarcated can be taken as sites for further geophysical and groundwater drilling operations. (See also W91-00215) (Lantz-PTT)
W91-00252

REMOTE SENSING BASED APPROPRIATE METHODOLOGY FOR THE GROUNDWATER EXPLORATION: A CASE STUDY FROM PRE-CAMBRIANS OF SOUTH INDIA.
Anna Univ., Madras (India). Inst. of Remote Sensing.
S. M. Ramasamy, S. T. Govindarajan, and T. Balasubramanian.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 341-344, 1 fig, 2 ref.

Descriptors: *Data acquisition, *Data interpretation, *Geohydrology, *Groundwater resources, Case studies, Groundwater level, Groundwater management, India, Paleohydrology.

A unique method is demonstrated for integrating groundwater resource information obtained from remotely sensed and proximally sensed/ground collected data. From the raw and digitally enhanced thematic mapper data lithological spectrum, deformational display of rocks and lineament fabric were extracted and these data were integrated by a multivariate analysis with water level, yield and transmissivity data and zones of groundwater mobility and stability were identified. The structural trends of such lithologies were interpreted on the basis of relief, drainage, soil tone and vegetation linearities/curvilinearities from the satellite imagery and total framework of such folds were brought out. The fracture controlled lineaments were interpreted on the basis of the same photo tone characters from the satellite data and such lineaments show a regional polymodel orientation. Water level fluctuations for a period of three years for over 2500 observation wells were standardized, values were plotted in their respective geographical positions, contoured, and from their contour linearity, groundwater level linearity was structured out. The integration of folded structures with groundwater level and yield shows that the water level linearity maxima faithfully follows the axis of the folds in Tirrunelveli, Madurrai, Pudukkottai and Ootacamund massif. The circular pattern of water level maxima northeast of Coimbatore shows the existence of a basin structure, a complimentary to Sankaridurg dome which holds the groundwater. Similarly, the yield maxima exhibits striking linearity and curvilinearity with axis of the first generation folds too which got refolded to NNW-SSE trending axial trace, whereas the transmissivity value maxima does not show any relation with folded structures. (See also W91-00215) (Lantz-PTT)
W91-00254

MOISTURE VARIATION STUDY BY NEUTRON-NEUTRON LOGGING.
Central Ground Water Board, Ahmedabad (India).
I. R. Bavaji.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 347-358, 6 fig, 4 tab, 4 ref.

Descriptors: *Borehole geophysics, *Data acquisition, *Data interpretation, *Groundwater resources, *India, *Neutron logging, *Neutron-neutron logging, *Soil water, Aeration zone, Boreholes, Ghanghar River Basin, Groundwater level, Logging (Recording), Water table.

Groundwater scientists are using the same borehole logging instruments that were initially designed for oil exploration purposes with little modification for groundwater studies. An attempt to solve one of the problems related to groundwater with neutron-neutron logging tools is addressed, with regard to locating soil moisture. Soil moisture is commonly regarded as the subsurface water in the zone of aeration. The zone of aeration is a zone of transition in which water is absorbed, held or transmitted either down toward the water table or up toward the soil surface and atmosphere. The neutron-neutron logging tool is one of the most useful tools available for porosity measurements of oil bearing formations, and was used to study the zones above the water table. The study of neutron-neutron logs recorded in 4-in. diameter wells in the Ghaghar River Basin reveals that the technique is very useful. On the basis of several case studies, it was concluded that a continuous volumetric record of moisture content is possible using neutron-neutron logging. The method also permits a repeated record without disturbing the formation and natural conditions. The depth-wise periodic variation in moisture content can be obtained using neutron-neutron logging. (See also W91-00215) (Lantz-PTT)
W91-00255

FUNCTIONAL RELATION FOR CAPILLARY SUCTION VS. MOISTURE CONTENT.
Roorkee Univ. (India). School of Hydrology.
K. M. Mohan Rao, D. Kashyap, and S. Chandra.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 405-409, 2 fig, 8 Ref.

Descriptors: *Capillary water, *Mathematical equations, *Soil water, *Soil water suction, Mathe-

matical models, Mathematical studies, Richards equation.

The Richard equation can be used to define a functional relationship between capillary suction and moisture, and to mathematically model flow in the unsaturated zone. A recommendation to adopt refined experimental data with an efficient numerical algorithm for differentiation and interpolation is made. In order to assist with the needs of elaborate experimental facilities, the proposed relationship between the Richards equation and capillary suction versus moisture content should be adopted. The Richard equation proved satisfactory when used for a field simulation problem. (See also W91-00215) (Lantz-PTT)
W91-00260

COMPUTER SIMULATION OF AN INJECTED TRACER MOVEMENT.
Central Water and Power Research Station, Poona (India).
For primary bibliographic entry see Field 2F.
W91-00262

INTERACTIVE GROUNDWATER DATABASE SYSTEM.
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
A. K. Dikshit, and S. Ramaseshan.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 443-456, 6 fig, 8 tab, 8 ref.

Descriptors: *Data storage and retrieval, *Databases, *Groundwater management, *Groundwater resources, *Hydrologic data collections, Computer programs, Computers, Data interpretation, Data processing, Water resources management.

Site specific water resources data, including design, development and operation of water resources systems are needed. To illustrate the development of a database and the use of Data Base Management Systems (DBMS), a groundwater database management system was developed for a part of Uttar Pradesh, India, using dBASE III PLUS language and data from the Central Groundwater Board for one year and U.P. Groundwater Investigation Organization for one decade for IBM-PC/XT. A multifile structure with a masterfile and other subsidiary files , each including a common field in order to establish a relationship between different databases has been used. A menu based interactive program using dBASE III PLUS has been developed to edit, update, sort and manipulate different databases and retrieve data as required. Since the DBMS languages provide for report generation, graphics and export of data to other systems, it is possible to generate formatted reports, results of statistical and numerical analyses, charts and maps from DBMS, and finally a menu-based interactive program will facilitate easy and efficient database management. (See also W91-00215) (Lantz-PTT)
W91-00263

TECHNIQUES OF AQUIFER PARAMETER EVALUATION USING POCKET COMPUTERS.
V.O.C. Coll., Tuticorin (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00265

ACQUISITION OF HYDROGEOLOGIC DATA FOR THE MAPPING OF SHALLOW UNCONFINED DECCAN BASALTIC AQUIFERS FROM MAHARASHTRA, INDIA.
Poona Univ. (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00266

HYSTERESIS AND NONLINEARITY OF DISCHARGE-SEDIMENT RELATIONSHIPS IN THE ATCHAFALAYA AND LOWER MISSISSIPPI RIVERS.
Louisiana Geological Survey, Baton Rouge. Coastal Geology Section.
For primary bibliographic entry see Field 2J.
W91-00292

DEVELOPING ACCURATE AND RELIABLE SEDIMENT YIELDS.
Illinois State Water Survey Div., Champaign.
K. P. Singh, and A. Durgunoglu.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 193-199, 4 fig, 1 tab, 8 ref.

Descriptors: *Data interpretation, *Mathematical models, *Model studies, *River sediments, *Sediment load, *Sediment yield, Analytical methods, Errors, Flow rates, Hydrographs, Regression analysis, River flow, Sampling, Seasonal variation, Sediment concentration, Sedimentation rates, Streamflow.

Quantitative estimates of stream sediment yields have usually been made by using empirical relations, most commonly the power function, which leads to considerable underestimation of annual sediment yields. The bias in the estimation of sediment loads by rating curve due to log-transformed estimates can be significantly reduced by using nonlinear regression. Further improvements can be achieved by identifying seasonalities and breaks in slopes of rating curves. Finally, the underestimation caused by using average daily flows with the rating curve can be eliminated by using sub-daily flow data, if available. The remaining problem that concerns both the log-transformed and the nonlinear regression methods is that a very limited number of sediment observations are made during high flows. Considering that 80-90% of the sediment load is carried during 10-15% of the flows, it is essential that more sediment samples be collected at high flows. (See also W91-00280) (MacKeen-PTT)
W91-00301

MODELLING AGRICULTURAL RUNOFF: OVERVIEW.
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
For primary bibliographic entry see Field 5B.
W91-00302

SOURCES OF HYDROLOGIC DATA ON MESOZOIC FORMATIONS IN THE UPPER COLORADO RIVER BASIN AND COMPARISON OF DATA ANALYSIS METHODS.
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00309

GEOPHYSICALLY DETERMINED POROSITY OF PALEOZOIC ROCKS IN THE UPPER COLORADO RIVER BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00314

USING A GEOGRAPHIC INFORMATION SYSTEM TO DEVELOP A GROUND-WATER FLOW MODEL.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00316

ESTIMATES OF EVAPOTRANSPIRATION IN ALKALINE SCRUB AND MEADOW COMMUNITIES OF OWENS VALLEY, CALIFORNIA, USING THE BOWEN-RATIO, EDDY-CORRELATION, AND PENMAN-COMBINATION METHODS.
Geological Survey, Washington, DC.
For primary bibliographic entry see Field 2D.
W91-00333

SELECTED QUALITY ASSURANCE DATA FOR WATER SAMPLES COLLECTED BY THE U.S. GEOLOGICAL SURVEY, IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO, 1980 TO 1988.
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 7B.
W91-00334

HYDROGEOLOGY AND SIMULATION OF GROUND-WATER FLOW AT SUPERFUND-SITE WELLS G AND H, WOBURN, MASSACHUSETTS.
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00340

WATER RESOURCES DATA COLLECTED DURING WATER YEAR 1988 AT SELECTED JAMES RIVER BASIN SITES IN NORTH DAKOTA AND SOUTH DAKOTA.
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 6G.
W91-00342

SIGNIFICANCE OF SEDIMENT TRANSPORT IN ARROYO DEVELOPMENT.
Geological Survey, Vancouver, WA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W91-00346

GEOHYDROLOGY AND SIMULATED EFFECTS OF PUMPAGE ON THE NEW ORLEANS AQUIFER SYSTEM AT NEW ORLEANS, LOUISIANA.
Geological Survey, Baton Rouge, LA.
For primary bibliographic entry see Field 2F.
W91-00348

STATISTICAL PROCESSOR FOR ANALYZING SIMULATIONS MADE USING THE MODULAR FINITE-DIFFERENCE GROUND-WATER FLOW MODEL.
Geological Survey, Oklahoma City, OK.
J. C. Scott.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4159, 1990. 218p, 9 fig, 10 tab, 16 ref.

Descriptors: *Computer programs, *Finite difference methods, *Flow models, *Groundwater movement, *Mathematical models, *Model studies, *Simulation analysis, Hydrologic data, Hydrologic models, Statistical analysis.

Many hydrologic studies of groundwater systems are conducted using a digital computer model as an aid to understanding the flow system. One of the most commonly used groundwater modeling programs is the Modular Three-Dimensional Finite-Difference Groundwater Flow Model (Modular Model). A computer program which summarizes the data input to and output from the Modular Model is presented. The program is named the Modular Model Statistical Processor and is designed to be run following the Modular Model. The Modular Model Statistical Processor provides groundwater modelers with the capabilities to easily read data input to and output from the Modular Model, calculate descriptive statistics, generate histograms, perform logical tests using relational operators, calculate data arrays using arithmetic operators, and calculate flow vectors for use in a graphical-display program. (Author's abstract)
W91-00353

ANALYSIS OF GEOPHYSICAL WELL LOGS AND FLOWMETER MEASUREMENTS IN BOREHOLES PENETRATING SUBHORIZON-

TAL FRACTURE ZONES, LAC DU BONNET BATHOLITH, MANITOBA, CANADA.
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2F.
W91-00354

SOLINPUT: A COMPUTER CODE TO CREATE AND MODIFY INPUT FILES FOR THE GEOCHEMICAL PROGRAM SOLMINEQ.88.
Geological Survey, Menlo Park, CA.
J. D. DeBraal, and Y. K. Kharaka.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-616, 1989. 140p, 11 fig, 8 tab, 4 append.

Descriptors: *Computer models, *Computer programs, *Documentation, *Geochemistry, *Model studies, Digital computers, Error analysis, Parameterization.

SOLINPUT, an interactive computer program designed to create and modify input files for the geochemical code SOLMINEQ.88, is documented. The construction of input files is detailed and the computing environment needed to execute both programs is specified. The reactions, equations, and actual coding required to add aqueous and mineral components to both SOLMINEQ.88 and SOLINPUT are also outlined. Input files for SOLMINEQ.88 are created and edited by SOLINPUT using a menu-driven format. SOLINPUT is made up of a Main Menu, an Options Menu, and seven sub-menus. The Main Menu is concerned with reading and writing the input file, which may consist of up to 10 data sets, and is the only point from which SOLINPUT can be exited. The Options Menu directs the user to the appropriate submenu through which the basic physical and chemical data are entered and the modeling options are chosen. The items within each menu are arranged from top to bottom in the order in which they will be accessed. The last choice of each menu exits that menu and returns to the previous menu. SOLINPUT describes all the chemical and physical parameters required for each run of SOLMINEQ.88 as well as the parameters needed for user selected options. SOLINPUT allows numeric data to be entered using several convenient formats. It also performs error checking on input entered and prompts the user to correct invalid entries. (Author's abstract)
W91-00359

GRAPHICAL KERNEL SYSTEM (GKS) VERSION OF COMPUTER PROGRAM MODPATH-PLOT FOR DISPLAYING PATH LINES GENERATED FROM THE U.S. GEOLOGICAL SURVEY THREE-DIMENSIONAL GROUNDWATER FLOW MODEL.
Geological Survey, Reston, VA.
D. W. Pollock.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-622, 1990. 49p, 7 ref, append.

Descriptors: *Computer models, *Computer programs, *Flow models, *Groundwater movement, *Mathematical models, *Model studies, Graphical analysis, Hydrologic models.

The computer program MODPATH-PLOT graphically displays results generated by the three-dimensional particle tracking program MODPATH. A new version of the computer program MODPATH-PLOT has been developed that uses the Graphical Kernel System (GKS) to generate graphical output. The Graphical Kernel System is a set of standardized graphics functions adopted by the American National Standards Institute (ANSI). GKS functions are widely available and can be obtained from many sources. The use of GKS in MODPATH-PLOT improves the program's portability between computers and makes the program accessible to a much broader cross section of groundwater hydrologists. (Author's abstract)
W91-00361

BIAS AND VARIANCE OF SOME ESTIMATORS OF SUSPENDED SEDIMENT LOAD.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
For primary bibliographic entry see Field 2J.
W91-00406

COUPLED SIMULATION OF TRANSIENT BED EVOLUTION IN ALLUVIAL CHANNELS.
National Chiao Tung Univ., Hsinchu (Taiwan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W91-00407

DYNAMIC MODEL FOR SHORT-SCALE RAINFALL DISAGGREGATION.
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W91-00409

COMPARATIVE STUDY OF MATHEMATICAL MODELS FOR THE RELATIONSHIP BETWEEN WATER TEMPERATURE AND BROOD DEVELOPMENT TIME OF GAMMARUS FOSSARUM AND G. ROESELI (CRUSTACEA: AMPHIPODA).
Vienna Univ. (Austria). Limnologische Lehrkanzel.
For primary bibliographic entry see Field 2H.
W91-00420

SIMPLIFIED METHODS OF ESTIMATING DAILY MEAN STREAM WATER TEMPERATURE.
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2E.
W91-00421

GROUND-WATER DATA FOR GEORGIA, 1988.
Geological Survey, Doraville, GA.
For primary bibliographic entry see Field 2F.
W91-00432

HYDROGEOLOGY AND WATER QUALITY OF SIGNIFICANT SAND AND GRAVEL AQUIFERS IN PARTS OF AROOSTOOK COUNTY, MAINE: SIGNIFICANT SAND AND GRAVEL AQUIFER MAPS 75, 76, 77, 78, 84, AND 85.
Maine Dept. of Environmental Protection, Augusta.
For primary bibliographic entry see Field 2F.
W91-00435

HYDROGEOLOGIC AND WATER-QUALITY DATA FROM WELL CLUSTERS NEAR THE WASTEWATER-TREATMENT PLANT, U.S. MARINE CORPS AIR STATION, CHERRY POINT, NORTH CAROLINA.
Geological Survey, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W91-00438

NATIONAL WATER INFORMATION SYSTEM USER'S MANUAL VOLUME 2, CHAPTER 3. AUTOMATED DATA PROCESSING SYSTEM.
Geological Survey, Reston, VA.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 90-116. 341p, 7 fig, 6 tab. Compiled by George R. Dempster.

Descriptors: *Data storage and retrieval, *Databases, *Documentation, *Information systems, *National Water Information System, *Surface water, Computer programs, Data acquisition, Data processing, Groundwater data, Water quality.

The Automated Data Processing System (ADAPS) was developed for the processing, storage, and retrieval of water data, and is part of the National Water Information System developed by the U.S. Geological Survey. The National Water Information System is a distributed water data base in which data can be processes over a network of minicomputers at U.S. Geological Survey offices throughout the United States. This system comprises the Automated DAta Processing System, the Ground-Water Site Inventory System, the Quality of Water System, and the Water-Use Data System. This chapter of the National Water Information System User's Manual describes the automated data processing of continuously recorded water data, which are primarily surface-water data. However, the system allows for processing water quality and groundwater data. The manual introduces and describes various components and features of ADAPS, and provides an overview of the data-processing system and a description of the system framework. The components and features included are: (1) data collection and processing; (2) system programs and menus; (3) main menu task selections; (4) interaction with the mainframe computer at U.S. Geological Survey headquarters in Reston, Virginia; (5) control and transfer file descriptions created by ADAPS; and (6) steps for processing station records. (Author's abstract)
W91-00442

SOURCES OF WATER-USE INFORMATION IN MAINE.
Maine Geological Survey, Augusta. Dept. of Conservation.
For primary bibliographic entry see Field 6D.
W91-00443

SPATIAL ALLOCATION FACTOR PROCEDURES FOR THE 1980 NAPAP (NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM) EMISSIONS INVENTORY DOCUMENTATION.
Alliance Technologies Corp., Bedford, MA.
For primary bibliographic entry see Field 5B.
W91-00453

BASIS OF HYDRO-CLIMATIC TIME SERIES IN GREENLAND.
Greenland Technical Organization, Copenhagen (Denmark). Section of Hydro-Technical Investigation.
T. Thomsen.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 139-150, 7 fig, 6 ref, append.

Descriptors: *Climatology, *Greenland, *Hydrologic budget, *Network design, *Statistical analysis, *Time series analysis, Arctic zone, Data interpretation, Mathematical analysis, Model studies.

Reliable and continuous time series of hydroclimatic parameters in Greenland exist only for a few stations. Time series determination for hydro-technical projects is performed with the use of a station technology making possible immediate use of approved data through recursive algorithms. An evaluation of parameters for statistical purposes for other localities and for other times than the measured can be estimated using models calibrated using time series analyses, satellite images and digital maps. The combination of transfers of place and time data makes it possible to solve hydrotechnical problems with only a limited number of time series data. (See also W91-00454) (Author's abstract)
W91-00469

MULTISPECTRAL SNOW AREA ALGORITHM FOR OPERATIONAL 7-DAY SNOW COVER MONITORING.
Bristol Univ. (England). Remote Sensing Unit.
For primary bibliographic entry see Field 2C.
W91-00471

FREQUENCY DISTRIBUTIONS OF HEAVY RAINSTORMS IN ILLINOIS.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2B.
W91-00553

PESTICIDES IN GROUND WATER DATA BASE: 1988 INTERIM REPORT.
Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.
For primary bibliographic entry see Field 5B.
W91-00569

ENHANCEMENT OF THE HWRIC DATABASE, YEAR 2. WITH AN EVALUATION OF DATABASE CONTENT.
Illinois State Water Survey Div., Champaign. Ground-Water Section.
S. C. Schock, M. M. Peyton, and E. P. Mills.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-197099. Price codes: A05 in paper copy, A01 in microfiche. Report No. HWRIC RR-024, June 1988. 76p, 26 fig, 15 tab, 5 ref, 2 append. State of Illinois Department of Energy and Natural Resources Contract Nos. HWR87-005 and STILENR-1-5-39133.

Descriptors: *Computer programs, *Data acquisition, *Data storage and retrieval, *Databases, *Hazard Waste Research and Information C, Computers, Hazardous wastes, Illinois.

The Hazardous Waste Research and Information Center (HWRIC) database has been in the development and enhancement stages for three years. The method for collection and addition of historic data has evolved over the years as the available information has become more familiar and better understood by database users. Evaluation of the relative contribution to the HWRIC database of the available large-volume computerized datasets and the hand gathered historic data has been an on going process. These analyses have yielded valuable information on the quality and quantity of data now available in the HWRIC database system. Analysis of data serves two major purposes: (1) to demonstrate the descriptive value of the data in the Hazardous Sites Inventory file. This aspect is important in extracting those site that are to be used for research or information; and (2) to evaluate the relative contribution to the HWRIC database from regulatory computer source files, non-regulatory source files, non-regulatory computer source files, and Illinois State Water Survey. (Author's Abstract)
W91-00571

QUALITATIVE VALIDATION OF POLLUTANT TRANSPORT COMPONENTS OF AN UNSATURATED SOIL ZONE MODEL (SESOIL).
Oak Ridge National Lab., TN. Computing and Telecommunications Div.
For primary bibliographic entry see Field 5B.
W91-00573

EXACT SOLUTION FOR FLOW OF SLIGHTLY COMPRESSIBLE FLUIDS THROUGH MULTIPLE-POROSITY, MULTIPLE-PERMEABILITY MEDIA.
Scientific Research Inst. of Petroleum Exploration and Development, Beijing (China).
For primary bibliographic entry see Field 2F.
W91-00588

COKRIGING TO ASSESS REGIONAL STREAM QUALITY IN THE SOUTHERN BLUE RIDGE PROVINCE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W91-00589

RAINFALL-RUNOFF RELATIONS DERIVED FROM THE PROBABILITY THEORY OF STORAGE.
IBM Research Lab., Yorktown Heights, NY.
For primary bibliographic entry see Field 2E.
W91-00592

ANALYTICAL SOLUTIONS OF THE ONE-DIMENSIONAL ADVECTION EQUATION AND TWO OR THREE-DIMENSIONAL DISPERSION EQUATION.
Auburn Univ., AL. Dept. of Agronomy and Soils.
For primary bibliographic entry see Field 5B.
W91-00594

FUZZY REGRESSION IN HYDROLOGY.
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
A. Bardossy, I. Bogardi, and L. Duckstein.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1497-1508, July 1990. 14 fig, 2 tab, 27 ref, 2 append. U.S. National Science Foundation Grant ECS-8812350, ECS-8802920; U.S. Geological Survey, Grant 14-08-0001-G1503.

Descriptors: *Data interpretation, *Mathematical analysis, *Model studies, *Regression analysis, *Statistical methods, Case studies, Decision making, Fuzzy regression, Hydrologic data.

A general methodology for fuzzy regression was developed and illustrated by hydrological case study. Fuzzy regression may be used whenever a relationship between variables is imprecise and/or sample sizes are insufficient. In such cases fuzzy regression may be used as a complement or alternative to statistical regression analysis. In fuzzy regression, several 'goodness of fit' criteria may be used, such as the maximum average vagueness criterion and the prediction vagueness criterion. The technique is illustrated by means of a case study involving the relationship between soil electrical resistivity and hydraulic permeability. This relationship is imprecise and based on only a few data points. A curvilinear relationship was fitted using fuzzy regression with six calculated resistivities and six measured permeabilities. Prediction vagueness criteria appears to yield a more robust fuzzy regression than the maximum average vagueness criteria. Potential application areas of fuzzy regression in hydrology include expression of the uncertainty in discharge curves, modeling water quality and quantity relationships, sediment transport and river flow relationships, estimation of aquifer parameters, flow in fractured rocks, health risk analyses, and functions expressing cost, economic loss and benefit of hydrologic works. The methodology is relatively simple, and the results can be interpreted to provide a valuable hydrological decision-making aid. (Author's abstract)
W91-00596

EFFICIENT DETERMINISTIC-PROBABILISTIC APPROACH TO MODELING REGIONAL GROUNDWATER FLOW: 1. THEORY.
California Univ., Irvine. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-00601

EFFICIENT DETERMINISTIC-PROBABILISTIC APPROACH TO MODELING REGIONAL GROUNDWATER FLOW: 2. APPLICATION TO OWENS VALLEY, CALIFORNIA.
California Univ., Irvine. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-00602

ASSESSMENT OF A CONCEPTUAL RAINFALL-RUNOFF MODEL'S ABILITY TO REPRESENT THE DYNAMICS OF SMALL HYPOTHETICAL CATCHMENTS: 1. MODELS, MODEL PROPERTIES, AND EXPERIMENTAL DESIGN.
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W91-00604

MODEL OF ORGANIC CHEMICAL UPTAKE AND CLEARANCE BY FISH FROM FOOD AND WATER.
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
For primary bibliographic entry see Field 5B.
W91-00622

DAILY FLOW FORECASTING WITH REGRESSION ANALYSIS.
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 2E.
W91-00634

PREDICTING SUCCESS OF WALLEYE STOCKING PROGRAMS IN THE UNITED STATES AND CANADA.
Idaho Univ., Moscow. Coll. of Forestry.
For primary bibliographic entry see Field 8I.
W91-00691

DISCHARGE CHARACTERISTICS OF LOCAL DISCONTINUOUS CONTRACTIONS, II.
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
For primary bibliographic entry see Field 8B.
W91-00762

PERTURBATION SOLUTION OF THE FLOOD-ROUTING PROBLEM.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 2, p 215-234, 1987. 13 fig, 8 ref.

Descriptors: *Channels, *Flood routing, *Flow pattern, *Kinematic wave theory, *Mathematical studies, *Routing, *Theoretical analysis, Boundary conditions, Flow, Hydrographs, Model studies, Rapid flow, Tranquil flow, Weirs.

Singular perturbation techniques are used to obtain an approximate solution of the flood routing problem. The first-order outer solution is given by the kinematic-wave approximation. Singularities in this outer solution then lead to two inner solutions: one that follows a kinematic shock as it moves downstream and one either at the downstream boundary in subcritical flow or at the upstream boundary in supercritical flow. Solutions calculated in each of these subregions allow conclusions to be drawn about the relative importance of various terms in the momentum equation. In the first-order approximation, inserting a downstream weir or channel obstruction in subcritical flow changes depths but not flow rates within the associated boundary layer. This suggests that flow rate hydrographs in an irregular channel can be approximated with flow rate hydrographs calculated for a prismatic, rectangular channel. However, depth hydrographs for the irregular channel would have to be approximated by using the calculated flow rates in either a calculated or measured rating curve that includes the effect of channel irregularities. The inner and outer solutions are combined to obtain composite solutions for flow depths and flow rates, and a numerical example is worked. (Agostine-PTT)
W91-00763

CONTROL OF PHYTOPLANKTON GROWTH IN NUTRIENT RECYCLING ECOSYSTEMS. THEORY AND TERMINOLOGY.
Bergen Univ. (Norway). Dept. of Microbiology and Plant Physiology.
For primary bibliographic entry see Field 2H.
W91-00765

VARIABILITY OF RESULTS FROM THE USE OF PHABSIM IN ESTIMATING HABITAT AREA.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
K. Gan, and T. McMahon.
Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 233-239, June/July 1990. 1 tab, 9 ref.

Descriptors: *Computer models, *Computer programs, *Habitats, *Instream Flow Incremental Methodology, Fish, Invertebrates, River systems, Variability.

The estimation of the area of a stream reach suitable as habitat for an aquatic species was made using the Instream Flow Incremental Methodology, (the collection of computer models and analytical procedures designed to predict changes in fish or invertebrate habitat changes due to flow changes). An important component of the methodology is PHABSIM, which is a collection of computer programs whereby useable stream area is computed as a function of discharge. This method comprises a variety of options for both hydraulic and habitat simulation. A single data set was used to calculate the useable area at one discharge for three life stages of brown trout using various options in habitat simulation. The results varied greatly according to the particular combination of options selected. Therefore, unless calculations are founded on biologically realistic assumptions, the potential within PHABSIM for the fudging of results is considerable. (Author's abstract)
W91-00775

INFILTRATION UNDER PONDED CONDITIONS: 3. A PREDICTIVE EQUATION BASED ON PHYSICAL PARAMETERS.
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 2G.
W91-00790

INFLUENCE OF OUTLIERS ON RESULTS OF WET DEPOSITION MEASUREMENTS AS A FUNCTION OF MEASUREMENT STRATEGY.
Netherlands Energy Research Foundation ECN, Petten.
For primary bibliographic entry see Field 5B.
W91-00849

SOURCE-RECEPTOR RELATIONSHIPS FOR WET SO4(2-) AND NO3(-) PRODUCTION.
For primary bibliographic entry see Field 5B.
W91-00851

EFFECTS OF FAULTS ON FLUID FLOW AND CHLORIDE CONTAMINATION IN A CARBONATE AQUIFER SYSTEM.
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00877

THEORY AND APPLICATION OF AN APPROXIMATE MODEL OF SALTWATER UPCONING IN AQUIFERS.
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2F.
W91-00883

NON-LINEAR SYSTEM TO DESCRIBE MOVEMENTS OF WATER MASSES AT THE LG-2 RESERVOIR (LA GRANDE, QUEBEC).
Sherbrooke Univ. (Quebec). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2H.
W91-00885

RAINFALL DEFICITS: DISTRIBUTION OF MONTHLY RUNS.
Canterbury Regional Council, Christchurch (New Zealand).
For primary bibliographic entry see Field 2B.
W91-00886

NOTE ON THE ANALYSIS OF MOISTURE-DEPTH CURVES OBTAINED BY THE HOT-AIR METHOD FOR THE DETERMINATION OF SOIL MOISTURE DIFFUSIVITY.
Botswana Univ., Gaborone. Dept. of Geology.
For primary bibliographic entry see Field 2G.
W91-00889

GEOSTATISTICAL METHODS FOR DETECTION OF OUTLIERS IN GROUNDWATER QUALITY SPATIAL FIELDS.
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
For primary bibliographic entry see Field 2F.
W91-00894

CLASSIFICATION OF SHALLOW GROUNDWATER TYPES IN A DUTCH COVERSAND LANDSCAPE.
Amsterdam Univ. (Netherlands). Landscape and Environmental Research Group.
For primary bibliographic entry see Field 2K.
W91-00895

NEW DIRECTIONS FOR SURFACE WATER MODELING.
Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. 444p. Edited by M. L. Kavvas.

Descriptors: *Drought, *Expert systems, *Floods, *Hydrologic models, *Hydrology, *Physical models, *Rainfall, *Surface water, *Water management, Symposium.

This volume presents the proceedings of a symposium on hydrologic modeling held during the Third Scientific Assembly of the International Association of Hydrological Sciences at Baltimore, Maryland, in May 1989. The symposium was organized by the International Association of Hydrological Sciences International Commission on Surface Water. The volume contains 43 papers from 24 countries, grouped under 6 topics: Rainfall fields; Physics-based hydrologic models; Rainfall-runoff models; Floods; Droughts; and Geographic information, decision support and expert systems. (See W91-00961 thru W91-01004) (Sand-PTT)
W91-00961

TOWARDS AN IMPROVED SYSTEM FOR WEATHER RADAR CALIBRATION AND RAINFALL FORECASTING USING RAINGAUGE DATA FROM A REGIONAL TELEMETRY SYSTEM.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2B.
W91-00963

AREAL REDUCTION FACTORS FOR DESIGN STORM CONSTRUCTION: JOINT USE OF RAINGAUGE AND RADAR DATA.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2B.
W91-00965

ACCURACY OF THE MAXIMUM RECORDED DEPTH IN EXTREME RAINSTORMS.
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W91-00966

PHYSICS-BASED APPROACH TO STOCHASTIC HYDROLOGY OF FIRST-ORDER DRAINAGE BASINS.
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00968

ENTROPY BASED METHOD FOR FLOOD FORECASTING.
Louisiana Geological Survey, Baton Rouge.
For primary bibliographic entry see Field 2E.
W91-00972

ASSESSMENT OF NETWORK MODELS IN FLOOD FORECASTING.
Bureau of Meteorology, Hobart (Australia).
For primary bibliographic entry see Field 2E.
W91-00973

REAL-TIME INTERCOMPARISON OF HYDROLOGICAL MODELS.
World Meteorological Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 2A.
W91-00974

FLOODS AND DROUGHTS IN LABE RIVER BASIN: THE HYDROGRAPH SHAPE.
Hydrometeorologicky Ustav, Prague (Czechoslovakia).
For primary bibliographic entry see Field 2E.
W91-00975

MODELLING OF HYDROLOGICAL PROCESSES FOR A MOUNTAINOUS BASIN.
Tokyo Metropolitan Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W91-00976

REGIONAL METHODS FOR ESTIMATION OF DESIGN FLOODS FOR SMALL TO MEDIUM SIZED DRAINAGE BASINS IN AUSTRALIA.
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00986

DETERMINATION OF DESIGN FLOOD HYDROGRAPHS BASED ON REGIONAL HYDROLOGICAL DATA.
Graz Univ. (Austria). Inst. for Hydromechanics, Hydraulics and Hydrology.
For primary bibliographic entry see Field 2E.
W91-00987

REGIONAL ANALYSIS OF THE MEAN ANNUAL FLOOD AND OF FLOOD FREQUENCY CHARACTERISTICS.
National Technical Univ., Athens (Greece). Div. of Water Resources.
For primary bibliographic entry see Field 2E.
W91-00988

REGIONAL FLOOD FREQUENCY ANALYSIS USING RIDGE REGRESSION.
Hydro-Quebec, Montreal.
For primary bibliographic entry see Field 2E.
W91-00990

REGIONALIZATION OF LOW FLOW CHARACTERISTICS USING LOGISTIC AND GLS REGRESSION.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W91-00993

DERIVING STREAM PARAMETERS FOR HYDROLOGIC MODELING FROM DIGITAL ELEVATION DATA.
Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.
For primary bibliographic entry see Field 2E.
W91-01000

INTELLIGENT GEOGRAPHIC INFORMATION SYSTEMS (IGIS) AND SURFACE WATER MODELING.
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wasserwirtschaft und Inst. fuer Wasserbau.
For primary bibliographic entry see Field 4A.
W91-01001

ENVIRONMENTAL GEOGRAPHIC INFORMATION SYSTEM IN FINLAND.
National Board of Waters, Helsinki (Finland).
Y. Sucksdorff, R. Lemmela, and T. Keisteri.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181.

International Association of Hydrological Sciences, Washington, DC. 1989. p 427-434. 5 fig, 2 tab, 4 ref.

Descriptors: *Databases, *Finland, *Geographic information systems, *Hydrologic data, Catchment areas, Data acquisition, Environmental quality, Land use, Remote sensing, Satellite technology, Water quality.

An environmental geographic information system called Figure Information System has been constructed in Finland. This system is the basis of an environmental data system which contains all registers for environmental protection purposes, including hydrological and water quality registers. The operational part of the system consists of digitalized drainage basin divides, terrain heights, administrative borders, basin characteristics interpreted from land-use satellite images, and a connection to an observation point register. (See also W91-00961) (Author's abstract)
W91-01003

8. ENGINEERING WORKS

8A. Structures

THREE-DIMENSIONAL ANALYSIS OF PRESSURES ON DAMS.
Sinotech Engineering Consultant, Inc., Taipei (Taiwan).
For primary bibliographic entry see Field 8B.
W91-00057

NONLINEAR HYDRODYNAMIC PRESSURE ON DAMS.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00058

AIR ENTRAINMENT BY SPILLWAY AERATORS.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 8B.
W91-00061

DIMENSIONLESS ANALYTICAL SOLUTIONS FOR DAM-BREACH EROSION.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and C. A. Quiroga.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 2, p 179-197, 1988. 9 fig, 4 tab, 8 ref.

Descriptors: *Accelerated erosion, *Dam failure, *Dams, *Earth dams, *Erosion, *Hydraulic structures, *Mathematical models, *Model studies, Flood data, Flood discharge, Floods.

Experience with physically based dam-break models such as the BEED model has shown that the utilization of sediment transport theories involves making assumptions beyond the original ranges stipulated in the models. Defining the rate of erosion in terms of a single factor simplifies the mathematical solution so that an analytical solution becomes possible. Earthen dam breach erosion was analyzed using dimensionless analytical solutions, with rectangular and triangular representations for the breach section. Data for the historical failures of the South Fork Dam near Johnstown, PA and Teton Dam in Idaho were used to test these solutions. The closed form dimensionless analytical solutions properly simulated dam breach erosion. Estimates of breach formation time, based upon the dimensionless solutions, were highly dependent on the empirical erodibility factor. However, peak discharge did not appear to be sensitive to the erodibility factor. The study results coincide with the influence of the friction factor in the BEED model. (Tappert-PTT)
W91-00069

FLOODING CONTROLLED BY BRIDGE RELOCATION.
Edwards and Kelcey, Inc., Minneapolis, MN.
For primary bibliographic entry see Field 4A.
W91-00105

THREE-DIMENSIONAL BOUNDARY ELEMENT RESERVOIR MODEL FOR SEISMIC ANALYSIS OF ARCH AND GRAVITY DAMS.
National Research Council of Canada, Ottawa (Ontario). Inst. for Research in Construction.
For primary bibliographic entry see Field 8D.
W91-00123

SEISMIC DAMAGE TO SEGMENTED BURIED PIPELINES.
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8G.
W91-00124

SIPHON QUENCHES.
Ketchikan Pulp Co., AK.
D. B. Loitz, A. L. deSteiguer, and W. R. Broz.
Civil Engineering (ASCE) CEWRA9, Vol. 60, No. 8, p 44-46, August 1990. 2 fig.

Descriptors: *Alaska, *Hydraulic engineering, *Pipes, *Siphons, *Water conveyance, Civil engineering, Design criteria, Drought, Economic aspects, Pulp and paper industry, Water supply development.

During the drought in the summer of 1989, in Ketchikan, Alaska, water measurements at the Lake Connell Dam reservoir revealed that, at the local pulp mill's normal usage rate, only three weeks of water remained. With 600 job layoffs imminent, the pulp company considered alternative water supplies and settled on a lake located south of Lake Connell at a higher elevation. It was decided to transfer the water from one lake to the other through an 1,800-foot flexible siphon. The nearly dry creek bed linking the two lakes formed an obvious route for the siphon, with a natural crown making for an acceptable rise from lake level existing in the form of a log dam at the head of the creek. Engineers found that lowering the lake by 20 feet would result in an operational time of 57 days at 20 million gallons per day, equivalent to a month's usage by the mill at full capacity--making the project economically viable and providing a bridge to the next rainy season. Because of the need to protect the surrounding habitat and a prohibition on mechanized equipment, it was necessary to construct the pipe of a lightweight, flexible, and rugged high-density polyethylene, which was quickly airlifted in along with the necessary personnel and equipment. 45 Tons of 24-in pipe was fused together at the principal work area just downstream of the lake outlet in 600-foot segments, then pulled into place by chain-saw winches, comealongs, and rollers. Solid axial restraint was provided by jointing, rather than thrust-blocking. The pipe wall thickness at the crown was specified to be sufficient for the design vacuum, to avoid pipe collapse. The relative simplicity of a siphon belies the difficulty of its construction, especially in the rugged terrain of Alaska. (Fish-PTT)
W91-00142

SHAKE TABLE TEST OF CYLINDRICAL WATER TANKS IN BASE-ISOLATED STRUCTURES.
Parsons (Ralph M.) Co., Pasadena, CA.
For primary bibliographic entry see Field 8E.
W91-00147

VORTEX DROP INLET FOR SUPERCRITICAL APPROACHING FLOW.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
W. H. Hager.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 8, p 1048-1054, August 1990. 7 fig, 9 ref.

Descriptors: *Hydraulic engineering, *Hydraulic structures, *Inlets, *Rapid flow, *Vortices, Critical flow, Froude number, Hydraulic geometry, Optimization, Standing waves.

A vortex drop consists of the inlet structure, the drop shaft, and the outlet works. The inlet structure may either be spiral-shaped or tangential. Drop inlets for supercritical approach flow may occur at relatively small bottom slopes of typically 0.5%. Based on detailed experimental observations collected at various inlet geometries, the shape of vortex inlet was optimized. The geometry recommended is of spiral shape, and depends mainly on the shaft radius and on the width of the approaching channel. Particular features of the inlet are its wide domain of application regarding the Froude number and bottom slope of the approaching channel, and zero transverse inlet slope. The discharge capacities of vortex drops were shown to be of the same order for both subcritical and supercritical approach flows. Further, the surface profile along the outer guiding wall was analyzed. It was found that both the Froude number of the approach flow and the radius of outer inlet wall influence significantly the maximum height of standing wave. The discharge of the drop shaft for both subcritical and supercritical flow are found to be about the same. (Fish-PTT)
W91-00153

HYDROLOGIC PARAMETER EFFECTS ON SMALL-DAM RISK ANALYSIS IN MISSOURI.
Missouri Univ.-Columbia. Dept. of Civil Engineering.
R. L. Peyton, and A. R. Kalmes.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 465-478, July/August 1990. 6 tab, 19 ref.

Descriptors: *Cost analysis, *Dam failure, *Dam inspection, *Dam safety, *Dam stability, *Missouri, *Risk analysis, Antecedent moisture, Drainage engineering, Probability distribution, Rainfall distribution, Sensitivity analysis.

The U.S. Army Corps of Engineers found that Missouri had the largest number of 'unsafe-emergency' dams in the nation. Since then, the state's dam safety council has established a permit program. The sensitivity of risk cost to hydrologic parameters was evaluated to determine the feasibility of risk analysis as an alternative approach to existing requirements for rehabilitation of small dams in Missouri. The sensitivity to probable maximum precipitation (PMP) exceedance probability is greatly reduced by interpolating rainfall exceedance probabilities between the PMP and the rainfall depth that initiates failure, instead of the PMP and the 100-year return period depth. This approach also reduces by a small amount the sensitivity of risk cost to the assumed probability distribution function. Variations in the time distribution of rainfall and the antecedent moisture condition (AMC) have a large influence on risk cost. Probabilistic combinations of the three AMC classes result in risk costs within 13% of the risk cost using AMC II, the 'average' condition. Of the three dam-breach parameters evaluated, risk cost is most sensitive to breach-development time and least sensitive to breach side slopes. (Author's abstract)
W91-00167

SINGLE-OUTLET DETENTION-POND ANALYSIS AND DESIGN.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
A. O. Akan.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 527-536, July/August 1990. 4 fig, 1 tab, 7 ref.

Descriptors: *Detention reservoirs, *Drainage engineering, *Hydraulic design, *Mathematical models, *Reservoir design, *Storm water management, *Urban hydrology, Charts, Computer models, Finite difference methods, Hydraulic profiles, Hydrograph analysis, Outlets, Parametric hydrology, Ponds.

Storm water runoff is controlled using detention ponds in many new communities. A desktop method was developed to analyze or size detention ponds and outlet facilities. Different initial conditions were allowed. When used for design purposes, the method determines the size of the outlet facility for a given pond. However, if the pond is inadequate to meet the design criteria set, the method determines the required stage-storage relationship. The method is based on the usual reservoir-routing technique that couples the hydrologic-storage equation with an expression describing the flow through the outlet structure. The equations are rearranged in terms of several dimensionless parameters. A computer model is used to solve the governing equation using a finite difference scheme. The numerical results obtained in terms of systematically chosen combinations of the governing dimensionless parameters are generalized based on the concept of similarity. A family of charts has been developed for quick analysis and preliminary design of single-outlet detention ponds. The mathematical model used in developing these charts has been tested and verified with analytical solutions. The major limitation of the pond charts is that they have been derived for inflow hydrographs of a specific shape. However, the shape chosen should represent most natural basins well. Moreover, considering the uncertainties involved in currently used hydrologic analysis techniques, errors arising from the assumed shape of a pond inflow hydrograph become insignificant. (Fish-PTT)
W91-00171

IMPROVEMENT OF BYPASSING AND BACKPASSING AT TIDAL INLETS.
P. Bruun.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 116, No. 4, p 494-500, July/August 1990. 5 fig, 12 ref.

Descriptors: *Bypass channels, *Coastal engineering, *Estuaries, *Hydraulic engineering, *Hydraulic structures, *Inlets, Beaches, Channel improvement, Dredging, Littoral drift, Longshore currents, Navigation channels.

Tidal inlets present a major barrier to longshore drift, particularly when they have been improved for navigation by dredged channels and/or jetties. Simulation models are useful for the establishment of inlet material budgets. Available bypassing techniques are inadequate, for much material is lost and down-drift beaches suffer unreasonably. An improved bypassing technique seems possible based on much larger traps to intercept the littoral drift toward the inlet. The same equipment used for transfers can be applied to maintenance of channel depths. With present technology, too much material is lost to ocean and bay shoals. It may be recovered by using the same technology as for bypassing. Improved bypassing and backpassing technologies are being developed. More shallow water and special dredge-barge equipment is needed and will undoubtedly become available by the dredging industries overseas and in the United States. (Fish-PTT)
W91-00178

RISK OF DEBRIS-BASIN FAILURE.
Maryland Univ., College Park. Dept. of Civil Engineering.
R. H. McCuen, B. M. Ayyub, and T. V. Hromadka.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 473-483, July/August 1990. 1 fig, 1 tab, 8 ref.

Descriptors: *Dam failure, *Debris basins, *Hydraulic engineering, California, Construction, Costs, Dredging, Hydraulic structures, Maintenance, Model studies, Precision, Rainfall, Watershed management.

Debris basins are a common engineering structure used to control debris flows. Knowledge of the risk of failure as a function of important design variables can improve decision making and can be used as a basis for minimizing the total annual cost (i.e., construction and maintenance plus risk cost). The failure risk was computed for four policy elements: the rainfall frequency, the interval between significant watershed burn, construction and dredging accuracy, and the regularity of maintenance of the debris basin. The burn interval and the rainfall magnitude are the two most important variables associated with the failure risk, with the expected annual risk varying from less than 1% to as much as 65% for different burn intervals and rainfall frequencies. A failure to maintain the basin can double the risk of failure. The risk of failure does not appear to change much for typical construction and dredging-volume accuracy. The risk estimates were made using a model developed from data from the southern California area and the conditional expectation variance reduction technique. (Author's abstract)
W91-00181

APPROPRIATE WELL DESIGN FOR DEVELOPING FRESH WATER AQUIFER IN A MIXED QUALITY AQUIFER SYSTEM.
Central Ground Water Board, Hyderabad (India).
K. V. J. R. Krupanidhi, V. S. S. Main, and N. Varadaraj.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 59-69, 3 fig, 1 tab, 4 ref.

Descriptors: *Aquifers, *Design standards, *Groundwater management, *Water resources development, *Well construction, Cements, Groundwater budget, Infiltration, Water quality, Well yield, Wells.

Guidelines are offered for the design of wells will be helpful in increasing the success rate of abstraction structures: (1) the groundwater potential, the elevation of the water table, its fluctuation, and the behavior of the fresh water-saline water interface must be visualized. The well design and pumping should have a minimum drawdown; (2) revitalization of poorly constructed infiltration wells can be made by horizontal filter points; (3) electrical logging of every borehole is necessary for the proper construction of tube wells in quality problem areas; (4) tube wells should be constructed with proper slot size, screen length, and gravel size; (5) the selection of cement sealing depth, depth range of gravel packing, margin for gravel sinking during development, sounding at different stages of well construction to check the desired depth of gravel and clay packing, as well as cement grouting are important factors for good production tube wells; and (6) fresh water aquifers without sufficient thickness of confining layers are likely to receive significant vertical leakage from other saline areas during pumping. In a group of mixed quality aquifers, only freshwater zones with considerable thickness of confining layers have to be tapped. (See also W91-00215) (Lantz-PTT)
W91-00221

INVISCID DAM-BREAK SOLUTION.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00376

FORCED AERATION OF HIGH VELOCITY FLOWS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
J. Bruschin.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 1, p 5-14, 1987. 1 fig, 2 tab, 22 ref, append.

Descriptors: *Aeration, *Cavitation, *Dam design, *Dams, Air entrainment, Design criteria, Forced aeration, High velocity flow, Hydraulic structures, Mathematical models.

Cavitation damage and its prevention are of increasing concern to designers and operators of large dams. Forced aeration of the wall jets results in an air-water mixture that can have a considerably reduced bulk modulus and therefore can reduce or eliminate the cavitation damage potential in risk situations. Three key topics in the field of forced aeration were discussed: forced aeration mechanisms, predictions methods for air-flow rates, and model-prototype correlations. Forced aeration mechanisms cause the formation of an air-water mixture at the bottom of the boundary layer between the separation point of the wall jet and its reattachment. The approach flow conditions will dominate the air entrainment ability of the flow. With enough air coming from below and above, the uniform aerated flow condition will establish itself after a relatively short distance. Prediction methods for air flow rates were provided by (1) ad hoc theoretical considerations using the integral parameters of the flows with or without free parameters and/or correction factors; (2) similarity considerations with comparable, simpler, or solved flow problems; and (3) laboratory tests. A mathematical treatment of model-prototype correlations was examined in an appendix and data on prototype measurements for the Foz do Areia, Guri and Fengjiashan spillway aerators were used to evaluate air flow velocities and differential pressures, and jet roughness (surface disturbances) index. (MacKeen-PTT)
W91-00396

MODIFIED ELEMENT METHOD FOR PIPE NETWORK ANALYSIS.
Laval Univ., Quebec. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00398

SIMULATION OF ONE-DIMENSIONAL DAM-BREAK FLOWS.
Florida International Univ., Miami. Dept. of Civil and Environmental Engineering.
R. J. Fennema, and M. H. Chaudhry.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 1, p 41-51, 1987. 7 fig, 18 ref, append.

Descriptors: *Dam failure, *Dams, *Model studies, *Rapid flow, *Simulation analysis, Flow models, One-dimensional flow, Surface flow, Tranquil flow, Unsteady flow.

Two new finite-difference schemes, were compared for the analysis of unsteady free surface flows resulting from the breaking of a dam. These schemes split the flux vector into positive and negative parts, each of which corresponds to the direction of a characteristic, thereby allowing use of proper finite differences for the space derivatives. Central finite differences are used for subcritical flow and upwind differences are used for supercritical flow. During real-life applications, if the ratio of initial upstream reservoir level to that on the downstream side of the dam following the failure of the dam is high, then supercritical flows are produced downstream of the dam. The schemes are attractive for solving the dam break problem, especially when supercritical flow is present. (Author's abstract)
W91-00399

SAFETY GOALS FOR HIGH-HAZARD DAMS: ARE DAMS TOO SAFE.
Carnegie-Mellon Univ., Pittsburgh, PA. Graduate School of Industrial Administration.
L. B. Lave, D. Resendiz-Carrillo, and F. C. McMichael.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1383-1391, July 1990. 2 fig, 4 tab, 39 ref.

Descriptors: *Cost-benefit analysis, *Dam failure, *Dam safety, *Dam stability, *Dams, *Design criteria, Emergency planning, Flood damage, Flood hazard, Probable maximum flood, Safety, Social costs.

The 1977 National Dam Inspection Program determined that many high-hazard dams in the United States were incapable of passing a probable maximum flood (PMF). Retrofitting these dams was estimated to cost at least $10 billion. Since the PMF is revised upward periodically, retrofit is a continual issue. But surviving a PMF is a more stringent safety criterion than preventing other sources of dam failure; in addition, it is more

stringent than safety criteria for other structures with respect to wind, earthquakes, or storm surges. This higher safety goal has large social costs. An alternative safety goal, separating property damage from possible loss of lives, is proposed. For a proposed dam whose failure could cause large loss of life or property damage, a careful evaluation should be done as to whether the dam should be built. For dams that impose smaller hazards, property damage should be handled by an analysis based on expected values of the annualized benefits and costs. An adjustment for scale could be used if the property damage were extremely large. Danger to lives should be handled by establishing programs to warn and evacuate people. This proposal should (1) lead to less injury and death, (2) use society's limited resources more efficiently, and (3) put the determination of safety goals on a more scientific and sensible basis. (Author's abstract)
W91-00587

SLIPS AHOY.
Johnson, Johnson and Roy, Inc., Ann Arbor, MI.
F. A. Klancnik.
Civil Engineering (ASCE) CEWRA9, Vol. 60, No. 5, p 59-61, May 1990.

Descriptors: *Boating, *Docks, *Marinas, *Recreation facilities, Design criteria, Environmental impact, Harbors, Land development, Management planning.

Although the market for boat docking facilities will remain substantial in the 1990s, the construction of marinas is not expected to increase due to lack of developable sites, as seen in California, and increased capital expenditure requirements. The opening of the Tennessee-Tombigbee Waterway has increased marina demand in the central Gulf region. Several trends will help to alleviate demand pressures for new marinas. Research and engineering of the past decade have led to more effective floating dock systems and wave attenuators; where water levels fluctuate more than 2 or 3 ft, as in the Great Lakes marinas, floating systems will dominate the market. Sophisticated modeling techniques and government-sponsored research are generating better and more cost-effective methods of protecting harbors and shorelines. Larger boats are increasing the spatial requirements for docking facilities and landside development costs are increasing as boat owners come to look upon the marina as a center of leisure activity. Long-term leasing of dock space is helping developers to recover the initial capital expenditures for building new dock sites. Public awareness of the environmental impact of marina construction is lengthening the planning and design time required before permits are secured and construction can begin. (Geiger-PTT)
W91-00677

MICROTUNNELING TECHNIQUES AID SEWER INSTALLATION.
Houston Dept. of Public Works, TX.
P. D. Barnhard, and J. E. Pate.
Public Works PUWOAH, Vol. 121, No. 8, p 69-70, 1990. 3 fig.

Descriptors: *Houston, *Microtunneling, *Sewer systems, *Texas, *Wastewater collection, Economic aspects, Gravity relief sewers, Noise, Pipelines, Public relations, Sanitary engineering.

As the River Oaks area of Houston developed, problems with the wastewater collection system multiplied and the system became heavily overloaded, which resulted in frequent system overflows. By the 1980's, the area required numerous wastewater system improvements. Because the same problem existed throughout Houston, the department of public works developed a comprehensive plan of wastewater improvements. To minimize disruption to the area during construction, the public works department selected the microtunneling technique for installing gravity sewer lines, rather than conventional open cut construction. The River Oaks project required the construction of 20000 feet of 8 inch through 21 inch gravity relief sewers, various appurtenances, two lift stations, and related force mains. Microtunneling is a method of installing pipes as small as ten inches in diameter by pipe jacking techniques. The machines operate from a jacking pit and the pipe is jacked in precise alignment toward a target. The microtunneling machine excavates material from its path as it is jacked forward from the starting pit. As the pipe is jacked forward, the soil ahead of it is removed and transported by slurry line or auger through a smaller pipe inside the one being jacked in place. Groundwater levels varied from 8 to 30 feet below the ground surface. The River Oaks sanitary sewer line varied in depth from 8 to 25 ft both above and below the water table depending on circumstances. Prices for microtunneling vary depending upon a variety of factors or cost determinants, including depth, pipe size, soil conditions, accessibility of the area, pit location, pipe type, and length of push involved. Microtunneling does have certain disadvantages, however, that should be considered when evaluating this construction alternative. Construction time from set-up to completion is lengthened; shafts for lateral sewer lines as well as the primary relief line are open longer than is required for conventional construction; and, microtunneling is a costly construction alternative. The microtunneling techniques does, however, significantly minimize business and neighborhood disruption, and avoids much of the noise associated with typical utility construction project. (Brunone-PTT)
W91-00773

SYNTHETIC LININGS.
Hovater Engineers, Laguna Hills, CA.
For primary bibliographic entry see Field 5E.
W91-00949

8B. Hydraulics

LOCAL SCOUR PROFILES DOWNSTREAM OF HYDRAULIC JUMP.
Ministry of Energy, Tehran (Iran).
J. Farhoudi, and K. V. Smith.
Journal of Hydraulic Research JHYRAF, Vol. 23, No. 4, p 343-358, 1985. 12 fig, 1 tab, 9 ref.

Descriptors: *Channel morphology, *Channel scour, *Flow characteristics, *Hydraulic geometry, *Hydraulic jump, *Hydraulic models, *Sediment transport, Bed load, Mathematical studies, Model studies, Suspended sediments.

The development over time of local scour holes downstream of a hydraulic-jump-type flow shows certain geometrical similarities. These similarities exist both in the process of scour and in the profiles that the scour holes follow downstream of hydraulic-jump flow. An investigation was carried out using three geometrically-similar models with the geometrical scale progressing by a factor of two. The sediment movement was governed by material moved in suspension for the initial period of scour. The suspension process was intensified by decreasing the weight of the sediment, increasing the flow, or lowering the tailwater. The suspension movement changed to bed-load movement with the passage of time. This type of scour differs from scour under vertical and plunging jets in which the suspension process predominates. But it is in agreement with scour reported from below horizontal jets. Among the characteristic geometric parameters of the scour hole a relationship exists which, for similar conditions, makes it possible to select only one of these parameters to describe all the scour hole geometry. The derived coefficients are independent of sediment properties although influenced by geometry and intensity of flow. The definition of the scour profile makes it possible to predict the volume of sediment removed from the scour hole at any time provided the corresponding maximum depth of scour is known. (Stoehr-PTT)
W91-00032

HYDRAULIC JUMPS AT POSITIVE AND NEGATIVE STEPS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
W. H. Hager, and N. V. Bretz.
Journal of Hydraulic Research JHYRAF, Vol. 24, No. 4, p 237-253, 1986. 14 fig, 15 ref, append.

Descriptors: *Channel morphology, *Flow characteristics, *Hydraulic geometry, *Hydraulic jump, *Stilling basins, Critical flow, Froude number, Hydraulic design, Standing waves, Tailwater.

The hydraulic flow features associated with a hydraulic jump over positive and negative steps were investigated. To facilitate the design of stilling basins, emphasis was placed on extreme values of the variables. In particular, the sequent depths ratio, the length characteristics, and the wave formation were analyzed by elementary means and confirmed by observations. The relations for the sequent depths ratios were in agreement with the data analyzed. The shape of the step was insignificant provided the transition from super to subcritical flow conditions prevailed at the step. The sequent depth ratio depended only on the relative step height, and the approaching Froude number, F1. The relative length of the standing wave was also a function of F1. Negative steps had approximately six times more variation in tailwater depth. For higher F1 values, the dissipation of all hydraulic jumps was approximately equal and corresponded to that of a hydraulic jump in a horizontal channel. The hydraulic jump at a positive step was more compact than that at a negative step. (Stoehr-PTT)
W91-00034

CONCENTRATION OF VERY FINE SILTS IN A STEADY VORTEX.
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 2J.
W91-00035

VELOCITY DISTRIBUTION IN ALLUVIAL CHANNEL FLOW.
Karnataka Regional Engineering Coll., Suratkal (India). Dept. of Civil Engineering.
B. R. Samaga, K. G. Ranga Raju, and R. J. Garde.
Journal of Hydraulic Research JHYRAF, Vol. 24, No. 4, p 297-308, 1986. 9 fig, 1 tab, 9 ref.

Descriptors: *Alluvial channels, *Channel flow, *Sediment transport, *Sediment-water interfaces, *Streambeds, *Velocity distribution, Mathematical models, Momentum transfer, Rhine River, Rio Grande, Suspended sediments.

The velocity distribution equations which have been developed recently using data on sediment-laden flow over a rigid plane bed were checked with experimental data for flow over alluvial beds of sediment mixtures and found to be unsatisfactory for this case. Making use of data from various sources, a two-layer model of velocity distribution over alluvial beds was developed. In this model it was assumed that, in the region where distance from the bed is less than 0.2 times the depth of flow, the momentum-transfer coefficient is a constant. This assumption was made in the light of the fact that, due to high sediment concentration and intense turbulence, the flow in this region is complicated, and the value of the momentum-transfer coefficient is different from its value for the region where distance from the bed is greater than one fifth of the depth of flow. The model agrees with field measurements of the Rhine and the Middle Rio Grande. (Stoehr-PTT)
W91-00036

FLOW RESISTANCE IN COMPOUND CHANNELS.
Ulster Univ. at Jordanstown, Newtownabbey (Northern Ireland). Dept. of Civil Engineering and Transport.
For primary bibliographic entry see Field 2E.
W91-00037

IMPROVED METHOD OF CALCULATION FOR STEADY UNIFORM FLOW IN PRISMATIC MAIN CHANNEL/FLOOD PLAIN SECTIONS.
Queen Mary Coll., London (England). Dept. of Civil Engineering.

P. R. Wormleaton, and D. J. Merrett.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 157-174, 1990. 9 fig, 1 tab, 29 ref.

Descriptors: *Channel flow, *Flood plains, *Hydraulics, *Open-channel flow, *Steady flow, *Uniform flow, Discharge measurement, Hydraulic models, Mathematical studies, Regression analysis, Shear stress.

Experimental results are presented from the Science and Engineering Research Council Flood Channel Facility at Hydraulics Research, Wallingford, for discharge and boundary shear stress distribution in symmetrical compound channel/flood plain sections of varying flood plain width and roughness. These are used to assess the performance of several standard discharge calculation methods, which assume different locations of the interface between main channel and flood plain subareas. It is shown that these methods can produce large errors in total and component discharges, which increase significantly with flood plain width and roughness. A modified form of the above methods is discussed, which makes a more realistic allowance for interaction at the main channel/flood plain interface. It achieves this by incorporating the Radojkovic indices to characterize momentum transfer between adjacent subareas into the calculation. This modified method is shown to be considerably more accurate than the standard methods in calculating total and component discharges. A tentative regression equation is presented for calculating Radojkovic indices from easily identifiable cross section characteristics. (Author's abstract)
W91-00038

TURBULENCE MEASUREMENTS IN A SHEAR LAYER REGION OF A COMPOUND CHANNEL.
Birmingham Univ. (England). Dept. of Civil Engineering.
D. W. Knight, and K. Shiono.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 175-196, 1990. 17 fig, 30 ref.

Descriptors: *Hydraulic models, *Open-channel flow, *Shear stress, *Turbulence, *Turbulent flow, Boundary processes, Eddies, Flood plains, Flow measurement, Momentum transfer, Upwelling.

The Science and Engineering Research Council Flood-Channel Facility at Hydraulics Research Ltd., Wallingford, England, represents a large-scale model of a river system with floodplains, and is designed to produce fully-developed boundary-layer flows with transverse shear. Some of the preliminary open-channel flow data, including turbulence measurements, performed in the facility are presented. The vertical distributions of primary velocity are essentially logarithmic in regions of a compound channel where the lateral shear stresses are low. Where the logarithmic law applies, the vertical distributions of turbulent intensity and kinetic energy follow standard forms and the appropriate empirical coefficients have been determined. The spatial distributions of primary velocity, turbulent intensity, kinetic energy, and Reynolds stresses are given for two overbank flows. In regions where there is high lateral shear superimposed on bed-generated turbulence, the vertical distributions of Reynolds stress are highly nonlinear. Longitudinal vortices, generating secondary flows along the river-channel/flood-plain interface were found to be important for depths as low as 0.25 relative to depth of flow in the main channel. The upwelling at the river-channel/flood-plain interface causes considerable variations in horizontal mean velocities and Reynolds stresses, which in turn produce large plan-form eddies that transfer momentum from the river channel to the flood plain. The lateral variations in local friction factor for different relative depths suggest that, unlike the depth-averaged eddy viscosity, constant values may be ascribed to particular subareas of a compound channel. (Author's abstract)
W91-00039

SERC FLOOD CHANNEL FACILITY: SKEWED FLOW EXPERIMENTS.
Bristol Univ. (England). Dept. of Civil Engineering.
S. C. Elliott, and R. H. Sellin.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 197-214, 1990.

Descriptors: *Hydraulic models, *Hydraulics, *Open-channel flow, *Velocity distribution, Boundary processes, Flood plains, Flow measurement, Momentum equation, Shear stress, Water circulation.

Experiments carried out on a skewed compound channel in the Science and Engineering Research Council (SERC) Flood-Channel Facility operated at Hydraulics Research Ltd., Wallingford, England, are described. The project is one of a coordinated group of four being run simultaneously by U.K. University research groups involving the hydraulics of overbank river flow. The interactive cross flows that occur between floodplain and main channel when the two are not parallel were examined. The project was designed to prepare the way for a later examination of overbank flow in meandering channels. Results show that the velocity distribution both in the main channel and over the two floodplains are distorted by the cross flow, as is the boundary shear stress distribution. The momentum equation was used to analyze the forces acting on the flow both for the whole cross section and also for the sub-units comprising the floodplains alone. The apparent shear force at the floodplain longitudinal interface was isolated from the momentum transport effects of the cross flow and compared with the comparable term in the prismatic compound channel case. From an analysis of velocity and flow-angle distribution in the main channel it was possible to construct a system of secondary circulation cells in the main channel. For the example given this was found to be complex and asymmetric, as might be expected from the imposed flow conditions. (Stoehr-PTT)
W91-00040

CLASSIFICATION OF UNIDIRECTIONAL THREE-LAYER FLOW OVER A HUMP.
Contra Costa Water District, Concord, CA.
R. A. Denton.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 215-233, 1990. 6 fig, 3 tab, 18 ref.

Descriptors: *Channel morphology, *Flow characteristics, *Flow models, *Hydraulics, *Stratified flow, Flow measurement, Flow rates, Froude number, Internal waves, Model studies.

The effect of increasing the constriction of steady multilayer flow over a hump and through a sidewall contraction was investigated. Classification diagrams of hump height versus a representative flowrate Froude number are useful for showing the range of flow conditions over which different flow regimes exist and their relationship with each other. Solutions of the three-layer model at a first-mode control suggest that the velocity profile for multilayer flow should always have an approximately two-layer shape where the flow is critical with respect to the first-mode internal wave. These laboratory experiments for three-layer flow and earlier two-layer experiments confirm that inviscid gradually-varying flow models are able to successfully predict the location of hydraulic controls and the interface profiles for most flow regimes. However, further work is needed to fully explain the difference between theory and experiment when the main control at the hump is an approach control. (Stoehr-PTT)
W91-00041

WAVE TYPE FLOW AT ABRUPT DROPS.
Hirosaki Univ. (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 2E.
W91-00042

THREE-DIMENSIONAL ANALYSIS OF PRESSURES ON DAMS.
Sinotech Engineering Consultant, Inc., Taipei (Taiwan).
M. H. Wang, and T. K. Hung.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 116, No. 6, p 1290-1304, June 1990. 9 fig, 2 tab, 18 ref. NSF Grant ECE-8414649.

Descriptors: *Dams, *Earthquakes, *Finite difference methods, *Hydrodynamics, *Mathematical models, *Model studies, Hydraulic structures, Reservoirs, Seismic properties.

The calculation of hydrodynamic pressures in a dam/reservoir system has been advanced from an added mass approach to a more complex dam/water interaction. A span-wise variation of nonlinear hydrodynamic pressures on dams during earthquakes was studied using a finite-difference approximation of Euler's equations, coupled with the nonlinear free-surface boundary condition. The pressure distribution was sensitive to both the longitudinal and lateral components of the ground motion. The dynamic effect of reservoir banks would increase with the dam width. The inward motion of a reservoir bank produced higher pressures on one side, while the outward motion of the other bank resulted in a reduction in hydrodynamic pressures. These effects will be smaller when the slope of the bank deviates from the vertical. The combined effect can be effectively obtained when the geometric parameters of a dam/reservoir system, the changes in water surface, and the earthquake force are cast in the equations of motion. In this case, the time-dependent water surface is transformed to the horizontal plane, and the flow field is mapped onto a cubic region, making it convenient to model the complex reservoir geometry and the wavy water surface by the finite-difference method. (Author's abstract)
W91-00057

NONLINEAR HYDRODYNAMIC PRESSURE ON DAMS.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
T. K. Hung, and B. F. Chen.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 116, No. 6, p 1372-1391, June 1990. 17 fig, 1 tab, 25 ref. NSF Grant ECE-8414649, Pittsburgh Supercomputing Center Grant PSCA20.

Descriptors: *Dams, *Earthquakes, *Finite difference methods, *Finite element method, *Hydrodynamics, *Mathematical models, California, Concrete dams, Gravity dams, Hydraulic structures, Pine Flat Dam, Reservoirs, Seismic properties, Waves.

The dynamic interaction between nonlinear hydrodynamic pressures and the vibration of a concrete gravity dam was analyzed by coupling Euler's equations with a finite element model of the dam. The Euler equations for compressible flow were solved with the nonlinear free-surface boundary condition, and with a finite element analysis of the dynamic behavior of the concrete gravity dam. The earthquake force components in the horizontal and vertical directions were cast as the forcing functions in the finite difference equations for fluid motion. The results were compared with those associated with a rigid dam motion. The pressure distributions are very sensitive to dam vibration and surface waves. For El Centro ground motion recorded on October 15, 1979, the calculated rise of the water surface on Pine Flat Dam on King River near Fresno, CA was 8 ft (2.7 m), indicating a strong nonlinear effect on hydrodynamic pressures and the potential hazards of surface waves in the reservoir. The hydrodynamic effect was highly augmented by the vibration of the dam. (Author's abstract)
W91-00058

AIR ENTRAINMENT BY SPILLWAY AERATORS.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
P. Rutschmann, and W. H. Hager.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 765-782, June 1990. 13 fig, 1 tab, 20 fig.

Descriptors: *Aerators, *Air entrainment, *Cavitation, *Model studies, *Spillways, Hydraulic models, Hydrodynamics, Mathematical models.

Aerators on spillways may be regarded as an effective protection against cavitational erosion. The air entrainment of aerators is governed by a number of independent parameters that include the slopes of the spillway and the aerator, the heights of ramp and offset, the approaching flow depth and Froude number, and the stagnation pressure in the nappe cavity. Based upon model observations, two approaches were used to determine the air entrainment coefficient. The direct approach is based upon the analysis of each effect on the coefficient. An expression is presented that should be tested for other geometries. The indirect approach is based on the length of jet for zero cavity subpressure. The resulting expression for the maximum air entrainment coefficient may then be corrected for the effect of cavity subpressure. The present approach introduces developing and developed aerator flow conditions. Further, the cavity subpressure is accounted for by a different Euler number. The final system of equations for the coefficient was compared to model and prototype data, and a fair agreement was noted. (Author's abstract)
W91-00061

BED FORM RESISTANCES IN OPEN CHANNEL FLOWS.
California Univ., Berkeley. Dept. of Civil Engineering.
H. W. Shen, H. E. Fehlman, and C. Mendoza.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 799-815, June 1990. 8 fig, 2 tab, 21 ref. NSF Grant No. ENG-7825054.

Descriptors: *Bed load, *Channel morphology, *Flow around objects, *Flow resistance, *Open-channel flow, *Sediment transport, *Sedimentation, *Streambeds, Darcy-Weisbach equation, Flow friction, Mathematical models, Model studies, Streamflow, Turbulent flow.

The different bed forms that develop at the interface between flow and the river bed are characterized by form resistance that can cause significant rises in flood levels. Many previous studies suggest the division of total resistance into skin resistance and form resistance without direct evidence. The skin resistance, form resistance, and total resistance were independently measured for a series of rigid bed forms in the laboratory. The data show that the sums of skin resistance and form resistance are close to the total resistance for all experimental runs conducted. Furthermore, data collected in this and other studies indicate that form resistance can be predicted from known bed form shapes. The Darcy-Weisbach form factor and the pressure drag coefficients are related only to the relative height of the dunes and independent of the flow velocities. The variation of form resistance for alluvial bed forms are similar to the expansion losses in pipelines. Skin resistance on the bed form has no significant effect on form resistance of the same bed form. The measured local skin stress increases almost linearly from a zero value at the flow reattachment point to a maximum value at the dune crest. A relationship was derived to predict the skin resistance as a function of flow Reynolds number, relative roughness, and relative height of dunes based on data collected in this and other studies. (Author's abstract)
W91-00063

ENERGY HEAD IMPLICATIONS OF THE INSTALLATION OF CIRCULAR FLAP GATES ON DRAINAGE OUTFALLS.
Liverpool Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W91-00068

COMPREHENSIVE GENERALIZED STUDY OF SCOUR AT CANTILEVERED PIPE OUTLETS.
Agricultural Research Service, Stillwater, OK. Water Conservation Structures Lab.
F. W. Blaisdell, and C. L. Anderson.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 4, p 357-376, 1988. 9 fig, 34 ref.

Descriptors: *Conveyance structures, *Erosion, *Hydraulic models, *Mathematical models, *Model studies, *Pipes, *Scour, *Spillways, Sediment transport.

Pipe spillways with cantilevered outlets have been used by the Soil Conservation Service on many of the principal spillways for several million relatively small farm ponds and several ten thousand relatively large upstream floodwater protection and water conservation structures. A literature review revealed information on the general principles of local scour at pipe exits, but inadequate practical information on scour and prevention of scour at pipe outlets. A study addressed the design of riprapped cantilevered pipe spillway plunge pool energy dissipators having the shape of self-formed scour pools. The design of the experiment was based upon the assumption that the cantilevered pipe will be a satisfactory spillway outlet structure for a range of discharges and bed material sizes, but that excessive scour will occur if the flow rate exceeds some limit. The study variables and their range were selected to cover the range of anticipated practical use. Discharge rate, pipe slope, water temperature, and a variety of bedload materials were used in the experiments. The flow was interrupted periodically during the test runs and the scour hole measured to record the time development of the scour. It was determined that the scour hole shape varies with the discharge, length of time of scour, and whether or not material is suspended in the scour hole. 'Beaching' occurs when the strength of the reverse currents along the sides of the scour hole are sufficient to erode the bank material. Equations for the jet trajectory were developed to determine the theoretical path from the pipe exit to the point at which the jet attacks the bed. (Tappert-PTT)
W91-00072

PREDICTION OF FLOW CHARACTERISTICS IN MAIN CHANNEL/FLOOD PLAIN FLOWS.
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. J. Keller, and W. Rodi.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 4, p 425-441, 1988. 7 fig, 2 tab, 26 ref.

Descriptors: *Channel flow, *Channels, *Flood channels, *Flumes, *Mathematical models, *Model studies, *Streamflow, Finite volume method, Flow models.

Flow in channels of compound cross-section, comprising a deep main channel and adjacent shallow flood plains, is a complex, three-dimensional phenomenon. The development of a depth-averaged two-dimensional mathematical model to calculate flow characteristics in channels of compound cross-section simplifies the calculations for instances where the resolution of vertical distributions is not of interest. The model utilizes a previously developed depth-averaged form of the kappa-epsilon turbulence model. The solution procedure is a finite volume method and is particularly economical with regard to both computing time and storage requirements. The model was tested against velocity and bed shear stress data taken from the literature and obtained in laboratory flumes modelling a main channel/flood plain geometry. Comparisons between these data and model predictions show generally good agreement. One necessary input to the model is the dimensionless transverse eddy diffusivity, e, which has a significant influence on the predicted distributions. A value of 0.15, adopted from the literature for rectangular laboratory flumes, was shown to be appropriate for laboratory compound channels. However, application of the model to natural compound channels requires further investigation of this parameter. (Tappert-PTT)
W91-00073

CONVERSION OF BRAIDED GRAVEL-BED RIVERS TO SINGLE-THREAD CHANNELS OF EQUIVALENT TRANSPORT CAPACITY.
Canterbury Regional Council, Christchurch (New Zealand).
For primary bibliographic entry see Field 2J.
W91-00078

HYDROLOGIC AND HYDRAULIC RESEARCH IN MOUNTAIN RIVERS.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2E.
W91-00083

PREDICTION OF ENTRAINMENT CONDITIONS FOR NONUNIFORM, NONCOHESIVE SEDIMENTS.
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W91-00094

DESIGN OF SETTLING BASINS.
Indira Gandhi National Open Univ., New Delhi (India).
For primary bibliographic entry see Field 2J.
W91-00097

BRIDGES AND CULVERTS REDUCED IN SIZE AND COST BY USE OF CRITICAL FLOW TRANSITIONS.
Shire of Stawell (Australia).
N. H. Cottman, and G. R. McKay.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 88, No. Pt 1, p 421-437, June 1990. 12 fig, 1 tab, 6 ref.

Descriptors: *Bridge design, *Bridges, *Culverts, *Hydraulic engineering, Channel design, Construction costs, Flood plain management, Streamflow.

A means for reducing the size and cost of bridges and culverts was explored to increase throat velocity by streamlining the whole of the upstream approach and downstream exit flows at structures, rather than increasing the head. This innovative concept for designing channel transitions converged wide, shallow, subcritical flows into high-velocity critical flows. The flows were then passed through deep, narrow throats that were cheaply culverted or bridged. The outflow was finally diverged, spread and decelerated before being passed downstream with minimum head losses. These minimum energy or maximum discharge designs were first used in Australia in 1961. They offered a means of passing large flows through much smaller, more efficient and more economical culverts and bridges, without the considerable upstream afflux that is the bane of conventional hydraulic structures. The design procedures accurately predicted performances in the field. The usual problems of erosion, siltation, debris and energy dissipation were shown to be either absent or manageable. The concept was very useful for increasing the capacity of many suitable flood plain bridges at minimal cost. (Mertz-PTT)
W91-00100

VARIATIONAL PRINCIPLE METHOD WITH VARIABLE DOMAIN IN THE FLOW PROBLEM WITH FREE SURFACE.
Shanghai Inst. of Mechanical Engineering (China).
C. Yue-Lin, and Y. Xiao-Fing.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 50-52, March 1990. 5 fig, 5 ref.

Descriptors: *Finite element method, *Fluid mechanics, *Free surfaces, *Mathematical models, Data interpretation, Gravity dams, Gravity flow, Hydraulic models, Mathematical analysis.

The finite element method has been used to solve hydraulic problems since the early 1970s. An important factor of the method is how to deal with the free surface problem when the exact position of the free surface is not known beforehand. A variational principle with variable domain is used in the solution. The method introduces a functional on the variable domain, then obtains a solution equal to that of differential equations by directly solving the extreme value of the functional. When

conventional finite element analysis is undertaken, the domain (D) is divided in two domains, D1 and D2, where D1 is a presumed fixed domain and D2 is a variable domain. The method can be used to calculate dam outflow. (Tappert-PTT)
W91-00122

SIPHON QUENCHES.
Ketchikan Pulp Co., AK.
For primary bibliographic entry see Field 8A.
W91-00142

EXPLICIT METHODS FOR 2-D TRANSIENT FREE-SURFACE FLOWS.
Florida International Univ., Miami. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W91-00151

VORTEX DROP INLET FOR SUPERCRITICAL APPROACHING FLOW.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 8A.
W91-00153

DESIGN OF STABLE ALLUVIAL CHANNELS.
Kuwait Inst. for Scientific Research, Safat. Hydraulics and Coastal Engineering Group.
For primary bibliographic entry see Field 2J.
W91-00154

SINGLE-OUTLET DETENTION-POND ANALYSIS AND DESIGN.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W91-00171

MODEL OF FLOW IN REGULATED OPEN-CHANNEL NETWORKS.
Miami Univ., Coral Gables, FL. Coll. of Engineering.
For primary bibliographic entry see Field 2E.
W91-00172

CATASTROPHE MODEL FOR THE FORCED HYDRAULIC JUMP.
Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria.
P. M. Austria.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 269-280, 1987. 11 fig, 1 tab, 13 ref.

Descriptors: *Catastrophe theory, *Hydraulic jump, *Hydraulic models, *Hydraulics, *Mathematical models, *Model studies, *Open-channel flow, Mathematical analysis, Mathematical equations.

In open channel flow, when a hydraulic jump is forced, an hysteretic behavior is observed in a particular range of values of the governing variables. The catastrophe theory was applied to the study of this phenomenon. The geometry of the cusp catastrophe was used as a descriptive model with which it was possible to gather certain behavior peculiarities in the phenomenon, such as hysteresis, sudden jumps, bimodality, and divergence. In addition, a nomenclature in accordance with the usual one in catastrophe theory has been proposed. The cusp catastrophe geometry has been used mainly as a descriptive model, the quantitative solution procedure consists essentially in applying well-known equations such as the specific energy equation, with the aid of the qualitative model, and considering the control parameter variation. The results were experimentally verified for a simplified study case, thus work showing how the elementary catastrophe theory can be used as a useful descriptive modeling tool in hydraulics. (Author's abstract)
W91-00373

LOCATING AND IDENTIFYING HYDRAULIC CONTROLS FOR LAYERED FLOW OVER AN OBSTRUCTION.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W91-00374

STATE SPACE APPROACH TO THE BEHAVIOR OF SEWER SYSTEMS.
Barcelona City Dept. of Public Works (Spain). Planning Div.
For primary bibliographic entry see Field 5D.
W91-00375

INVISCID DAM-BREAK SOLUTION.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 313-327, 1987. 11 fig, 13 ref.

Descriptors: *Channel flow, *Dam failure, *Hydraulic models, *Hydraulics, Dams, Mathematical analysis, Mathematical equations, Mathematical models, Model studies, St Venant equation.

A solution has been calculated and plotted dimensionlessly for a dam-break flood on a sloping channel that is initially dry. The solution neglects channel bed resistance and assumes that the entire dam is removed instantaneously. In obtaining this solution, it has been shown that a solution for a dry channel does not exist when the usual approximations are made for a non-zero bed-resistance term in the St. Venant equations. Comparisons of the inviscid solution with experimental measurements for two different channel roughnesses showed that increasing the channel roughness caused large increases in both flow depths and wetting-front arrival times. Since increasing the scale of an experiment often causes a decrease in relative roughness and an increase in Reynolds numbers, it is concluded that prototype measurements relatively close to the burst dam may well be approximated more closely with the inviscid solution calculated herein than with experimental measurements obtained from a small-scale model. (Author's abstract)
W91-00376

TRANSIENT ANALYSIS OF WATER DISTRIBUTION SYSTEMS.
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-00379

FORCED AERATION OF HIGH VELOCITY FLOWS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
For primary bibliographic entry see Field 8A.
W91-00396

LOCAL SCOUR AROUND BRIDGE PIERS.
Nanyang Technological Inst., Singapore.
For primary bibliographic entry see Field 2J.
W91-00397

MODIFIED ELEMENT METHOD FOR PIPE NETWORK ANALYSIS.
Laval Univ., Quebec. Dept. of Civil Engineering.
P. Dupuis, J. L. Robert, and Y. Ouellet.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 1, p 27-40, 1987. 4 fig, 1 tab, 19 ref.

Descriptors: *Hydraulic systems, *Network analysis, *Pipe flow, *Pipes, Approximation method, Computer models, Element method, Mathematical analysis.

As a result of the recent boom in microcomputer hardware, the element method for pipe network analysis has become feasible for determining flow and pressure in hydraulic networks. The proposed modified method addresses the convergence behavior by using a Newton-Raphson procedure on the residue of a partionned matrix system. Reordering of the elements gives a sub-matrix topology of particular types that can be inverted with efficient algorithms. It results in a matrix, the order of which corresponds to the number of loops in the system, to be inverted during the iterative process. Two examples, taken from previous papers, illustrate the advantages of the method: a gain in convergence compared to classical methods, a resolution strategy optimized by the improvement of the matrix topology and its partitioning into a linear and non-linear submatrix, and good convergence behavior for bad cases and use of the self-adjusting friction factor. (MacKeen-PTT)
W91-00398

STEADY UNIFORM FLOW IN PRISMATIC CHANNELS WITH FLOOD PLAINS.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00761

DISCHARGE CHARACTERISTICS OF LOCAL DISCONTINUOUS CONTRACTIONS, II.
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
W. H. Hager.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 2, p 197-213, 1987. 14 fig, 9 ref, append.

Descriptors: *Channels, *Discharge hydrographs, *Flow, *Flow characteristics, *Hydraulic models, *Open-channel flow, *Submerged flow, Flow pattern, Head loss, Theoretical analysis.

Discharge characteristics of a local, discontinuous contraction in a rectangular channel for submerged flow conditions were studied using a theoretical approach analyzing the separation zone as well as the local head-loss along the contraction by accounting for the contraction ratio, the inlet angle and the relative contraction length. General solutions are obtained by a matching procedure, and design relations are established. It was found that the separation of the flow from the leading edges of the contraction geometry and the local head-loss for zones of diverging streamlines must be accounted for. Based on a quasi two-dimensional approach, these two quantities are theoretically investigated for two limit cases. The general solution for arbitrary contraction geometry and subcritical flow characteristics is found by a matching procedure. The final result allows direct application to arbitrary cases. The possible flow pattern in connection with local contractions can be classified into a transitional, a purely subcritical and a locally supercritical flow state with surface undulations. Experiments were performed in order to verify the theoretical approach, and a good agreement was found. The deviations with respect to the upstream flow depth were always below 30%. (Agostine-PTT)
W91-00762

8C. Hydraulic Machinery

ENERGY HEAD IMPLICATIONS OF THE INSTALLATION OF CIRCULAR FLAP GATES ON DRAINAGE OUTFALLS.
Liverpool Univ. (England). Dept. of Civil Engineering.
R. Burrows, and J. Emmonds.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 2, p 131-142, 1988. 6 fig, 12 ref.

Descriptors: *Flap gates, *Gates, *Head loss, *Hydraulic gates, *Hydraulic machinery, *Hydraulic structures, *Sewer systems, Flooding, Hydraulics, Hydrodynamics, Outfall sewers, Urban areas.

Flap gates are widely used for the protection of drainage systems against flood influx from high receiving stream levels or from tidal levels in coastal locations. Inclusion of a gate will increase the consequential upstream surcharge or flooding, especially for closed conduit systems such as urban sewers where little detention storage capacity is available for temporary retention of the storm

influx. Experimental apparatus was constructed to establish what additional upstream head results from the use of flap gates. The effect of gate weight, gate angle, flow rate, and other construction parameters was investigated. Energy losses resulting from the flow constriction are found to be largely dependent on the flowrate and the gate's weight when subjected to a tailwater surcharge. Guidance on gate selection and head loss implications in the literature is sparse and design curves are presented to partially fill this gap. These curves show that the total energy loss at the outfall resulting from the use of heavy gates can be more than double the kinetic energy head of the pipe flow, representing the normal pipe exit losses. Protection of the outfall by means of a wing-wall surround with raised sill may further increase the head requirement. (Tappert-PTT)
W91-00068

ANALYSIS OF SCALE EFFECTS ON PERFORMANCE CHARACTERISTICS OF HYDRAULIC TURBINES: PART 2: EFFECTS OF SURFACE ROUGHNESS, RUNNER SEAL CLEARANCE AND REYNOLDS NUMBER ON PERFORMANCE AND LOSS DISTRIBUTION COEFFICIENTS.
Kanagawa Univ. (Japan). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 8G.
W91-00098

8D. Soil Mechanics

THREE-DIMENSIONAL BOUNDARY ELEMENT RESERVOIR MODEL FOR SEISMIC ANALYSIS OF ARCH AND GRAVITY DAMS.
National Research Council of Canada, Ottawa (Ontario). Inst. for Research in Construction.
A. M. Jablonski, and J. L. Humar.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 19, No. 3, p 359-376, April 1990. 12 fig, 27 ref.

Descriptors: *Arch dams, *Boundary element method, *Gravity dams, *Mathematical models, *Model studies, *Seismic properties, Dam foundations, Data interpretation, Mathematical analysis, Reservoirs.

The seismic analysis and design of an arch dam has not been studied in as much detail as that of a concrete gravity dam because of the complex nature of the problem. The boundary element method has been successfully applied in the past to the analysis of hydrodynamic forces in two-dimensional infinite as well as two-dimensional and three-dimensional finite reservoirs subjected to seismic ground motion. More recent research on the application of the constant boundary element method (BEM) to the 3D analysis of reservoir vibration demonstrate the effectiveness of the procedure for evaluating hydrodynamic pressures in a 3D water reservoir of arbitrary shape. The energy loss in the waves traveling to infinity is represented by a special boundary condition to be applied to the truncated far end of the reservoir. Special boundary conditions, previously used in the 2D case to treat infinite radiation damping and damping from foundation soil and banks, have been incorporated in this formulation. Numerical results for vibration of a 3D infinite rectangular reservoir as well as of a 3D infinite reservoir impounded by an arch dam are presented and compared with some existing results obtained by other researcher. Most of the results show qualitative similarities, although significant differences exist presumably due to the difference in the geometry of the infinite part. One drawback of the BEM is the frequency dependence of the fundamental solution which requires the computation of the elements of boundary element matrices for each excitation frequency. (Tappert-PTT)
W91-00123

8E. Rock Mechanics and Geology

GEOLOGIC AND HYDROLOGIC ISSUES RELATED TO SITING A REPOSITORY FOR HIGH-LEVEL NUCLEAR WASTE AT YUCCA MOUNTAIN, NEVADA, U.S.A.
Department of Energy, Carson City, NV. Nevada Nuclear Waste Project Office.
For primary bibliographic entry see Field 5E.
W91-00030

SHAKE TABLE TEST OF CYLINDRICAL WATER TANKS IN BASE-ISOLATED STRUCTURES.
Parsons (Ralph M.) Co., Pasadena, CA.
M. S. Chalhoub, and J. M. Kelly.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 116, No. 7, p 1451-1472, July 1990. 24 fig, 1 tab, 10 ref, append.

Descriptors: *Earthquake engineering, *Hydrodynamics, *Isolation, *Structural behavior, *Water tanks, Buildings, Kinematic wave theory, Structural engineering, Waves.

Extensive work has been done on the response of internal equipment in structures subjected to ground motion. An important advantage of base isolation is the protection of internal equipment, including fluid containers, in buildings against high accelerations transmitted from the ground and amplified in the structure. The dynamic pressure exerted by the fluid on the walls of its container greatly depends on the support acceleration. Base isolation reduces drastically the amplification of these accelerations. The low frequency that characterizes the motion of base isolated structures can affect the water elevation response. The response of a cylindrical water tank fixed to the shake table was compared to that of a similar one installed in the bottom of a base-isolated nine-story steel structure. The structure was isolated on eight multilayered elastomeric bearings. Due to the reduction in ground accelerations, the dynamic pressure is reduced for the tank in the isolated structure. Free-surface water elevation was slightly increased due to the lower frequency that characterizes the motion of base-isolated structures. This problem can by overcome by appropriate selection of the isolation system or by the addition of dampers at the location of maximum water particle velocities. The response of fixed base structures is amplified along their height, while for base-isolated structures, the base and higher stories have practically the same response. For this reason, when fluid containers are located in the upper stories of a building, base isolation is very favorable. A theoretical solution developed from linear wave theory correlates very well with the experimental results. (Fish-PTT)
W91-00147

HYDROGEOLOGY OF THE DINARIC KARST.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00318

GEOLOGY OF KARST TERRAINS AND THEORY IN THE WORKS OF JOVAN CVIJIC.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
B. F. Mijatovic, and M. Komatina.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 9-16, 2 fig, 9 ref.

Descriptors: *Aquifer systems, *Aquifers, *Geohydrology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Erosion, Geologic history, Geology, Groundwater, Hydrography, Theoretical analysis.

The research of Jovan Cvijic in the field of karst phenomena is discussed. Cvijic published his observations on geologic, geomorphologic and hydrographic conditions of individual karst terrains and karst in general, in a number of books in the early 20th century. His contribution to the understanding of the Central Dinaric Karst, and in particular its main phenomena, the karst poljes, is in his interpretation of poljes' origin, evolution and hydrographic features. According to Cvijic, the poljes are erosion forms but their tectonic predisposition is often highly expressed. The target points of the erosion are often connected to marginal and other faults. Cvijic's postulatiens concern three hydrographic zones in karst: the dry zone, the transition zone, and the zone with permanent water flows. The need for proper understanding of field geology for the detection and capture of waters of karst aquifers is stressed. (See also W91-00318) (MacKeen-PTT)
W91-00319

8G. Materials

ANALYSIS OF SCALE EFFECTS ON PERFORMANCE CHARACTERISTICS OF HYDRAULIC TURBINES: PART 2: EFFECTS OF SURFACE ROUGHNESS, RUNNER SEAL CLEARANCE AND REYNOLDS NUMBER ON PERFORMANCE AND LOSS DISTRIBUTION COEFFICIENTS.
Kanagawa Univ. (Japan). Dept. of Mechanical Engineering.
T. Ida.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 93-104, 1990. 9 fig, 10 ref.

Descriptors: *Hydraulic turbines, *Hydraulics, *Reynolds number, *Roughness coefficient, *Turbines, Flow rates, Loss distribution coefficient, Surface roughness, Surface velocity, Water temperature.

The effect of surface roughness of flow passages, runner seal clearance and the Reynolds number on the hydraulic performance and loss distribution coefficient was examined. V-(opt), which is the value of the loss distribution coefficient at the optimum efficiency point, varies within the range of approximately 0.96-1.05 times the original value when the surface roughness of all of flow passages in a model turbine becomes 0.5-2 times the original roughness. However, the loss distribution coefficient at the optimum efficiency point does not vary with the runner seal clearance. When the Reynolds number varies with the change of head or water temperature, the admissible surface roughness of each flow passage decreases as the Reynolds number increases, thus each friction coefficient becomes the value corresponding to the rough surface region. As a result, the change of performance and the loss distribution coefficient at the optimum efficiency point due to the change of the Reynolds number becomes smaller in comparison to that in the case with smooth surfaces. On the contrary, when the head, water temperature and surface roughness are unchanged and the Reynolds number varies only with the size of turbine, the relative roughness decreases as the Reynolds number increases and becomes the value in the smooth surface region. As a result, the change of performance and loss distribution coefficient at the optimum efficiency point is larger than the former case mentioned above. In other words, the effect of roughness cannot be neglected for examining the effect of the Reynolds number on the optimum efficiency loss distribution coefficient. (Author's abstract)
W91-00098

SEISMIC DAMAGE TO SEGMENTED BURIED PIPELINES.
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
K. Elhmahdi, and M. J. O'Rourke.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 19, No. 4, p 529-539, May 1990. 9 fig, 3 tab, 12 ref.

Descriptors: *Earthquake engineering, *Mathematical models, *Pipelines, *Pipes, *Seismic waves,

*Water conveyance, Leakage, Soil properties, Strain, Water mains.

Segmented buried pipelines are commonly used in water supply, sewage, and gas systems. These pipelines are frequently damaged during earthquakes as a result of permanent ground deformation or seismic wave propagation. This damage most often occurs at the joints. An analytical model for evaluating the response of long straight runs of segmented buried pipelines to seismic wave propagation is presented that takes into account the non-linearity as well as the variability of the system characteristics. Model results indicate that the variability of joint displacement is strongly influenced by a variability in joint stiffness characteristics, but not significantly influenced by variations in soil properties. The probability of leakage is a function of the normalized joint displacement. Results from laboratory tests by others are used to establish the relative joint displacement which leads to leakage. These elements are combined to predict the damage ratio (number of leaks per kilometer) for cast iron pipes with lead caulked joints subject to a joint pull-out failure mode. The joint pull-out damage ratio is a decreasing function of pipe diameter, and for any diameter it is a non-linear function of ground strain. (Tappert-PTT)
W91-00124

HYDROLOGIC PARAMETER EFFECTS ON SMALL-DAM RISK ANALYSIS IN MISSOURI.
Missouri Univ.-Columbia. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W91-00167

RISK OF DEBRIS-BASIN FAILURE.
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W91-00181

HYDROGEOLOGICAL STUDY OF LATERITE AT A REPRESENTATIVE DAM SITE IN MALVAN VALLEY OF KONKAN REGION (MAHARASHTRA-INDIA) USING SEISMIC REFRACTION METHOD.
Central Water and Power Research Station, Poona (India).
For primary bibliographic entry see Field 2F.
W91-00240

TRANSPORT OF LOW-CONCENTRATION CONTAMINANTS IN SATURATED EARTHEN BARRIERS.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W91-00372

SAFETY GOALS FOR HIGH-HAZARD DAMS: ARE DAMS TOO SAFE.
Carnegie-Mellon Univ., Pittsburgh, PA. Graduate School of Industrial Administration.
For primary bibliographic entry see Field 8A.
W91-00587

STAINLESS STEEL IN WASTEWATER TREATMENT PLANTS.
Tuthill Associates, Blacksburg, VA.
For primary bibliographic entry see Field 5D.
W91-00628

STRIDES IN NONDESTRUCTIVE TESTING.
Olson Wright NDT and E, Inc., Lakewood, CO.
L. D. Olson, C. Wright, and K. H. Stokoe.
Civil Engineering (ASCE) CEWRA9, Vol. 60, No. 5, p 52-55, May 1990. 4 fig.

Descriptors: *Materials testing, *Nondestructive tests, *Seismology, *Spectral analysis, Civil engineering, Dam inspection, Foundations, Materials engineering, Seismic waves, Shear stress, Stability analysis, Stress analysis, Youngs modulus.

Stress wave methods of materials testing are finding increasing applications in the civil engineering field. Mechanically generated stress waves involve one of four measurements approaches (1) frequency or spectral analysis of surface wave propagation; (2) direct measurement of stress wave velocities; (3) measurement of stress wave echoes; and (4) resonant, or modal vibration measurements. A new seismic method, spectral analysis of surface waves (SASW) determines shear modulus profiles at soil sites and Young's modulus profiles at pavement sites. SASW was used to determine the global density of a massive landslide in the Valtellina valley of northern Italy in 1987. The SASW measurements were effective to depths of more than 150 ft without drilling borings. Two primary low-strain stress wave techniques for evaluating the integrity and length of deep foundations from the foundation head are seismic echo (SE) and impulse response (IR). The two surface methods were used on a drilled shaft foundation for a microwave communication tower for which the New Jersey Transit Authority specified quality assurance with respect to deep foundation integrity. The two methods gave comparable results and the IR test also measured the low-strain dynamic stiffness (force-deflection) at the foundation head. The IR method was adapted for subgrade support evaluation of concrete slabs and pavements and can be used to evaluate spillways, conduits, tunnels, and grouting. The adapted IR method detected loss of subgrade support in the foundation of a warehouse damaged by water. Two main stress wave techniques are used to evaluate structural integrity: ultrasonic pulse velocity (a direct measurement technique) and impact echo (IE). IE is a sonic echo test for detecting flaws and measuring thicknesses of structural concrete members. IE methods detected cracks in Humphrey's Dam, an arch dam in southwest Colorado. (Geiger-PTT)
W91-00676

CASE HISTORIES OF SULFIDE CORROSION: PROBLEMS AND TREATMENTS.
Brown and Caldwell, Sacramento, CA.
R. A. Witzgall, I. S. Horner, and P. L. Schafer.
Water Environment & Technology WAETEJ, Vol. 2, No. 7, p 42-47, July 1990. 2 tab, 3 ref.

Descriptors: *Corrosion, *Sulfides, *Wastewater facilities, *Wastewater treatment, Biochemical oxygen demand, Case studies, Dissolved oxygen, Environmental effects, Model studies, Odor control, Oxygen uptake, Sulfates, Suspended solids, Temperature, pH.

Five wastewater systems that experienced sulfide corrosion problems were studied. The projects selected spanned the U.S., with one project in Lakeland, Fla., and two projects each in Omaha, Neb., and Sacremento, Calif. Four of the five case studies were based on projects undertaken to investigate existing sulfide corrosion and odor problems. Each of these projects required extensive data collection and field investigation to characterize the wastewater and environmental conditions and to determine the extent of corrosion problems. The following wastewater parameters were of interest: biochemical oxygen demand (BOD) and soluble BOD, temperature, sulfate concentration, pH, dissolved oxygen (DO), oxygen uptake rate, total suspended solids, oxidation-reduction potential, and total and dissolved sulfide. In addition, hydrogen sulfide gas in the sewer atmosphere was of primary interest. In each of these five studies, sulfide and corrosion modeling was conducted to evaluate future conditions and to determine the accuracy of the models and why corrosion was occurring. In a comparison of the models with actual data, the sulfide model predicted with 50% accuracy. Making correlations on the corrosion model was more difficult because few wastewater agencies have the history of sulfide data required to make the comparison. The case studies indicated a general level of agreement with the corrosion model, certainly better than an order of magnitude. In general, municipalities have not prepared sufficiently detailed information on their successes and failures in sulfide and corrosion contr 1 to allow others to benefit. (Agostine-PTT)
W91-00768

8I. Fisheries Engineering

IMPROVING THE EFFECTIVENESS OF FISHERIES AGENCIES IN DEVELOPING HYDROPOWER MITIGATION.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 6E.
W91-00008

SEASONAL HABITAT USE BY WALLEYE IN A WARMWATER RIVER SYSTEM, AS DETERMINED BY RADIOTELEMETRY.
Iowa Dept. of Natural Resources, Manchester. Northeast District Headquarters.
V. L. Paragamian.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 392-401, Fall 1989. 6 fig, 2 tab, 18 ref. Federal Aid in Fish Restoration, project F-115-R.

Descriptors: *Aquatic habitats, *Fish behavior, *Iowa, *Spawning, *Stream fisheries, *Walleyes, Ceder River, Dams, Ecosystems, Seasonal distribution, Tailwater, Telemetry, Water currents, Water temperature.

Thirty-one adult walleyes, Stizostedion vitreum, were implanted with radio transmitters and tracked in the main-stem Ceder River, Iowa, and two of its tributaries from September 1986 through July 1988. The objectives were to identify specific habitat use by walleyes at various times of the year, to determine interstream movement patterns, and to identify walleye spawning sites. Fish with transmitters were located 363 times, and 92% of fish locations were within 9.7 km of a dam on the Ceder River. Walleyes preferred gravel-cobble substrates during autumn and were often in water 1.25-1.8 m deep. Overhead cover was not essential. When decreasing water temperature approached 5 C, most fish overwintered in pools 1.5-3.0 m deep. Activity of walleyes increased as spring water temperatures rose to about 2.8 C, the approximate temperature at which most walleyes moved upstream. Actual spawning took place at about 11 C and occurred in a ruffle (the tailwater of a dam) comprising large cobble and small boulders in a current of 1.4-1.5 m/s. Walleyes drifted downstream after spawning to pools 1.2-1.8 m deep and were sedentary for about 2 weeks. Several female walleyes died soon after the spawning season. During summer, walleyes preferred gravel-cobble substrates, used a variety of depths, and were near current breaks and upstream edges of pools. When summer temperatures reached 30 C, some walleyes sought deep pools. Exploitation of walleyes within the first year of the study would have been 54% if most fish had not been released by anglers. This indicated that: (1) adult walleyes preferred moderate current with cobble-gravel substrates most of the times of the year; (2) spawning occurred nearly exclusively in the tailwater of a dam; (3) walleyes were concentrated and spawned within a very short time span; (4) preferred walleye habitat is nearly nonexistent in many portions of the Ceder River system; and (5) impoundments accumulate sediment and thereby reduce walleye habitat upstream but protect habitat downstream. (Author's abstract)
W91-00009

EFFECTS OF A FIXED-CREST WEIR ON BROWN SHRIMP PENAEUS AZTECUS GROWTH, MORTALITY, AND EMIGRATION IN A LOUISIANA COASTAL MARSH.
Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
E. E. Knudsen, R. F. Paille, B. D. Rodgers, and W. H. Herke.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 411-419, Fall 1989. 4 fig, 3 tab, 31 ref.

Descriptors: *Coastal marshes, *Dam effects, *Ecological effects, *Estuaries, *Shrimp, *Water resources development, *Weirs, Animal behavior, Growth, Louisiana, Migration, Mortality.

The effects of water-control weirs on growth, emigration, and mortality of brown shrimp were investigated. Juvenile shrimp were captured, marked, and released in two shallow-water marsh ponds. One pond had a weir at its only exit. All surviving marked shrimp were recaptured as they emigrated from each pond. Shrimp remained in the weired pond 12-18 d longer after marking than in the unweired pond. Growth of brown shrimp was best described by quadratic functions and was significantly faster in the weired pond than in the unweired one although differences in growth may have been confounded by delayed emigration from the weired pond. Estimated monthly instantaneous mortality of juvenile shrimp, from marking to recapture, ranged from 0.550 to 1.582 in the weired pond, and 0.877 to 1.270 in the unweired pond and apparently varied between the years. Even though brown shrimp remained in the weired pond longer, peaks in emigrating from both ponds coincided with new and full moons. Mean total lengths of marked shrimp at emigration ranged from 83 to 106 mm for the weired pond, and from 66 to 84 mm for the unweired pond. Size of shrimp at emigration and time of emigration varied between years. Although shrimp emigrating from the weired pond were larger than those from the unweired pond, probably due to faster growth and delayed emigration, conclusions from concurrent research were that total biomass of brown shrimp emigrating from the unweired pond was more than double the biomass from the weired pond. (Author's abstract)
W91-00010

EVALUATION OF TROUT PASSAGE THROUGH SIX HIGHWAY CULVERTS IN MONTANA.
Montana Cooperative Fishery Research Unit, Bozeman.
D. A. Belford, and W. R. Gould.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 437-445, Fall 1989. 4 fig, 2 tab, 19 ref. Federal Highway Administration Grant 8093.

Descriptors: *Culverts, *Ecological effects, *Fish passages, *Highway effects, *Stream fisheries, *Trout, Fish behavior, Flow velocity, Highways, Montana, Water velocity.

Combination of water velocity and passage length in highway culverts were evaluated to determine conditions that enabled or prevented the passage of nonanadromous rainbow trout Oncorhynchus mykiss, brown trout Salmo trutta, cutthroat trout O. clarki, and brook trout Salvelinus fontinalis. Fish passage through six culverts 45-93 m long was determined by trapping and electrofishing. Water velocities were measured 5 cm above the bottom (bottom velocity) and at 0.6 of the water depth at intervals between rest sites throughout the lengths of the culverts. Nonlinear regression lines specific to species and state of sexual maturity were fit to the combinations of mean bottom velocity and passage length representing the most strenuous conditions that allowed the upstream passage of trout. Because of the similarity of the strenuous passage relations among species, the spawning rainbow trout relation could be used as the general criterion for passage of the trout studied. This relation indicated that fish could swim distances of 10, 30, 50, 70, and 90 m with mean bottom velocities up to 0.96, 0.80, 0.74, 0.70, and 0.67 m/s, respectively. (Author's abstract)
W91-00012

STREAM CANOPY AND ITS RELATIONSHIP TO SALMONID BIOMASS IN THE INTERMOUNTAIN WEST.
Forest Service, Ogden, UT. Intermountain Research Station.
W. S. Platts, and R. L. Nelson.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 446-457, Fall 1989. 3 fig, 4 tab, 29 ref.

Descriptors: *Biomass, *Canopy, *Fish populations, *Riparian vegetation, *Salmon, *Stream fisheries, *Trout, Fish behavior, Grazing, Great Basin, Light intensity, Rocky Mountains, Thermal radiation.

To assess prevailing stream canopy (riparian overstory) conditions on representative streams in the northern Rocky Mountains, and the Great Basin of the western USA, several riparian habitats, including canopy density, light intensity, unobstructed sun arc, and average potential daily thermal input were measured in grazed and ungrazed (rested) portions of each stream. It was also determined to what extent, if any, these habitat components were correlated with salmonid biomass and whether either they or salmonids differed significantly between geographic regions or between grazed or rested pastures. Unobstructed sun arc was significantly and positively correlated with thermal input, and it was the best overall predictor of salmonid biomass per unit volume. Thermal input was a better predictor of salmonid biomass per unit volume in the Great Basin than in the Rocky Mountains, where the thermal regime may exert more influence on fish populations. Mean estimates of fish biomass per unit volume differed significantly between the Great Basin (55.9 g/cum) and Rocky Mountain (13.1 g/cum) study areas and were better related to stream canopy attributes than biomass estimates based on stream surface area; in the Great Basin study areas, the two types of biomass estimates were only weakly correlated with each other. In the Rocky Mountains, ungrazed sites generally had more canopy cover than grazed sites. In the Great Basin study areas, however, differences in canopy were unimportant and were probably related to local management practices in several cases. (Author's abstract)
W91-00013

TESTING OF HABITAT ASSESSMENT MODELS FOR SMALL TROUT STREAMS IN THE MEDICINE BOW NATIONAL FOREST, WYOMING.
Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie.
S. J. Kozel, and W. A. Hubert.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 458-464, Fall 1989. 5 tab, 7 ref.

Descriptors: *Aquatic habitats, *Medicine Bow National Forest, *Model studies, *Stream fisheries, *Trout, *Wyoming, Fish populations, Reach, Standing stock, Streams.

The applicability of four habitat assessment models to small trout streams in the Medicine Bow National Forest were tested. All models yielded predictions of trout standing stocks or ratings of trout cover that were correlated with measured trout standing stocks; however, the predicted and measured standing stocks were not directly proportional, and not all model variables appeared to contribute to the predictions or ratings derived from the models. Among the habitat variables included in the four models, those most highly correlated with trout standing stocks were width-to-depth ratio, abundance of overhead bank cover, average stream width, and level of late-summer streamflow. It is hypothesized that much of the variation in measured habitat and model predictions among the study reaches was due to natural variation in habitat features associated with stream size and reach gradient. (Sand-PTT)
W91-00014

SALMON STOCKS AND SALMON FISHERIES IN THE BALTIC SEA (ITAMEREN LOHIKANNAT JA LOHENKALASTUS).
Finnish Game and Fisheries Research Inst., Helsinki.
E. Ikonen, and V. Pruuki.
Suomen Kalatalous, Vol. 1990, No. 56, p 27-39, 1990. 6 tab, 47 ref. English summary.

Descriptors: *Fish management, *Fish populations, *Fish stocking, *Salmon, *Stream fisheries, Baltic Sea, Finland, Gulf of Bothnia, Smolt, Spawning.

In recent history, the salmon rivers flowing to the Baltic Sea and Gulf of Bothnia from Finland annually produced about 7 million salmon smolts. Presently, the production is < 0.5 million. The main reason for this decreased smolt production is damming of the salmon rivers. Part of the lost smolt production has been compensated for by releasing 5-6 million artificially reared salmon smolts in the river mouths. Annual salmon catches in the 1920s were 1000 tons in the sea; in the late 1980s they have been about 3500 tons. The interceptive exploitation of salmon in the sea is so effective that naturally reproducing stocks suffer greatly from the lack of spawners. If the fishing effort in the sea were decreased, the total catches would be higher and the natural stocks would survive. The Gulf of Finland annually received about 0.5 million salmon smolts in the beginning of the 1900s. Natural production is now about 15,000 and the releases of artificially reared smolts amount to 0.5 million. Due to the smolt releases the catches have increased from 100 tons in the 1970s to 300 tons. The total catch could be higher if the age of recruitment to the fishery was raised. (Author's abstract)
W91-00015

SALMON OF THE RIVER SIMOJOKI: RESEARCH AND MANAGEMENT (SIMOJOEN LOHI TUTKIMUKSEN JA HOIDON KOHTEENA).
Finnish Game and Fisheries Research Inst., Helsinki.
E. Jutila.
Suomen Kalatalous, Vol. 1990, No. 56, p 40-48, 1990. 2 fig, 1 tab, 21 ref. English summary.

Descriptors: *Finland, *Fish management, *Fish populations, *Fish stocking, *Salmon, *Simojoki River, *Stream fisheries, Baltic Sea, Dredging, Ecological effects, Gulf of Bothnia, Logging, Smolt, Spawning.

The last river within the Finnish borders which retains its original naturally spawning salmon stock is the Simojoki. In the 1870s the annual salmon catch from the river was about 6500 kg but during the 1970s the annual catch decreased from 1300 kg to 400 kg. During the 1980s it has been 50-200 kg. This decrease is due to the dredging of the river bed for timber floating, and overfishing of salmon in the Baltic Sea and the Gulf of Bothnia. According to capture-recapture results, in the late 1970s the annual salmon smolt production was 30,000-60,000, but during the 1980s only 1500-2000. The dredging, mostly performed in the 1950s, seriously reduced reproduction of the salmon stock. Restoration was done after the cessation of log floating, but this compensated for only about half of the damage. Still more restoration is needed in the river. Because of the increased sea fishery there have not been enough spawners to fill areas suitable for salmon fingerlings. The international regulation of the salmon fishery in the Baltic Sea has not succeeded in putting a stop to overfishing. To avoid extinction of the salmon stock in the Simojoki, stocking with parr has begun in the upper part of the river, where no salmon parr are left. Good results have been reached with releases of one-year-old parr. Currently over 60% of the salmon production of the Simojoki originates from stocking. Smolt production in the Simojoki is slightly increasing due to stocking with salmon parr and the national regulation of the sea and river fishery. (Author's abstract)
W91-00016

REINTRODUCTION OF SALMON AND SEA TROUT INTO THE VANTAANJOKI AND KYMIJOKI RIVERS (LOHEN JA MERITAIMENEN PALAUTTTAMINEN VANTAANJOKEEN JA KYMIJOKEEN).
Finnish Game and Fisheries Research Inst., Helsinki.
A. Saura, and J. Mikkola.
Suomen Kalatalous, Vol. 1990, No. 56, p 49-57, 1990. 6 fig, 14 ref. English summary.

Descriptors: *Finland, *Fish management, *Fish populations, *Fish stocking, *Kymijoki River, *Salmon, *Stream fisheries, *Trout, *Vantaanjoki River, Fish ladders, Fish migration, Smolt, Spawning.

The Kymijoki River was once Finland's most important salmon river flowing into the Gulf of Finland. The Vantaanjoki River was once a significant

sea trout river. The original salmonid stocks in both rivers have been destroyed as a result of damming and pollution of the rivers. In the 1970s and 1980s, environmental protection measures aimed at waters, combined with developments in salmon cultivation, provided a solid basis for an attempt at returning salmonids to the Vantaanjoki and Kymijoki rivers. Presently, 100,000 salmon and 60,000 sea trout smolts are released annually in the Vantaanjoki River, and about 300,000 salmon smolts in the Kymijoki River. In addition, salmon and trout parr of different ages have also been released in rapids in both rivers. Smolt releases have resulted in spawning migrations into the river mouths and upstream. The first fish ladders in the Vantaanjoki and Kymijoki rivers are already in use. The catch in the Vantaanjoki River mouth has been, for example, about 300-400 sea trout and 200-300 salmon annually. The river mouth catch represents for trout about 5% and for salmon about 2% of the total annual catch produced by releases in the Vantaanjoki River. The total annual salmon yield from the Langinkoski branch and the mouth of the Kymijoki River was estimated at about 25 tons. Limiting of sea fisheries would increase particular salmon catches in river mouths and upstream. When released in river rapids as 0-year-old fry, trout grow to 10 cm, and salmon to 7 cm on average in the first summer. Both salmon and trout grow to smolt size in 2 years. Regular releases have resulted in many of the experimental rapids in salmon or trout becoming the dominant species. Solely through efficient stocking of fry, the Vantaanjoki River is capable of producing about 50,000 sea trout or salmon smolts annually. The freely flowing (undammed) rapids in the Kymijoki River could produce, correspondingly, at least 100,000 salmon smolts. (Author's abstract)
W91-00017

CULTIVATON AND MANAGEMENT OF LANDLOCKED SALMON AND CHARR IN LAKE SAIMAA (SAIMAAN JARVILOHEN JA NIERIAN VILJELY JA HOITO).
Finnish Game and Fisheries Research Inst., Helsinki.
J. Piironen.
Suomen Kalatalous, Vol. 1990, No. 56, p 66-73, 1990. 1 fig, 3 tab, 22 ref. English summary.

Descriptors: *Char, *Finland, *Fish management, *Fish stocking, *Lake Saimaa, *Lake fisheries, *Salmon, Endangered species, Fish populations.

The presence of fish rarities--the landlocked salmon (Salmo salar m. sebago) and Arctic charr (Salvelinus alpinus)--in the Vuoksi watercourse is the consequence of events which occurred during the last glaciation period. Landlocked salmon have occurred in the whole area of Lake Saimaa, but have reproduced only in the rapids of the rivers Lieksanjoki, Pielisjoki, and Ala-Koitajoki. Arctic charr have also occurred infrequently in many lakes, but the main populations inhabit deep, oligotrophic lakes in the southern rocky belt of Lake Saimaa. Landlocked salmon became an endangered species due to construction in the rivers for hydroelectric power and dredging, which destroyed the spawning areas. Presently, Arctic charr are also very rare, although the reasons for its decrease are not as well known as for the landlocked salmon. The preservation and propagation of both stocks now depend entirely on intensive fish cultivation and stocking, but effective measures must also be found to promote natural reproduction. This article summarizes the history of culture and stocking and describes present practices and problems in the cultivation of landlocked salmon and Arctic charr. Research on the biology and culture of the two species is briefly presented. (Author's abstract)
W91-00018

RESEARCH ON THE FISHERIES OF SMALL LAKES (PIENTEN JARVIEN KALATUTKIMUKSET).
M. Rask, and J. Ruuhijarvi.
Suomen Kalatalous, Vol. 1990, No. 56, p 101-115, 1990. 2 fig, 4 tab, 74 ref. English summary.

Descriptors: *Finland, *Fish management, *Fish populations, *Lake fisheries, *Sport fishing, *Water pollution effects, Acidification, Carp, Crayfish, Eel, Fish stocking, Heavy metals, Mercury, Perch, Pike, Roach, Trout.

The occurrence of fish species in small Finnish lakes may be limited by colonization barriers, temporarily low oxygen concentrations in the water, high acidity or the simple structure of the habitats. The latter can result in the lack of suitable spawning, nursery or feeding sites for fish. The number of species in small lakes is generally low, the most common species being perch, pike, roach, ruffle and burbot. According to Finnish studies, the total fish biomass in small lakes tends to be 20-40 kg/ha, varying between 10 and 100 kg/ha. The highest biomasses of single species, e.g. roach, perch and crucian carp, have been 50 kg/ha. The annual fish production has been estimated to average 5-15 kg/ha. The monetary value of fish yields from small lakes is usually low, with the possible exception of crayfish, but the potential for recreational fishing may be of value. Introductions of valuable species are commonly used to increase the value of fisheries. Stocking with whitefish, bream and eel has been most successful. Introductions of rainbow trout and brown trout of catchable size seems to be a promising means of creating sport fishing waters. The most severe threat to the fisheries of small lakes is environmental degradation. Large scale problems are posed by acidification and the accumulation of mercury and other toxic substances. At the local level, silvicultural and other practices in the catchment areas may cause increasing organic or nutrient loads, which have a deleterious effect on lakes and their fisheries. (Author's abstract)
W91-00019

FISHES OF BULLITT COUNTY, KENTUCKY.
Clemson Univ., SC. Dept. of Biological Sciences.
For primary bibliographic entry see Field 4C.
W91-00108

WATER TEMPERATURE IN A STREAM GRAVEL BED AND IMPLICATIONS FOR SALMONID INCUBATION.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
D. T. Crisp.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 601-612, June 1990. 5 fig, 3 tab, 14 ref. UK Department of the Environment Contract PECD 7/7/159.

Descriptors: *Aquatic life, *Fish, *Freshwater, *Gravel, *Incubation, *Limnology, *Salmonids, *Streambeds, *Streams, *Water temperature, England, Statistical analysis, Trout.

Water temperatures were recorded at hourly intervals in the gravel of a trout spawning area in a small stony stream at depths of 0-20 cm in 1985-86 and 0-40 cm in 1987. As depth within gravel increased, the size of the daily fluctuations reduced and their time of occurrence was delayed by about 12 min/cm in 1985-86 and about 6 min/cm in 1987. From October to February mean temperatures at 20 cm depth were, on average, 0.5 C higher than those at the gravel surface. This reflected elevated daily minima more than it reflected elevated daily maxima. From March to July daily minima were lower and daily maxima were higher in the stream than in the gravel. Consequences were: (a) an appreciable increase in mean daily range at all depths in the gravel during the summer, (b) higher daily means (by an average of about 0.4 C) in the water than in the gravel in May to August. Some implications for the early development of salmonid fish are that trout eggs incubated at 20 cm depth in gravel will hatch some 10-11 days earlier than eggs incubated at the gravel surface. However, the predicted time of eyeing of the eggs (a point in development at which they become markedly less vulnerable to mechanical shock), and of time of swim-up of the fry, differed very little between gravel depths. Because of lower temperatures at increasing depths within the gravel, deeply buried eggs would probably reach swim-up appreciably later than those from shallowly buried eggs. After hatching, the salmonids can and do move in the gravel. They are therefore potentially capable of moving along temperature gradients within the gravel in order to optimize their rate of development. (Agostine-PTT)
W91-00427

MANIPULATING LAKE COMMUNITY STRUCTURE: WHERE DO WE GO FROM HERE.
York Univ., Toronto (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-00428

PLASMA ELECTROLYTES, GILL ALUMINUM CONTENT, AND GILL MORPHOLOGY OF JUVENILE ATLANTIC SALMON (SALMO SALAR) AND BROOK TROUT (SALVELINUS FONTINALIS) INDIGENOUS TO ACIDIC STREAMS OF NOVA SCOTIA.
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
For primary bibliographic entry see Field 5C.
W91-00616

PATTERNS OF FISH SPAWNING IN HUDSON RIVER TRIBUTARIES: RESPONSE TO AN URBAN GRADIENT.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
K. E. Limburg, and R. E. Schmidt.
Ecology ECOLAR, Vol. 71, No. 4, p 1238-1245, August 1990. 6 fig, 1 tab, 20 ref. Hudson River Foundation Grant 005/87R/012.

Descriptors: *Alewife, *Anadromous fish, *Estuarine fisheries, *Hudson River, *Spawning, *Urban watersheds, Environmental gradient, Fish, Fish eggs, Regression analysis, Survival, Tributaries.

Two features of many large river watersheds, their large geographic extent and their occupation and use by humans, should render them good candidates for the manifestation of anthropogenic, ecological gradients. This study was conducted to evaluate the contribution of nontidal tributaries to anadromous fish spawning within a large, riverine estuary. The study was conducted in the watershed of the tidal Hudson River, located in eastern New York State, and 16 tributaries were selected, grouped into four geographic areas ('reaches'). A variety of data were collected, including water quality, physiography, stream characteristics, land use and geographic position in the overall watershed. All streams were sampled weekly from mid-March through June 1988, the period bracketing anadromous fish spawning in the mainstem. Multiple regression analyses were used to examine the relationship of total, anadromous, and resident species' spawning and survival in relationship to water quality parameters, physiography, and land use. Dissolved oxygen values were correlated with neither watershed area nor mean depth at the sampling site, but were both spatially and temporally more variable with increasing land under urbanized use. Spawning activity was highly regionalized, with the vast majority of eggs and larvae collected in three streams in one reach. A total of 23 species was collected, but alewife (Alosa pseudoharengus), composed 93% of the catch. The strongest and most consistent relationship was between densities of eggs and larvae and the index of urbanization, with the data demonstrating a strong threshold effect of urbanization on anadromous spawning success. Salt front location in the Hudson mainstem was not significantly correlated with spawning. The proximal causes of spawning variability result, at least in part, from some aspects of urbanization. (VerNooy-PTT)
W91-00617

RESPONSE OF A BROOK TROUT (SALVELINUS FONTINALIS) POPULATION TO A REDUCTION IN STREAM BENTHOS FOLLOWING AN INSECTICIDE TREATMENT.
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
For primary bibliographic entry see Field 5C.
W91-00660

PREDICTING SUCCESS OF WALLEYE STOCKING PROGRAMS IN THE UNITED STATES AND CANADA.
Idaho Univ., Moscow. Coll. of Forestry.
D. H. Bennett, and T. J. McArthur.
Fisheries (Bethesda) FISHDN, Vol. 15, No. 4, p 19-23, July/August 1990. 3 tab, 14 ref.

Descriptors: *Fish stocking, *Lakes, *Mathematical models, *Reservoirs, *Surveys, *Walleyes, Computers, Lake morphometry, Water quality.

A model was developed to predict the probability of establishing a reproducing population of walleye (Stizostedion vitreum) in lakes and reservoirs in North America. A list of 542 lakes of reservoirs where walleye stocking occurred was obtained by questionnaire survey. Water quality and morphometric data for these systems were obtained from STORET, the national computer data base of the Environmental Protection Agency, and various reports. Two stepwise discriminate analyses were performed on normalized data; the variables area, maximum depth, and pH were found to be significantly related to walleye success in lakes. In addition, the variable date of dam closure was included in the reservoir data set. Using a jackknife discriminate analysis, 71% of the lakes and 72% of the reservoirs were classified correctly. Use of the model increases the probability of predicting the establishment of a self-sustaining walleye population by about 20%. (Author's abstract)
W91-00691

WATER QUALITY IN THE BARYCZ RIVER AND ITS TRIBUTARIES WITHIN THE AREA OF THE LOW SILESIAN COMMERCIAL FISHERY FARM IN MILICZ (JAKOSC WODY RZEKI BARYCZY I JEJ DOPLYWOW NA OBSAZARZE DOLNOSLASKIEGO KOMBINATU RYBACKIEGO).
Akademia Rolnicza, Wroclaw (Poland). Dept. of Limnology.
For primary bibliographic entry see Field 5B.
W91-00734

EFFECT OF REGULATION ON 0+ FISH RECRUITMENT IN THE GREAT OUSE, A LOWLAND RIVER.
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 6G.
W91-00777

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: I. CHARACTERISTICS AND EVALUATION OF FEEDING CONDITIONS (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: I. CHARAKTERYSTYKA I OCENA WARUNKOW POKARMOWYCH).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
J. Leszczynska-Kowalska.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 1, p 7-16, 1990. 2 tab, 31 ref. English summary.

Descriptors: *Carp, *Eutrophic lakes, *Fish food, *Fish stocking, *Lake fisheries, *Limnology, *Poland, Biomass, Eutrophication, Fish behavior, Phytoplankton, Zooplankton.

The feeding conditions encountered by a population of silver carp introduced into a eutrophic lake were evaluated. Five qualitative and quantitative investigations on the phytoplankton and zooplankton composition were carried out during the 1976 growing season. The biomass of phytoplankton was high during the study period, reaching 14.3 to 34.1 mg/L. A quantitative and qualitative analysis of the phytoplankton composition, especially of the blue-green algae which (at high concentrations) can cause perturbations in fish feeding, showed that the algae were not too abundant and no danger of algal toxins was present. The biomass of zooplankton was also high (over 10 mg/L) and declined (to 1.7 mg/L) only towards the end of June, when fish feeding was intensive. The abundance and fractional size of the zooplankton was satisfactory throughout the growing season. Feeding conditions in the lake under study were favorable for the development of the introduced silver carp population. (See also W91-00784 and W91-00785) (Author's abstract)
W91-00783

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: II. QUALITATIVE AND QUANTITATIVE ANALYSES OF NUTRITION AND NUTRITIONAL SELECTIVITY (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: II. JAKOSCIOWA I ILOSCIOWA ANALIZA POKARMU ORAZ WYBIORCZOSC POKARMOWA).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
J. Leszczynska-Kowalska.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 1, p 17-39, 1990. 3 fig, 6 tab, 50 ref. English summary.

Descriptors: *Carp, *Fish food, *Fish stocking, *Lake fisheries, *Limnology, *Poland, Cladocerans, Cyanophyta, Detritus, Eutrophic lakes, Eutrophication, Fish behavior, Lake Paprotecki, Nutrition, Phytoplankton, Population dynamics, Rotifers, Seasonal variation, Species composition, Zooplankton.

Qualitative and quantitative investigations were carried out on the feeding preferences of a silver carp population aged 3+ introduced into a eutrophic lake of known food conditions. Samples were taken five times during the algal growing season at periods coinciding with phytoplankton and zooplankton investigations. Silver carp feed mainly on detritus with phytoplankton and zooplankton making up the balance of the diet. The percentage of zooplankton in the diet was, at times, higher than of the phytoplankton. Feeding intensity was dependent upon thermal conditions and independent of food abundance. Analyses of feeding selectivity showed that silver carp fed on phytoplankton indiscriminantly, consuming all the blue-green algal species found in the lake, but distinct preferences were shown towards small zooplankton taxa. Rotifers and cladocerans were preferred over copepods. The feeding behavior of the silver carp population has a definite impact on the population dynamics and faunal composition of the lake. (See also W91-00785 and W91-00783) (Author's abstract)
W91-00784

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: III. ATTEMPT TO EVALUATE THE PRESSURE ON PLANKTON OF THE INTRODUCED FISH POPULATION (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: III. PROBA OCENY PRESJI INTRODUKOWANEJ POPULACJI RYB NA PLANKTON).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
J. Leszczynska-Kowalska.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 1, p 41-54, 1990. 6 tab, 33 ref. English summary.

Descriptors: *Carp, *Fish food, *Fish stocking, *Lake fisheries, *Limnology, *Poland, Biomass, Ecosystems, Fish behavior, Lake Paprotecki, Phytoplankton, Population dynamics, Zooplankton.

An attempt was made to evaluate the impact of the silver carp population introduced into a eutrophic lake on the plankton biocenosis. On the basis of investigations on the plant and animal plankton an estimation was made of phytoplankton and zooplankton production in the lake, and on their consumption by the introduced fish population. Calculations were made of indices to show utilization of plankton biomass as food by the fish. Utilization of plankton biomass for fish consumption may reach a maximum of 5% for zooplankton and 1% for phytoplankton. Plankton biomass capable of being converted to usable energy by the fish was respectively lower: for zooplankton, around 0.6%; for phytoplankton, around 0.1%. The impact of the fish population on the plankton biocenosis was only slight, making it feasible to increase the level of fish stocking in the lake. Further investigations should be carried out at increased stocking with fish and for longer periods of time. (See also W91-00783 and W91-00784) (Author's abstract)
W91-00785

USE OF UV RADIATION FOR DISINFECTING WATER IN FIRST STAGE GROWTH TANKS STOCKED WITH RAINBOW TROUT LARVAE (ZASTOSOWANIE PROMIENIOWANIA UV DO DEZYNFEKCJI WODY W PODCHOWALNI WYLEGU PSTRAGA).
Instytut Rybactwa Srodladowego, Piaseczno (Poland). Zaklad Rybactwa Stawowego.
R. Kolman.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 1, p 71-85, 1990. 6 fig, 3 tab, 15 ref. English summary.

Descriptors: *Disinfection, *Fish stocking, *Ultraviolet radiation, *Water treatment, Aquatic bacteria, Bacterial analysis, Fish diseases, Fisheries, Recirculated water, Water analysis.

A system was designed and constructed using pressure bactericidal lamps type TUV-30 for disinfecting water. The studies dealing with the effectiveness of this system consisted of the following: model studies, aimed at checking effectiveness of the system at various operation variances, and semitechnical studies, which yielded abundant material characterizing the effect of applied radiation doses at continuous operation on total bacterial counts. The system was found to be useful for treatment of water in recirculating systems used for the production of stocking material. (Author's abstract)
W91-00786

SPATIAL AND TEMPORAL VARIATION IN FISHES OF RIFFLE HABITATS: A COMPARISON OF ANALYTICAL APPROACHES FOR THE ROANOKE RIVER.
Oklahoma Univ., Kingston. Biological Station.
W. J. Matthews.
American Midland Naturalist AMNAAF, Vol. 124, No. 1, p 31-45, July 1990. 3 fig, 5 tab, 33 ref, append.

Descriptors: *Fish populations, *Riffles, *Roanoke River, *Virginia, Bottom sampling, Cluster analysis, Darters, Data acquisition, Fish behavior, Multivariate analysis, Sampling techniques, Seasonal variation, Spatial distribution, Statistical analysis, Temporal distribution.

Spatial and temporal variation in fishes in riffles of the upper Roanoke River system (Virginia) were analyzed in three ways: a two-way (space-time) analysis of variance (ANOVA) of species abundance; a comparison of spatially adjacent and temporally consecutive fish assemblages by Morisita's index of similarity; and comparison of all space x time samples by cluster analysis. At six sites on the river mainstream or large tributaries, fish in riffles were collected by kickset sampling in five surveys from May to November 1978. For species with significant differences in abundance across space or time, variance components were combined into ratios that show relative importance of 'temporal,' 'fixed spatial' and 'ephemeral spatial' effects. The ANOVA was carried out on individual species, but Morisita's index and the cluster analysis were calculated for the entire assemblage of riffle fishes in each sample. Four of the nine most common species (three benthic darters and one sucker) exhibited significant spatial and/or temporal variance, with more of the variance accounted for by spatial than by temporal differences. For two of the four species, the spatial variance was primarily ephemeral, but for the other two spatial variance was

persistent (fixed). Results of the cluster analysis reinforced for whole assemblages the patterns detected for individual species, in that more within-site than within-time similarity existed. Comparison of adjacent and temporally consecutive sites by Morisita's index produced results differing somewhat from those of the first two analyses, in that spatial and temporal differences in assemblages appeared essentially equal. Each of the analytical approaches provided a somewhat different view of sources of spatial and temporal variation in riffle fishes of this stream system, but the overall conclusion was that spatial variation generally exceeded temporal variation. The results suggested that to adequately survey fish of riffles in this or similar systems it may be better to increase the total number of sampling sites, than to increase the number of collections per site. (Author's abstract)
W91-00868

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

PROFESSIONAL CERTIFICATION AND REGISTRATION FOR WATER-RESOURCES AND RELATED DISCIPLINES.
For primary bibliographic entry see Field 6E.
W91-00267

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

NATIONAL WATER INFORMATION SYSTEM USER'S MANUAL VOLUME 2, CHAPTER 3. AUTOMATED DATA PROCESSING SYSTEM.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W91-00442

SOURCES OF WATER-USE INFORMATION IN MAINE.
Maine Geological Survey, Augusta. Dept. of Conservation.
For primary bibliographic entry see Field 6D.
W91-00443

10F. Preparation Of Reviews

FATE AND TRANSPORT OF PETROLEUM RELEASED FROM UNDERGROUND STORAGE TANKS.
University of Southern California, Los Angeles.
For primary bibliographic entry see Field 5B.
W91-00452

SUBJECT INDEX

ABSORPTION
Use of a Gel-Forming Biopolymer Directly Dispensed into a Loop Fluidized Bed Reactor to Recover Dissolved Copper.
W91-00813 5D

ACCELERATED EROSION
Dimensionless Analytical Solutions for Dam-Breach Erosion.
W91-00069 8A

ACCIDENTS
Ecotoxicology: Contamination of the Rhine by the Sandoz Chemical Accident in Basel (Oko-toxikologie am Beispiel der Rheinverschmut-zung durch den Chemie-Unfall bei Sadoz in Basel).
W91-00384 5C

ACETIC ACID
Carcinogenicity of Chlorinated Acetic Acids.
W91-00492 5C

ACID LAKES
Inferred Effects of Lake Acidification on Daphnia galeata mendotae.
W91-00626 5C

Use of Extant Populations of Scaled Chrysophytes for the Inference of Lakewater pH.
W91-00658 5A

Phytoplankton Communities of Lakes Experimentally Acidified with Sulfuric and Nitric Acids.
W91-00659 5C

Creating Conditions for Changes in Prey Community Structure by Chaoborus spp. in a Lake in Sweden.
W91-00697 2H

ACID MINE DRAINAGE
Streamflow and Water-Quality Data for Meadow Run Basin, Fayette County, Pennsylvania, December 1987 - November 1988.
W91-00431 5B

ACID RAIN
Acid Precursor Concentrations Above the Northeastern United States during Summer 1987: Three Case Studies.
W91-00148 5B

Estimates of Ion Sources in Deciduous and Coniferous Throughfall.
W91-00415 5B

Spatial Allocation Factor Procedures for the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory Documentation.
W91-00453 5B

Episodic Acidification of Adirondack Lakes During Snowmelt.
W91-00608 5B

Constant or Increasing Nitrogen Concentrations in Sphagnum Mosses on Mires in Southern Sweden During the Last Few Decades.
W91-00645 2H

Use of Extant Populations of Scaled Chrysophytes for the Inference of Lakewater pH.
W91-00658 5A

Oxidation of S(IV) in Rain-Water Collected in Japan.
W91-00668 5B

Wet Deposition of Volcanic Gases and Ash in the Vicinity of Mount Sakurajima.
W91-00669 5B

Origin of Soluble Chemical Species in Bulk Precipitation Collected in Tokyo, Japan: Statistical Evaluation of Source Materials.
W91-00670 5B

Mesoscale Modeling of Acidity Production in Orographic Clouds and Rain.
W91-00671 5B

Atmospheric Chemistry of Peroxides: A Review.
W91-00841 5B

Field Investigations on the Snow Chemistry in Central and Southern California-I. Inorganic Ions and Hydrogen Peroxide.
W91-00842 5B

Field Investigations on the Snow Chemistry in Central and Southern California-II. Carbonyls and Carboxylic Acids.
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Intensive Studies of Sierra Nevada Cloudwater Chemistry and Its Relationship to Precursor Aerosol and Gas Concentrations.
W91-00846 2B

Chemical Characterization of Acid Precipitation in Albany, New York.
W91-00850 5A

Source-Receptor Relationships for Wet SO4(2-) and NO3(-) Production.
W91-00851 5B

Trace Metal Wet Deposition in Sweden: Insight Gained from Daily Wet Only Collection.
W91-00853 5B

Chemical Composition Differences in Fog and Cloud Droplets of Different Sizes.
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Topographic Effects on Flow Path and Surface Water Chemistry of the Llyn Brianne Catchments in Wales.
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Effects of Catchment Liming and Afforestation on the Concentration and Fractional Composition of Aluminum in the Loch Fleet Catchment, SW Scotland.
W91-00897 5G

ACID RAIN EFFECTS
Longitudinal and Seasonal Water Chemistry Variations in a Northern Appalachian Stream.
W91-00089 2K

Effect of Humic Substances on the Toxicity of Aluminum to Adult Rainbow Trout, Oncorhynchus mykiss (Walbaum).
W91-00371 5C

Responses of Zooplankton and Zoobenthos to Experimental Acidification in a High-Elevation Lake (Sierra Nevada, California, U.S.A).
W91-00425 5C

Cokriging to Assess Regional Stream Quality in the Southern Blue Ridge Province.
W91-00589 5B

Comparative Analysis of Aluminum Biogeochemistry in a Northeastern and a Southeastern Forested Watershed.
W91-00590 2K

Plasma Electrolytes, Gill Aluminum Content, and Gill Morphology of Juvenile Atlantic Salmon (Salmo salar) and Brook Trout (Salvelinus fontinalis) Indigenous to Acidic Streams of Nova Scotia.
W91-00616 5C

Inferred Effects of Lake Acidification on Daphnia galeata mendotae.
W91-00626 5C

Relationships Between Acidity and Benthic Invertebrates of Low-Order Woodland Streams in the Adirondack Mountains, New York.
W91-00657 5C

Phytoplankton Communities of Lakes Experimentally Acidified with Sulfuric and Nitric Acids.
W91-00659 5C

Effect of Fluoride Complexation on Aluminum Toxicity Towards Juvenile Atlantic Salmon (Salmo salar).
W91-00663 5C

Effects of Low pH and Low Calcium Concentration on the Pulmonate Snail Planorbella trivolvis: A Laboratory Study.
W91-00838 5C

Seasonal, Hydrological, and Land Management Factors Controlling Dissolved Organic Carbon Concentrations in the Loch Fleet Catchments, Southwest Scotland.
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Effects of Catchment Liming and Afforestation on the Concentration and Fractional Composition of Aluminum in the Loch Fleet Catchment, SW Scotland.
W91-00897 5G

ACID STREAMS
Longitudinal and Seasonal Water Chemistry Variations in a Northern Appalachian Stream.
W91-00089 2K

Relationships Between Acidity and Benthic Invertebrates of Low-Order Woodland Streams in the Adirondack Mountains, New York.
W91-00657 5C

ACIDIC WATER
Effect of Humic Substances on the Toxicity of Aluminum to Adult Rainbow Trout, Oncorhynchus mykiss (Walbaum).
W91-00371 5C

Episodic Acidification of Adirondack Lakes During Snowmelt.
W91-00608 5B

Effects of Catchment Liming and Afforestation on the Concentration and Fractional Composition of Aluminum in the Loch Fleet Catchment, SW Scotland.
W91-00897 5G

ACIDIFICATION
Responses of Zooplankton and Zoobenthos to Experimental Acidification in a High-Elevation Lake (Sierra Nevada, California, U.S.A).
W91-00425 5C

Cokriging to Assess Regional Stream Quality in the Southern Blue Ridge Province.
W91-00589 5B

Effects of Low pH and Low Calcium Concentration on the Pulmonate Snail Planorbella trivolvis: A Laboratory Study.
W91-00838 5C

Atmospheric Chemistry of Peroxides: A Review.
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ACTIVATED CARBON
Adsorption Removal of Cresol by Granular Activated Carbon for Medical Waste Water Treatment.
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Activated-Carbon Adsorption.
W91-00912 5D

ACTIVATED SLUDGE
Comparison of Growth and Nutrient Removal Efficiency of Chlorella pyrenoidosa in Settled and Activated Sewages.
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Instability of the Morpholine-Degradative Phenotype in Mycobacteria Isolated from Activated Sludge.
W91-00875 5D

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Effect of Withdrawal of Morpholine from the Influent and Its Reinstatement on the Performance and Microbial Ecology of a Model Activated Sludge Plant Treating a Morpholine-Containing Influent.
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ACUTE TOXICITY
Reproductive Strategy of Daphnia magna Affects the Sensitivity of Its Progeny in Acute Toxicity Tests.
W91-00192 5A

Influence of pH, Temperature and Sediment Type on the Toxicity, Accumulation and Degradation of Parathion in Aquatic Systems.
W91-00193 5B

Behavioral Changes in Gammarus pulex and Its Significance in the Toxicity Assessment of Very Low Levels of Environmental Pollutants.
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Effects of Deltamethrin and Ethanol on Survival, and Mechanical Response of Daphnia spinulata.
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Comparative Toxicity of an Effluent from a Chlor-Alkali Industry and HgCl2.
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Seasonal Changes in the Testes of Fish Puntius ticto, and Their Relation to Heavy Metal Toxicity.
W91-00211 5C

Gonadal Histopathology Following Nickel Intoxication in the Giant Gaurami Colisa fasciatus (Bloch and Schneider), a Freshwater Tropical Perch.
W91-00213 5C

Effect of Humic Substances on the Toxicity of Aluminum to Adult Rainbow Trout, Oncorhynchus mykiss (Walbaum).
W91-00371 5C

ADAPTATION
Reproductive Strategy of Daphnia magna Affects the Sensitivity of Its Progeny in Acute Toxicity Tests.
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Episodic Acidification of Adirondack Lakes During Snowmelt.
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Superfund Record of Decision: Independent Nail, SC.
W91-00446 5G

Superfund Record of Decision: French Limited, TX.
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Forced Aeration of High Velocity Flows.
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Gas Exchange Rates for a First-Order Stream Determined with Deliberate and Natural Tracers.
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Commercial Oxygen Use in Water-Quality Management.
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AERATION ZONE
Qualitative Validation of Pollutant Transport Components of an Unsaturated Soil Zone Model (SESOIL).
W91-00573 5B

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W91-00061 8B

AEROBIC TREATMENT
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W91-00801 5G

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Targeting Remedial Measures to Control Nonpoint Source Pollution.
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State Agricultural Pollution Regulation: A Quantitative Analysis.
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Air Entrainment by Spillway Aerators.
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Spatial Allocation Factor Procedures for the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory Documentation.
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W91-00841 5B

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W91-00846 2B

Effect of Daytime Surface Evaporation on Pollution Dispersion.
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W91-00850 5A

Source-Receptor Relationships for Wet SO4(2-) and NO3(-) Production.
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Trace Metal Wet Deposition in Sweden: Insight Gained from Daily Wet Only Collection.
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Chemical Composition Differences in Fog and Cloud Droplets of Different Sizes.
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AIR POLLUTION SOURCES
Effect of Daytime Surface Evaporation on Pollution Dispersion.
W91-00848 5B

Chemical Characterization of Acid Precipitation in Albany, New York.
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Air Stripping and Steam Stripping.
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Gas Exchange Rates for a First-Order Stream Determined with Deliberate and Natural Tracers.
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Short-Term Productivity Responses of Algae and Bacteria to Zooplankton Grazing in Two Freshwater Lakes.
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Interactions Among Nutrients, Algae and Invertebrates in a New Zealand Mountain Stream.
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Photosynthesis of Dunaliella parva Lerche as a Function of Temperature, Light and Salinity.
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Seasonal Variation of Sirodotia delicatula Skuja (Rhodophyta, Batrachospermaceae) in a Small Stream From Sao Paulo State, Southeastern Brazil.
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Studies on the Algae of a Small Softwater Stream II. Algal Standing Crop (Measured by Chlorophyll-a) on Soft and Hard Substrata.
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Large-Scale Patterns of Nodularia spumigena Blooms in Pyramid Lake, Nevada, Determined from Landsat Imagery: 1972-1986.
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Reduction of Phosphorus and Chlorophyll a Concentrations Following CaCO3 and Ca(OH)2 Additions to Hypereutrophic Figure Eight Lake, Alberta, Canada.
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Microcystin Composition of an Axenic Clonal Strain of Microcystis viridis and Microcystis viridis-Containing Waterblooms in Japanese Freshwaters.
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 24, NUMBER 2
FEBRUARY 1991

W91-01005 -- W91-02043
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 24, NUMBER 2
FEBRUARY 1991

W91-01005 -- W91-02043

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The Secretary of the Interior has deterimined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 1991.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

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Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

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SELECTED WATER RESOURCES ABSTRACTS

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2A. General

PHYSICALLY BASED MODEL FOR PREDICTING SOLUTE TRANSFER FROM SOIL SOLUTION TO RAINFALL-INDUCED RUNOFF WATER.
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 5B.
W91-01527

KINEMATIC CASCADES: DERIVATION OF A GENERALIZED SHOCK FORMATION CRITERION.
Technische Univ., Vienna (Austria). Inst. fuer Hydraulik Gewasserkunde und Wasserwirtschaft.
For primary bibliographic entry see Field 8B.
W91-01673

2B. Precipitation

PRECIPITATION NUTRIENT INPUTS IN SEMIARID ENVIRONMENTS.
Agricultural Research Service, Tucson, AZ. Aridland Watershed Management Research Unit.
W. E. Emmerich.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 621-624, July/September 1990. 1 fig, 5 tab, 18 ref.

Descriptors: *Chemistry of precipitation, *Nutrient transport, *Nutrients, *Precipitation, *Semiarid lands, Air masses, Ammonium, Arizona, Nitrates, Nutrient concentrations, Phosphates, Potassium, Seasonal variation, Spatial variation, Storms.

Seasonal and spatial variations in precipitation nutrient inputs were suggested by differences in storm type and air mass origin into southeastern Arizona. Wet precipitation nitrate-N, ammonium-N, phosphate-P, and K inputs were collected at seven sites to determine seasonal and spatial variations in nutrient inputs. Total nutrient inputs and concentrations in summer precipitation were significantly greater than in winter precipitation. Higher total summer inputs and concentrations were attributed to storm type and air mass origin rather than to precipitation amount, as summer precipitation accounted for 56% of the precipitation and 79, 69, 66, and 73% of the nitrate-N, ammonium-N, phosphate-P, and K, respectively. Spatial variability in nutrient input was limited to specific nutrients, seasons, and sites and attributed to precipitation variability and localized sources. Generally, the air masses and storm types that produced seasonal differences in nutrient inputs and concentrations affected all sites uniformly. (Author's abstract)
W91-01030

RAINFALL INDUCED SOIL SEAL (C) A DYNAMIC MODEL WITH KINETIC ENERGY INSTEAD OF CUMULATIVE RAINFALL AS INDEPENDENT VARIABLE.
Hebrew Univ., Rehovoth (Israel). Dept. of Soil and Water Sciences.
For primary bibliographic entry see Field 2G.
W91-01089

MODIFIED KOEPPEN CLASSIFICATION APPLIED TO MODEL SIMULATIONS OF GLACIAL AND INTERGLACIAL CLIMATES.
Wisconsin Univ.-Madison. Center for Climatic Research.
P. J. Guetter, and J. E. Kutzbach.
Climatic Change CLCHDX, Vol. 16, No. 2, p 193-215, April 1990. 7 fig, 3 tab, 41 ref.

Descriptors: *Atmospheric circulation, *Classification, *Climates, *Climatic changes, *Climatology, *Glaciers, *Global warming, *Mathematical models, Koeppen classification, Solar radiation.

A series of experiments was done using an atmospheric general circulation model to simulate climates from full glacial time at 18 ka (thousands of years before the present) to the present at 3000 year intervals, and at 126 ka, the previous interglacial period. A modified Koeppen climate classification was developed to aid in the interpretation of the results of the circulation model experiments. The climate classification scheme permits the characterization of eleven distinct seasonal temperature and precipitation regimes. For the modern climate, the modified classification agrees well with a classification of natural vegetation zones, and provides an easily-assimilated depiction of climate changes resulting from the varying boundary conditions in the past. At 18 ka, the time of glacial maximum, 45% of the land surface had climate classifications different from the present. At 126 ka, a time when northern hemisphere summer radiation was much greater than at present owing to changes in the date of perihelion and tilt of the earth's axis, the corresponding difference was 32%. For all experiments, 3 to 18 ka and 126 ka, only 30% of the land surface showed no change in climate classification from the present. Core areas showing no change included the Amazon basin, the northern Sahara and Australia. (Author's abstract)
W91-01091

CLIMATE AND VEGETATION IN CHINA. III. WATER BALANCE AND DISTRIBUTION OF VEGETATION.
Osaka Univ. (Japan). Faculty of Science.
For primary bibliographic entry see Field 2I.
W91-01125

ACID RAIN MODEL DEVELOPMENT CONSIDERING ALTITUDINAL PRECIPITATION RATE.
Korea Advanced Inst. of Science and Technology, Seoul (Republic of Korea). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-01286

SEMI-EMPIRICAL APPROACH TO ESTIMATE VERTICAL TRANSPORT BY NONPRECIPITATING CONVECTIVE CLOUDS ON A REGIONAL SCALE.
Research Triangle Inst., Research Triangle Park, NC.
For primary bibliographic entry see Field 5B.
W91-01287

CHEMISTRY OF DEWS AND FROSTS IN INDIANAPOLIS, INDIANA.
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
For primary bibliographic entry see Field 5B.
W91-01288

HAILSTONES AS CLOUD WATER COMPOSITION PROBES: AN INITIAL ASSESSMENT.
Washington State Univ., Pullman. Lab. for Atmospheric Research.
For primary bibliographic entry see Field 2K.
W91-01289

DESIGN FOR AN OCCULT PRECIPITATION COLLECTOR.
Victoria Univ. of Manchester (England). Dept. of Environmental Biology.
For primary bibliographic entry see Field 7B.
W91-01291

GLOBAL CLIMATE CHANGE: IMPLICATIONS FOR AIR TEMPERATURE AND WATER SUPPLY IN CANADA.
Canadian Climate Centre, Downsview (Ontario).
H. G. Hengeveld.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 176-182, March 1990. 3 fig, 1 tab, 33 ref.

Descriptors: *Air temperature, *Canada, *Climatic changes, *Climatology, *Global warming, *Water supply, Air pollution, Aquatic environment, Atmospheric chemistry, Data interpretation, Model studies, Precipitation, Research priorities, Runoff, Soil moisture.

Results of recent research on changes in atmospheric chemistry and responses of the climate system, with particular focus on those factors important to aquatic ecosystems, are summarized. Measurements of atmospheric concentrations of climatically important gases over the past 30 years indicate a rapid rise in values, largely attributable to human activities. Results of climate model experiments project a major global climate warming of 1.5-4.5 C during the next century, should the concentrations of these gases continue to increase as predicted. In addition to the direct effects of warming on regional air temperatures and the frequency and severity of extreme heat events, hemispheric wind patterns and hence rainfall distribution will be affected. As a result, soil moisture, runoff, and water supplies to catch basins will change. Such changes have important implications for the nature of future aquatic environments. These projected changes need to be addressed by integrated research, planning, and management. (Author's abstract)
W91-01388

POTENTIAL CHANGES IN THERMAL STRUCTURE AND CYCLE OF LAKE MICHIGAN DUE TO GLOBAL WARMING.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W91-01389

THERMAL STRUCTURE OF THE LOWER GREAT LAKES IN A WARM YEAR: IMPLICATIONS FOR THE OCCURRENCE OF HYPOLIMNION ANOXIA.
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W91-01390

EFFECTS OF CLIMATE WARMING ON DISSOLVED OXYGEN CONCENTRATIONS IN LAKE ERIE.
HydroQual, Inc., Mahwah, NJ.
For primary bibliographic entry see Field 2H.
W91-01391

POTENTIAL APPLICATION OF MODELS IN FORECASTING THE EFFECTS OF CLIMATE CHANGES ON FISHERIES.
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. L. DeAngelis, and R. M. Cushman.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 224-239, March 1990. 5 fig, 2 tab, 38 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Climatic changes, *Climatology, *Fisheries, *Global warming, *Model studies, Carbon dioxide, Forecasting, Greenhouse effect, Literature review, Mathematical models.

Increased concentrations of carbon dioxide and other 'greenhouse gases' in the atmosphere and the possible resulting climatic changes will affect marine and freshwater fisheries. Many of the links in the causal chains relating these environmental changes to possible changes in fish stocks may be amenable to prediction through mathematical modeling. The adequacy of existing types of mathematical models relating changes in atmospheric CO2 to changes in environmental conditions and ultimately to changes in fish stocks is reviewed in the context of an overall strategy for forecasting changes in fish stocks. The model types include ecosystem models, fish physiological process models, and fish population models. When integrated with the chain of linkages suggested by envirograms, these models can form a coherent strategy for prediction of future changes. This strategy includes: (1) identification, through modeling and other information, of the causal chains

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likely to be strongest for a variety of important fisheries; (2) a focus of efforts on improving the accuracy of models representing these chains by continuing to refine models through corroboration with appropriate data collected year by year, and an estimation of uncertainties and incorporation of these into models; and (3) by viewing modeling as a means to generate ranges of possible outcomes rather than definite predictions. (White-Reimer-PTT)
W91-01392

TEMPERATURE-OXYGEN HABITAT FOR FRESHWATER AND COASTAL STRIPED BASS IN A CHANGING CLIMATE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
C. C. Coutant.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 240-253, March 1990. 7 fig, 55 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Aquatic habitats, *Climatic changes, *Climatology, *Global warming, *Physicochemical properties, *Striped bass, Chesapeake Bay, Coastal areas, Dissolved oxygen, Florida, Gulf of Mexico, Gulf of St Lawrence, Model studies, Temperature effects.

Habitat space for a fish species is normally constrained by extreme temperatures and low dissolved oxygen concentrations that the fish avoid. Both latitudinal limits to a species' geographic distribution and availability of suitable habitat on the local level may be altered by climate change. During the next century, average temperatures are expected to rise globally, and rainfall is expected to decrease in mid latitudes and increase in high latitudes. Some possible effects of climate change on distribution of anadromous and landlocked stocks of striped bass Morone saxatilis are predicted. The tenuous existence of striped bass along the northern coast of the Gulf of Mexico and in Florida will likely be jeopardized by regional warming and reduced streamflow. In many freshwater lakes, reservoirs, and estuaries, the existing summer constriction of suitable habitat by high temperatures and low oxygen concentrations may be aggravated by warming, altered streamflow, and increased hypoxia. A major loss of habitat is predicted to occur in the Chesapeake Bay, where the species has had its greatest abundance historically. An expansion of the species' range around Nova Scotia and farther into the Gulf of St. Lawrence may occur, although the cold Labrador Current may increase in volume and cancel any potential water temperature increases in the northernmost range of the species. The understanding of the habitat requirements of many commercially and recreationally important fish species exceeds the confidence in climate models, but will allow forecasts of changes in regional and local habitat suitability as the understanding of climate and the ability to forecast it improve. (Author's abstract)
W91-01393

POTENTIAL CHANGES IN THE THERMAL HABITAT OF GREAT LAKES FISH AFTER GLOBAL CLIMATE WARMING.
Wisconsin Univ.-Madison. Center for Limnology.
J. J. Magnuson, J. D. Meisner, and D. K. Hill.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 254-264, March 1990. 3 fig, 2 tab, 38 ref. National Sea Grant College Program and state of Washington federal grant NA800-AA-D-0086, project R/GB-28.

Descriptors: *Aquatic habitats, *Climatic changes, *Climatology, *Fisheries, *Global warming, *Great Lakes, *Limnology, *Temperature effects, Anoxic conditions, Black bass, Fish populations, Lake Erie, Lake Michigan, Model studies, Perch, Pikeperch, Salmon, Thermal stratification, Trout, Whitefish.

The potential changes in the size of thermal habitat of representative cold-, cool-, and warmwater fish were estimated for southern Lake Michigan and the central basin of Lake Erie before and after simulated global warming. Observed midlake thermal structures were modeled (BASE) and then manipulated with three general circulation climate models (OSU, GISS, GFDL) that projected warmer climates when atmospheric carbon dioxide concentrations were doubled. Under BASE conditions, on an annual basis, lake trout Salvelinus namaycush had the largest thermal habitat in southern Lake Michigan, coho salmon Oncorhynchus kisutch and yellow perch Perca flavescens had smaller thermal habitats, and largemouth bass Micropterus salmoides had none. Even for lake trout, the suitable thermal habitat was only 5-20% of the upper 200 m through the year. With rare exceptions, thermal habitat increased for species in all thermal guilds for all climate-warming scenarios. No thermal habitat was estimated for cold-water fish in the central basin of Lake Erie because the hypolimnion becomes anoxic in summer. The median increase in thermal habitat was 2.5 x BASE condition both for southern Lake Michigan and the central basin of Lake Erie. After climate warming, minimum thermal habitat during summer decreased for walleye Stizostedion vetreum, increased for yellow perch, and remained the same for lake whitefish Coregonus clupeaformis and lake trout. Fish yields estimated from published empirical models that relate thermal habitat in summer to maximum sustained yields remained about the same for lake trout and lake whitefish but increased for walleye. It was concluded that the sizes of the habitat favorable for cold-, cool-, and warmwater fish would increase in Lake Michigan, whereas the habitats favorable only for cool-, and warm water fish would increase in Lake Erie. (Author's abstract)
W91-01394

POTENTIAL EFFECTS OF GLOBAL CLIMATE WARMING ON THE GROWTH AND PREY CONSUMPTION OF GREAT LAKES FISH.
Wisconsin Univ.-Madison. Center for Limnology.
D. K. Hill, and J. J. Magnuson.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 265-275, March 1990. 5 fig, 1 tab, 34 ref. National Sea Grant College Program and state of Wisconsin federal grant NA800AA-D-00086.

Descriptors: *Climatic changes, *Climatology, *Fish growth, *Fish populations, *Food chains, *Global warming, *Great Lakes, *Limnology, *Temperature effects, Bioenergetics, Model studies, Predation, Prey, Seasonal variation, Thermoregulation.

Fish bioenergetics models were used to assess the effect of global climate warming on the growth and prey consumption of warm-, cool-, and cold-water fishes at three sites spanning the range of thermal environments in the Great Lakes. Historical air and water temperature data and projected air temperature changes from three global climate models were used as input to regression models, which generated projections of water temperature changes before and after climate warming that would result from a doubling in atmospheric CO2 concentration. The bioenergetics simulations indicated that annual growth by yearling fish would increase with climate warming if prey consumption increased, but would decrease if prey consumption was constant. Changes in growth would be most pronounced in spring and autumn owing to a lengthening of the period during which fishes may behaviorally thermoregulate to find their optimal temperature for growth. Fish unable to thermoregulate (e.g. due to hypolimnetic oxygen depletion) would undergo decreased growth or weight loss in summer in warmer areas of the Great Lakes, where near-surface water temperatures would increase above the fishes' optimum. It was concluded that the food web dynamics and the potential for thermoregulation will greatly influence the direction and magnitude of changes in fish growth as the climate warms. (Author's abstract)
W91-01395

EFFECT OF AIR TEMPERATURE ON GROWTH OF LARGEMOUTH BASS IN NORTH AMERICA.
Wilfrid Laurier Univ., Waterloo (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-01396

POTENTIAL LOSS OF THERMAL HABITAT FOR BROOK TROUT, DUE TO CLIMATIC WARMING, IN TWO SOUTHERN ONTARIO STREAMS.
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 8I.
W91-01397

SEA LAMPREY AS AN EARLY RESPONDER TO CLIMATE CHANGE IN THE GREAT LAKES BASIN.
Toronto Univ. (Ontario). Dept. of Zoology.
J. A. Holmes.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 292-300, March 1990. 2 fig, 2 tab, 49 ref. Natural Sciences and Engineering Research Council of Canada Operating Grant OGP0003918.

Descriptors: *Bioindicators, *Climatic changes, *Climatology, *Global warming, *Great Lakes Basin, *Lamprey, *Limnology, Conductivity, Egg incubation, Forecasting, Growth, Model studies, Regression analysis, Temperature effects.

Forecasts based on initial assessments of climate change and its consequences for aquatic ecosystems are unlikely to be taken seriously unless some evidence becomes available that the forecasted effects are occurring. Many population rate processes should respond early to temperature and these responses may be used to detect some of the ecological effects of climate warming early in the process of change. In the Great Lakes basin, larval sea lampreys Petromyzon marinus and other stream fish may be such indicators. The hypothesis that temperature exerts a significant influence on two rate processes of sea lamprey, egg hatching and larval growth rate were tested by regression analysis using the Arrhenius model. The length of egg incubation was significantly related to the proportion of eggs hatching and to temperature ($P < 0.01$); temperature accounted for 88% of the total variability in hatching time. Both temperature and conductivity (as surrogate measure of stream productivity) were significant ($P < 0.01$) univariate predictors of growth rate in larval sea lamprey populations subjected to repeated lampricide treatments. However, temperature was the better predictor of growth ($r\ sq = 0.56$) and the conductivity variable did not contribute significantly ($P > 0.15$) in a stepwise multiple regression. Forecasts can be based on these temperature relationships which can be tested if and when climate change occurs. (Author's abstract)
W91-01398

SIZE-DEPENDENT WINTER MORTALITY OF YOUNG-OF-THE-YEAR WHITE PERCH: CLIMATE WARMING AND INVASION OF THE LAURENTIAN GREAT LAKES.
York Univ., Toronto (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 8I.
W91-01399

CLIMATE, POPULATION VIABILITY, AND THE ZOOGEOGRAPHY OF TEMPERATE FISHES.
Ontario Ministry of Natural Resources, Maple. Fisheries Branch.
B. J. Shuter, and J. R. Post.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 314-336, March 1990. 15 fig, 5 tab, 72 ref, append.

Descriptors: *Climatic changes, *Climatic effects, *Climatology, *Fish populations, *Population dynamics, *Zoogeography, Age classes, Black bass, Distribution, Fish behavior, Global warming, Perch, Seasonal variation, Starvation, Thermal effects.

The feeding activity of warmwater and coolwater fishes can be severely restricted during the long period of cold temperatures characteristic of

winter in temperate zone lakes and rivers. The effect of such restriction is greater for smaller fish. Weight-specific basal metabolism increases as size decreases; however, there is no corresponding increase in energy storage capacity. Thus, smaller fish tend to be less tolerant of starvation conditions because they exhaust their energy stores sooner. Such size dependence of starvation endurance has often been observed in laboratory experiments. In wild populations commonly subject to winter starvation, population viability hinges on the ability of young-of-the-year to complete a minimum amount of growth during their first year of life. From south to north, this ability is increasingly restricted as the growing season shortens and the starvation period lengthens. It is shown that this constraint is sufficient to explain the present locations of the northern distributional limit for yellow perch Perca flavescens in central and western North America, the northern distributional limit for Eurasian perch P. fluviatilis in Eurasia, and the northern distributional limit for smallmouth bass Micropterus dolomieui in central North America. Shifts in North American climate may relax this constraint and permit both yellow perch and smallmouth bass to thrive well to the north of their present distributions. (Author's abstract)
W91-01400

CLIMATE CHANGE AND FISH COMMUNITIES: A CONCEPTUAL FRAMEWORK.
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 8I.
W91-01401

IMPLICATIONS OF CLIMATE CHANGE FOR FISHERIES MANAGEMENT POLICY.
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
For primary bibliographic entry see Field 8I.
W91-01402

INFLUENCE OF TEMPERATURE CHANGES ON AQUATIC ECOSYSTEMS: AN INTERPRETATION OF EMPIRICAL DATA.
Toronto Univ. (Ontario). Dept. of Zoology.
H. A. Regier, J. A. Holmes, and D. Pauly.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 374-389, March 1990. 12 fig, 3 tab, 66 ref. Natural Sciences and Engineering Research Council of Canada Grant OGP0003918.

Descriptors: *Aquatic organisms, *Climatic changes, *Climatology, *Data interpretation, *Ecosystems, *Limnology, *Temperature effects, Adaptation, Exponential models, Global warming, Model studies, Physicochemical properties, Temperature.

Many mathematical relationships have been used to summarize quantitative information about the effects of temperature on rate processes in ectothermic living systems. One of the more common relationships, which has been used for a century is termed the 'combined exponential model.' An exponential model, as with a first-order chemical reaction, is used to define a coefficient for a rate at a particular temperature; another exponential relationship (of the van't Hoff or the Arrhenius form) is then used to relate the coefficients of the rate process to their respective temperatures. The Arrhenius form has come to be preferred over the van't Hoff form. In ectotherm physiology, the combined exponential model applies when the relevant organism has not evolved means of compensating biologically for the underlying physicochemical dynamics as affected by temperature. The applicability of the combined model, of the Arrhenius form, to analogous ecological situations for aquatic ectothermic populations and ecosystems was assessed. On an empirical basis, it was found that this combined model has some utility in that it permits approximate assessments of some ecosystemic effects of climate warming. Aquatic ecosystems of temperate waters or that are dominated by ectothermic r-type species appear to possess relatively little self-organizing capability to compensate for climate warming. As with other living systems at lower 'levels of organization' that have not evolved internal ways to temper external temperature fluctuations, certain ecosystem processes may adapt to climate warming approximately as indicated by the combined exponential model. (Author's abstract)
W91-01403

DRY DEPOSITION OF SULFUR: A 23-YEAR RECORD FOR THE HUBBARD BROOK FOREST ECOSYSTEM.
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
For primary bibliographic entry see Field 5B.
W91-01411

RELATIONSHIP BETWEEN CANADIAN PRAIRIE DRY AND WET MONTHS AND CIRCULATION ANOMALIES IN THE MID-TROPOSPHERE.
J. L. Knox, and R. G. Lawford.
Atmosphere - Ocean ATOCDA, Vol. 28, No. 2, p 189-215, June 1990. 11 fig, 5 tab, 24 ref. 2 append.

Descriptors: *Atmospheric circulation, *Canada, *Climatology, *Prairies, *Precipitation, Areal precipitation, Atmospheric physics, Atmospheric water, Climatic changes, Climatic zones, Data analysis, Model studies, Precipitation mapping, United States.

The dry and wet months for the Canadian prairies during the 40-year period 1946-1985 were identified and the relationship to the Northern Hemisphere circulation at the 50-kPa and 100-kPa levels is investigated. The target area is first subdivided into five zones on the basis of characteristic differences in precipitation climatology, and for each zone the dates of occurrence of dry and wet months are determined. These events are then stratified into five 'seasons'. Much of the analysis focuses on the two growing seasons: spring, defined as April and May, and early summer, June and July. Composite anomaly fields for the Northern Hemisphere are constructed for the 50-kPa level by 'season' and zone, and for the dry and wet groupings. For each zone, the two 50-kPa anomaly fields dry and wet are clearly distinguishable, not only over North America but in many instances, upstream and downstream of the continent. Composite anomalies are shown to be zone-sensitive. The 100-kPa and 50-kPa anomalous wind fields associated with the dry and wet regimes, respectively, are found to be consistent with dynamic and thermodynamic processes that control the production of precipitation. Anomaly field structures over the oceans and North America are related to Northern Hemisphere tropospheric circulation modes, including the Pacific-North Atlantic pattern, and the North Pacific and North Atlantic oscillations. High-latitude blocking over the North Atlantic and North Pacific is often associated with wet months, particularly in spring, whereas 'in situ' blocking over western Canada or simply amplified ridging extending northward from the western United States is almost invariably associated with dry months. (Author's abstract)
W91-01429

RADAR OBSERVATIONS OF PRECIPITATION PRODUCTION IN THUNDERSTORMS.
McGill Univ., Montreal (Quebec). Dept. of Meteorology.
G. W. Reuter.
Atmosphere - Ocean ATOCDA, Vol. 28, No. 2, p 216-229, June 1990. 6 fig, 4 tab, 24 ref.

Descriptors: *Meteorology, *Precipitation, *Radar, *Rainstorms, *Thunderstorms, Atmospheric physics, Atmospheric water, Local precipitation, Mathematical analysis, Mathematical equations, Rainfall intensity, Rainfall rate, South Africa.

Little is known about the magnitudes and temporal behavior of integrated storm parameters for thunderstorms in regions outside North America. Precipitation production was investigated for 9 intense thunderstorms that developed over the Lowveld in South Africa. A C-band radar was used to observe the 3-dimensional reflectivity pattern of the storms. Using an empirical relation between reflectivity factor and precipitation content and integrating over the storm volume provides an estimate of the total precipitation content aloft. Likewise, an area integration of the instantaneous rain rate at cloud base yields an estimate of the rate of total outflow. At their maturing stage, the storms had precipitation contents of 0.2 to 5.0 Tg and rainfall rates of about 0.3 to 2.0 Gg/s. The total accumulation of rain at the ground ranged from 1 to 10 Tg. The characteristic storm updraft, defined as the ratio of the area-averaged rainfall rate to the volume-averaged precipitation content, was about 5 m/x for all storms. The time evolution of integral storm parameters is also presented and related to the overall storm development. The precipitation production values observed in the Lowveld storms compares well with previous estimates reported for large thunderstorms observed in Alberta and New England. (Author's abstract)
W91-01430

RELEVANCE OF THE MICROPHYSICAL AND RADIATIVE PROPERTIES OF CIRRUS CLOUDS TO CLIMATE AND CLIMATIC FEEDBACK.
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
G. L. Stephens, S. C. Tsay, P. W. Stackhouse, and P. J. Flatu.
Journal of the Atmospheric Sciences JAHSAK, Vol. 47, No. 14, p 1742-1753, July 15, 1990. 8 fig, 1 tab, 30 ref. append. NSF Contract ATM-8812353 and USAF Contract AFOSR-88-0143.

Descriptors: *Air temperature, *Climatology, *Cloud physics, *Ice, *Radiation, Albedo, Atmospheric physics, Atmospheric water, Carbon dioxide, Climatic changes, Data analysis, Global warming, Mathematical analysis, Mathematical models, Model studies, Physical properties, Radar.

The effects of the relationship between cirrus cloud ice water content and cloud temperature on climate change are examined. A simple mechanistic climate model is used to study the feedback between ice water content and temperature. The central question studied concerns the extent to which both the radiative and microphysical properties of cirrus cloud influence such a feedback. To address this question, a parameterization of the albedo and emissivity of clouds is introduced. Observations that relate the ice water content to cloud temperature are incorporated in the parameterization to introduce a temperature dependence to both albedo and emittance. The cloud properties relevant to the cloud feedback are expressed as functions of particles size re, asymmetry parameter g and cloud temperature and analyses of aircraft measurements, lidar and ground based radiometer data are used to select re and g. Scattering calculations assuming spherical particles with a distribution described by re = 16 microns reasonably matched the lidar and radiometer data. However, comparison of cloud radiation properties measured from aircraft to those parameterized in this study required values of g significantly smaller than those derived for spheres but consistent with our understanding of nonspherical particle scattering. The climate simulations revealed that the influence of cirrus cloud on climate was strongly affected by the choice or re and g: parameters that are both poorly known for cirrus. The effect of ice water feedback on a CO2 warming simulation could be either positive or negative depending on the value of re assumed. Based on these results, it was concluded that prediction of cirrus cloud feedback on climate is both premature and limited by our lack of understanding of the relationship between size and shape of ice crystals and the gross radiative properties of cirrus. (Author's abstract)
W91-01445

TIME SCALES AND VARIABILITY OF AREA-AVERAGED TROPICAL OCEANIC RAINFALL.
Texas A and M Univ., College Station. Dept. of Meteorology.
K. S. Shin, G. R. North, Y. S. Ahn, and P. A. Arkin.
Monthly Weather Review MWREAB, Vol. 118,

No. 7, p 1507-1516, July 1990. 7 fig, 24 ref. NOAA Grant NA87AA-D-CC118 and NASA Grant NAG5-868.

Descriptors: *Marine climates, *Meteorology, *Pacific Ocean, *Rainfall distribution, *Statistical analysis, *Tropical regions, Analysis of variance, Convection, Correlation analysis, Data interpretation, Diurnal variation, Mathematical analysis, Meteorological data, Satellite technology, Tropic zone, Variability.

A statistical analysis of time series of area-averaged rainfall over the oceans has been conducted around the diurnal time scale. The results of this analysis can be applied directly to the problem of establishing the magnitude of expected errors to be incurred in the estimation of monthly area-averaged rain rates from low orbiting satellites. Such statistics as the mean, standard deviation, integral time scale of background red noise and spectral analyses were performed on time series of the GOES Precipitation Index (GPI) taken at 3-hour intervals during the period spanning December 19, 1987 to March 31, 1988 over the central and eastern tropical Pacific. The analyses have been conducted on 2.5 degree x 2.5 degree and 5 degree x 5 degree grid boxes, separately. The ratio of standard deviation to mean for area-averaged rain rate in the Pacific ITCZ is very regular and similar to that in GATE. Analysis of the area-averaged rainfall in the SPCZ shows a longer autocorrelation time scale than that in the ITCZ. The SPCZ exhibits significant power at the diurnal and semidiurnal frequencies, but the ITCZ shows only a marginally significant diurnal cycle in the data. The rainfall characteristics in the Pacific ITCZ appear to be similar to those in the Atlantic ITCZ in both autocorrelation time scale and diurnal variation. The mechanism driving convection in the ITCZ is suggested to be different from that in the SPCZ. Rainfall measurements by a sun-synchronous satellite visiting a spot twice per day will include a bias due to the existence of semidiurnal cycle in the SPCZ ranging from 5 to 10 percentage points. The bias in the ITCZ may be of the order of 5 percentage points. (Author's abstract)
W91-01446

CHEMICAL COMPOSITION AND ACIDITY OF RAINFALL IN THE ALLIGATOR RIVERS REGION, NORTHERN TERRITORY, AUSTRALIA.
Office of the Supervising Scientist for the Alligator Rivers Region, Sydney (Australia).
For primary bibliographic entry see Field 5B.
W91-01449

SPATIAL VARIABILITY OF ANNUAL PRECIPITATION AND ENSO EVENTS IN WESTERN PERU.
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
T. D. Tapley, and P. R. Waylen.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 4, p 429-446, August 1990. 10 fig, 6 tab, 20 ref. NSF Grant SES 8713738.

Descriptors: *Annual precipitation, *Climatology, *El Nino/Southern Oscillation, *Hydrologic models, *Model studies, *Peru, *Rainfall distribution, Areal precipitation, Drought, Rainfall, Spatial distribution, Stochastic hydrology.

The El Nino-Southern Oscillation (ENSO) phenomenon has been the focus of many diverse investigations since the mid 1960s. It is well known that the ENSO brings abnormally high precipitation to the northern coast of Peru. The probability distributions of annual rainfall totals at 18 stations from the north coast of Peru to the southern highlands and Altiplano were analyzed. It was found that most stations exhibit high interannual variability which cannot be satisfactorily modeled by a single lognormal distribution. Indices of the ENSO identified two precipitation regimes: the ENSO regime and the non-ENSO regime. Simple descriptive statistics of rainfalls within the two sub-samples indicate that during ENSO years the Altiplano and southern highland regions experience drought, with an average reduction in mean annual precipitation of 18%, while the north coastal region receives over 88% above non-ENSO rainfall. A mixed lognormal model of annual precipitation was successfully fitted to all stations. The estimated parameters reflect the contrasting response of the two regions to ENSO events. Pearson product-moment correlation matrices generated between stations for each sub-sample further support the hypothesized negative relationship between conditions on the northern coast and the Altiplano. The resulting model describes the stochastic nature of annual precipitation in the area and illustrates regional differences in the influence of ENSO. (Author's abstract)
W91-01463

DECADAL-SCALE CHANGES OF THE CIRCULATION IN THE TROPICAL ATLANTIC SECTOR ASSOCIATED WITH SAHEL DROUGHT.
Wisconsin Univ.-Madison. Dept. of Meteorology.
S. Hastenrath.
International Journal of Climatology IJCLEU, Vol. 10, No. 5, p 459-472, July/August 1990. 7 fig, 1 tab, 24 ref. NSF Grant ATM-8722410; NOAA Grant NA86AA-D-ACO64.

Descriptors: *Atmospheric circulation, *Climatic changes, *Climatology, *Drought effects, *Tropical regions, Africa, Air temperature, Arid climates, Atmospheric pressure, Clouds, Coasts, Drought, Sahara Desert, Wind.

Trends in the general circulation setting during 1948-1983 accompanying the progressive aggravation of drought in sub-Saharan Africa were investigated from ship observations over the tropical Atlantic and surface station records in western Africa. Decadal-scale circulation changes in the Atlantic sector include a pressure rise over the tropical North Atlantic; southward displacement of the near-equatorial wind confluence and associated maximum cloud belt; acceleration of the northeast trades and possibly a strengthening of the South Atlantic trades, along with increasing cloudiness in the equatorial zone; increasing cloudiness over the tropical North Atlantic and Central American seas; and cooling of surface waters in a band across the tropical North Atlantic contrasting with warming in the South Atlantic. These changes occurred in all seasons, but were most pronounced at the height of boreal summer. Records at land stations in western Africa show that near the coasts the temperature and pressure trends are consistent with the adjacent ocean areas. In the interior of sub-Saharan Africa, warming trends prevail in boreal summer, with concomitant downward pressure trends. During the past four decades, the near-equatorial wind confluence over the eastern Atlantic migrated southward by 200 km in July-August and 150 km for the rainy season as a whole. These circulation shifts are large enough to account for the observed downward trend in Sahel rainfall. (Author's abstract)
W91-01465

REGIONALIZATION AND SPATIAL ESTIMATION OF ETHIOPIAN MEAN ANNUAL RAINFALL.
Lund Univ. (Sweden). Dept. of Physical Geography.
L. Eklundh, and P. Pilesjo.
International Journal of Climatology IJCLEU, Vol. 10, No. 5, p 473-494, July/August 1990. 21 fig, 7 tab, 19 ref.

Descriptors: *Annual precipitation, *Climatic data, *Climatology, *Data interpretation, *Ethiopia, *Rainfall distribution, Climatic zones, Dispersion, Factor analysis, Model studies, Model testing, Precipitation mapping, Principal component analysis, Rainfall, Regression analysis, Spatial distribution.

A need has been recognized for developing methods that will lead to the generation of a reliable mean annual precipitation database for Ethiopia. Multiple regression models have been formulated that explain the mean annual rainfall as a function of elevation and geographical location. The estimations, based on yearly values from a data set of 63 Ethiopian rainfall stations with records between 1969 and 1985, were developed for the whole country as well as for the already existing Food and Agricultural Organization (FAO) rainfall pattern regions, and a new zonation derived by principal component and common factor analyses (PCA/CFA). The optimal zonation was derived by testing 36 different combinations resulting in different rainfall pattern regions. The alternatives tested were: correlation and covariance dispersion matrices, PCA and CFA eigentechniques, unrotated and rotated components/factors and number of possible significant components/factors. Principal component analysis of covariance matrix, rotation and seven extracted components gave by far the best relationship between mean annual rainfall, elevation, and geographical location. Models explaining at least 72 percent of the variation in rainfall were constructed for regions covering about 98 percent of the country, which is better than models based on the FAO rainfall pattern regions and a model for the whole country. (Author's abstract)
W91-01466

TEMPORAL AND SPATIAL CHARACTERISTICS OF ANNUAL PRECIPITATION OVER THE BALKANS IN THE TWENTIETH CENTURY.
Thessaloniki Univ., Salonika (Greece). Inst. of Meteorology and Climatology.
P. Maheras, and F. Kolyva-Machera.
International Journal of Climatology IJCLEU, Vol. 10, No. 5, p 495-504, July/August 1990. 4 fig, 3 tab, 23 ref.

Descriptors: *Annual precipitation, *Balkans, *Climatology, *Mediterranean Sea, *Rainfall distribution, *Temporal distribution, Atmospheric circulation, Drought, Principal component analysis, Spatial distribution, Statistical analysis.

There has been great interest recently in fluctuations in precipitation the past century for western and central Europe and for the western Mediterranean. The annual totals of precipitation were studied for 12 stations in the Balkan area for a period of 92 years (1894-1985). The homogeneity of the precipitation series and their statistical characteristics were analyzed. An abrupt climatic change was found at the station of Belgrad, and a statistically significant trend of annual precipitation was found for various periods at the stations of Kerkyra, Patras, Hvar, and Sarajevo. Persistence was ascertained only for the Belgrad station. The application of principal component analysis yielded three groups of stations. Group A includes northern and continental stations, group B includes stations of the Ionian and Adriatic Seas, and group C includes the stations of Thessaloniki and Athens. The most important period of fluctuations covers the years 1933-1953, when a humid period was followed by a dry period. The most recent 5-year period was a very dry one. Finally, comparisons between rainfall fluctuations and types of circulation show that the predominance of meridional circulation over the Balkans results in an increase of precipitation, while a zonal circulation results in a decrease of precipitation. (Author's abstract)
W91-01467

RAIN SCAVENGING OF TEPHRA AEROSOLS FROM MOUNT ST. HELENS 1980 ERUPTIONS.
Arkansas Univ., Fayetteville. Dept. of Geology.
G. H. Wagner, and K. E. Steele.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 5, p 368-374, 1990. 1 fig, 4 tab, 11 ref.

Descriptors: *Ash, *Mineralogy, *Precipitation scavenging, *Tephra, *Volcanoes, Aerosols, Atmospheric circulation, Clay minerals, Illite, Kaolinite, Meteorological data, Mount St Helens, Particulate matter, Quartz, Rainfall disposition, Washington.

Mount St. Helens in southern Washington state had three major eruptions in 1980: 18 May, 25 May, and 12 June. Tephra in the atmosphere from these eruptions was traced by analyzing the particulate matter from weekly rain collections at 62 National Atmospheric Deposition Program sites

across the United States. The particulate matter was on 0.45 micron pore-sized filters (47 mm diameter) in amounts of 0-214 mg. Identification of tephra in the particulate matter was made by x-ray diffraction, identification of feldspar (70% of the tephra), and chemical analyses compared to a standard tephra. Tephra was identified at sites in the path defined by observable amounts on the ground and outside and beyond this path. Dilution of the tephra by other aerosols varied from 20% near Mount St. Helens to about 300% at downwind sites, which were two days and 3000 km from Mount St. Helens. Atmospheric cleanup of the tephra at a given site occurred in 1-2 weeks, sometimes in a few days, as measured by the particulate matter in rain. Particulate matter captured in rains before the eruptions was mainly alpha quartz, feldspar, illite, kaolinite and organics with an average flux for the United States of 112 kg per ha per week. (Author's abstract)
W91-01468

META-ANALYTIC REAPPRAISAL OF STATISTICAL RESULTS IN THE ENVIRONMENTAL SCIENCES: THE CASE OF A HYDROLOGICAL EFFECT OF CLOUD SEEDING.
Hebrew Univ. of Jerusalem (Israel). Inst. of Earth Sciences.
For primary bibliographic entry see Field 3B.
W91-01470

FURTHER EXPLORATORY EVALUATIONS OF GROSSVERSUCH IV USING HAILPAD DATA: ANALYSIS OF HAIL PATTERNS AND STRATIFICATION BY STORM TYPE FOR SEEDING EFFECT.
Groupement National d'Etudes des Fleaux Atmospheriques, Aubiere, France.
J. F. Mezeix.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 5, p 401-417, 1990. 7 fig, 9 tab, 28 ref, append.

Descriptors: *Cloud seeding, *Data interpretation, *Hail, *Hydrologic models, *Meteorological data, *Soviet Union, *Storms, Areal precipitation, Distribution patterns, France, Italy, Model studies, Precipitation mapping, Spatial distribution, Switzerland.

In the Grossversuch IV experiment, scientific groups from three countries (Switzerland, Italy, and France) worked together to test the Soviet hail suppression method, based on the concept of beneficial competition of hailstone embryos. Further exploratory evaluations were made of the hail suppression experiment using the spatial distribution of ground-measured variables within hail patterns. The possibility of a seeding effect limited to a part of a hailfall or to various objectively stratified types of precipitation cells was investigated. The results show an increase in the ratio of the hailed areas with maximum hailstone diameters greater than 10 mm versus the total hailed area, and an increase in the maximum hailstone diameter for type II repetitive evolution cells. Differences observed for the main test variables in relation to the various cell types were shown to largely exceed those that could stem from a possible seeding effect. A satisfactory physical interpretation of the differential tendency related to the storm type is impossible, however, because the simple storm model on which the Grossversuch IV experiment is not based on three-dimensional storm measurements. Future test experiments should be based on several test variables characteristic of the overall hailfall phenomenon and especially of the area factor. In addition, storms should be physically stratified in an objective manner. (Author's abstract)
W91-01471

DETERMINATION FROM SPACE OF ATMOSPHERIC TOTAL WATER VAPOR AMOUNTS BY DIFFERENTIAL ABSORPTION NEAR 940 NM: THEORY AND AIRBORNE VERIFICATION.
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. d'Optique Atmospherique.
For primary bibliographic entry see Field 7B.
W91-01472

PERSISTENCE OF SEEDING EFFECTS IN A WINTER OROGRAPHIC CLOUD SEEDED WITH SILVER IODIDE BURNED IN ACETONE.
Bureau of Reclamation, Auburn, CA.
For primary bibliographic entry see Field 3B.
W91-01473

ALGORITHM FOR RETRIEVING WATER VAPOR PROFILES IN CLEAR AND CLOUDY ATMOSPHERES FROM 183 GHZ RADIOMETRIC MEASUREMENTS: SIMULATION STUDIES.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 7C.
W91-01474

THUNDERSTORMS ABOVE FRONTAL SURFACES IN ENVIRONMENTS WITHOUT POSITIVE CAPE. PART I: A CLIMATOLOGY.
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
B. R. Colman.
Monthly Weather Review MWREAB, Vol. 118, No. 5, p 1103-1121, 1990. 19 fig, 21 ref. NSF Grant ATM-8019301.

Descriptors: *Climatology, *Convective precipitation, *Meteorology, *Thunderstorms, *Weather patterns, Advection, Atmospheric circulation, Atmospheric pressure, Climatic data, Convection, Frequency distribution, Meteorological data collection, Wind.

Thunderstorms occur frequently above frontal surfaces in environments without positive convective available potential energy (CAPE). The climatology of such storms were studied for the conterminous United States using a dataset consisting of 1093 observations made over a 4-year period. A composite of the dataset shows that the typical 'elevated' thunderstorm occurs northeast of an associated surface low pressure center, and north of a surface warm front in a region with northeasterly surface winds. The planetary boundary layer is generally very stable. The thunderstorms are usually found in the left exit region of a low-level wind maximum. The large-scale environment is strongly baroclinic with large vertical wind shear and warm advection. Several of the identified characteristics suggest that frequently elevated thunderstorms are the result of physical mechanisms different from those fundamental to surface-based thunderstorms, e.g., for elevated thunderstorms there is generally very little positive CAPE in the environment, as the atmosphere is slightly more stable than moist adiabatic above the frontal inversion. The annual frequency distribution of elevated thunderstorms is bimodal, with a primary peak in April and a secondary peak in September. The events are concentrated in an area extending northward from the central Gulf Coast along the Mississippi River valley. Nearly all winter season thunderstorms east of the Rocky Mountains are of the elevated type, except those over the Florida Peninsula, where surface-based convection persists throughout the year. Most of the winter season elevated thunderstorms occur near the Gulf Coast downstream from migrating cyclones. (See also W91-01482) (Author's abstract)
W91-01481

THUNDERSTORMS ABOVE FRONTAL SURFACES IN ENVIRONMENTS WITHOUT POSITIVE CAPE. PART II: ORGANIZATION AND INSTABILITY MECHANISMS.
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
B. R. Colman.
Monthly Weather Review MWREAB, Vol. 118, No. 5, p 1123-1144, 1990. 33 fig, 17 ref. NSF Grant ATM-8019301.

Descriptors: *Climatology, *Convective precipitation, *Meteorology, *Thunderstorms, *Weather patterns, Air temperature, Atmospheric circulation, Boundary layers, Convection, Hydrostatic pressure, Meteorological data collection, Temperature effects, Thermodynamics.

Thunderstorms occur above frontal surfaces frequently in environments without positive convective available potential energy (CAPE). An impressive outbreak of elevated thunderstorms during the Atmospheric Variability Experiment-Severe Environmental Storms and Mesoscale Experiment were studied. The thunderstorms occurred in three convective impulses, each of which developed in a warm sector before propagating onto the frontal surface; subsequent thunderstorms developed over the frontal surface. While in the warm sector, the convection was supported by an extremely unstable boundary layer. However, this convective energy quickly diminished above the frontal surface and thunderstorms continued and developed for many hours in an essentially stable hydrostatic environment. During the lifetime of these impulses, mesoscale updrafts developed and moved with the convective areas, maintaining nearly steady-state systems with strong low-level inflow. The environment was found to be symmetrically neutral in the region of the inflow. Numerous pressure waves were observed in association with the elevated thunderstorms, yet these features were evidently not important in triggering the storms. An investigation of a convective band that formed above the frontal surface revealed that the development probably took place in two steps. Initially, the high potential temperature contour for a saturated environment in the air overlying the frontal inversion was stable to vertical displacements, but inertially unstable. Then, along the instantaneous path of the unstable parcel, the thermodynamic structure changed, the parcel became gravitationally unstable, and upright convection resulted. (See also W91-01481) (Author's abstract)
W91-01482

PRECIPITATION AND ENVIRONMENTAL CONDITIONS DURING ACCRETION IN CANADIAN EAST COAST WINTER STORMS.
Atmospheric Environment Service, Downsview (Ontario).
R. E. Stewart, R. W. Crawford, N. R. Donaldson, T. B. Low, and B. E. Sheppard.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 7, p 525-538, July 1990. 13 fig, 1 tab, 28 ref, append.

Descriptors: *Accretion, *Canada, *Ice formation, *Meteorology, *Precipitation, *Storms, Air temperature, Freezing, Ice, Model studies, Particle shape, Remote sensing, Simulation, Snow, Wind velocity.

Ice and snow accretion cause a large amount of damage in winter storms with consequences ranging from slight to disastrous. Precipitation and environmental conditions occurring during accretion in Canadian east coast winter storms have been investigated. Accretion is generally associated with snow, freezing rain, and ice pellets within saturated conditions. Precipitation types are sometimes invariant but usually evolve during individual accretion events. Accretion events are also generally associated with moderate wind speeds (average of 7.5 m/s) and warm temperatures (between -1 C and 0 C are most common). Remote sensing of particle shapes and terminal velocities are capable of identifying some of the features of these precipitation types. Model calculations indicate that a detailed understanding of precipitation characteristics, such as the nature of wet snow, is needed to accurately simulate accretion. (Author's abstract)
W91-01487

AIRCRAFT-BASED RADIOMETRIC IMAGING OF TROPOSPHERIC TEMPERATURE AND PRECIPITATION USING THE 118.75-GHZ OXYGEN RESONANCE.
Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
For primary bibliographic entry see Field 7B.
W91-01488

THUNDERSTORMS, COSMIC RAYS, AND SOLAR-LUNAR INFLUENCES.
M. D. Lethbridge.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 95, No. 9, p 13,645-13,649, August 20, 1990. 4 fig, 25 ref.

Descriptors: *Cosmic rays, *Meteorology, *Solar radiation, *Synergistic effects, *Thunderstorms, Frequency analysis, Geophysics, Particulate matter, Storms.

Cosmic ray and thunderstorm frequency was studied by superposed epoch analysis of thunderstorms over the eastern two thirds of the United States for 1957-1976. A decrease in thunderstorms was observed at the time of high cosmic rays and an increase in thunderstorms 2-4 days later. When data for spring and fall months were used, the minimum deepened again and was significant at less tan the 0.01% level. It is believed that when the sun, earth, and moon are aligned, particulate matter in the lower stratosphere is modulated and acted upon by cosmic rays, bringing about an immediate decrease in thunderstorms. (Author's abstract)
W91-01490

FOURIER DOMAIN SHAPE ANALYSIS METHODS: A BRIEF REVIEW AND AN ILLUSTRATIVE APPLICATION TO RAINFALL AREA EVOLUTION.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
P. Kumar, and E. Foufoula-Georgiou.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2219-2227, September 1990. 4 fig, 14 ref. NSF Grants CES-8708825 and BSC-8957469.

Descriptors: *Fourier analysis, *Mathematical analysis, *Precipitation, *Rainfall area, Weather forecasting.

Morphological shape analysis techniques offer valuable tools for the study of several hydrologic and atmospheric processes. Detailed description of patterns, as well as evolution and comparison of patterns can be efficiently performed in the Fourier domain and by means of a finite number of Fourier descriptors. Three Fourier domain shape analysis methods are briefly summarized: the complex plane method, the angular direction method, and the polar coordinates method. The complex plane method, applicable to any kind of shape, is more versatile than the other two methods and is also computationally efficient. The use of the complex plane method for studying the evolution of rainfall areas within a radar-depicted rainfall field for the purpose of short-term precipitation forecasting is illustrated. (Author's abstract)
W91-01537

MONITORING OF RAINFALL IN RELATION TO THE CONTROL OF MIGRANT PESTS.
Reading Univ. (England). Dept. of Meteorology.
J. R. Milford, and G. Dugdale.
Philosophical Transaction of the Royal Society of London. Series B. Biological Sciences PTRBAE, Vol. 328, No. 1251, p 689-704, June 30, 1990. 6 fig, 1 tab, 17 ref.

Descriptors: *Habitats, *Hydrologic budget, *Insect control, *Meteorology, *Rainfall distribution, *Satellite technology, *Soil water, Remote sensing, Terrain analysis, Topography, Vegetation, Weather forecasting, Weed control.

Of all climatic parameters, rainfall has the greatest variability in space as well as time. It also has the greatest influence on the breeding and behavior of migrant pests, such as locusts, supplying the moisture needed both for their development and for the growth of vegetation to sustain a population. Soil moisture controls both processes directly but cannot be adequately surveyed even by remote sensing techniques, so water balance models are relied upon to interpret rainfall measurements and to forecast pest populations. Both terrain and rainfall are very inhomogeneous on the kilometric scale, a scale which is not matched by observations either from conventional rain gages or current meteorological satellites. Modeling the effects of rainfall must take account of these inhomogeneities. However, it is clear that more detailed studies of rainfall-habitat interaction are needed to derive soil moisture from rainfall estimates by using knowledge of the microtopography. Such relationships must be capable of being generalized so that future monitoring by satellites, essential to give complete and uniform coverage, can be realistically interpreted. (Author's abstract)
W91-01561

RECORD-BREAKING RISE OF GREAT SALT LAKE IN 1981-1986 RELATED TO ANOMALOUS MID-TROPASPHERIC WIND PATTERNS.
Scripps Institution of Oceanography, La Jolla, CA.
For primary bibliographic entry see Field 2H.
W91-01580

NEW EQUATION FOR THE ATMOSPHERIC ENERGY BUDGET (EINE NEUE GLEICHUNG FUER DIE ATMOSPHAERISCHEN ENERGIEHAUSHAELTE).
Vienna Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
M. Hantel.
Wetter und Leben WTLBAR, Vol. 41, No. 1/4, p 95-108, 1989. 4 fig, 16 ref. English summary.

Descriptors: *Climatology, *Mathematical equations, *Meteorology, *Weather forecasting, Energy, Latent heat, Precipitation, Rainfall.

The moisture budget equation of the atmosphere comprises mesoscale (routinely measurable) and sub-mesoscale (non-measurable) contributions. The sub-mesoscale terms are divergences of moisture flux and rain flux. These fluxes play an important role in the moisture budget. In order to diagnose them objectively the budget equation for sensible heat was added and coupled to the budget equation for latent heat via the rain flux. By means of the Bowen ratio in the free atmosphere the equations are closed, yielding a governing differential equation of the first order in pressure for the sub-mesoscale heat flux. This equation is in simple cases analytically solvable and in all cases numerically solvable. In this way the mesoscale atmospheric measurements yield the sub-mesoscale heat flux and, by means of algebraic and quadrature formulae, the rain and moisture flux. (Author's abstract)
W91-01581

CHANGEABLE WEATHER-A CHAOTIC PHENOMENON TRIGGERED OFF BY MESOSCALE PRECIPITATION-EDDIES (WETTERLAUNEN ALS CHAOTISCHE MESO-SKALIGE STRUKTUREN).
Vienna Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
G. Skoda.
Wetter und Leben WTLBAR, Vol. 41, No. 1/4, p 117-122, 1989. 2 fig, 1 tab, 6 ref. English summary.

Descriptors: *Climatology, *Cloud physics, *Meteorology, *Precipitation, Condensation, Logistic maps, Mathematical equations.

The rate of condensation quickly enters a chaotic region according to a simple nonlinear technique, the logistic map. The logistic map which is probably the simplest nonlinear difference equation, appears in many applications. Considering the process of condensation, if the number of cloud particles, N, grows at a given rate v, the iterations, Ni+1, of particle formation display a rather complicated behavior as a function of the external parameter v, which becomes chaotic at v greater than 2.5. As specific growth rates of condensation between different scales of precipitation-eddies are compared, v is found within the scales of MESO-beta, a structural lifetime which is greater than 36 hr, and MESO-gamma, 0.5 to 4 hr, with critical values of 2.5. This corresponds to the high intermittency of precipitation. High rates of condensation or cloud formation lead to precipitation eddies and the system enters a chaotic region. (Author's abstract)
W91-01582

EXTREME, SINGULAR AND COHERENT PRECIPITATION IN THE CATCHMENT BASIN OF THE UPPER INN RIVER (EXTREME, SINGULAERE UND KOHAERENTE NIEDERSCLAEGE IM GEBIET DES APLINEN INN).
F. Fliri.
Wetter und Leben WTLBAR, Vol. 41, No. 1/4, p 141-152, 1989. 1 fig, 7 tab, 8 ref. English summary.

Descriptors: *Austria, *Precipitation, *Storms, *Weather patterns, Hydrographic models, Hydrographs, Inn River, Mathematical models, Rainfall.

Due to a series of sudden intense and individually catastrophic downpours which occurred in both parts of the Tirol in 1981, 1983 and 1985, a study was conducted by the University of Innsbruck and the Obervinschgau of Marienberg in 1985. Subsequently, more catastrophic instances occurred in the summer of 1987, and a regional hydrographic investigation was needed. Using daily precipitation values from 46 stations in the catchment basin of the upper Inn River (9313 square m) from 1946 to 1987 between Mont Blanc and Hohen Tauern, the mean annual and absolute maxima for periods of one, two and more consecutive days and estimates of 30 and 100 year maxima were determined. A relationship was established by means of a regression analysis between mean annual maxima and basin size that permited estimates of extrema in smaller areas. The frequency distribution and extreme values of mean basin precipitation of periods of one or of several consecutive days are presented and the occurrence of spatially singular or coherent precipitation was determined to be dependent on precipitation totals. (Author's abstract)
W91-01583

NEW SNOW IN THE URBAN AREA OF VIENNA (NEUSCHNEE IM RAUM WIEN).
Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria).
H. Mohnl.
Wetter und Leben WTLBAR, Vol. 41, No. 1/4, p 269-277, 1989. 6 fig, 2 tab, 4 ref. English summary.

Descriptors: *Austria, *Public policy, *Snow forecasting, *Snow management, *Statistical models, *Weather forecasting, Climatic data, Precipitation, Roads, Snow accumulation, Vienna.

In urban areas, freshly fallen snow is an undesired phenomenon because it generates substantial problems for public traffic and technical systems. Therefore, in regional planning, climatic statistical parameters like means, percentiles of the frequency distributions, and return periods of extreme values for the amount of freshly fallen snow are used to optimize the fundamental relationships between human life and the climate. Between 1951/52 and 1980/81, statistics were collected within the city of Vienna and the bordering Vienna Woods on the height of new fallen snow. The data from areas uninfluenced by the heat of the city show a strong linear dependence at the levels of lowlands (from 200 m to 500 m) on altitude. The data were filtered with a Gaussian low pass to suppress periods of less than 20 years to show the variation of the annual amount of freshly fallen snow within the past 90 years. (Author's abstract)
W91-01584

USE OF POLARIZATION TO CHARACTERIZE PRECIPITATION AND DISCRIMINATE LARGE HAIL.
National Severe Storms Lab., Norman, OK.
N. Balakrishnan, and D. S. Zrnic.
Journal of the Atmospheric Sciences JAHSAK, Vol. 47, No. 13, p 1525-1540, July 1990. 11 fig, 59 ref, 2 append.

Descriptors: *Data acquisition, *Hail, *Meteorology, *Polarimetric radar measurements, *Precipitation, *Radar, *Rain, Correlation analysis, Correlation coefficient, Hydrometeors, Reflectance, Reflectance techniques, Reflectivity, Remote sensing.

Polarimetric radar measurements provide bulk estimates of the shapes of the ensemble of hydrometeors in the radar resolution volume. There is evidence that the shape of a rain drop is related to its size. Also, rain drops exhibit little or no canting and fall with their minor axes oriented vertically. The work of Seliga and Bringi showed that the existence of such accurate relation between rain drop shape and size can be exploited to obtain an improved estimation of rainfall from polarimetric measurements. An examination was made of the utility of the correlation coefficient between linear orthogonally polarized echoes for determining precipitation type and gaging hail size. Models and measurements from pure rain coincide in predicting very high correlations (0.98); similar results are obtained with pure hail. Several mechanisms could cause the lowering of the correlation but the behavior of the examined data is definitely attributed to a mixture of hydrometeor types. This decrease is an indicator of hail size; it is shown theoretically that in at least two other realistic situations the correlation would decrease the hail size. For the examined case a model of hail shape and orientation during fall is able to reproduce the essential features of polarimetric measurements. It suggests, together with data obtained in the current investigation and data from other investigations, that substantial negative differential reflectivity (about -1 dB) in a region of high reflectivity factor values is caused by hailstones larger than about 2 cm in diameter. (Author's abstract)
W91-01656

ENTRAINMENT AND MIXING PROCESSES AS RELATED TO DROPLET GROWTH IN WARM MIDLATITUDE AND TROPICAL CLOUDS.
Centre National de la Recherche Scientifique, CRPA, Magny les Hameaux, France.
E. Hicks, C. Pontikis, and A. Rigaud.
Journal of the Atmospheric Sciences JAHSAK, Vol. 47, No. 13, p 1589-1618, July 1990. 30 fig, 6 tab, 55 ref, append.

Descriptors: *Cloud physics, *Clouds, *Condensates, *Entrainment, *Meteorological data, *Mixing, *Precipitation, *Rain, Data acquisition, Data collections, France, Tropical regions.

Aircraft measurements in warm continental cumuli and in tradewind maritime bandclouds are analyzed in order to determine the influence of entrainment and mixing processes on the evolution of condensate droplet spectrum. The results provide some insight on the similarities and differences between maritime and continental warm cumuli as related to warm rain production. The entrainment sources are determined by Paluch's thermodynamic method and contrasting results are obtained. Cloud top entrainment prevails in the midlatitude isolated cumuli whereas bandclouds of both data sets are subject to multilevel lateral entrainment. Microphysical characteristics such as the droplet concentration and the spectral peak radius are analyzed in relation to the dilution degree of cloud parcels in order to examine the mixing process involved during entrainment events. The findings support the inhomogeneous mixing hypotheses with total evaporation of some droplets of all sizes during mixing in all observed continental cases, whereas the dominant process in all studied maritime clouds is closer to the homogeneous picture. In both databases, the highest concentrations of droplets in the large droplet tail of the spectrum are found in samples with an intermediate level of dilution, thus confirming the influence of dilution on enhanced droplet growth. The role of entrainment, mixing and subsequent cloud dilution in the production of large droplets as shown seriously restricts the use of simple parameterizations of precipitation water initiation in cloud models. (Author's abstract)
W91-01657

PRECIPITATION PRODUCTION IN A LARGE MONTANA HAILSTORM: AIRFLOW AND PARTICLE GROWTH TRAJECTORIES.
National Center for Atmospheric Research, Boulder, CO.
L. J. Miller, J. D. Tuttle, and G. B. Foote.
Journal of the Atmospheric Sciences JAHSAK, Vol. 47, No. 13, p 1619-1646, July 1990. 23 fig, 1 tab, 67 ref.

Descriptors: *Cloud physics, *Hail, *Meteorology, *Precipitation, *Radar, Air circulation, Clouds, Doppler radar measurements, Graupel, Precipitation mapping, Weather.

Computations of air motion and precipitation growth using winds derived from Doppler radar measurements were analyzed to reveal important flow features that influenced the production of precipitation during the nearly steady phase of a well-observed severe storm in Montana that produced hail as large as 5 cm in diameter. Based on particle growth calculations, measurements by radar and research aircraft, cloud photography and direct hailstone examination, four general sources of hail embryos were apparent: (1) graupel grown along the updraft fringes, (2) a derivative of the former consisting of drops produced by melting graupel, (3) water drops shed from melting hail, and (4) shedding from hailstones that were in wet growth conditions. The graupel embryos were deduced to originate primarily in two columnar regions on the flanks of the updraft core. Following the embryo growth stage, three types of hail growth trajectories were found: (1) those passing into the southern (cyclonic) branch of the middle-to-upper level airflow, (2) those passing into the northern (anticyclonic) branch of this flow, and (3) those passing in a nearly straight line through the updraft core in midlevels (preferentially the northeastern side of the core). Of these the straight-line trajectory produced the largest hail. Precipitation from graupel grown in the western updraft fringes, from drops produced by transport and melting of these graupel grown in the northern updraft fringes was necessary to explain the observed patterns of radar reflectivity, dual-wavelength ratio and specific attenuation. Further, only embryos from the west and south flanks led to large diameter hail near where stones of similar sizes were observed from aircraft near the ground. (Author's abstract)
W91-01658

USE OF DAILY VALUES OF SURFACE PARAMETERS AT DURBAN AND CAPE TOWN TO DETERMINE THE PRECIPITABLE WATER CONTENT OF THE ATMOSPHERE.
Natal Univ., Pietermaritzburg (South Africa). Dept. of Geography.
O. S. McGee, and R. N. De Vos.
South African Journal of Science SAJSAR, Vol. 85, No. 9, p 602-603, September 1989. 2 tab, 3 ref.

Descriptors: *Air circulation, *Meteorological data collection, *Meteorology, *Precipitation, *Regression analysis, *South Africa, *Water vapor, Data collections, Data interpretation, Dewpoint, Mathematical studies, Synoptic analysis, Temperature.

The precipitable water (vapor) or total content of vapor above any locality on the earth's surface plays an important role in hydrology and meteorology. Its value has been shown to differ according to the local airflow regime which prevails at the time and may be predicted from surface dewpoint values using a linear regression equation which is specific to the prevailing airflow type. This type of regression equations is customarily based on monthly mean values of precipitable water and surface dewpoint. South African upper air data was examined to show that daily values may be used, without combining them into monthly values, to generate multiple linear regression equations which differ for different airflow types and according to season. A preliminary investigation of upper air data for both Cape Town and Durban between 1969 and 1987 included the calculated precipitable water vapor, as well as surface temperature, dewpoint temperature, air pressure and wind speed. Exploratory regression analyses of precipitable water values vs. surface dewpoint temperatures were performed at each station. A multiple regression was then performed using all selected variables. The use of the daily data (not monthly statistics) was found to be dependent on the determination of airflow types at the surface. Since this was done by computer, the actual synoptic situations at the stations should be distinguished. This would presumably lead to different data groupings. (Korn-PTT)
W91-01660

CLIMATIC CONTROL OF VEGETATION DISTRIBUTION: THE ROLE OF THE WATER BALANCE.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
N. L. Stephenson.
American Naturalist AMNTA4, Vol. 135, No. 5, p 649-670, May 1990. 4 fig, 2 tab, 85 ref.

Descriptors: *Climatology, *Distribution patterns, *Ecology, *Hydrologic budget, *Literature review, *Vegetation, Energy, Evapotranspiration, Precipitation, Temperature, Water deficit.

The water balance describes climate as it is sensed by plants: as the interaction of energy and water in the environment. Discriminant analysis showed that the distribution of North American plant formations was more highly correlated with the water balance (actual evapotranspiration and deficit) than the more traditional measures of climate (such as temperature and precipitation) used in other studies. Much of the improved correlation could be contributed to the ability of the water balance to distinguish between climates similar in mean annual energy and water supplies, but different in the seasonal timing of the two. Consideration of the water balance aided in the interpretation of possible mechanisms controlling the distribution of plant formations. For example, coniferous forests occurred at low actual evapotranspiration (low simultaneous availability of water and energy), consistent with the suggestion that conifers are better adapted than deciduous trees to environments with a low potential for primary production. A better understanding of the mechanisms by which climate can control the distribution of vegetation will help in predicting the effects of changing climate on the future distribution of vegetation types. This literature review article attempts to enhance current understanding by discussing: (1) the relationship between the energy balance and the water balance; (2) biological importance of the water balance; (3) correlations between vegetation and climate; (4) statistical comparisons between the water balance and other climatic parameters; (5) the distribution of North American plant formations relative to the water balance; and (6) the distribution of coniferous and deciduous forests. (Lantz-PTT)
W91-01684

CO2 CLIMATE SENSITIVITY AND SNOW-SEA-ICE ALBEDO PARAMETERIZATION IN AN ATMOSPHERIC GCM COUPLED TO A MIXED-LAYER OCEAN MODEL.
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 5C.
W91-01694

PERSPECTIVE ON EL NINO AND LA NINA: GLOBAL IMPLICATIONS FOR STREAM ECOLOGY.
New Mexico Univ., Albuquerque. Dept. of Biology.
M. C. Molles, and C. N. Dahm.
Journal of the North American Benthological Society JNASEC, Vol. 9, No. 1, p 68-76, March 1990. 3 fig, 1 tab, 66 ref. NSF Grant Nr. BSR-8616438.

Descriptors: *Climatology, *El Nino, *El Nino/Southern Oscillation, *Gila River, *La Nina, *Meteorology, *Pecos River, *Streamflow forecasting, *Weather forecasting, New Mexico.

Analyses of flow data for the Gila (60 years) and Pecos (68 years) Rivers in New Mexico showed that spring flows during snowmelt were significantly increased during El Nino years (periods of elevated sea surface temperature and reduced barometric pressure in the eastern tropical Pacific) and

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significantly decreased during La Nina years (periods of reduced sea surface temperature and elevated barometric pressure). Over the period of record for these two rivers, mean spring runoff during El Nino years was 2.3 to 3.2 times higher than during medial years and 6.0 to 7.4 times higher than during La Nina years. The results of this study indicate a strong correspondence between El Nino-Southern Oscillation (ENSO) phenomena and stream flow in New Mexico. These results also suggest that, in this region, the increasingly accurate, and remote forecasting of ENSO phenomenon, often months in advance of the event, could be used to place future studies of biotic responses to variations in flow on a more predictive basis. Since it has been shown that the ENSO phenomenon affects the weather of large portions of the North American continent and tropical and subtropical regions worldwide, a similar potential for improved study designs exists for other regions. (Author's abstract)
W91-01811

RAINWATER ACIDITY AT JABIRU, AUSTRALIA, IN THE WET SEASON OF 1983/84.
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
For primary bibliographic entry see Field 5B.
W91-01818

CHEMICAL COMPOSITION OF BULK PRECIPITATION ACROSS THE MOUNTAINS OF SNOWDONIA, U.K.
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
B. Reynolds, T. G. Williams, and P. A. Stevens.
Science of the Total Environment STENDL, Vol. 92, p 223-234, March 1990. 4 fig, 5 tab, 19 ref.

Descriptors: *Acid rain, *Chemical composition, *Chemistry of precipitation, *Meteorology, *Path of pollutants, *Precipitation, *Spatial distribution, Data collections, Meteorological data collection, Topography, Variability, Wales.

Bulk precipitation chemistry was monitored monthly for 18 months at 10 mountain sites and one coastal site in north Wales, U. K. The sites ranged in altitude from sea level to 891 m above sea level in an area where annual rainfall ranges from 1300 to 4000 mm. The precipitation was acidic (weighted mean H(+) of 23 microequivalents/L, pH 4.64), although ionic composition was dominated by sea salts. However, approximately 70% of the SO4 was not of sea salt origin. Concentrations of excess SO4 and NO3 were small (42 and 11 microequivalents/L, respectively) relative to polluted areas of Europe, although deposition rates were large (1.62 g S/sq m/year and 0.54 g N/sq m/year as NO3) due to the high annual rainfall. There was considerable spatial variability in the solute concentrations and deposition data which resulted from the effects of the complex topography of the area. Simple linear relationships between solute deposition and rainfall quantity were not generally observed except for sea salt deposition on seaward north-west facing slopes. (Author's abstract)
W91-01820

RAINFALL INDUCED SOIL SEAL: (A) A CRITICAL REVIEW OF OBSERVATIONS AND MODELS.
Hebrew Univ., Rehovoth (Israel). Dept. of Soil and Water Sciences.
For primary bibliographic entry see Field 2G.
W91-01872

RAINFALL INDUCED SOIL SEAL: (B) APPLICATION OF A NEW MODEL TO SATURATED SOILS.
Hebrew Univ., Rehovoth (Israel). Dept. of Soil and Water Sciences.
For primary bibliographic entry see Field 2G.
W91-01873

2C. Snow, Ice, and Frost

DIURNAL VARIATIONS IN THE INORGANIC SOLUTE CONTENT OF WATER DRAINING FROM AN ALPINE SNOWPATCH.
Heidelberg Univ. (Germany, F.R.). Geographisches Inst.
For primary bibliographic entry see Field 2K.
W91-01083

MODIFIED KOEPPEN CLASSIFICATION APPLIED TO MODEL SIMULATIONS OF GLACIAL AND INTERGLACIAL CLIMATES.
Wisconsin Univ.-Madison. Center for Climatic Research.
For primary bibliographic entry see Field 2B.
W91-01091

SURFACE ENERGY BALANCE OF A PERENNIAL SNOWBANK, MELVILLE ISLAND, NORTHWEST TERRITORIES, CANADA.
Erindale Coll., Mississauga (Ontario). Dept. of Geography.
K. L. Young, and A. G. Lewkowicz.
Arctic and Alpine Research ATLPAV, Vol. 22, No. 3, p 290-301, August 1990. 9 fig, 1 tab, 48 ref.

Descriptors: *Arctic regions, *Climatology, *Energy, *Melville Island, *Permafrost, *Snowpack, Ablation, Albedo, Canada, Latent heat, Radiation, Snowmelt.

The energy balance of a large perennial snowbank located in the continuous permafrost zone was examined during the summer of 1986. Three meteorological towers allowed energy fluxes to be determined for separate zones of the snow bank. Over the melt season, net radiation accounted for 85% of the energy absorbed by the snow surface, while sensible heat contributed 15% and latent heat was a net loss of 2%. Albedo varied across the snowbank due to an irregular distribution of surface aeolian deposits. Direct measurements of snowmelt from a snow survey compare favorably with calculated values obtained from the energy balance. The net shortwave radiation flux was a significant influence on ablation, explaining an average 77% of the variance in the measured melt. The predominance of the radiant fluxes is attributed to the large size of the snowbank and its sustained melt through the cool arctic summer. (Author's abstract)
W91-01370

ESTIMATE OF SNOW AVALANCHE DEBRIS TRANSPORT, KAGHAN VALLEY, HIMALAYA, PAKISTAN.
Waterloo Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W91-01371

INFLUENCE OF HUDSON BAY RUNOFF AND ICE-MELT ON THE SALINITY OF THE INNER NEWFOUNDLAND SHELF.
Department of Fisheries and Oceans, St. John's (Newfoundland). Science Branch.
For primary bibliographic entry see Field 2E.
W91-01432

SEASONAL DESCRIPTION OF THE QUALITY AND QUANTITY OF SNOWMELT IN A MOUNTAINOUS REGION USING AN INTEGRATED MODEL.
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Hydrologie a Hydrauliky.
G. Babiakova, D. Palkovic, and D. Bodis.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 4, p 383-393, August 1990. 5 fig, 2 tab, 9 ref.

Descriptors: *Acid rain, *Model studies, *Mountains, *Path of pollutants, *Snow cover, *Snowmelt, *Sulfates, *Water quality, Alpine regions, Catchment areas, Chemical analysis, Chemical properties, Czechoslovakia, Hydrological models, Runoff, Seasonal storage, Seasonal variation, Snow sampling.

An integrated model for the simulation and prediction of snowmelt quantity and quality from seasonal snow cover in a mountain basin has been developed in Czechoslovakia. To find the best method for modeling snow accumulation, and the accumulation of SO4(-2) washout, an approach was attempted which would satisfactorily combine hydrological and chemical modules. Surface runoff acidity and precipitation acidity were related by quantifying the progressive hydrological and chemical input and output sequences of the physical components. The Bystrianka drainage basin was considered to be representative of accumulation under mountain conditions. Measurements of snow cover were supplemented by sampling for snow quality, to characterize the accumulation and evaluate the chemical composition of both the snow and stream water, and to find out the concentration of sulfate at various sampling points throughout the winter season. From the daily SO4(-2) measurements, it was found that in periods without any SO4(-2) coming from the basin, the change in the flow corresponded to the outflow curve equation. The values of the sulfate concentration were influenced by their source, a rock medium. With the discharge increase which follows from snowmelt or precipitation, an increase of SO4(-2) contents occurs. This increase or decrease in the SO4(-2) concentration depends upon the discharge amount and the duration of the contribution episode. The whole model was tested using data for three winter seasons, wherein it was concluded that the model only moderately satisfies the fitting requirements. Differences which occur between the measured and calculated values occur in the period of intensive snowmelt. (Fish-PTT)
W91-01460

PREDICTION MODEL FOR SNOWMELT, SNOW SURFACE TEMPERATURE AND FREEZING DEPTH USING A HEAT BALANCE METHOD.
Tohoku Univ., Sendai (Japan). Geophysical Inst.
J. Kondo, and T. Yamazaki.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 5, p 375-384, 1990. 11 fig, 20 ref, 3 append.

Descriptors: *Data interpretation, *Flood forecasting, *Meteorological data, *Model studies, *Simulation analysis, *Snowmelt, *Streamflow forecasting, Air temperature, Albedo, Dams, Humidity, Model testing, Snow cover, Solar radiation, Thermal conductivity, Water resources management, Wind velocity.

The evaluation of snowmelt is not only important in the effective utilization of water resources and the forecasting of flood runoff, but it also influences climate through the change in ground surface properties. A model of snowmelt was developed on the basis upon the heat balance of the snow cover, with the assumption of a linear temperature profile in the snow. The model predicts the amount of snowmelt, the heat balance components, the snow surface temperature, and freezing depth. The components necessary as the input data to the model are: the solar radiation, downward longwave radiation, wind velocity, air temperature, and humidity. Also, for the parameters of snow cover; the albedo, density, water content, and thermal conductivity need to be known prior to the calculation. This simulated process of snowmelt agrees well with observations made over a flat farmland. Moreover, the calculated snow surface temperature corresponds with the actual value. As the maximum water content or thermal conductivity increases, the calculated snowmelt decreases because the snow surface temperature is kept higher during the night for larger maximum water content and thermal conductivity. Snowmelt largely depends on albedo. Finally, the model was applied to a large area to estimate inflow to a dam. In this calculation, it was assumed that the initial snow water equivalent increased linearly with altitude. The predicted values of inflow are consistent with those observed. (Fish-PTT)
W91-01469

PERSISTENCE OF SEEDING EFFECTS IN A WINTER OROGRAPHIC CLOUD SEEDED

WITH SILVER IODIDE BURNED IN ACETONE.
Bureau of Reclamation, Auburn, CA.
For primary bibliographic entry see Field 3B.
W91-01473

PRECIPITATION AND ENVIRONMENTAL CONDITIONS DURING ACCRETION IN CANADIAN EAST COAST WINTER STORMS.
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W91-01487

VARIATIONAL SENSITIVITY ANALYSIS, DATA REQUIREMENTS, AND PARAMETER IDENTIFICATION IN A LEAKY AQUIFER SYSTEM.
California Univ., Los Angeles. Dept. of Civil Engineering.
W. W. G. Yeh, and N. Z. Sun.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 1927-1938, September 1990. 8 fig, 10 tab, 26 ref. NSF Contract CES8814888, USGS Contract 14-08-0001-G1499.

Descriptors: *Aquifer systems, *Data requirements, *Groundwater movement, *Leaky aquifers, *Mathematical models, *Model studies, *Sensitivity analysis, Algorithms, Aquitards, Confined aquifers, Error analysis, Pumping tests, Unconfined aquifers.

The adjoint state sensitivity method was developed to aid the analysis of a pumping test design for parameter identification in a leaky aquifer system. The system considered consists of an unconfined aquifer overlaying an aquitard which overspreads a confined aquifer. The adjoint equations are derived in the continuous form without discretizing the governing equations and are expressed in terms of 'convection-diffusion' equations with time dependent coefficients. The multiple cell balance (MCB) method was used to solve the nonlinear governing equations as well as their adjoint equations. Algorithms were developed for calculating sensitivity coefficients of heads in each layer of an aquifer with respect to various parameters. A concept called 'contribution of an observation' is introduced which can be used to measure the usefulness of an observation in connection with data requirements for parameter identification. It links experimental design with observation errors and the requirement of model application. The sufficiency of an observation system for parameter identification can be evaluated at the design stage before extensive resources are committed to data collection. A numerical example is given to verify the proposed method and to explain its applicability to the design of a pumping test. (Author's abstract)
W91-01512

EXPERIENCE WITH PRECIPITATION FORECASTING FOR THE WINTER ROAD SERVICE (ERFAHRUNGEN MIT NIEDERSCHLAGSPROGNOSEN FUER DEN SRASSENWINTERDIENST).
Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria).
H. Bica, and H. Falkel.
Wetter und Leben WTLBAR, Vol. 41, No. 1/4, p 67-75, 1989. 1 fig, 9 tab, 2 ref. English summary.

Descriptors: *Austria. *Snow accumulation, *Snow management, *Snow removal, *Weather forecasting, Burgenland, Precipitation, Public policy, Roads.

Since the winter of 1985-1986, The Department of Synoptic Meteorology of the Central Office of Meteorology and Geodynamics (ZAMG) produced weather forecasts to determine the needs of the winter road service in Lower Austria and during the 1986-1987 season for Burgenland as well. During the first winter, forecasts were made twice daily, once in the morning and once in the afternoon for eight sects of the Autobahn in Lower Austria. In the second season, forecasts were made four times a day, at 6 AM, 11 AM, 3 PM, and 10 PM for 27 sectors of road including Burgenland. The forecasts of precipitation in the first season were correct 88% of the time and none of the eight sectors were correct less than 83% of the time. The first large-scale testing has shown that the available network of stations feeding weather information back from the Autobahn ministry is still not always ideal for the different regions. The network of stations must be expanded with more tightly packed stations over a larger area and more frequent measurements. Also, more accurate data should be obtained on the temperature of road surfaces, especially bridges, moisture on road surfaces, and ground winds. (King-PTT)
W91-01579

NEW SNOW IN THE URBAN AREA OF VIENNA (NEUSCHNEE IM RAUM WIEN).
Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria).
For primary bibliographic entry see Field 2B.
W91-01584

2D. Evaporation and Transpiration

EFFECTS OF CLEARFELLING A SITKA SPRUCE STAND ON THE WATER BALANCE OF A PEATY GLEY SOIL AT KERSHOPE FOREST, CUMBRIA.
Forestry Commission, Midlothian (Scotland). Northern Research Station.
For primary bibliographic entry see Field 4C.
W91-01069

EVAPOTRANSPIRATION, WATER USE EFFICIENCY, MOISTURE EXTRACTION PATTERN AND PLANT WATER RELATIONS OF RAPE (BRASSICA CAMPESTRIS) GENOTYPES IN RELATION TO ROOT DEVELOPMENT UNDER VARYING IRRIGATION SCHEDULES.
Haryana Agricultural Univ., Hissar (India).
V. Raja, and K. C. Bishnoi.
Experimental Agriculture EXAGAL, Vol. 26, No. 2, p 227-233, April 1990. 1 fig, 5 tab, 8 ref.

Descriptors: *Evapotranspiration, *Irrigation effects, *Rapeseed, *Root development, *Soil-water-plant relationships, *Water use efficiency, India, Irrigation requirements, Plant growth, Plant physiology, Plant water potential, Soil types.

A field experiment was conducted on sandy loam soil at Hisar, India, during the autumn seasons 1984 to 1985 and 1985 to 1986 to study rape genotypes under varying irrigation schedules. Root volume and dry weight increased, while tap root and lateral root lengths decreased with irrigation. Increased irrigation frequency increased evapotranspiration but decreased water use efficiency. The relative water content and osmotic potential of the leaves increased with more frequent irrigation, but plant water retention capacity decreased. There were genotypic differences between the characters examined. Out of the five genotypes examined (Sangam, T-9, B-54, TH-72, and TH-84), genotypes T-9 and Sangam are recommended for use with irrigation and B-54 for use under unirrigated conditions. (Author's abstract)
W91-01114

PREDICTING WATER USE AND WATER APPLICATION EFFICIENCIES FOR DIFFERENT IRRIGATION DEPTHS IN WHEAT.
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
For primary bibliographic entry see Field 3F.
W91-01115

WATER BODY EVAPORATION EXPERIMENT OF POYANG LAKE (IN CHINESE).
Hydrometerological Experiment Station of Poyang Lake, Xingzi (China).
For primary bibliographic entry see Field 2H.
W91-01576

ANALYSIS OF AIR TEMPERATURE EFFECT OF TAIHU LAKE (IN CHINESE).
Academia Sinica, Nanjing (China). Inst. of Geography.
For primary bibliographic entry see Field 2H.
W91-01577

2E. Streamflow and Runoff

BIOGEOCHEMISTRY OF CARBON IN THE AMAZON RIVER.
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 5B.
W91-01039

FLOODPLAIN DYNAMICS OF A WANDERING RIVER, DENDOCHRONOLOGY OF THE MORICE RIVER, BRITISH COLUMBIA, CANADA.
Northwest Community Coll., Terrace (British Columbia).
A. S. Gottesfeld, and L. M. Johnson-Gottesfield.
Geomorphology GEMPEZ, Vol. 3, No. 2, p 159-179, June 1990. 13 fig, 2 tab, 43 ref.

Descriptors: *Canada, *Channel morphology, *Dendrochronology, *Flood plains, *Geomorphology, *Meanders, *Morice River, *Paleohydrology, Channels, Debris flow, Floods, History, River flow, Tree rings, Trees.

Dendochronological techniques were used to develop a history of flood occurrence and relative stage for the middle section of the Morice River based on flood scars, bank undercutting dates and tree establishment dates on fluvial features. Thirty-one significant floods over the past 105 years were detected through dendochronology of flood scarred trees. On the Morice River, flood scars are predominantly caused by flood-transported logs. Abundant log transport results in damage to channel margin trees during events only slightly above bankfull discharge. The record of flood scars on channel margin trees and establishment dates of forest stands on abandoned channels and surfaces show that the Morice River has maintained its present regimen for the past 115 years. During the Neoglacial age the Morice river was more active than in recent times, and its channels occupied twice the present area. Tree-establishment dates show that Neoglacial surfaces and channels of the Morice River were abandoned during the 1820's. The modern floodplain configuration was assumed by 1870. (Lantz-PTT)
W91-01070

FLOW AND PARTICLE PATHS AT A NATURAL RIVER CONFLUENCE WITH COARSE BED MATERIAL.
Montreal Univ. (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W91-01071

APPLICATION OF A SIMPLE LUMPED RIVER FLOW FORECASTING MODEL TO HILLSLOPE SOIL WATER STORAGE ESTIMATION.
Kobe Univ. (Japan). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W91-01086

URBAN RUNOFF MODELING FOR ADMINISTRATIVE PURPOSES.
Wright Water Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 4C.
W91-01193

APPLICATION OF SWMM IN THE NEW ORLEANS AREA.
Tulane Univ., New Orleans, LA.
For primary bibliographic entry see Field 4C.
W91-01195

USE OF SWMM/EXTRAN AND TR-20 TO DEVELOP REGIONAL STORMWATER DETEN-

LIBRARY U. OF L. UNDERWATER SOUND LAB.

TION PLANS IN THE WASHINGTON, D.C. REGION.
Camp, Dresser and McKee, Inc., Annandale, VA.
For primary bibliographic entry see Field 4C.
W91-01196

HYDROLOGIC DATA AUTOMATION USING AUTOCAD.
Kiowa Engineering Corp., Denver, CO.
For primary bibliographic entry see Field 7C.
W91-01202

DISTRIBUTED RAINFALL-RUNOFF MODELING BASED ON DIGITAL MAP DATABASE.
Colorado Univ. at Denver. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W91-01203

PC-SYNOP, A RAINFALL ANALYSIS TOOL.
Woodward-Clyde Consultants, Oakland, CA.
For primary bibliographic entry see Field 7C.
W91-01204

HYETOGRAPH COMPOSITING EFFECTS ON URBAN RUNOFF MODELLING.
Kiowa Engineering Corp., Denver, CO.
For primary bibliographic entry see Field 7C.
W91-01206

FLOOD HYDROGRAPH FOR UNGAGED WATERSHED.
Stewart Environmental Consultants, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 7C.
W91-01207

UNIT-HYDROGRAPH PROCEDURES FOR ARID LANDS.
For primary bibliographic entry see Field 7C.
W91-01208

DETERMINATION OF DESIGNATED FLOODWAY BOUNDARIES AROUND LONG ISLANDS IN STREAM CHANNELS.
Oklahoma Univ., Norman. School of Civil Engineering and Environmental Science.
J. F. Harp.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 217-223, 2 fig, 3 ref.

Descriptors: *Backwater analysis, *Channels, *Computer programs, *Data interpretation, *Flood routing, *Flow around objects, *Islands, *River flow, Flood flow, Flow profiles.

Whenever river islands are encountered in hydraulic analysis, special problems exist with respect to the proper application of most backwater package programs. This problem is due to flow divisions in the side channels that must remain constant, unless there are provisions for short circuiting the flows along the riverine pathway. The correct solution is achieved whenever the flows divide so that the head loss around each side-channel is the same. The correct flow division, and resulting backwater profile is achievable using the HEC-2 computer program. However, even with the computer assist, a trial and error procedure is required. This procedure utilizes one of three methods: (1) utilizes a large cross-section containing all the GR points, and a usual application of HEC-2 methodology; (2) assumes that the original flow ratio division remains constant, and two runs are made around the island using the tributary option and the preserved energy gradient; and (3) where smooth encroachment stations are set at outer reasonable delineations, and the side channel flows are rebalanced until equal head losses again occur around each side channel, while the incremented water surface is achieved. (See also W91-01188) (Lantz-PTT)
W91-01209

GULF COAST FLOOD ROUTING.
Wright Water Engineers, Inc., Denver, CO.
R. L. Rossmiller, and K. R. Wright.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 224-231, 1 tab, 6 ref.

Descriptors: *Coastal waters, *Flood routing, *Gulf of Mexico, *Storm runoff, *Urban hydrology, *Urban runoff, Bayous, Flood control, Flood flow, Urban areas, Water management, Wetlands.

Low elevation urban centers along the coast of the Gulf of Mexico require special flood control measures to provide adequate drainage. Of particular concern to the drainage engineer are the flat slopes of the land surface and channels with usual grades of 0.0002 to 0.0005 feet/foot. Flood flow modeling and routing of stormwater where bayou thalwegs may range from -5 to 10 feet below mid sea level (msl) are described at Beaumont, Texas. Plans for a mid-city interceptor channel are described which provide downstream bayou flood relief. Another potential southern interceptor channel would provide not only additional downstream bayou flood relief, but water quality improvement to the stormwater runoff as well. Information is gained from an investigation of runoff in a southern coastal city. The techniques investigated may prove useful in other locations as well. (See also W91-01188) (Lantz-PTT)
W91-01210

SUSPENSION AND SETTLEMENT OF PARTICLES IN FLOWING WATER: COMPARISON OF THE EFFECTS OF VARYING WATER DEPTH AND VELOCITY IN CIRCULATING CHANNELS.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
For primary bibliographic entry see Field 2J.
W91-01340

DISSOLVED ORGANIC CARBON CONCENTRATIONS AND FLUXES ALONG THE MOISIE RIVER, QUEBEC.
University Coll. of North Wales, Bangor. School of Animal Biology.
For primary bibliographic entry see Field 2K.
W91-01341

FORESTS AND THE TEMPERATURE OF UPLAND STREAMS IN WALES: A MODELLING EXPLORATION OF THE BIOLOGICAL EFFECTS.
University Coll., Cardiff (Wales). School of Pure and Applied Biology.
N. S. Weatherly, and S. J. Ormerod.
Freshwater Biology FWBLAB, Vol. 24, No. 1, p 109-122, August 1990. 7 fig, 4 tab, 54 ref.

Descriptors: *Forest ecosystems, *Land use, *Model studies, *Stream ecology, *Temperature effects, *Wales, *Water temperature, Aquatic insects, Fish populations, Growth, Mayflies, Moors, Stoneflies, Trout.

Daily temperature data from six streams in upland Wales were used to explore the thermal effects of afforestation on stream ecology. The data were linked to published biological models to simulate fish and invertebrate development. Mean daily temperatures in forest streams were lower than those of moorland streams in spring and summer, and higher in winter. These spatial comparisons were supported by the results of experimental bank-side clearance at a forest site, where there was evidence that stream temperatures fell in winter and rose in spring following treatment. Simulations indicated that brown trout (Salmo trutta) could weigh over 30% more by the end of their second growing season in a moorland compared with a forest stream. Several species of insects showed slower simulated egg development at forest sites. For two ephemeropteran species simulated nymphal growth was also retarded, suggesting significant alterations to the life cycle. Two plecopteran species were affected only slightly by the different temperature regimes. The simulations suggested that afforestation, by reducing summer temperatures, could lead to marked reductions in rates of development of some invertebrates and fish. (Author's abstract)
W91-01343

ECOLOGY OF TWO INTERMITTENT STREAMS IN VICTORIA, AUSTRALIA. I. MULTIVARIATE ANALYSES OF PHYSICO-CHEMICAL FEATURES.
Monash Univ., Clayton (Australia). Centre for Stream Ecology.
A. J. Boulton, and P. S. Lake.
Freshwater Biology FWBLAB, Vol. 24, No. 1, p 123-141, August 1990. 8 fig, 8 tab, 48 ref.

Descriptors: *Australia, *Intermittent streams, *Multivariate analysis, *Physicochemical properties, *Stream ecology, Conductivity, Dissolved oxygen, Flow characteristics, Flow velocity, Macroinvertebrates, Pools, Riffles, Temperature.

Amplitudes in physicochemical features in intermittent streams exceed those in nearby permanent streams and strongly influence macroinvertebrate community structure; however, this relationship has not been objectively described. Therefore, multivariate techniques of ordination and classification were applied to environmental data collected from pools and riffles at four sites on two intermittent streams in central Victoria, Australia, during a drought year followed by a wetter year. A cyclical sequence of flow phases was usually evident in pool and riffle habitats at all sites over both years: pre-flow, early flow, main flow, diminishing flow and post-flow. Several spates that occurred during the sampling period only briefly distorted the cyclical pattern. No single variable characterized these phases at each site; instead, the phases represented complex combinations of discharge, current velocity, dissolved oxygen, conductivity, water temperature and time-related variables. This highlights the advantages of an integrative, multivariate approach to seek patterns in environmental data, especially since physicochemical features are often highly inter-correlated. Although the temporal variation in most of the physicochemical variables at each site over both years was generally consistent, some differences could be ascribed to the low rainfall and discharges during the 1982 drought. Water temperature in the riffles closely reflected ambient air temperature, conductivity was usually greater, and dissolved oxygen seldom reached saturation, even in the riffles during the drought. During the wetter years after the 1982 drought, flow continued during summer at the study sites. Multivariate analyses indicated that a complete cycle in which the diminishing flow phase merged into the preflow phase would result. This is probably the usual situation in permanent streams in Australia. (White-Reimer-PTT)
W91-01344

INHIBITORY EFFECTS OF HIGH MOLECULAR WEIGHT DISSOLVED ORGANIC MATTER UPON METABOLIC PROCESSES IN BIOFILMS FROM CONTRASTING RIVERS AND STREAMS.
University Coll. of North Wales, Bangor. School of Biological Sciences.
For primary bibliographic entry see Field 2K.
W91-01345

MODELLING BLACK FLY PRODUCTION DYNAMICS IN BLACKWATER STREAMS.
Alabama Univ., University. Aquatic Biology Program.
For primary bibliographic entry see Field 2H.
W91-01346

STONEFLY PREDATION ALONG A HYDRAULIC GRADIENT: A FIELD TEST OF THE HARSH--BENIGN HYPOTHESIS.
Cornell Univ., Ithaca, NY. Dept. of Entomology.
For primary bibliographic entry see Field 2H.
W91-01347

ASSOCIATIONS OF AQUATIC INSECTS (EPHEMEROPTERA, PLECOPTERA, AND TRICHOPTERA) IN A NETWORK OF SUBARCTIC LAKES AND STREAMS IN QUEBEC.
Montreal Univ. (Quebec). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-01349

SILTATION OF STONE-SURFACE PERIPHYTON IN RIVERS BY CLAY-SIZED PARTICLES FROM LOW CONCENTRATIONS IN SUSPENSION.
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2J.
W91-01353

ANCIENT CHANNELS OF THE SUSQUEHANNA RIVER BENEATH CHESAPEAKE BAY AND THE DELMARVA PENINSULA.
Geological Survey, Woods Hole, MA.
For primary bibliographic entry see Field 2J.
W91-01378

COLONIZATION PROCESS OF A TYPICAL EPILITHIC ALGAL COMMUNITY--HOMOEOTHRIX JANTHINA-ACHNANTHES JAPONICA COMMUNITY--IN A LESS POLLUTED RIVER IN JAPAN (IN JAPANESE).
For primary bibliographic entry see Field 2H.
W91-01383

SEASONAL AND LONG-TERM TRENDS IN TRUCKEE RIVER NUTRIENT CONCENTRATIONS AND TRUCKEE RIVER NUTRIENT CONCENTRATIONS AND LOADINGS TO PYRAMID LAKE, NEVADA: A TERMINAL SALINE LAKE.
Fish and Wildlife Service, Columbia, MO.
For primary bibliographic entry see Field 5B.
W91-01425

INFLUENCE OF HUDSON BAY RUNOFF AND ICE-MELT ON THE SALINITY OF THE INNER NEWFOUNDLAND SHELF.
Department of Fisheries and Oceans, St. John's (Newfoundland). Science Branch.
R. A. Myers, S. A. Akenhead, and K. Drinkwater.
Atmosphere - Ocean ATOCDA, Vol. 28, No. 2, p 241-256, June 1990. 10 fig, 37 ref.

Descriptors: *Continental shelf, *Hudson Bay, *Melting, *Newfoundland, *Runoff, *Salinity, *Sea ice, Canada, Correlation analysis, Floating ice, Labrador Shelf, Mathematical analysis, Seasonal variation, Ungava Bay.

This study examines the sources of interannual variability in salinity on the Newfoundland continental shelf observed in a 40-year time series from an oceanographic station known as Station 27. Specifically, through lag-correlation analysis, the a priori hypotheses that the salinity anomalies at Station 27 are determined by freshwater runoff anomalies from Hudson and Ungava Bays and by ice-melt anomalies in Hudson Bay and on the Labrador Shelf were investigated. Interannual variations of summer runoff into Hudson Bay were significantly negatively correlated with salinity anomalies on the Newfoundland Shelf with a lag (9 months) that is consistent with expected travel times based on known current velocities in Hudson Bay and along the Labrador Shelf. Sea-ice extent over the Labrador and northern Newfoundland shelves was significantly negatively correlated with salinity at a lag of 3 to 4 months, corresponding to the time of minimum salinity at Station 27. It appears that ice-melt over the Labrador-northern Newfoundland Shelf is primarily responsible for the seasonal salinity minimum over the Newfoundland Shelf. Interannual variability in runoff into Ungava Bay and ice-melt in Hudson Bay were not correlated with interannual salinity variations on the Newfoundland Shelf. (Author's abstract)
W91-01432

STOCHASTIC MODELS OF STREAMFLOW: SOME CASE STUDIES.
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
P. P. Mujumdar, and D. Nagesh Kumar.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 4, p 395-410, August 1990. 3 fig, 8 tab, 16 ref.

Descriptors: *Hydrologic models, *India, *Model studies, *Stochastic hydrology, *Streamflow forecasting, *Time series analysis, Case studies, Cauvery River, Data interpretation, Hemavathy River, Malaprabha River, Regression analysis, Streamflow, Water resources data.

The development and use of stochastic models of hydrological phenomena play an important role in water resources engineering, including their use to forecast river flows. The problem of model selection is an important one in time series analysis as there are an infinite number of possible models, and the choice of a wrong model may result in a costly decision. Out of the possible models of the Auto-Regressive Moving Average (ARMA) however, only a few need to be considered for modeling a given streamflow sequence. AR parameters of up to order 6 and MA parameters of up to order 2 would, in general, serve the purpose. Ten candidate models of the ARMA family (AR(1), AR(2), ..., AR(6), ARMA(1,1), ARMA(2,1), ARMA(3,1), ARMA(1,2) and ARMA(2,2)) were investigated for representing and forecasting monthly and ten-day streamflow in three Indian rivers. The best models for forecasting and data representation were selected using the criteria of Minimum Mean Square Error (MMSE) and Maximum Likelihood (ML). The selected models were validated for significance of the residual mean, significance of the periodicities in the residuals, and significance of the correlation in the residuals. The models selected, based on the ML criterion for the synthetic generation of the three monthly series are: AR(4) for the Cauvery River; ARMA(2,1) for the Hemavathy River; and ARMA(3,1) for the Malaprabha River. For the ten-day series of the Malaprabha River, the AR(4) model was selected. The AR(1) model resulted in a minimum mean square error in all the cases studied, and was recommended for use in forecasting flows one time step ahead. (Fish-PTT)
W91-01461

DEVELOPMENT, CALIBRATION AND FIELD TESTING OF A SOIL LOSS AND A RUNOFF MODEL DERIVED FROM A SMALL-SCALE PHYSICAL SIMULATION OF THE EROSION ENVIRONMENT ON ARABLE LAND IN ZIMBABWE.
Institute of Agricultural Engineering, Harare (Zimbabwe).
For primary bibliographic entry see Field 2J.
W91-01478

FLOW STABILITY AND FRICTION FACTOR IN ROUGH CHANNELS.
Politecnico di Torino (Italy). Inst. di Idraulica.
For primary bibliographic entry see Field 8B.
W91-01494

ADVECTION SIMULATION BY MINIMAX-CHARACTERISTICS METHOD.
Hong Kong Polytechnic, Kowloon. Dept. of Civil and Structural Engineering.
For primary bibliographic entry see Field 8B.
W91-01496

CHANGES IN STREAM MORPHOLOGY AND STORM TRANSPORT OF SESTON FOLLOWING WATERSHED DISTURBANCE.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 2J.
W91-01505

ANNUAL STONEFLY (PLECOPTERA) PRODUCTION IN A SECOND ORDER OKLAHOMA OZARK STREAM.
North Texas State Univ., Denton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-01506

MEAN SQUARE ERROR OF REGRESSION-BASED CONSTITUENT TRANSPORT ESTIMATES.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W91-01522

PROBLEMS IN DETERMINING THE RETURN OF A WATERSHED TO PRETREATMENT CONDITIONS: TECHNIQUES APPLIED TO A STUDY AT CASPAR CREEK, CALIFORNIA.
Forest Service, Arcadia, CA.
For primary bibliographic entry see Field 4C.
W91-01523

THEORETICAL MODEL OF OPTIMAL DRAINAGE NETWORKS.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
A. D. Howard.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2107-2117, September 1990. 6 fig, 1 tab, 48 ref.

Descriptors: *Catchment areas, *Drainage patterns, *Geomorphology, *Model studies, *Stream erosion, Channel morphology, Erosion, Stochastic models, Streamflow, Valleys.

A simulation model of drainage network optimization has been developed in which channels shift to minimize total stream power within the network. The simulation model starts from an arbitrary initial stream network developed on a square matrix, such as produced by random headward growth. Discrete stream capture is then simulated within the network, occurring wherever a new stream linkage would produce a steeper course than the original. Such capture produced a network with minimum power optimization but flow directions constrained to eight directions. Individual segment end points are allowed to migrate by iterative relaxation with a direction and rapidity of motion governed by the gradient of stream power at the node. This valley migration is subject to the constraint that the sources and outlet remain fixed. The resulting networks are visually and morphometrically more similar to natural stream networks than the original networks produced by the random headward growth model. (Author's abstract)
W91-01526

PRACTICAL ASPECTS OF LOW-FLOW FREQUENCY ANALYSIS.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
R. J. Nathan, and T. A. McMahon.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2135-2141, September 1990. 3 fig, 5 tab, 24 ref.

Descriptors: *Drought, *Flow equations, *Frequency analysis, *Low flow, Forecasting, Mathematical analysis, Streamflow, Streamflow data.

Some practical aspects concerning the application of the Weibull distribution to low-flow frequency analysis were examined. Two-parameter and three-parameter forms of the distribution were fitted to a total of 987 distributions derived from the daily flow data of 134 catchments located in southeastern Australia. The relative performance of three estimation methods (moments, maximum likelihood, and probability weighted moments) was investigated, and it is found that the different estimation methods provide distinct sets of quantile estimates. The method of probability weighted moments is more likely to give unsatisfactory estimates of the smallest drought and in general tends to yield less severe estimates of drought volumes relative to the other two methods. The method of maximum likelihood occasionally provides estimates of drought volumes that are many times

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greater than that yielded by the methods moments or probability weighted moments. The differences between low-flow frequency estimates based on calendar and hydrologic years were also investigated. Low-flow frequency estimates based on calendar years overestimate low-flow volumes for durations of 3 mo and more, whereas the opposite effect is apparent for shorter durations. It is evident that drought estimates should be based on the hydrologic year, regardless of the duration considered. (Peters-PTT)
W91-01529

DEPRESSIONAL STORAGE FOR MARKOV-GAUSSIAN SURFACES.
National Soil Erosion Lab., West Lafayette, IN.
For primary bibliographic entry see Field 2J.
W91-01539

STUDY OF POLLUTANT DIFFUSION IN THE JIUJIANG SEGMENT OF THE CHANGJIANG RIVER (IN CHINESE).
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 5B.
W91-01571

REACTION OF MICROBIAL PERIPHYTON TO SUBSTRATE CONCENTRATION CHANGES IN A RUNNING WATER MODEL.
Vyzkumny Ustav Vodohospodarsky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 2H.
W91-01603

HETEROTROPHIC MICROPLANKTON IN PLANKTON SUCCESSIONS AND SELF PURIFICATION PROCESSES ALONG THE YENISEI RIVER.
Oceanology Dept, Gelendzhik, Krasnodar, 353470 USSR.
For primary bibliographic entry see Field 2H.
W91-01616

STREAMWATER ACIDIFICATION IN RELATION TO ACID PRECIPITATIONS--VEGETATION AND BEDROCK INFLUENCES, CONSEQUENCES FOR TROUT POPULATIONS: THE VOSGES MASSIF CASE STUDY (ACIDIFICATION DES EAUX DE SURFACE SOUS L'INFLUENCE DES PRECIPITATIONS ACIDES : ROLE DE LA VEGETATION ET DU SUBSTRATUM, CONSEQUENCES POUR LES POPULATIONS DE TRUITES. LE CAS DES RUISSEAUX DES VOSGES).
Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
For primary bibliographic entry see Field 5C.
W91-01738

EFFECT OF NUTRIENT CONTENT ON LEAF DECOMPOSITION IN A COASTAL PLAIN STREAM: A COMPARISON OF GREEN AND SENESCENT LEAVES.
Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 2H.
W91-01742

COMPARISON OF DETRITUS PROCESSING BETWEEN PERMANENT AND INTERMITTENT HEADWATER STREAMS.
Central Michigan Univ., Mount Pleasant. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-01744

REDD SITE SELECTION BY BROWN TROUT IN DOUGLAS CREEK, WYOMING.
Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie.
For primary bibliographic entry see Field 8I.
W91-01745

NEW APPROACH FOR MEASURING COVER IN FISH HABITAT STUDIES.
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 2H.
W91-01746

ALGAE, OTHER THAN DIATOMS, AFFECTING THE DENSITY, SPECIES RICHNESS AND DIVERSITY OF DIATOM COMMUNITIES IN RIVERS.
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
For primary bibliographic entry see Field 2H.
W91-01765

BENTHIC COMMUNITY STRUCTURE AND THE EFFECT OF ROTENONE PISCICIDE ON INVERTEBRATE DRIFT AND STANDING STOCKS IN TWO PAPUA NEW GUINEA STREAMS.
Hong Kong Univ. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-01767

STUDIES ON THE CHEMISTRY OF INTERSTITIAL WATER TAKEN FROM DEFINED HORIZONS IN THE FINE SEDIMENTS OF BIVALVE HABITATS IN SEVERAL NORTHERN GERMAN LOWLAND WATERS: I. SAMPLING TECHNIQUES.
Tieraerztliche Hochschule Hannover (Germany, F.R.). Inst. fuer Zoologie.
For primary bibliographic entry see Field 2H.
W91-01768

DISTRIBUTION AND PRIMARY PRODUCTIVITY OF THE EPIZOIC MACROALGA BOLDIA ERYTHROSIPHON (RHODOPHYTA) IN A SMALL ALABAMA STREAM.
Alabama Univ., University. Aquatic Biology Program.
For primary bibliographic entry see Field 2H.
W91-01805

EFFECTS OF HERBIVORE TYPE AND DENSITY ON TAXONOMIC STRUCTURE AND PHYSIOGNOMY OF ALGAL ASSEMBLAGES IN LABORATORY STREAMS.
Oregon State Univ., Corvallis. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 2H.
W91-01806

EFFECTS OF HERBIVORE TYPE AND DENSITY ON CHEMICAL COMPOSITION OF ALGAL ASSEMBLAGES IN LABORATORY STREAMS.
Oregon State Univ., Corvallis. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 2H.
W91-01807

RATES OF PROTOZOAN BACTERIVORY IN THREE HABITATS OF A SOUTHEASTERN BLACKWATER RIVER.
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 2H.
W91-01809

PERSPECTIVE ON EL NINO AND LA NINA: GLOBAL IMPLICATIONS FOR STREAM ECOLOGY.
New Mexico Univ., Albuquerque. Dept. of Biology.
For primary bibliographic entry see Field 2B.
W91-01811

WATER RESOURCES DATA FOR NEW MEXICO, WATER YEAR 1989.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01828

WATER RESOURCES DATA FOR NEBRASKA, WATER YEAR 1989.
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01829

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1989, VOLUME 1. EASTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01830

PEAK-FLOW CHARACTERISTICS OF SMALL URBAN DRAINAGE ALONG THE WASATCH FRONT, UTAH.
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W91-01834

FLOOD OF OCTOBER 1983 AND HISTORY OF FLOODING ALONG THE SAN FRANCISCO RIVER, CLIFTON, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
H. W. Hjalmarson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 85-4225-B, 1990. 42p, 31 fig, 6 tab, 11 ref.

Descriptors: *Arizona, *Flood frequency, *Flood peak, *San Francisco River, Blue River, Clifton.

Clifton, Arizona, has received major damage from floods at least 12 times since the town was settled in 1870. Residents built floodwalls along the main channel of the San Francisco River, filled in floodplain areas, and raised buildings and roads in an effort to protect homes and businesses. Although the floodwalls provide protection during low and medium flows, they provide little protection during large flows. During the flood of October 1 and 2, 1983, floodwaters overtopped the floodwalls and inundated flood plains. The 2,766-square-mile basin of the San Francisco River is steep and has a large topographic relief, especially near Clifton. Intense orographic rainfall from winter storms results in rapid runoff in the San Francisco River basin. Flood routing and hydrograph analyses indicate that runoff from the southern part of the San Francisco River basin produced many large flood peaks at Clifton. (USGS)
W91-01849

WATER RESOURCES DATA FOR IOWA, WATER YEAR 1989.
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01856

WATER RESOURCES DATA FOR WEST VIRGINIA, WATER YEAR 1988.
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01858

WATER RESOURCES DATA FOR MICHIGAN, WATER YEAR 1989.
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01864

MINIMUM FROUDE NUMBER AND THE EQUILIBRIUM OF ALLUVIAL SAND RIVERS.
Victoria Univ. of Manchester (England). Dept. of Geography.
Y. Jia.
Earth Surface Processes and Landforms ESPLDB,

Vol. 15, No. 3, p 199-209, May 1990. 8 Fig, 28 Ref.

Descriptors: *Alluvial rivers, *Channel morphology, *Equilibrium, *Flow, *Froude number, *Geomorphology, *Model studies, *River flow, *Sediment load, *Sediment transport, Channel flow, Channel stability, Channels, Computer models, Flow velocity, Hydraulic geometry, Particle size, Sand, Sedimentation, Simulation.

Rivers adjust towards an equilibrium condition, the stability of which depends on a set of controlling factors expressed by the Froude number. As alluvial river channels approach stable conditions, the Froude number of the channel flow will tend to attain a minimum value which reflects minimum bed material motion and maximum channel stability, under the constraints imposed by water discharge, sediment load, and particle size. Computer simulations for sand bed rivers show that the Froude number of the flow tends to a minimum value when the equilibrium river tends to a certain hydraulic geometry. Evidence from 57 alluvial sand material rivers and stable channels shows that this simulated hydraulic geometry with minimum Froude number corresponds to the natural equilibrium state. The results from these simulations may be used in designing stable channels or judging the stability of alluvial channels. (Author's abstract)
W91-01874

CHANNEL SEDIMENT VARIABILITY ALONG A RIVER: A CASE STUDY OF THE SIRET RIVER (ROMANIA).
Statiunea de Cercetari Stejarul, Piatra-Neamt (Romania). Geomorphology Lab.
I. Ichim, and M. Radoane.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 3, p 211-225, May 1990. 10 fig, 4 tab, 35 ref.

Descriptors: *Channel flow, *Channel morphology, *Channels, *Geomorphology, *Particle size, *River sediments, *Rivers, *Romania, *Sediment transport, *Sediments, *Siret River, *Stream profiles, Bed load, Carpathian Mountains, Deformation, Flow channels, Mountain streams, Petrography, River beds.

The Siret River has the largest drainage basin in Romania. It gathers all the rivers from the eastern part of the Eastern Carpathians, which causes marked asymmetry of the basin. Changes in the form of the longitudinal profile and the grain size variability introduced by the Carpathian tributaries were examined. Channel sediment analyses considered the petrography, granulometry, and morphometry of the pebbles, relating these to the river bed and floodplain geometry and to some properties of the drainage basin. It was determined that the Siret River undergoes an intense regrading of its longitudinal profile, with marked aggradation between transects 24 and 26. This reflects selective accumulation of coarse material due to the massive contribution of the Carpathian tributaries. It is hypothesized that the deformation results from the failure of the river to reduce its bed elevation in its middle-lower reach to the theoretical equilibrium profile which causes the river not to attain the state of grade. This phenomenon has been continuous throughout the Holocene, resulting in the gravel sheet formation of the Pericarpathian piedmont. (Author's abstract)
W91-01875

CHANNEL AVULSION AND RIVER METAMORPHOSIS: THE CASE OF THE THOMSON RIVER, VICTORIA, AUSTRALIA.
Melbourne Univ., Parkville (Australia). Dept. of Geography.
S. O. Brizga, and B. L. Finlayson.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 5, p 391-404, August 1990. 9 fig, 2 tab, 26 ref.

Descriptors: *Avulsion, *Channel morphology, *Channels, *Floodwater, *Geomorphology, *Meanders, *Paleohydrology, *Rivers, Alluvial channels, Australia, Flood plains, Hydrology, Thomson River, Victoria.

Channel avulsion occurred on the Thomson River in Victoria, Australia, in 1952 along a 12 km length of the valley. A comparison of the old and new channels reveals considerable differences in channel characteristics. The old channel was perched above the floodplain on an alluvial ridge and when bankfull capacity was exceeded, floodwaters concentrated on the lowest part of the floodplain some distance away. This is where the new channel formed. It is an incised channel with larger capacity and longer meander wavelength than the old channel and is also shorter and steeper. The new channel is subject to larger floodflows and a more variable flood regime than the old course because of the differences in the channel/floodplain relationship and channel capacity. The resulting concentration of stream power along the new course is responsible for the contrast in channel characteristics and for the more rapid meander migration. This example shows that river metamorphosis can occur without major environmental changes. Measures of channel geometry such as gradient, sinuosity, and meander wavelength cannot be used in palaeohydrological work to infer climatic or other environmental changes without independent supporting evidence. Differences in channel geometry can arise simply from changes in the relationship between the channel and its floodplain. (Author's abstract)
W91-01879

BLANKET PEAT EROSION IN A MID-WALES CATCHMENT DURING TWO DROUGHT YEARS.
University Coll. of Wales, Aberystwyth. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W91-01881

INFLUENCE OF DEBRIS FLOWS ON CHANNELS AND VALLEY FLOORS IN THE OREGON COAST RANGE, U.S.A.
Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2J.
W91-01882

COMPARISON OF PHYTOPLANKTON ASSEMBLAGES AND ENVIRONMENTAL RELATIONSHIPS IN THREE ESTUARINE RIVERS OF THE LOWER CHESAPEAKE BAY.
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2L.
W91-01905

STABILITY OF PERIPHYTON AND MACROINVERTEBRATES TO DISTURBANCE BY FLASH FLOODS IN A DESERT STREAM.
Arizona State Univ., Tempe. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-01924

DISCHARGE-EXPORT RELATIONSHIPS IN HEADWATER STREAMS: THE INFLUENCE OF INVERTEBRATE MANIPULATIONS AND DROUGHT.
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 2H.
W91-01925

MASS-BALANCE OF METALS AND IDENTIFICATION OF THEIR SOURCES IN BOTH RIVER AND FALLOUT FLUXES NEAR GDANSK BAY, BALTIC SEA.
Akademia Medyczna, Gdansk (Poland). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5B.
W91-02007

PHTHALATE ESTERS IN RIVERS OF THE GREATER MANCHESTER AREA, U. K.
Obafemi Awolowo Univ., Ile-Ife (Nigeria). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W91-02011

2F. Groundwater

VIRUS TRANSPORT AND SURVIVAL IN SATURATED AND UNSATURATED FLOW THROUGH SOIL COLUMNS.
Arizona Univ., Tucson. Dept. of Soil and Water Science.
For primary bibliographic entry see Field 5B.
W91-01008

AEROBIC AND ANAEROBIC DEGRADATION OF ALACHLOR IN SAMPLES FROM A SURFACE-TO GROUNDWATER PROFILE.
Agricultural Research Service, Stoneville, MS. Southern Weed Science Lab.
For primary bibliographic entry see Field 5B.
W91-01019

MURKY STANDARDS FOR GROUNDWATER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Hazardous Sites and Superfund Enforcement.
D. A. Brown.
Environmental Forum ENVFEN, Vol. 7, No. 3, p 16-21, May/June 1990.

Descriptors: *Environmental protection, *Groundwater management, *Groundwater pollution, *Water pollution control, *Water quality standards, Aquifers, Cleanup operations, Contamination, Federal jurisdiction, Legal aspects, Liability, Political aspects, Regulations, Resource Conservation and Recovery Act.

Federal groundwater policy has provided the states with incomplete guidance since it was first patched together six years ago. When the EPA started to formulate its policy in the early 1980s, it realized that none of the nine major federal environmental laws gave the agency comprehensive authority over national groundwater resources. The EPA has now proposed that protecting uncontaminated groundwater requires a different approach than one for remediating polluted aquifers. The new policy is presented in two documents: 'EPA Statement of Groundwater Principles' and 'State/Federal Relationships Options Paper, EPA Ground-Water Task Force.' While the EPA is moving away from permitting degradation either to maximum contaminant levels (MCL) or maximum contaminant level goal levels, unfortunately its new policy retains former, less strict standard in making decisions on remediating already contaminated supplies. Once adopted under Superfund and Resource Conservation and Recovery Act (RCRA), MCLs and other cleanup standards constitute not only the levels that will be deemed acceptable for cleanup, but also the limit of liability for cleanup for the persons who are responsible for creating the environmental problem. In actuality, EPA reconciles the inherent conflict between large remedy costs and cleanup standards by minimizing costs and setting standards in individual cases in a way that structures the responsible parties' liability at a level that has already taken the cost to them into consideration. By trying to place protection on an equal footing with remediation, the two recent EPA documents present a shift in how the agency presents its groundwater policy, and seem to send a message to the states that groundwater protection efforts should not rely on MCLs as a degradation ceiling. (Brunone-PTT)
W91-01096

GROUNDWATER: A REVIEW OF THE 1989 LITERATURE.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
C. T. Miller, and A. S. Mayer.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 5, p 700-737, July/August 1990. 655 ref.

Descriptors: *Groundwater, *Groundwater management, *Groundwater movement, *Literature review, *Saturated flow, *Unsaturated flow, Biodegradation, Biological properties, Chemical interactions, Desorption, Hydrology, Monitoring,

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Radon, Salinity, Sorption, Transport, Water quality.

Distinctions are made among single-, two-, and three-phase systems in this review. Single-phase systems refer to groundwater systems subjected to saturated flow conditions, whereas the two-phase and three-phase systems include groundwater systems subjected to unsaturated flow conditions, or conditions influenced by immiscible organic fluids such as petroleum products. Within the single-, two-, and three-phase system categories. Subdivisions are made among physical, chemical, or biological processes such as hydrodynamics, sorption/desorption, chemical reactions, and biodegradation. Specialized areas such as radon and radionuclide transport, facilitated transport, and saline groundwaters also are treated separately. The Rounding out this year's review, papers concerning groundwater quality monitoring, remediation, and management are discussed. (Author's abstract)
W91-01178

CONSTRAINTS ON THE USE OF MODELS TO PREDICT THE MOVEMENT OF PESTICIDES TO GROUNDWATER.
For primary bibliographic entry see Field 5B.
W91-01223

HYDROLYSIS OF CHLOROSTILBENE OXIDE: II. MODELING OF HYDROLYSIS IN AQUIFER SAMPLES AND IN SEDIMENT-WATER SYSTEMS.
Environmental Protection Agency, Athens, GA. Southeast Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W91-01256

CHLORINATED SOLVENTS IN UK AQUIFERS.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5B.
W91-01271

ECOLOGICAL CORRELATION BETWEEN ARSENIC LEVEL IN WELL WATER AND AGE-ADJUSTED MORTALITY FROM MALIGNANT NEOPLASMS.
National Taiwan Univ., Taipei. Inst. of Public Health.
For primary bibliographic entry see Field 5C.
W91-01292

DEVICE FOR IN SITU DETERMINATION OF GEOCHEMICAL TRANSPORT PARAMETERS. 1. RETARDATION.
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W91-01293

LOGNORMAL DISTRIBUTION OF RADON CONCENTRATION IN GROUND WATER.
Ecole Polytechnique, Montreal (Quebec).
For primary bibliographic entry see Field 5B.
W91-01294

USE OF TREE-RING CHEMISTRY TO DOCUMENT HISTORICAL GROUND-WATER CONTAMINATION EVENTS.
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-01295

HYDROGEOLOGIC DATABASE FOR GROUND-WATER MODELING.
Groundwater Services, Inc., Houston, TX.
For primary bibliographic entry see Field 7C.
W91-01298

PH AND REDOX BUFFERING MECHANISMS IN A GLACIAL DRIFT AQUIFER CONTAMINATED BY LANDFILL LEACHATE.
Western Michigan Univ., Kalamazoo. Center for Water Research.
For primary bibliographic entry see Field 5B.
W91-01300

HYDROGEOLOGICAL DECISION ANALYSIS: 1. A FRAMEWORK.
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
For primary bibliographic entry see Field 6A.
W91-01301

EXPERT TESTIMONY FOR THE PLAINTIFFS IN THE CASE THAT BROUGHT OHIO GROUND-WATER LAW INTO THE 20TH CENTURY.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 6E.
W91-01302

RELATION BETWEEN SATURATED CONDUCTIVITY AND CAPILLARY RETENTION CHARACTERISTICS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
S. Mishra, and J. C. Parker.
Ground Water GRWAAP, Vol. 28, No. 5, p 775-777, September/October 1990. 1 fig, 1 tab, 14 ref.

Descriptors: *Capillary capacity, *Groundwater movement, *Hydraulic conductivity, *Mathematical equations, *Saturated flow, *Soil water, *Unsaturated flow, Capillary conductivity, Capillary water, Mathematical studies, Model studies.

A simple closed form equation for saturated hydraulic conductivity, has been derived using the statistical pore structure model of Maulem with van Genuchten's capillary retention relationship. Application of this equation to an experimental data set shows reasonable mean agreement between measured and predicted saturated conductivities with approximately order-of-magnitude precision in predictions. Equations which are presented provide a consistent theoretical basis for estimating both saturated and unsaturated conductivities from capillary retention characteristics, and should be useful as predictive tools in the absence of actual conductivity measurements. As such, these equations are an alternative to purely statistical models which relate soil texture to hydraulic properties. The proposed procedure should be applicable in estimating saturated/unsaturated conductivity from capillary retention characteristics when moisture retention curve and the retention parameters are indirectly generated from particle size distribution data. (Lantz-PTT)
W91-01303

PROGRAM TO CALCULATE HYDRAULIC CONDUCTIVITY USING SLUG TEST DATA.
Idaho National Engineering Lab., Idaho Falls.
For primary bibliographic entry see Field 7C.
W91-01305

LOGGING OF SPECIAL HYDROGEOLOGICAL WELLS.
Karlova Univ., Prague (Czechoslovakia). Faculty of Science.
For primary bibliographic entry see Field 7B.
W91-01360

WHAT SHOULD BE DONE TO MITIGATE GROUNDWATER CONTAMINATION.
Academy of Natural Sciences of Philadelphia, PA.
For primary bibliographic entry see Field 5G.
W91-01374

ZINC IN POOR SANDY SOILS AND ASSOCIATED GROUNDWATER. A CASE STUDY.
Amsterdam Univ. (Netherlands). Landscape and Environmental Research Group.
For primary bibliographic entry see Field 5B.
W91-01450

ADVECTION SIMULATION BY MINIMAX-CHARACTERISTICS METHOD.
Hong Kong Polytechnic, Kowloon. Dept. of Civil and Structural Engineering.
For primary bibliographic entry see Field 8B.
W91-01496

DIMENSIONLESS STRAIGHT-TYPE LINES FOR AQUIFER TESTS.
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Hydrogeology.
Z. Sen.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 9, p 1145-1156, September 1990. 5 fig, 1 tab, 7 ref, append.

Descriptors: *Aquifer characteristics, *Aquifer testing, *Flow models, *Groundwater movement, *Model studies, *Pumping tests, Drawdown, Flow equations, Hydrological regime, Nonlinear programming, Transmissivity, Turbulent flow.

Type curves for the general nonlinear flow based on the exponential flow law were derived with the application of the Boltzmann transformation to the groundwater continuity and flow-law equations. The initial and moderate portions of these curves are very significant for the estimation of aquifer parameters. Recently, nonlinear flow-type straight-line expressions were derived on the basis of exponential flow law instead of the linear Darcy law. A procedure of hypothesis testing for the flow-regime linearity has been developed. Using this procedure, it was concluded that any straight line for late time-drawdown data on semilogarithmic paper does not necessarily guarantee the accurate application of the classical Jacob methods, but confirms the flow is radial. A dimensionless time-drawdown plot should be used for the identification of flow regime. If the dimensionless time-drawdown plot for the late time-drawdown data fits a straight line with the same slope as the Jacob straight line, then the underlying flow regime is linear. Otherwise, the flow regime is nonlinear. Once the flow regime is nonlinear, the necessary equations should be applied for the estimation of parameters such as the storability, turbulence exponent, and transmissivity. The methodology has been applied successfully to field data. (Author's abstract)
W91-01497

TWO-PHASE RELATIVE PERMEABILITY AND CAPILLARY PRESSURE OF ROUGH-WALLED ROCK FRACTURES.
Lawrence Berkeley Lab., CA. Earth Sciences Div.
K. Pruess, and Y. W. Tsang.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 1915-1926, September 1990. 9 fig, 52 ref.
DOE Contract DE-AC03-76SF00098.

Descriptors: *Fracture permeability, *Geologic fractures, *Groundwater movement, *Model studies, *Multiphase flow, Capillarity, Permeability, Rock properties, Wetting.

A conceptual and numerical model of multiphase flow in fractures has been developed. The void space of real rough-walled rock fractures is conceptualized as a two-dimensional heterogeneous porous medium, characterized by aperture as a function of position in the fracture plane. Portions of a fracture are occupied by wetting and nonwetting phase, respectively, according to local capillary pressure and global accessibility criteria. Phase occupancy and permeability are derived by assuming a parallel-plate approximation for suitably small subregions in the fracture plane. For log normal aperture distributions, a simple approximation to fracture capillary pressure is obtained in closed form; it resembles the typical shape of Leverett's j function. Approximations to wetting and nonwetting phase relative permeabilities are calculated by numerically simulating single phase flows separately in the wetted and nonwetted pore spaces. Illustrative examples indicate that relative permeabilities depend on the nature and range of spatial correlation between apertures. It was also observed that interference between fluid phases flowing in a fracture tends to be strong, with the

sum of wetting and nonwetting phase relative permeabilities being considerably less than 1 at intermediate saturations. (Author's abstract)
W91-01511

INTERBED STORAGE CHANGES AND COMPACTION IN MODELS OF REGIONAL GROUNDWATER FLOW.
Geological Survey, Tucson, AZ.
S. A. Leake.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 1939-1950, September 1990. 8 fig, 1 tab, 32 ref.

Descriptors: *Compaction, *Groundwater movement, *Land subsidence, *Model studies, *Pumping head, *Storage coefficient, *Subsidence, California, Confined aquifers, Flow models, Groundwater storage, Mathematical models, Pumping, Storage equation.

Water released from permanent compaction of compressible fine-grained interbeds within confined aquifers may be a significant source of pumped water. Permanent or inelastic compaction of the interbeds occurs when head declines from pumping cause the effective stress or grain-to-grain load to exceed the elastic limits of the interbeds. As a result, the grains in the interbeds rearrange and excess water is expelled. The amount of inelastic compaction generally is proportional to the increase in effective stress and the decrease in head. A common approach for the simulation of elastic and inelastic compaction in groundwater flow models is to assume that head changes in the aquifer result in instantaneous storage changes in the compressible interbeds. A term is added to the groundwater flow equation to account for the storage changes. Changes in specific storage may be computed explicitly from the results at the previous time step in the finite difference formulation of the groundwater flow equation. A better approach is to implicitly apportion storage changes between elastic and inelastic components within a time step. If storage changes cannot be considered to occur instantaneously with change in head in the aquifer, another approach is taken. Equations for horizontal flow in the aquifer are coupled with equations for vertical flow in the compressible interbeds to simulate flow in half a representative doubly draining interbed. Storage changes and compaction are calculated for the representative half thickness and are extrapolated to the entire thickness of all interbeds within each cell. This approach was applied to an existing model of groundwater flow in the Central Valley of California. The simulation demonstrated that solving coupled systems of equations is feasible for a regional flow model. (Author's abstract)
W91-01513

SOLVING GROUNDWATER FLOW PROBLEMS BY CONJUGATE-GRADIENT METHODS AND THE STRONGLY IMPLICIT PROCEDURE.
Geological Survey, Lakewood, CO.
M. C. Hill.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 1961-1969, September 1990. 1 fig, 2 tab, 33 ref.

Descriptors: *Computer models, *Flow models, *Groundwater movement, *Model studies, Computers.

The performance of the preconditioned conjugate-gradient method with three preconditioners for solving groundwater flow problems was compared with the strongly implicit procedure (SIP) using a scalar computer. The preconditioners considered are the incomplete Cholesky (ICCG) and the modified incomplete Cholesky (MICCG), which require the same computer storage as SIP as programmed for a problem with a symmetric matrix, and a polynomial preconditioner (POLCG), which requires less computer storage than SIP. Although POLCG is usually used on vector computers, it was included because of its small storage requirements. Published comparisons of the solvers were evaluated, all four solvers were compared for the first time, and new test cases were examined to provide a more complete basis by which the solvers can be judged for typical groundwater flow problems. Based on nine test cases, the following conclusions were reached: (1) SIP is actually as efficient as ICCG for some of the published, linear, two-dimensional test cases that were reportedly solved much more efficiently by ICCG; (2) SIP is more efficient than other published comparisons would indicate when common convergence criteria are used; and (3) for problems that are three-dimensional, nonlinear, or both, and for which common convergence criteria are used, SIP is often more efficient than ICCG, and is sometimes more efficient than MICCG. (Author's abstract)
W91-01515

GEOCHEMICAL MODELING OF THE MADISON AQUIFER IN PARTS OF MONTANA, WYOMING, AND SOUTH DAKOTA.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2K.
W91-01517

MOMENTARY INSTABILITY OF A SATURATED POROUS LAYER WITH A TIME-DEPENDENT TEMPERATURE DISTRIBUTION, AND THE MOST UNSTABLE DISTURBANCE.
Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W91-01518

STREAM FUNCTIONS AND EQUIVALENT FRESHWATER HEADS FOR MODELING REGIONAL FLOW OF VARIABLE-DENSITY GROUNDWATER. 1. REVIEW OF THEORY AND VERIFICATION.
Texas Univ. at Austin. Bureau of Economic Geology.
R. K. Senger, and G. E. Fogg.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2089-2096, September 1990. 6 fig, 25 ref.

Descriptors: *Flow equations, *Geohydrology, *Groundwater movement, *Model studies, *Path of pollutants, *Saline water intrusion, Boundary conditions, Confined aquifers, Errors, Hydraulic gradient, Mathematical models, Variable density.

Steady state flow of variable-density groundwater was simulated using equivalent freshwater heads and stream functions. On the basis of previously published work, fluids with different fluid densities are replaced by one hypothetical fluid, and singularities are introduced along interfaces where the actual fluids change densities. The basic flow equation describing variable-density flow, written in terms of equivalent freshwater head, was used to derive the corresponding stream function equation and associated boundary conditions. Neumann boundary conditions for the stream function equation can be determined from gradients of equivalent freshwater heads along the boundary. Stream functions provide a direct representation of the groundwater flow pattern and flow rates where fluid densities vary in space. In comparison, equivalent freshwater heads and fluid densities describe the two driving forces, hydraulic gradient and buoyancy force, but head gradients do not necessarily describe the flow direction of variable-density groundwater in isotropic media. Comparison of the finite element formulations indicated that potential errors in the centroid-consistent velocity calculation based on the stream function solution can be expected to be smaller than those in the velocity calculation based on the head solution for cross-sectional flow models, because discretization in the vertical direction is typically finer than in the horizontal direction. The approach of using stream functions and equivalent freshwater head for simulating groundwater flow of variable density fluid is demonstrated using a cross-sectional study of seawater intrusion into a confined aquifer as an example. (See also W91-01525) (Author's abstract)
W91-01524

STREAM FUNCTIONS AND EQUIVALENT FRESHWATER HEADS FOR MODELING REGIONAL FLOW OF VARIABLE-DENSITY GROUNDWATER. 2. APPLICATION AND IMPLICATIONS FOR MODELING STRATEGY.
Texas Univ. at Austin. Bureau of Economic Geology.
R. K. Senger, and G. E. Fogg.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2097-2106, September 1990. 7 fig, 1 tab, 25 ref.

Descriptors: *Convection, *Flow models, *Geohydrology, *Groundwater movement, *Model studies, *Path of pollutants, *Surface-groundwater relations, Boundary conditions, Brines, Hydraulic properties, Saline water, Uncertainty.

Stream functions and equivalent freshwater heads were used to simulate steady state flow of variable-density groundwater in a regional, cross-sectional flow model through the Palo Duro Basin, Texas, where fluid densities vary between 1.0 and 1.15 g/cu cm. Centroid-consistent velocities computed from the stream function solution allow a more precise interpretation of local flow patterns in cross-sectional models than those from the head solution. Effects of significant fluid density variation on the regional groundwater flow pattern were studied by comparing simulation results that incorporate spatially varying, time-invariant densities with those that assume uniform density. Modeling shows that the regional groundwater flow pattern in the Palo Duro Basin is not significantly affected by variations in fluid densities, indicating that the topographically driven flow component dominates buoyancy forces associated with dense brines. An exception is near the eastern boundary where high fluid densities cause stronger downward flow. However, simulated equivalent freshwater heads in the variable-density model differ significantly from simulated heads in the freshwater density model, which is important for model calibration. In addition to the problems of hydraulic parameter and boundary condition uncertainties, modeling strategies for regional flow systems require consideration of uncertainties associated with fluid density and evaluation of equivalent freshwater head data. (See also W91-01524) (Author's abstract)
W91-01525

TIDAL DYNAMICS OF THE WATER TABLE IN BEACHES.
Sydney Univ. (Australia). Ocean Technology Group.
P. Nielsen.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2127-2134, September 1990. 8 fig, 2 tab, 10 ref.

Descriptors: *Beaches, *Model studies, *Surface-groundwater relations, *Tidal effects, *Water level, *Water table, Boundary conditions, Field tests, Mathematical models, Slopes, Tides.

Tidal motions of the water table height inside a sloping beach were investigated via field measurements and theoretical considerations. Only the movements forced by the tide were considered, so a beach with negligible wave activity was chosen for the field measurements. The data show that even in the absence of precipitation the time averaged inland water table stands considerably above the mean sea level. Also the water table at a fixed point inside the beach is far from sinusoidal even though its variation is forced by an essentially sinusoidal tide. This effect is due to the boundary condition along the sloping beach face which acts as a highly nonlinear filter. The observed behavior of the water table is explained in terms of perturbation extensions to the classical 'deep aquifer solution'. One extension deals with the nonlinearity in the interior, the other with the boundary condition at the sloping beach face. (Author's abstract)
W91-01528

BIOFILM GROWTH AND THE RELATED CHANGES IN THE PHYSICAL PROPERTIES OF A POROUS MEDIUM. 1. EXPERIMENTAL INVESTIGATION.
Princeton Univ., NJ. Dept. of Computer Science.

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S. W. Taylor, and P. R. Jaffe.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2153-2159, September 1990. 7 fig, 2 tab, 23 ref. USGS Grant 14-08-0001-G1136.

Descriptors: *Artificial recharge, *Biofilms, *Clogging, *Injection wells, *Permeability, *Physical properties, *Porous media, Bacteria, Biomass, Experimental data, Laboratory methods, Model studies, Piezometric head, Plugging.

An experimental investigation was conducted to quantify the permeability reduction caused by enhanced biological growth in a porous medium. Studies were conducted using sand-packed column reactors for which variations in piezometric head, substrate concentration, and biomass measured as organic carbon were monitored in space and time. Methanol was used as a growth substrate. Permeability reductions by factors of order 0.001 were observed. The data show that a limit on permeability reduction exists, having a magnitude of 0.0005 in the present study. The limit on permeability reduction and existence of high densities of bacteria in substrate depleted zones are explained with an open pore model. Permeability reduction correlated well with biomass density for values less than 0.4 mg/cu cm, and exhibited independence at higher densities. (See also W91-01532 and W91-01533) (Author's abstract)
W91-01531

BIOFILM GROWTH AND THE RELATED CHANGES IN THE PHYSICAL PROPERTIES OF A POROUS MEDIUM. 2. PERMEABILITY.
Princeton Univ., NJ. Dept. of Civil Engineering and Operations Research.
S. W. Taylor, P. C. D. Milly, and P. R. Jaffe.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2161-2169, September 1990. 10 fig, 17 ref. USGS Grant 14-08-0001-G1136.

Descriptors: *Artificial recharge, *Biofilms, *Clogging, *Injection wells, *Model studies, *Permeability, *Porous media, Biomass, Comparison studies, Mathematical models, Physical properties, Porosity.

Growth of a biofilm in a porous medium reduces the total volume and the average size of the pores. The change in the pore size distributions is easily quantified when certain geometric assumptions are made. Existing models of permeability or of relative permeability can be manipulated to yield estimates of the resulting reduction in permeability as a function of biofilm thickness. The associated reductions in porosity and specific surface can be estimated as well. Based on a sphere model of the medium, the Kozeny-Carman permeability model predicts physically realistic results for this problem. Using a cut-and-random-rejoin-type model of the medium, the permeability model of Childs and Collis-George yields qualitatively reasonable results for this problem, as does a generalization of the relative permeability model of Mualem. Permeability models of Kozeny-Carman and of Millington and Quirk lead to unrealistic results for a cut-and-random-rejoin-type medium. The Childs and Collis-George and the Mualem models predict that the permeability reduction for a given volume of biomass is greatest when the porous medium has uniform pore sizes. (See also W91-01531 and W91-01533) (Author's abstract)
W91-01532

BIOFILM GROWTH AND THE RELATED CHANGES IN THE PHYSICAL PROPERTIES OF A POROUS MEDIUM. 3. DISPERSIVITY AND MODEL VERIFICATION.
Princeton Univ., NJ. Dept. of Civil Engineering and Operations Research.
S. W. Taylor, and P. R. Jaffe.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2171-2180, September 1990. 9 fig, 3 tab, 26 ref. USGS Grant 14-08-0001-G1136.

Descriptors: *Artificial recharge, *Biofilms, *Clogging, *Dispersivity, *Injection wells, *Model studies, *Physical properties, *Porous media, Experimental data, Least squares method, Mathematical models, Permeability, Porosity, Solute transport, Tracers.

The change in dispersivity resulting from the growth of a biofilm in a porous medium was derived from an existing model of dispersivity and a cut-and-random-rejoin-type model of the pore geometry. The change in dispersivity due to a biofilm was also estimated from experimental data. Tracer experiments were conducted in biofilm column reactors and dispersion coefficients estimated by solving the inverse solute transport problem by nonlinear, least squares regression. Due to the presence of the biofilm in the porous media, solute flux into the biofilm is an important transport process and was given special attention. Both the dispersivity model and experimentally estimated dispersivities show order of magnitude increases in dispersivity as a result of significant biofilm growth. The models for the biofilm-affected permeability, porosity, and specific surface derived in a companion paper were verified using data from biofilm column reactors. These models were used to determine parameters for an equation describing the transport of substrate in the experimental columns. Numerical simulations were performed and compared to observed substrate data. Results show that the models for permeability and porosity can be used to make estimates of these parameters, while the model for specific surface appears to be inadequate. (See also W91-01531 and W91-01532) (Author's abstract)
W91-01533

SUBSTRATE AND BIOMASS TRANSPORT IN A POROUS MEDIUM.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
S. W. Taylor, and P. R. Jaffe.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2181-2194, September 1990. 12 fig, 1 tab, 33 ref.

Descriptors: *Aquifers, *Artificial recharge, *Bacteria, *Biofilms, *Biomass, *Clogging, *Injection wells, *Model studies, *Porous media, *Solute transport, Dispersivity, Finite element method, Groundwater recharge, Mathematical models, Permeability, Porosity, Pumping rates.

A model describing the transport of substrate and biomass in porous media was formulated which accounts for the transport, growth and decay of biomass suspended in the water phase and attached to the solid matrix as a biofilm. Interphase transport of biomass between the water phase and attached biofilm phase due to fluid mechanical shear and filtration was also considered. Special attention is given to changes in the porosity, permeability, and dispersivity resulting from the biofilm altering the microscopic geometry of the pore space. A numerical solution to the governing equations was obtained by the finite element method. The model was calibrated and verified against experimental data. The model was applied to the problem of aquifer clogging during the injection of water containing a growth-limiting substrate to assess the effects of pulsed substrate loading, flow rate, and flow duration on the clogging of porous media by biomass. Results from numerical experiments conducted with the model suggest the following: (1) Pulsed substrate loading does little to mitigate aquifer clogging for one-dimensional flow, but for radial flow from an injection well source, pulsing is expected to result in significantly less clogging. (2) Reduced substrate loading and increased pumping duration minimizes aquifer clogging. (3) Reduced substrate loading and increased pumping rate is most effective in minimizing aquifer clogging. (Author's abstract)
W91-01534

EVALUATING GROUND-WATER VULNERABILITY TO PESTICIDES.
Woodward-Clyde Consultants, Oakland, CA.
For primary bibliographic entry see Field 5B.
W91-01558

PREDICTING WELL DRAWDOWN DURING PROLONGED PUMPING.
Westinghouse Environmental and Geotechnical Services, Cary, NC.
For primary bibliographic entry see Field 4B.
W91-01682

SPATIAL AND TEMPORAL PATTERNS IN THE HYDROGEOCHEMISTRY OF A POOR FEN IN NORTHERN WISCONSIN.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2H.
W91-01720

STUDY OF AQUATIC COMMUNITY DYNAMICS IN A KARSTIC SYSTEM BY THE USE OF ARTIFICIAL SUBSTRATES.
Lyon-1 Univ., Villeurbanne (France). Lab. d'Hydrobiologie et Ecologie Souterraines.
For primary bibliographic entry see Field 2H.
W91-01766

WELL LOCATION IN CAPTURE ZONE DESIGN USING SIMULATION AND OPTIMIZATION TECHNIQUES.
Connecticut Univ., Storrs. Environmental Research Inst.
For primary bibliographic entry see Field 5G.
W91-01778

SOURCE OF GROUND WATER IN THE DESERTS OF NORTHERN CHILE: EVIDENCE OF DEEP CIRCULATION OF GROUND WATER FROM THE ANDES.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
M. Magaritz, R. Aravena, H. Pena, O. Suzuki, and A. Grilli.
Ground Water GRWAAP, Vol. 28, No. 4, p 513-517, July/August 1990. 5 fig, 16 ref.

Descriptors: *Geohydrology, *Groundwater basins, *Groundwater movement, *Groundwater recharge, Andes Mountains, Chile, Geologic fractures, Groundwater dating, Saline groundwater.

Isotopic, chemical and geologic evidence and temperature measurements support the hypothesis of a regional ground-water flow system in the Pampa del Tamarugal, Chile, basin associated with recharge areas located in the higher part of the Andes region. The discharge of this flow system should occur as fracture flow and or flow through the volcanic units and is suspected to be along faults situated at the foothills of the Andes and in the desert belt along the central valley. Some of the groundwaters located in the Pica and Canchones area are pre-Holocene in age, but most of the groundwaters located in the central part of the basin are younger and recharged during the Holocene. (14)C measurements in dissolved inorganic carbon were used to estimate groundwater residence times. Generally, the electric conductivity values increas from the eastern to the western part of the basin. Groundwater temperature distribution also identified the circulation of deep groundwater. (Miller-PTT)
W91-01779

GEOELECTRICAL INVESTIGATION FOR GROUND WATER IN CRYSTALLINE TERRAINS OF CENTRAL BAHIA, BRAZIL.
Universidade Federal do Rio Grande do Norte, Natal (Brazil). Dept. de Fisica.
W. E. Medeiros, and O. A. de Lima.
Ground Water GRWAAP, Vol. 28, No. 4, p 518-523, July/August 1990. 7 fig, 1 tab, 16 ref.

Descriptors: *Aquifer testing, *Brazil, *Geohydrology, *Geologic fractures, *Geophysical exploration, *Groundwater movement, *Mapping, Algorithms, Crystalline rocks, Data acquisition, Data interpretation, Dry wells, Electrical well logging, Groundwater, Resistivity.

A practical procedure was evaluated for acquisition and representation of electrical resistivity data, including a two-dimensional methodology for quantitative structural interpretation. This technique was combined with Schlumberger vertical electrical soundings(VES) and electrical well logs

for a comprehensive evaluation of the subsurface hydrological conditions of fractured crystalline aquifers of the Itabera area, Bahia state, Brazil. The apparent resistivity sections constructed from partial electrical sounding measurements taken at a closely spaced interval along a traverse were interpreted using a finite-difference algorithm. This scheme allowed detailed description of the lateral and vertical extent of fractured aquifers and some of their hydrogeophysical characteristics. The results of a case study from Bahia state compare satisfactorily with available geophysical logs and production data of existing wells. (Miller-PTT)
W91-01780

LABORATORY STUDIES OF THE FLOW OF SOME ORGANIC SOLVENTS AND THEIR AQUEOUS SOLUTIONS THROUGH BENTONITE AND KAOLIN CLAYS.
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5B.
W91-01781

NATURAL BIOREMEDIATION OF ORGANIC CONTAMINANTS IN GROUND WATER: CLIFFS-DOW SUPERFUND SITE.
Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab.
For primary bibliographic entry see Field 5B.
W91-01782

CAUSES OF SOIL SALINIZATION: 2. A BASIN IN EAST-CENTRAL ALBERTA, CANADA.
Alberta Agriculture, Lethbridge.
For primary bibliographic entry see Field 2G.
W91-01783

ELUCIDATING GROUND-WATER FLOW PATHS IN A DESERT TERRANE BY GEOCHEMICAL METHODS.
Purdue Univ., Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
S. J. Fritz, H. J. Lopez, and M. P. Wilson.
Ground Water GRWAAP, Vol. 28, No. 4, p 551-558, July/August 1990. 7 fig, 2 tab, 21 ref. National Park Service Contract No. CX702920018.

Descriptors: *Deserts, *Geochemistry, *Geohydrology, *Groundwater movement, *Groundwater recharge, *Springs, *Texas, *Water chemistry, Arid lands, Carbon radioisotopes, Precipitation, Stable isotopes, Tritium.

Four wells and six perennial springs located in The Big Bend National Park were sampled and analyzed to determine recharge sources for the springs which discharge along banks of arroyos incised in alluvial pediment lying about 900 meters below the uplands of the Chisos Mountains. The waters total dissolved solids and calcite saturation indices increase with decreasing altitude, suggesting recharge from the Chisos uplands. Temperature, dissolved oxygen, delta 018, tritium and Carbon-14 data indicate a significant recharge component to springs occurs by infiltration of infrequent precipitation falling on the arid alluvial lowlands. This water percolates through the soil zone to aquitards (essentially calcitic hardpans) which function as horizons which channel the water laterally toward discharge in springs. The springs recharge-to-discharge paths are short with flow being slow enough to reflect seasonal temperature differences of greater than 12 C, yet recent enough to contain post-bomb spikes of tritium and Carbon-14. (Author's abstract)
W91-01784

INDICATORS OF CHEMICAL POLLUTION FROM SEPTIC SYSTEMS.
Geraghty and Miller, Inc., Raleigh, NC.
For primary bibliographic entry see Field 5A.
W91-01785

GROUND-SURFACE DELINEATION OF FRACTURES OVER MINED-OUT OPENINGS USING CARBON DIOXIDE EMISSIONS.
Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
For primary bibliographic entry see Field 5G.
W91-01787

MEASUREMENT AND INTERPRETATION OF LOW LEVELS OF DISSOLVED OXYGEN IN GROUND WATER.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7B.
W91-01788

FIELD EVALUATION OF IN-SITU BIODEGRADATION OF CHLORINATED ETHENES: PART I, METHODOLOGY AND FIELD SITE CHARACTERIZATION.
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-01789

MODELING ORGANIC CONTAMINANT SORPTION IMPACTS ON AQUIFER RESTORATION.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W91-01827

WATER RESOURCES DATA FOR NEW MEXICO, WATER YEAR 1989.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01828

WATER RESOURCES DATA FOR NEBRASKA, WATER YEAR 1989.
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01829

GROUND-WATER RESOURCES OF THE ARKANSAS RIVER BASIN IN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
J. M. Kilpatrick, and A. H. Ludwig.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-725, 1990. 45p, 12 fig, 34 ref.

Descriptors: *Arkansas, *Geohydrology, *Groundwater, *Groundwater availability, *Groundwater resources, *Water quality, *Water resources data, Arkansas River, Water use.

The Arkansas River basin in Arkansas lies almost entirely within the Interior Highlands physiographic division. The Interior Highlands consist of hilly to mountainous terrain underlain by sandstone, shale, limestone, and dolomite. That part of the basin southeast of Little Rock lies within the Gulf Coastal Plain and is characterized by flat to hilly topography. Significant water-yielding units within the Arkansas River basin include subsurface Paleozoic units such as the Eminence and Potosi Dolomites, the Gasconade Dolomite, and the Van Buren Formations, and Roubidoux Formation as well as outcrops of Paleozoic rocks, the Sparta Sand, and Quaternary deposits. The quality of groundwater withdrawn from the various aquifers in the study area is generally suitable for most uses, although commonly very hard and highly mineralized. Only the Sparta Sand yields a soft, less mineralized water. Yields from the different water-bearing units are highly variable. Several of the subsurface Paleozoic rocks rarely yield more than 10 gal/min. In the Coastal Plain, the Sparta Sand and the Quaternary deposits yield as much as 2,000 and 2,500 gal/min, respectively. Several studies have indicated substantial bacterial contamination of both wells and springs in this part of the study area. Also, nitrate concentrations that exceed U.S. Environmental Protection Agency primary drinking water standards occur in some areas. (USGS)
W91-01835

GROUND-WATER FLOW IN THE GULF COAST AQUIFER SYSTEMS, SOUTH-CENTRAL UNITED STATES--A PRELIMINARY ANALYSIS.
Geological Survey, Austin, TX. Water Resources Div.
A. K. Williamson, H. F. Grubb, and J. S. Weiss.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4071, 1990. 124p, 33 fig, 5 tab, 140 ref.

Descriptors: *Groundwater, *Groundwater movement, *Hydrologic data, *Water resources data, Computer models, Gulf Coast Aquifer System, Pumpage, Recharge, Regional analysis, Simulation, Topography, Vertical flow, Water table.

A major objective of the Gulf Coast Regional Aquifer-System Analysis is to use digital models of regional groundwater flow systems to develop better understanding and to improve management of the resource. Modeling is used to synthesize information about the aquifer systems and to test hypotheses about the relative importance of the components of the systems. The 290,000-sq mile study area in the Gulf of Mexico Coastal Plain includes the Mississippi embayment, Gulf Coastal Plain of Texas, and the Continental Shelf that are underlain by deposits of Tertiary and younger age, which contain fresh and saline water. A 10-layer, finite-difference, variable density model, with blocks 10 miles on a side, was used to simulate groundwater flow before development and in 1980, assuming steady-state conditions. Preliminary results indicate that the major factors controlling predevelopment regional flow are the topography, land-surface outcrop pattern, and geometry of aquifers and confining units. Geologic structure and the distribution of precipitation were less significant factors. The density of saline water in the deeper parts of the aquifer system probably has a substantial effect on regional groundwater flow that extends into the freshwater part of the system. Variable water density may be a significant driving force that transports salt great distances in many directions, including updip. The distribution and rates of regional recharge and discharge have been substantially changed by development. Groundwater pumpage in 1980 was about five times the value of predevelopment regional recharge. About 80% of the pumpage was supplied from increased regional recharge. Also resistance to vertical flow caused by many fine-grained beds within the permeable zones can be as important as resistance caused by regional confining units. (USGS)
W91-01838

ASSESSMENT OF HYDROLOGIC AND HYDROGEOLOGIC DATA AT CAMP LEJEUNE MARINE CORPS BASE, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
D. A. Harned, O. B. Lloyd, and M. W. Treece.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4096. 1989. 64p, 20 fig, 2 tab, 19 ref.

Descriptors: *Camp Lejeune, *Groundwater movement, *Hydrogeology, *Hydrologic data, *North Carolina, *Water level, *Water resources data, *Water use, Castle Hayne Aquifer, Coastal plains.

The U.S. Geological Survey, in cooperation with the U.S. Marine Corps, is studying the groundwater resources of the Marine Corps Base at Camp Lejeune, North Carolina, and is constructing a groundwater flow model of the area. Water use by the Base increased from about 4 million gal/day in 1941 to about 7 million gal/day in 1986. In the last decade, water demand has not increased substantially. The Castle Hayne aquifer is the source of water for the Base. The aquifer, which lies between 50 and 300 ft below the Base, is composed of a series of sand and limestone beds. Contour maps of water levels show that the New River is a major discharge area for the Castle Hayne, as is the Atlantic Ocean. The top of the aquifer ranges from about 20 ft above sea level in the northern

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part of the area to about 40 ft below sea level in the southeastern part. Thin and discontinuous clay beds, less than 30 ft thick, compose about 15% to 24% of the section, indicating that the aquifer is in a leaky, confined aquifer system. Well-acceptance tests indicate a mean specific capacity of 8.8 gal/min/ft of drawdown. The mean transmissivity value estimated from specific capacities is 9,900 sq ft/day. The mean estimated hydraulic conductivity is 48 ft/day. (USGS)
W91-01840

HYDROGEOLOGY OF AQUIFERS IN CRETACEOUS AND YOUNGER ROCKS IN THE VICINITY OF ONSLOW AND SOUTHERN JONES COUNTIES, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
W. L. Lyke, and M. D. Winner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4128, 1990. 49p, 12 fig, 3 tab, 21 ref.

Descriptors: *Aquifers, *Coastal plains, *Geohydrology, *Groundwater, *Hydrologic data, *North Carolina, *Water resources data, Cross-sections, Hydrogeology, Maps.

Unconsolidated sediments in Onslow and Jones Counties, North Carolina overlie crystalline basement rocks and range in thickness from about 700 ft to more than 1,800 ft, thickening toward the east. This material is composed of permeable sand and limestone interlayered with relatively impermeable clay and silt beds. Sediments are divided into two groups: aquifers in Quaternary-, and Tertiary-aged rocks and aquifers in Cretaceous-aged rocks. Aquifers in the Cretaceous rocks provide most of the groundwater for public supplies and are the focus of this report. The aquifers in Cretaceous rocks are the Peedee, Black Creek, upper Cape Fear, and lower Cape Fear aquifers, which are composed of beds or groups of beds of sand and gravel. Each aquifer is overlain by a clay and silt bed, that impedes the flow of water between aquifers. The thickness of Cretaceous hydrogeologic units ranges from about 700 ft to more than 1,300 ft. Hydrogeologic units are correlated using 60 geophysical logs and accompanying drillers' logs along with water level and water quality data. Three hydrogeologic sections demonstrate the continuity of the aquifers and confining units, show water levels and chloride concentration in water from test intervals, and delineate where chloride concentration in water exceeds 250 mg/L within each aquifer. Maps of each aquifer in Cretaceous rocks show altitude of its top, thickness, sand percentage, and the transition from freshwater to saltwater. Maps of the confining units show thickness and sand percentage of each. (USGS)
W91-01841

WATER RESOURCES OF CODINGTON AND GRANT COUNTIES, SOUTH DAKOTA.
Geological Survey, Huron, SD. Water Resources Div.
D. S. Hansen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4147, 1990. 47p, 25 fig, 8 tab, 18 ref.

Descriptors: *Groundwater, *Hydrologic data, *North Dakota, *Water resources data, Bedrock aquifers, Glacial aquifers, Groundwater recharge, Water quality, Water use.

The primary sources of surface water in Codington and Grant Counties are Lakes Kampeska and Pelican and numerous potholes in western Codington County. Seasonal variations in streamflow and lake levels are directly related to seasonal variations in precipitation and evapotranspiration. Dissolved-solids concentrations in water from streams and lakes increase as stream discharge decreases and lake levels decline. Seven aquifers in glacial-outwash deposits and two bedrock aquifers were delineated in Codington and Grant Counties. The extent of the outwash aquifers ranges from 30 sq mi for the Antelope Valley aquifer to 860 sq mi for the Altamost aquifer. The average thickness of the glacial aquifers ranges from 20 ft for the Prairie Coteau to 63 ft for the Revillo. The Big Sioux and Antelope Valley aquifers are less than 10 ft below land surface. The Veblen, Prairie Coteau, and the Lonesome Lake aquifers are less than 380 ft below land surface. The Revillo and Altamost aquifers are less than 668 ft below land surface. Reported well yields are as much as 800 gal/min for the Big Sioux, Antelope Valley, and Prairie Coteau aquifers. Predominant ions are calcium and bicarbonate in water from the Big Sioux, Antelope Valley, Prairie Coteau, Veblen, Revillo, and Lonesome Lake aquifers. Sulfate also is predominant in water from the Veblen aquifer. Average dissolved-solids concentrations in water from the aquifers range 350 to 2,120 mg/L. The two bedrock aquifers delineated are the Dakota and granite wash. The water level has declined 10 ft from 1958 to 1985. Predominant ions in water from the Dakota and granite wash aquifers are sodium and sulfate. (USGS)
W91-01842

SIMULATION OF GROUND-WATER FLOW IN AQUIFERS IN CRETACEOUS ROCKS IN THE CENTRAL COASTAL PLAIN, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
J. L. Eimers, W. L. Lyke, and A. R. Brockman.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4153, 1990. 101p, 43 fig, 11 tab, 41 ref.

Descriptors: *Aquifer characteristics, *Coastal plains, *Geohydrology, *Groundwater movement, *Mathematical models, *North Carolina, Groundwater management, Hydrogeologic units.

The principal water supply aquifers in Cretaceous rocks in the central Coastal Plain of North Carolina are the Peedee, Black Creek, and upper Cape Fear aquifers. Groundwater withdrawals from this aquifer system have increased from about 0.25 million gal/day in 1910 to more than 30 million gal/day in 1986, causing water level declines of as much 160 ft. The maximum rate of water level decline has been about 11 ft/yr in the Black Creek aquifer. A quasi-three dimensional groundwater flow model was constructed and calibrated for the period 1900 to 1986 to simulate this decline and to provide a means to estimate the effects of future pumping. Comparisons of 1,867 observed and computed water levels were made at 323 well sites. The average difference between computed and observed water levels is -1 ft. About 68% of the differences between computed and observed water levels falls in the range from -21.0 to 21.0 ft. Net flow across the top of the aquifers in Cretaceous rocks has changed from a discharge of 2 million gal/day in 1900 to a recharge of 18 million gal/day in 1986. The model was used to simulate the effects of two pumping scenarios on water levels through 1991. For these simulations, the model indicated additional declines of 10 and 30 ft. (USGS)
W91-01843

HYDROGEOLOGIC, WATER-LEVEL, AND WATER-QUALITY DATA FROM MONITORING WELLS AT THE U.S. MARINE CORPS AIR STATION, CHERRY POINT, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-01844

SUMMARY OF PUBLIC WATER-SUPPLY WITHDRAWALS AND GEOHYDROLOGIC DATA FOR THE LOWER CONNECTICUT RIVER VALLEY FROM WINDSOR TO VERNON, VERMONT.
Geological Survey, Bow, NH. Water Resources Div.
J. Ayotte.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-341, 1989. 35p, 4 fig, 3 tab, 16 ref.

Descriptors: *Connecticut River Valley, *Geohydrologic data, *Geohydrology, *Groundwater resources, *Public water supply, *Vermont, *Water resources data, Groundwater, Hydrology, Seismic reflection, Seismic refraction, Stratified-drift aquifers, Stratigraphic logs, Water resources, Well surveys.

Public water supply withdrawal data and geohydrologic data were collected along a 50 mile segment of the Connecticut River valley from Windsor to Vernon, Vermont. An inventory of wells indicates that domestic groundwater supplies come primarily from bedrock, whereas public water supplies are derived from discontinuous, glacial sand and gravel deposits. Self supplied industries generally use surface water supplies. Data from eight seismic-refraction surveys, and from a seismic-reflection survey along this 50-mile reach of the Connecticut River, were compared with stratigraphic information from 217 drillers' logs. Stratified-drift deposits range from 0 to 270 ft and average about 65 ft. Stratigraphic information from drillers' logs and seismic-reflection records show that predominantly fine-grained stratified drift fills the valley and that coarse sand and gravel deposits exist discontinuously within this area. (USGS)
W91-01845

GEOLOGY AND GROUND-WATER RESOURCES OF THE MEMPHIS SAND IN WESTERN TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
W. S. Parks, and J. K. Carmichael.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4182, 1990. 30p, 9 fig, 2 plates, 4 tab, 20 ref.

Descriptors: *Aquifers, *Geohydrology, *Groundwater, *Groundwater availability, *Tennessee, *Water quality, *Water resources data, Aquifer characteristics, Geologic formations, Geology, Groundwater movement, Groundwater recharge, Memphis Aquifer, Memphis Sand, Potentiometric level, Stratigraphy, Structural geology, Water level fluctuations, Water supply development.

The Memphis Sand of the Claiborne Group of Tertiary age underlies approximately 7,400 sq mi in western Tennessee. The formation consists primarily of a thick body of very fine to very coarse sand that contains subordinate lenses or beds of clay and silt at various horizons. The Memphis Sand ranges from 0 to about 900 ft in thickness. Recharge to the Memphis aquifer is from precipitation on the outcrop or by downward infiltration of water from the overlying fluvial deposits of Tertiary and Quaternary age and alluvium of Quaternary age. Long-term data indicate that water levels in the Memphis aquifer have declined at average rates ranging from less than 0.1 to 1.3 ft/yr during the period 1928-83. The water generally is a calcium bicarbonate type. It contains low concentrations of most major constituents and generally is suitable for most uses. Dissolved solids concentrations range from 19 to 333 mg/L. Seventy-six aquifer tests made during the period 1949-62 indicate that transmissivities range from 2,700 to 53,500 sq ft/day and storage coefficients range from 0.0001 to 0.003. The Memphis aquifer presently provides moderate to large quantities of water for many public and industrial water supplies in western Tennessee, and small quantities to numerous domestic and farm wells. Withdrawals for public and industrial supplies in 1983 averaged about 225 million gal/day, of which 183 million gal/day was in the Memphis area. The Memphis aquifer has much potential for future use, particularly outside the Memphis area. (USGS)
W91-01851

HYDROLOGY OF THE POWDER RIVER ALLUVIUM BETWEEN SUSSEX, WYOMING, AND MOORHEAD, MONTANA.
Geological Survey, Cheyenne, WY. Water Resources Div.

B. H. Ringen, and P. W. Daddow.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4002, 1990. 48p, 17 fig, 7 tab, 20 ref. USGS Project No. WY078.

Descriptors: *Alluvial aquifers, *Montana, *Potential water supply, *Powder River Basin, *Surface-groundwater relations, *Wyoming, Dissolved solids, Moorhead, Sussex, Well data.

The potential for developing water supplies from the alluvium along the Powder River between Sussex, Wyoming, and Moorehead, Montana, is very limited. The areal extent and saturated thickness of the alluvium are not large. Water in the alluvium primarily is derived from seepage from the river, which goes dry periodically. Low flow is sustained by groundwater discharge or irrigation return flow near Sussex, but not near Arvada, Wyoming, or Moorhead. The alluvium and the river have good hydraulic connection, but evidently are isolated from the bedrock. Pumpage from wells completed in the alluvium is highly dependent on water supplied directly from the river. The quality of water in the alluvium also limits use of the water. Although the quality improves downstream, it is unacceptable for drinking water and possibly for irrigation and some industrial uses, but is acceptable for most livestock watering. (USGS)
W91-01852

GEOHYDROLOGIC CHARACTERISTICS AND SIMULATED RESPONSE TO PUMPING STRESSES IN THE SPARTA AQUIFER IN EAST-CENTRAL ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
D. J. Fitzpatrick, J. M. Kilpatrick, and H. McWreath.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4201, 1990. 50p, 27 fig, 51 ref.

Descriptors: *Arkansas, *Geohydrology, *Groundwater, *Groundwater movement, *Model studies, *Sparta Aquifer, Water level fluctuations.

A finite difference digital model of the Sparta aquifer system in Arkansas was developed to aid in assessing the geohydrologic characteristics of the aquifer as well as the impact of withdrawals on water-level declines in the aquifer. The model consists of two layers. The Cockfield aquifer, represented by layer 1, was modeled as a constant head surface. The Sparta aquifer is represented by layer 2. The base of the Sparta aquifer was modeled as a no-flow boundary. The model boundaries to the north, south, and east in Mississippi were represented by specified heads, while boundaries to the west in Louisiana were represented as no flow. The model period of 1989 to 1985 was divided into 25 stress periods. Appropriate aquifer withdrawals were assigned to each stress period. Calibrated hydraulic conductivities of the Sparta aquifer, ranged from 1 to 35 ft/day. Calibrated hydraulic vertical conductivities of the Cook Mountain confining unit ranged from 0.0003 to 0.000009 ft/day. The calibrated storage coefficient of the aquifer was 0.0001. More than 80% of the recharge to the aquifer came from vertical leakage and from direct recharge on the outcrop. Greater than 90% of outflow from the aquifer was from pumpage or leakage to rivers. Theoretical pumping schemes to the year 2005 indicated that virtually no change to the potentiometric surface occurred when 1985 pumping rates were extended to 2005. Doubling of pumpage over the entire study area resulted in additional water-level declines of up to 130 ft. (USGS)
W91-01854

GROUND-WATER LEVELS, FLOW, AND SPECIFIC CONDUCTANCE IN UNCONSOLIDATED AQUIFERS NEAR LAKE ERIE, CLEVELAND TO CONNEAUT, OHIO, SEPTEMBER 1984.
Geological Survey, Columbus, OH. Water Resources Div.
A. W. Coen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4202, 1990. 22p, 7 fig, 9 ref.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Ohio, *Water resources data, Glacial drift, Specific conductivity, Water level, Water quality.

Groundwater levels and flow and specific conductance of water in aquifers underlying the southern shore of Lake Erie from Cleveland to Conneaut, Ohio were collected in September 1984 as part of the U.S. Geological Survey's Northeast Glacial Buried Valley Regional Aquifer-Systems Analysis. The 60 mile long study area extends inland from the lake about 10 miles and encompasses parts of Cuyahoga, Lake, and Ashtabula Counties. Water levels were measured in 202 wells, all of which were completed in glacial deposits. Specific conductance was measured in 59 of the wells. Water levels in most of the area are within 20 ft of the land surface. Groundwater flows locally toward streams and, regionally, to the north-northwest towards Lake Erie. Specific-conductance values ranged from 160 to 2,9000 microsiemens/cm at 25 C with a median value of 540 microsiemens/cm. Elevated specific-conductance values were randomly distributed areally and could derive from road-deicing salt, leachate from landfills, natural brines associated with oil and gas drilling, and the upward leakage of saline water from bedrock. (USGS)
W91-01855

WATER RESOURCES DATA FOR IOWA, WATER YEAR 1989.
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01856

WATER RESOURCES DATA FOR WEST VIRGINIA, WATER YEAR 1988.
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01858

WATER RESOURCES DATA FOR MICHIGAN, WATER YEAR 1989.
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01864

GROUND-WATER LEVELS, SPRINGS 1985, AND GROUND-WATER LEVEL CHANGES, SPRING 1983 TO SPRING 1985, IN THREE BASALT UNITS UNDERLYING THE COLUMBIA PLATEAU, WASHINGTON AND OREGON.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01868

SPECIFIC CHEMICAL COMPOSITION OF KARST GROUNDWATER IN THE OPHIOLITE BELT OF THE YUGOSLAV INNER DINARIDES: A CASE FOR COVERED KARST.
Belgrade Univ. (Yugoslavia). Faculty of Mining and Geology.
N. Kresic, and P. Papic.
Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 2, p 131-135, March/April 1990. 7 fig, 8 ref.

Descriptors: *Aquifer systems, *Chemical analysis, *Geochemistry, *Geohydrology, *Groundwater chemistry, *Karst, *Karst hydrology, *Water chemistry, *Yugoslavia, Limestone, Sedimentary rocks.

The Oliolite Belt of the Yugoslav Inner Dinarides was considered to be a chaotic melange of the olistostrome type because of its very complicated tectonic fabric. Its sections of Triassic limestone were understood as thin slide sheets over ophiolites (diabases, cherts, ultramafics). Hydrogeological research, conducted in the last few years, refuted such theories. The results showed that Triassic limestone was much more common and was covered with ophiolites of the Jurassic age. Hydrochemical analysis established relationships between the main chemical components and groundwater in the area. They also made possible conclusions about the origin of karst groundwaters, properties of karst aquifers, and influences of ultramafics on the aquifers. Fifty-one percent of samples collected had characteristics of real calcareous waters. Thirty-three percent of the samples indicated a significant recharge of karst aquifers by leakage from ophiolite rocks. The remaining samples were waters with a calcium-magnesium ratio of less than one, which showed recharge from the ophiolites. By including silica content with the calcium-magnesium ratio, it became clear that magnesium in karst groundwater was from rocks rich in both magnesium and silica origin. Functional dependence between these elements has been proven. (Stoehr-PTT)
W91-01885

2G. Water In Soils

TEMPORAL SOLUBILITY TRENDS OF ALUMINUM AND IRON LEACHED FROM COAL SPOILS AND CONTAMINATED SOIL MATERIALS.
Kentucky Agricultural Experiment Station, Lexington. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W91-01007

LEACHING OF RADIONUCLIDES FROM DECAYING BLUEBERRY LEAVES: RELATIVE RATE INDEPENDENT OF CONCENTRATION.
Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
For primary bibliographic entry see Field 5B.
W91-01018

ATRAZINE AND BROMIDE MOVEMENT THROUGH A SILT LOAM SOIL.
Agricultural Research Service, Beltsville, MD. Environmental Chemistry Lab.
For primary bibliographic entry see Field 5B.
W91-01022

SORPTION OF NAPROPAMIDE ON CLAY AND SOIL IN THE PRESENCE OF DISSOLVED ORGANIC MATTER.
National Taiwan Univ., Taipei. Dept. of Agricultural Chemistry.
For primary bibliographic entry see Field 5B.
W91-01023

SOME PHYSICAL PROPERTIES OF STRUCTURAL AGGREGATES SEPARATED FROM ORGANIC WASTE-AMENDED SOILS.
Nigeria Univ., Nsukka. Dept. of Soil Science.
For primary bibliographic entry see Field 5E.
W91-01054

VARIABILITY AND DYNAMICS OF LEACHING OF THE FLYSCH CARPATHIAN SLOPE.
Polish Academy of Sciences, Krakow. Inst. of Geography and Spatial Organization.
A. Welc.
Catena, Vol. 16, No. 2, p 425-435, April 1989. 9 ref, 2 tab, 13 ref.

Descriptors: *Carpathian Mountains, *Flysch, *Geochemistry, *Leaching, *Water circulation, *Weathering, Climates, Groundwater flow, Sandstones, Seasonal variation, Shales.

The mechanism, dynamics and variability of leaching caused by water circulation within the various flysch slopes in the Polish Carpathian Mountains was investigated using two slopes as examples.

Leaching on the slopes built of Magura sandstones is less intensive than that on the slopes sculptured in limy sandstones and marly shales. In the case of the first slope, the salts were carried away mainly by groundwater circulating in deeper levels of the weathering covers and rocky substratum. In the second case, the majority of the salts were carried away by surface and shallow subsurface runoff. Therefore, lithological differentiation of the flysch affected the water circulation pattern and leaching of the slopes. Differentiated climatological conditions during one year resulted in patterns and intensities characteristic for a given condition of leaching of the slopes. Irregular influences of the oceanic and continental climates in this part of Europe cause the leaching to prevail in summer in certain years and in winter in others. Studies lasting several years indicated that leaching of slopes prevailed in the winter period with particular intensification of the process in January and March. Despite the long-lasting periods of leaching of the slope covers in some years, short periods usually decide the magnitude of leaching. (Author's abstract)
W91-01078

HUMUS FORM DEVELOPMENT AND HILLSLOPE RUNOFF, AND THE EFFECT OF FIRE AND MANAGEMENT, UNDER MEDITERRANEAN FOREST IN NE-SPAIN.
Amsterdam Univ. (Netherlands). Lab. for Physical Geography and Soil Science.
J. Sevink, A. C. Imeson, and J. M. Verstraten.
Catena, Vol. 16, No. 2, p 461-475, April 1989. 3 fig, 4 tab, 16 ref.

Descriptors: *Decomposing organic matter, *Forest fires, *Forest management, *Forest soils, *Humus, *Runoff, *Soil types, *Spain, *Wetlands, Infiltration capacity, Plant growth, Soil horizons, Soil water.

Study of a series of plots on acid to intermediate rocks under well preserved mediterranean type forests in northeast Spain showed that soils have well developed mor or moder type humus forms. Mor type humus forms were observed in soils with a shallow lithic contact or an abrupt textural change, and consist of an ectorganic layer (L, Fq, H) abruptly overlying a generally water repellant Ae or E horizon. Moder type humus forms, with a gradual transition between ectorganic layer (L, Fa and Ah horizon), were found in soils with more favorable rooting and soil moisture conditions, indicating that these conditions have a strong control over humus development. Quantities of organic matter (ectorganic layer and Ah/Ae) ranged from about 5 kg/sq m in mor to about 10 kg/sp m in moder humus forms, the difference being due to the presence of a well-developed Ah horizon in the latter. Rainfall simulator experiments showed that slopes with more type humus forms are likely to produce hillslopes runoff during summer rain storms in spite of the relatively high storage capacity of the ectorganic layer. This is due to the hydrophobicity of the mineral top soil (if dry), which hampers infiltration. Furthermore, during the wet season the soils commonly have a perched water table, inducing saturated overland flow. Slopes with moder type humus forms, on the contrary, are very unlikely to produce any hillslope runoff, because of the high storage and infiltration capacity of the soils. (Author's abstract)
W91-01079

IDENTIFICATION, CHARACTERIZATION, AND HYDROLOGICAL IMPLICATIONS OF WATER REPELLENCY IN MOUNTAIN SOILS, SOUTHERN BRITISH COLUMBIA.
Toronto Univ. (Ontario). Dept. of Geography.
G. Barrett, and O. Slaymaker.
Catena, Vol. 16, No. 2, p 477-489, April 1989. 8 fig, 1 tab, 23 ref.

Descriptors: *British Columbia, *Soil moisture retention, *Soil water, *Water repellent soils, Organic matter, Soil chemistry, Soil physical properties, Soil profiles.

The physicochemical properties of soils, which determine how readily the soils wet, were shown to vary significantly in mountain soils collected at six sites in southern British Columbia, even within individual profiles. The results of water drop penetration time were used to classify samples using a very simple scheme which is based upon the current understanding of the possible physicochemical interactions between soil surfaces, water, and soil air. In all cases where the samples were collected at sites in the subalpine-alpine ecotone, a layer which either wets reluctantly or is water-repellant exists at or near the surface of the profile. These layers occur only where there is evidence for accumulation of organic matter, and are usually no more than a few centimeters thick. At the one site which was below the alpine-subalpine ecotone, the soils wet readily throughout the profile. These results suggest that the type of organic matter which accumulates in soils of the alpine-subalpine ecotone of southern British Columbia either limits the affinity of soils for water or renders the soil water-repellant. (Author's abstract)
W91-01080

APPLICATION OF A SIMPLE LUMPED RIVER FLOW FORECASTING MODEL TO HILLSLOPE SOIL WATER STORAGE ESTIMATION.
Kobe Univ. (Japan). Dept. of Agricultural Engineering.
T. Hata, and M. G. Anderson.
Catena, Vol. 17, No. 3, p 249-259, June 1990. 5 fig, 1 tab, 21 ref.

Descriptors: *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *River flow, *River forecasting, *Soil water, Catchments, Hydrology, Slopes, Topography, Watersheds.

For a number of applied geomorphological and hydrological problems, the prediction of hillslope soil water conditions from restricted data is frequently required. Physically based distributed models of catchment hydrology are currently regarded as too cumbersome to meet these requirements either operationally or in a standard research context. A simple lumped sequential flow forecasting model is applied to a 0.73 sq km catchment. The catchment selected for modeling was located at Winford, near Bristol, England. Parameterization of the model was undertaken using the following data sources: 193 days of daily precipitation, air temperature, soil moisture, and discharge data. The hillslope sectors, into which the catchment is subdivided, are represented by their mean slope angles and are assumed rectangular in plan. Each hillslope sector has its own maximum water storage. The governing equations of subsurface, overland, and channel flow utilize Darcy's equation, Manning's equation, and the continuity equation. If field permeability is available, there is significant potential for the scheme to estimate the mean soil water storage in catchment segments. In addition, the model provides reliable river flow forecasting. Further, more extensive trials of the model are needed on catchments with differing topography to compare with the preliminary results reported here. (Author's abstract)
W91-01086

RAINFALL INDUCED SOIL SEAL (C) A DYNAMIC MODEL WITH KINETIC ENERGY INSTEAD OF CUMULATIVE RAINFALL AS INDEPENDENT VARIABLE.
Hebrew Univ., Rehovoth (Israel). Dept. of Soil and Water Sciences.
Y. Mualem, S. Assouline, and H. Rohdenburg.
Catena, Vol. 17, No. 3, p 289-303, June 1990. 7 fig, 2 tab, 27 ref, append.

Descriptors: *Hydrologic models, *Kinetic energy, *Rainfall, *Soil compaction, *Surface sealing, *Water repellent soils, Infiltration capacity, Rainfall infiltration, Rainfall intensity, Soil sealants, Soil types.

A dynamic model of soil sealing, based on an extension of a previous model that considers the seal as a non-uniform layer, and the rainfall kinetic energy as the rain property dominating the sealing process is presented. The model was applied in the case of two soils, sandy loam and loam, under saturated conditions, using an inverse procedure for its calibration. The validity of the theoretical model was examined for each soil by results of an infiltration test carried out under rainfall and flow boundary conditions different from those related to the data used for the model calibration. Very good agreement was found between the observed and the predicted infiltration curves in the case of sandy loam, but not as good in the case of loam soil. The error that may occur when using cumulative rainfall instead of rainfall kinetic energy as the independent variable of the soil sealing model was analyzed under varying conditions. In cases where the rainfall kinetic energy per unit mass is a constant, independent of the rainfall intensity, the use of the cumulative rainfall is equivalent to the use of the rainfall kinetic energy. However, rainfall events often include long rainfall of low intensity and short time intervals of high rainfall intensity, with the kinetic energy per unit mass varying considerably during a single rainfall event. In such a case, the use of the cumulative rainfall as the model variable may lead to considerable error. Applying the calibrated model for the sandy loam and characteristics of simulated and natural rainfall, the error associated with the use of the cumulative rainfall was found to lead to a large error in calculation of the infiltration rate during the sealing process. (Author's abstract)
W91-01089

TEMPORAL VARIABILITY OF SOIL WETNESS AND ITS IMPACT ON CLIMATE.
Princeton Univ., NJ. Geophysical Fluid Dynamics Program.
S. Manabe, and T. Delworth.
Climatic Change CLCHDX, Vol. 16, No. 2, p 185-192, April 1990. 3 fig, 1 tab, 9 ref.

Descriptors: *Climates, *Climatology, *Clouds, *Mathematical models, *Soil water, Carbon dioxide, Diurnal variation, Evaporation, Precipitation, Relative humidity, Seasonal variation, Temporal distribution, Variability.

The temporal variability of soil wetness and its interactions with the atmosphere were studied using a general circulation model of the atmosphere, in which zonally uniform clouds are prescribed as a function of latitude and height; carbon dioxide is constant everywhere; the diurnal cycle is omitted but the seasonal cycle is included; the geographical and seasonal distribution of sea surface temperature and sea ice are prescribed; and precipitation is predicted whenever the relative humidity exceeds 100%. Time series of soil wetness computed by the model contain substantial amounts of variance at low frequencies, suggesting that interactions between soil moisture and the atmosphere have the potential to make substantial contributions to low frequency atmospheric variability. Long time-scale anomalies of soil moisture resemble the red noise response of the soil layer to white noise rainfall forcing. The temporal variability of soil moisture depends upon potential climatic values of evaporation and precipitation. (Brunone-PTT)
W91-01090

HYDROLYSIS OF CHLOROSTILBENE OXIDE: II. MODELING OF HYDROLYSIS IN AQUIFER SAMPLES AND IN SEDIMENT-WATER SYSTEMS.
Environmental Protection Agency, Athens, GA. Southeast Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W91-01256

RELATION BETWEEN SATURATED CONDUCTIVITY AND CAPILLARY RETENTION CHARACTERISTICS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 2F.
W91-01303

EFFECT OF ROCK BUNDS AND TIED RIDGES ON SOIL WATER CONTENT AND SOIL PROPERTIES IN THE SUDAN SAVANNAH OF BURKINA FASO.
Semi-Arid Food Grain Research and Development Office, Ouagadougou (Burkina Faso).
For primary bibliographic entry see Field 3F.
W91-01330

ZINC IN POOR SANDY SOILS AND ASSOCIATED GROUNDWATER. A CASE STUDY.
Amsterdam Univ. (Netherlands). Landscape and Environmental Research Group.
For primary bibliographic entry see Field 5B.
W91-01450

BASIC MODEL OF WATER- AND GAS-FLOW THROUGH SMECTITE CLAY BUFFERS.
Clay Technology A.B., Lund (Sweden). Ideon Research Center.
R. Pusch, and H. Hokmark.
Engineering Geology EGGOAO, Vol. 28, No. 3/4, p 379-389, 1990. 9 fig, 8 tab, 6 ref.

Descriptors: *Bentonite, *Clay minerals, *Clays, *Hazardous waste disposal, *Liners, *Radioactive waste disposal, *Smectite, *Soil physical properties, *Soil porosity, *Void space, Gels, Geohydrology, Hydration, Hydraulic properties, Interstitial water, Montmorillonite, Permeability, Sodium, Soil density, Soil water, Sweden.

A large number of voids combine to form natural passageways for water or gas in soft rather than in very dense smectite clays. The very dense artificially-produced sodium (Na) montmorillonite clay materials used for isolating purposes in Swedish repositories for radioactive wastes have microstructural features formed by the initial arrangement of bentonite grains that are compressed to yield elements of highly compacted bentonite. Canister embedment of highly compacted Na bentonite forms a low-permeable medium of significant homogeneity both macroscopically and microscopically. However, despite the fact that a large part of the pore water is in interlamellar positions and not mobile by ordinary hydraulic gradients, there are still a number of pore passages that let water and gas through even at very high bulk densities. A microstructural model of artificial Na montmorillonite clay was examined. A study of this model indicates that the microstructure of 'artificial' Na montmorillonite clay, formed from bentonite powder grains, controls all the relevant transport mechanisms. The key feature of the model is that the dense grains constitute a basic network with continuous 'external' voids of varying size. At hydration of the system under confined conditions the grains expand and reduce the porosity, and the remaining voids become filled by soft clay gels that emanate from the dense grains. The density of these gels is a function of the void size; there is a significant variation in hydraulic and gas conductivities as well as in ion diffusivity over a cross-section of the clay. (Fish-PTT)
W91-01458

DUAL WATER FLOW PATTERN IN THE UNSATURATED ZONE UNDER A GYPSUM-AMENDED SOIL.
Weizmann Inst. of Science, Rehovoth (Israel).
H. Gvirtzman, M. Magaritz, and A. Nadler.
Journal of Soil Science JSSCAH, Vol. 41, No. 2, p 177-187, June 1990. 7 fig, 1 tab, 20 ref.

Descriptors: *Aeration zone, *Flow velocity, *Gypsum, *Infiltration, *Soil amendments, *Soil science, *Soil water, *Solute transport, Boreholes, Environmental tracers, Field tests, Groundwater movement, Irrigation water, Loess, Saline groundwater, Tritium.

Substantial progress has been made in describing the process of water and solute transport in the unsaturated zone by means of mathematical and conceptual models, and by column displacement experiments. Unfortunately, field studies, which are of critical importance for understanding natural transport processes in the unsaturated zone, are still relatively rare, possibly due to the methodological difficulties of tracing water and solute transport. One of the methods for conducting in situ field measurements is by using environmental isotopes as tracers, such as tritium. The tritium dating method was applied in order to describe the water flow mechanism in a natural field that has been irrigated by saline sodic waters and reclaimed by extensive gypsum application. Sediment samples were obtained from boreholes down to approximately 20 m in a gypsum-treated, saline water irrigated soil, and from nearby uncultivated fields at two locations. Measurements of tritium concentrations in the soil solution enabled the determination of two types of flow in the unsaturated zone: fast and slow. The slow component, the 'piston-flow type' in the sandy loess section of the first location had a vertical velocity of 0.16m/a, and in the clayey loess section of the second location had a vertical velocity of 0.23 m/a. The faster component typically transported the solution through fractures and other preferred paths. The percentage of the slow component was 40% in the sandy and 60% in the clayey loess. A previous prediction of delayed transport of salts was verified and is related to the interaction between chemical composition of irrigation water and the agrotechnical practices of gypsum application. (Fish-PTT)
W91-01475

SIMPLIFIED ANALYSIS OF SOIL WATER FLOW TO A MOLE DRAIN.
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
D. R. Scotter, L. K. Heng, D. J. Horne, and R. E. White.
Journal of Soil Science JSSCAH, Vol. 41, No. 2, p 189-198, June 1990. 4 fig, 1 tab, 21 ref.

Descriptors: *Data interpretation, *Mole drainage, *Soil water, *Soil water table, *Surface runoff, *Surface-groundwater relations, Drainage coefficient, Drainage practices, Dupuit-Forchheimer theory, Evaporation, Flow rates, Hydraulic conductivity, Hydrographs, Percolation, Rainfall intensity, Soil porosity, Soil properties, Soil science, Soil texture.

There is a long standing interest in simplified analyses of soil water movement to drains as a function of rainfall and soil hydraulic properties. An analysis has been developed which allows transient mole drain flow, surface runoff and water table depth to be computed, given measured or assumed values for rainfall, evaporation, deep percolation, mole drain spacing and depth, surface detention, the drainage coefficient, and the saturated hydraulic conductivity, total porosity and macroporosity of the topsoil and subsoil. The Dupuit-Forchheimer flow below the water table, and the vertical hydraulic potential equilibrium above the water table are assumed. The analysis was successfully tested by simulating the hydrographs for three contrasting rainfall events in New Zealand in 1988. The 6 October rainfall event was short and intense. The 29 June event had a lower maximum intensity and extended over a longer period. The 24 July rainfall event was unusually large and intense. Of note are the high maximum drain flow rates, and the rapid response of the drainage flow to changes in rainfall intensity. Only during this large rainfall event did a quasi-steady state occur, with drain flow approximately equal to rainfall intensity. The peak flow rates indicate how effective preferential flow can be in moving water to mole drains in fine-textured soils. The prediction of somewhat earlier than observed initial responses in drain flow to rain is probably due to the assumption of instantaneous vertical hydraulic potential equilibrium in the soil. This approach for modeling the behavior of mole drains is easy to use, and needs only readily obtainable soil physical and weather data as inputs. (Fish-PTT)
W91-01476

CALIBRATION AND VALIDATION OF A MODEL OF NON-INTERACTIVE SOLUTE LEACHING IN A CLAY-LOAM ARABLE SOIL.
Edinburgh School of Agriculture (Scotland). Dept. of Soil Science.
For primary bibliographic entry see Field 7C.
W91-01477

RELEASE OF CATIONIC ALUMINIUM FROM ACIDIC SOILS INTO DRAINAGE WATER AND RELATIONSHIPS WITH LAND USE.
University Coll. of Wales, Aberystwyth. Soil Science Unit.
For primary bibliographic entry see Field 5B.
W91-01479

SOIL AND SOIL SOLUTION CHEMICAL COMPOSITION AT THREE SITES WITHIN THE LOCH DEE CATCHMENT, SW SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 2K.
W91-01480

EXPERIMENTAL TESTING OF TRANSIENT UNSATURATED FLOW THEORY AT LOW WATER CONTENT IN A CENTRIFUGAL FIELD.
Geological Survey, Menlo Park, CA. Water Resources Div.
J. R. Nimmo.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 1951-1960, September 1990. 10 fig, 1 tab, 26 ref.

Descriptors: *Flow equations, *Hydraulic conductivity, *Laboratory methods, *Soil properties, *Soil water, *Unsaturated flow, Centrifugation, Experimental data, Sand, Testing procedures.

Experimental measurements and theoretical predictions of transient moisture conditions have been compared for a sandy soil approaching hydrostatic equilibrium in a centrifugal field. Starting near saturation, samples were centrifuged at constant speed with a constant suction at the outflow boundary. Water flowed freely out of the sample through a porous plate. Step increases in centrifuge speed produced transient moisture conditions suitable for comparison between experiment and theory. Measurements of electrical conductivity by a direct contact four-electrode technique indicated the water content according to a calibration based on known moisture conditions at various equilibrium states. A specially modified centrifuge permitted electrical measurements during centrifugation. For comparison, the transient water contents were computed by a finite-difference solution of Richards' equation (modified by replacing gravitational with centrifugal potential), using soil characteristics measured previously by steady state techniques. The time dependence of water content changes, used as the basis for comparison between experiment and theory, shows agreement which is reasonable given the degree of uncertainty of the measurements. The experiment confirms, within a factor of 4, the validity of Richards' equation for moisture conditions as dry as 25% of saturation, over a hydraulic conductivity range of 5 x 10 to the minus 11th power to 1 x 10 to the minus 8th power m/s, and in a centrifugal field up to about 200 g. (Author's abstract)
W91-01514

INVERSE SOLUTION FOR ONE-DIMENSIONAL INFILTRATION, AND THE RATIO A/K1.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2023-2027, September 1990. 1 fig, 2 tab, 10 ref.

Descriptors: *Infiltration, *Mathematical analysis, *Soil water, *Unsaturated flow, Infiltration coefficient, Mathematical equations, Soil physical properties, Soil texture.

The inverse method of solving the nonlinear diffusion equation was extended to give the two leading terms of the infiltration series solution of the nonlinear Fokker-Planck equation of unsaturated flow. The method was used, together with a new integral result for the ratio A/K1, to investigate the physical determinants of A/K1. K1 is the saturated

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conductivity, and A the second coefficient of the two-term infiltration equation i = St(1/2) + At. The relatively superficial direct effect of the initial moisture content 0o (important only when 0o is very large) was separated from the more complicated effect, dependent both on soil texture and on 0o, of the shapes of the diffusivity D and the conductivity derivative dK/d0. Normalized first moments of these functions measure the steepness of their variation. The full range of combinations of shapes of D and dK/d0 from essentially flat to essentially infinite steep was examined. For soils with Ko/k1 negligibly small, A/K1 lies in the range 0 to 2/3. The dominant physical effect is that A/K1 decreases monotonically as dK/d0 increases in steepness. On the other hand, A/K1 increases (relatively slowly) with the steepness of D. (Author's abstract)
W91-01519

APPROXIMATE SOLUTIONS FOR CATION TRANSPORT DURING UNSTEADY, UNSATURATED SOIL WATER FLOW.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
W. J. Bond, and I. R. Phillips.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2195-2205, September 1990. 6 fig, 42 ref, 2 append. Australian Water Research Advisory Council Project 84/164.

Descriptors: *Mathematical analysis, *Path of pollutants, *Porous media, *Soil water, *Solute transport, *Unsaturated flow, *Unsteady flow, Adsorption, Cation exchange, Cations, Dispersion, Infiltration, Interstitial water, Isotherms.

Approximate analytical solutions were derived for the transport of reactive solutes during unsteady flow of water in unsaturated porous media. The solutions apply to solutes that undergo adsorption reactions including ion exchange, specific adsorption, or negative adsorption (anion exclusion). No particular form of adsorption or exchange equation was assumed, and solutions were developed for both unfavorable (concave upward) and favorable (convex upward) isotherms, as well as for multisite isotherms. The main approximations that were assumed in deriving the solutions are (1) that local chemical and physical equilibrium is attained rapidly relative to the time scale for transport, (2) that the reaction takes place in a region of constant total charge concentration in both the solution and solid phases, (3) that the effects of dispersion and the shape of the adsorption isotherm may be treated separately and then combined, and (4) that as has been assumed previously for unsteady flow of nonreactive solutes, the water content and pore water velocity may be treated as constant over the region of dispersion. The solutions were tested using experimental data for the transport of exchanging cations during horizontal infiltration in laboratory columns. The solution for unfavorable isotherms was compared with data for sodium invading a calcium-dominated soil; that for multisite isotherms, which combines the solutions for both favorable and unfavorable isotherms, was compared with data for potassium invading a calcium-dominated soil. In both cases, good agreement was found between the measured distributions of solution and sorbed cations and those predicted using these solutions together with independently measured cation exchange isotherms. (Author's abstract)
W91-01535

STOCHASTIC ANALYSIS OF UNSATURATED FLOW: ONE-DIMENSIONAL MONTE CARLO SIMULATIONS AND COMPARISONS WITH SPECTRAL PERTURBATION ANALYSIS AND FIELD OBSERVATIONS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
K. Unlu, D. R. Nielsen, and J. W. Biggar.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2207-2218, September 1990. 13 fig, 2 tab, 21 ref.

Descriptors: *Hydraulic properties, *Model studies, *Monte Carlo method, *Soil water, *Stochastic models, *Unsaturated flow, Flow equations, Hydraulic conductivity, Mathematical models, Statistical analysis.

A numerical experiment was designed to study the stochastic behavior of one-dimensional transient unsaturated flow in a Monte Carlo setting. Soil hydraulic properties, log-saturated hydraulic conductivity (ln K sub s), pore size distribution parameter(alpha), and the specific water capacity (C) were assumed to be statistically homogeneous random fields described by exponential correlation functions with identical correlation lengths. Fifty realizations of each soil hydraulic property, with statistical properties obtained from a field experiment, were generated by using a nearest-neighbor model. Numerical solutions of the one-dimensional flow equation are used repeatedly to obtain realizations of soil water pressure head and flux corresponding to the realizations of ln K sub s, alpha, and C. The dependence of the pressure head and flux on the statistical properties of ln K sub s, alpha, and C and the magnitude of the hydraulic head gradient prevailing at the lower boundary were investigated. In addition, results of Monte Carlo analysis and spectral perturbation analyses were compared with field observations. The greatest variability of the soil water pressure head and flux were observed when soil hydraulic properties are uncorrelated and have large variances and integral scales and when G at the lower boundary is unity. The Monte Carlo and spectral perturbation analyses tend to agree reasonably well for the flow domains in which ergodicity of local soil hydraulic properties is assured. Results of the Monte Carlo and spectral perturbation analyses are also supported by field observations. (Author's abstract)
W91-01536

SOIL SOLUTION CHEMISTRY OF AN ADIRONDACK SPODOSOL: LYSIMETRY AND N DYNAMICS.
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 2K.
W91-01693

STANDING-WATER DEPOSITS AS INDICATORS OF LATE QUATERNARY DUNE MIGRATION IN THE NORTHWESTERN NEGEV, ISRAEL.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2J.
W91-01695

CROPPING SYSTEM AND TILLAGE EFFECTS ON AVAILABLE SOIL WATER AND YIELD OF GRAIN SORGHUM AND WINTER WHEAT.
Southwest Kansas Research-Extension Center, Garden City.
For primary bibliographic entry see Field 3F.
W91-01705

CLIPPING DATE EFFECTS ON SOIL WATER AND REGROWTH IN CRESTED WHEATGRASS.
Oregon State Univ., Union. Eastern Oregon Agricultural Research Center.
R. F. Miller, M. R. Haferkamp, and R. F. Angell.
Journal of Range Management JRMGAQ, Vol. 43, No. 3, p 253-257, May 1990. 2 fig, 6 tab, 23 ref.

Descriptors: *Agricultural practices, *Soil water, *Soil-plant-water relationships, *Wheat, Defoliation, Forages, Water potentials.

Although extensive work has evaluated plant response to season of defoliation, few studies have evaluated the influence of season of defoliation on soil water depletion, amount of regrowth, and total seasonal biomass production. This 5-year study evaluated the effect of clipping date and yearly climatic variation on soil water depletion, amount of regrowth, and total seasonal forage production. Timing of clipping significantly affected soil water depletion patterns. Clipping at the early vegetative phase had little effect on soil water potential unless soil water potentials were below 0.03 MPa. In mid-June soils beneath plants defoliated during the boot stage were consistently wetter than soils beneath undefoliated plants. However, total seasonal soil water depletion was usually similar among treatments by the end of the growing season. Phenology and the amount of standing crop present when defoliation occurred were significantly correlated with regrowth. Date of defoliation also significantly affected total production in wet years. Total seasonal foliage production on plots clipped during the boot stage was generally lower than on plots clipped during the vegetative or late flowering stages of development. (Author's abstract)
W91-01706

EFFECT OF SOIL WATER, NITROGEN, AND GROWING DEGREE-DAYS ON MORPHOLOGICAL DEVELOPMENT OF CRESTED AND WESTERN WHEAT-GRASS.
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 2I.
W91-01707

CAUSES OF SOIL SALINIZATION: 2. A BASIN IN EAST-CENTRAL ALBERTA, CANADA.
Alberta Agriculture, Lethbridge.
M. J. Hendry, G. W. Chan, and D. B. Harker.
Ground Water GRWAAP, Vol. 28, No. 4, p 544-550, July/August 1990. 8 fig, 2 tab, 13 ref.

Descriptors: *Alberta, *Evaporation, *Geohydrology, *Groundwater, *Groundwater flow, *Model studies, *Saline soils, *Tritium, Canada, Flow models, Hydraulic conductivity, Ponding, Snowmelt, Water table.

The cause of soil salinization in a 21-ha area of gently rolling topography in Alberta was investigated. The geology of the basin consists of lenticular Cretaceous sediments overlain by tills and lacustrine deposits. Interpretation of vertical hydraulic-head data showed that regional discharge of groundwater from bedrock is not a cause of salinization in the study area. Results of stream function modeling suggested that most of the water causing salinization is not derived from local topographic highs. Modeling results also suggested that the direction of groundwater flow throughout the area is vertically downward through unconsolidated Quaternary deposits and into bedrock. Tritium analyses of pore water distilled from core samples confirmed that the groundwater causing salinization was not derived from the local topographic highs, nor from the deeper geologic deposits. Hydrograph analysis indicated that the salinization was derived from evaporation from seasonally high water tables caused by ponded surface water and spring snowmelt in localized depressional areas. (See also W90-09139) (Author's abstract)
W91-01783

EVALUATE A SOIL LOSS PREDICTION MODEL COMBINED WITH AN INFILTRATION MODEL FOR TILLED SOILS.
South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
S. T. Chu, and R. A. Kohl.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-217233/AS. Price codes: A03 in papercopy, A01 in microfiche. South Dakota Water Resources Institute, Brookings, Completion Report, August 1988. 23p, 1 fig, 12 tab, 7 ref. USGS Contract No. 14-08-0001-G1449-04. USGS Project No. G1449-04.

Descriptors: *Infiltration models, *Sediment erosion, *Soil conservation, *Soil erosion, *Soil stabilization.

Soil and water are two basic resources necessary to human existence. Soil erosion strips the top soil away from the ground surface and depletes the productivity of the land. The transported sediment fills the reservoirs and accumulates in the waterways, which shortens the life of reservoirs and is the major cause of downstream flooding problems. Nutrients, organic matter, pesticides and insecticides carried by the sediments are the primary sources of water pollution from agricultural lands.

A soil loss prediction model is a useful tool to identify erosion hazard sites and is a time saving substitute for the field measurements. Soil loss estimation and prediction is an integral part of a well organized soil erosion control program. The purpose of this research was to combine an infiltration model for tilled soils with an existing soil loss model for soil loss prediction on tilled soils. Horton's model was shown to be adequate to describe the infiltration process on bare tilled soil where the development of a surface seal is the mechanism to determine surface runoff. The Green-Ampt infiltration model was shown to be adequate to describe the infiltration process on well protected tilled Vienna loam. For the partially protected tilled soil plots, neither of the two infiltration models provides good performance. The sediment loading ratio was shown to be a useful parameter in soil loss prediction. The product of the sediment loading ratio and the calculated runoff from the infiltration models is the predicted soil loss. (USGS)
W91-01861

SURFACE COVER EFFECTS ON SOIL INFILTRATION.
South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
R. A. Kohl, and S. T. Chu.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-217258/AS. Price codes: A02 in paper copy, A01 in microfiche. South Dakota Water Resources Institute Brookings, Completion Report, 1988. 4p, 1 tab, 3 ref. ASAE Paper No. 88-2004. USGS Contract No. 14-08-0001-G1252. USGS Project No. G1252-06.

Descriptors: *Infiltration, *Infiltrometers, Soil sealants, Surface sealing.

Permeable and impermeable pieces representing soil residue were placed on the soil and the plots were exposed to a sprinkling infiltrometer. Both surface cover treatments increased infiltration rates compared to bare soil. The soil under the central portion of the permeable cover had higher infiltration rates than under the impermeable cover. (USGS)
W91-01863

MODELLING SOIL WATER SUPPLY TO CROPS.
Wye Coll., Ashford (England). Dept. of Agriculture, Horticulture and the Environment.
H. F. Cook, and D. L. Dent.
Catena, Vol. 17, No. 1, p 25-39, February 1990. 10 fig, 29 ref.

Descriptors: *Agricultural hydrology, *Agronomy, *Model studies, *Simulation analysis, *Soil surveys, *Soil water, *Soil-water-plant relationships, Crop yield, Hydraulic conductivity, Soil moisture retention, Soil properties, Soil water potential, Transpiration, Water demand, Water supply.

Process simulation models are needed to make use of static soil survey data to predict crop performance. One critical link in this chain, the supply of water by the soil to meet the transpirational demand of crops, has been modelled on the assumption that water supply is directly related to soil water potential. Field testing of this simple model shows a close correlation between predicted and measured supply of water over a range of crops and soils grouped according to their soil water release characteristics. Crop water use and soil water-induced stress can be predicted by a demand-supply model based on: water demand estimated from Penman evapotranspiration and K ab c values for the crop; allocation of this demand through the soil profile according to the activity of the root system; water release by the soil according to soil water potential (the model requires soil water release curves for the topsoil and subsoil or classification of soils into hydrological families defined by their soil water release characteristics); and estimates of effective rainfall and upward flux of water from below the root zone. (Author's abstract)
W91-01869

RAINFALL INDUCED SOIL SEAL: (A) A CRITICAL REVIEW OF OBSERVATIONS AND MODELS.
Hebrew Univ., Rehovoth (Israel). Dept. of Soil and Water Sciences.
Y. Mualem, S. Assouline, and H. Rohdenburg.
Catena, Vol. 17, No. 2, p 185-203, April 1990. 45 ref.

Descriptors: *Infiltration, *Infiltration rate, *Model studies, *Rainfall impact, *Reviews, *Runoff, *Soil surfaces, *Surface sealing, Chemical properties, Hydraulic conductivity, Particle size, Particulate matter, Physical properties, Soil properties, Soil water, Suspended solids.

Most soils exposed to rainfall are subjected to physical and chemical processes which change their properties at the vicinity of the soil surface. This phenomenon, called soil seal, can be harmful to agriculture. It decreases the infiltration rate, reduces the available water at the root zone, increases runoff and soil erosion and affects seedling and plant growth. This review explains the definition of rainfall induced soil seal, the mechanisms involved in its formation, its properties, and its role in shaping the soil water regime. The review concludes: (1) no universal seal, such as skin 0.1 mm, can accurately represent a real seal layer, (2) seal properties depend on both rainfall and soil properties. (3) soil sealing depends on initial and boundary conditions. (4) the infiltration rate is determined by the state and properties of the seal layer, as well as the undisturbed subsoil subjected to the particular boundary conditions; and (5) the physical identity of soil seal cannot be fully represented by visible parameters, even with the aid of microscopes or scanning electron microscopy. (See also W91-01873) (Stoehr-PTT)
W91-01872

RAINFALL INDUCED SOIL SEAL: (B) APPLICATION OF A NEW MODEL TO SATURATED SOILS.
Hebrew Univ., Rehovoth (Israel). Dept. of Soil and Water Sciences.
Y. Mualem, S. Assouline, and H. Rohdenburg.
Catena, Vol. 17, No. 2, p 205-218, April 1990. 9 fig, 1 tab, 11 ref.

Descriptors: *Hydraulic conductivity, *Hydraulic gradient, *Infiltration, *Infiltration rate, *Model studies, *Rainfall impact, *Saturated soils, *Soil types, Clays, Loam, Physical properties, Sand, Silt, Soil properties, Soil water, Surface permeability, Suspended solids.

A conceptual model is proposed in which the saturated soil seal (crust) properties are derived on the basis of physical concepts estimated empirically. The reduced hydraulic conductivity of the soil surface is attributed to its decreased porosity and increased ineffective water content. The characteristics of the modeled soil seal were examined using data of sandy loam and loam (loess) soils. An inverse approach was applied for calibration using infiltration rate data. The results indicate that the importance of the 0.1 mm compact clay and silt seal layer (the skin) has been overestimated. The sealing of bare soils formed under high-energy rainfall cannot be attributed to the skin. The suggested theory allows the seal properties, including its thickness and hydraulic conductivity, to vary with respect to rain and soil properties as well as the flow boundary conditions. Seal thickness, hydraulic conductivity and conductance were calculated as a function of the driving hydraulic head for the two soils. The sandy loam had a thicker sealing layer with a higher hydraulic conductivity and sensitivity to flow conditions than the loam. While the hydraulic conductance of the loam seal decreased slowly as a function of the hydraulic gradient, the conductance of the sandy loam soil dropped sharply with an increase in the hydraulic gradient, and reached a lower value than that of the loam for large gradients. (See also W91-01872) (Author's abstract)
W91-01873

2H. Lakes

MODELING LINKED WATERSHED AND LAKE PROCESSES FOR WATER QUALITY MANAGEMENT DECISIONS.
Agricultural Research Service, Durant, OK.
For primary bibliographic entry see Field 5G.
W91-01012

MOLYBDENUM AND SULFATE AS CONTROLS ON THE ABUNDANCE OF NITROGEN-FIXING CYANOBACTERIA IN SALINE LAKES IN ALBERTA.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
R. Marino, R. W. Howarth, J. Shamess, and E. Prepas.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 245-259, March 1990. 4 fig, 6 tab, 60 ref. NSF Ecosystems Study Program Grant BSR 86-04688.

Descriptors: *Alberta, *Cyanophyta, *Limiting nutrients, *Limnology, *Molybdenum, *Nitrogen fixation, *Saline lakes, *Sulfates, Chemical analysis, Model studies, Nitrogen, Nutrient requirements, Phosphorus, Regression analysis, Statistical analysis.

Thirteen saline lakes in Alberta were studied to test the hypothesis that Mo availability influences the abundance of planktonic, N-fixing cyanobacteria in saline ecosystems. Earlier work in oxic seawater showed that the availability of Mo is controlled in part by the ratio of sulfate to Mo because sulfate inhibits the assimilation of molybdate. The sulfate:Mo ratio in seawater is very high relative to most freshwater lakes, a finding that is consistent with the scarcity of planktonic, N-fixing cyanobacteria in coastal marine ecosystems. This ratio is constant in seawater; however, limiting a test of this hypothesis in marine systems. The Alberta salt lakes provide a more robust test in saline systems. The ratio of sulfate to Mo within any given saline lake was relatively constant over a summer season, but the ratio between lakes varied and ranged from values typical of freshwater lakes to values higher than in seawater. N-fixing cyanobacteria are significant fractions of the plankton in six of the 13 lakes studied and are rare or absent in the others. The sulfate:Mo ratio was a strong predictor of the abundance of planktonic, N-fixing cyanobacteria. However, sulfate or Mo concentrations alone were not. This finding is consistent with the hypothesis that sulfate can control Mo availability in oxic waters. Phosphorus concentrations, and the ratio of N to P, were not good predictors of the abundance of N-fixing cyanobacteria in these saline lakes although they often are in freshwater lakes. The differences between predictions from a freshwater, P regression model and actual abundances of N-fixing cyanobacteria in the saline lakes were best explained by the sulfate:Mo ratio. (Author's abstract)
W91-01034

GROWTH AND VOLTINISM OF LOTIC MIDGE LARVAE: PATTERNS ACROSS AN APPALACHIAN MOUNTAIN BASIN.
Georgia Univ., Athens. Dept. of Entomology.
A. D. Huryn.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 339-351, March 1990. 6 fig, 6 tab, 36 ref. NSF Grants BSR 85-16497 and BSR 85-14328.

Descriptors: *Appalachian Mountains, *Aquatic insects, *Midges, *Stream biota, *Temperature effects, Larvae, Life cycles, Regression analysis, Seasonal variation.

The influence of thermal regime upon community-level growth rates and voltinism was estimated for larval Chironomidae inhabiting litter accumulations in four streams located in an Appalachian Mountain basin. Groups of larvae were confined in growth chambers and incubated in situ at time intervals representing the observed range of annual thermal variation. Estimates of daily growth rates (g) were derived from change in average length

over the incubation period. Using multiple regression, temperature and larval size were found to have significant positive and negative effects on g, respectively. Equations derived for each stream described a substantial proportion of the variance among observed g values (R(2) = 0.71-0.82) but did not differ significantly. Therefore, the data from all streams were combined to derive a single general equation which, along with larval size distribution, biomass, and temperature data, was used to model the variation in annual biomass turnover (G) and hypothetical size-dependent voltinism among the study streams. Size distribution of larvae did not differ significantly among streams and variation in G (range = 12.8-18.6) was attributed primarily to variation in thermal regime. Differences in voltinism were predicted to be minor, but were closely dependent on both terminal size of larvae and thermal regime. The model provides evidence that spatial variation of G on the order of 31% can be expected for midge communities within a < 30 square km area of this Appalachian Mountain basin. (Author's abstract)
W91-01038

FLUXES AND TRANSFORMATION OF AQUATIC PIGMENTS IN LAKE MENDOTA, WISCONSIN.
Wisconsin Univ.-Madison. Water Chemistry Program.
J. P. Hurley, and D. E. Armstrong.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 384-398, March 1990. 6 fig, 4 tab, 46 ref. NSF Grants DEB 80-12313 and EAR 88-16561.

Descriptors: *Carotenoids, *Chlorophyll, *Lake sediments, *Limnology, *Pigments, *Sediment chemistry, *Sedimentation, *Suspended solids, *Wisconsin, Chemical analysis, Microbial degradation, Seasonal variation, Suspended sediments.

Concentrations and fluxes of chlorophyll and carotenoid pigments were measured in suspended and settling particulate matter and in surface sediments in Lake Mendota. Flux comparisons were used to calculate the extent of alteration or degradation within the water column and at the sediment surface. Losses within the water column for specific time intervals ranged from almost negligible for diatoxanthin to 96% for peridinin. The extent of loss was influenced by pigment type and transport process. Surface sediment diagenesis in Lake Mendota resulted in differential degradation rates among chlorophyll and carotenoid constituents. Deposition of pheophorbide a, a grazing indicator, was most important during late spring, as zooplankton populations increased and chlorophyll levels in the water column dropped below 1 nmol/liter. The ability to trace the magnitude of this annual event through the sedimentary record was obscured by selective degradation of pheophorbide relative to chlorophyll and pheophytin. Similarly, carotenoid composition was dramatically altered both within the water column and at the sediment surface. Fucoxanthin and peridinin, major water column carotenoids, were degraded extensively before incorporation in the sediments. (Author's abstract)
W91-01041

MECHANISM FOR THE HYDROGEN SULFIDE-INDUCED GROWTH LIMITATION IN WETLAND MACROPHYTES.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
M. S. Koch, I. A. Mendelssohn, and K. L. McKee.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 399-408, March 1990. 1 fig, 2 tab, 53 ref.

Descriptors: *Hydrogen sulfide, *Limnology, *Macrophytes, *Marshes, *Wetlands, Adenosine triphosphate, Anoxic conditions, Enzymes, Fermentation, Marsh plants, Metabolism, Nitrogen cycle, Phytotoxicity, Plant growth, Respiration.

Hydrogen sulfide, a phytotoxin that often accumulates in anoxic marine and freshwater marsh soils, suppressed the activity of alcohol dehydrogenase (ADH), then enzyme that catalyzes the terminal step in alcoholic fermentation, in the roots of two wetland macrophytes. This inhibition of root ADH activity with increasing sulfide concentration was associated with decreases in root total adenine nucleotide pool (ATP + ADP + AMP), the adenylate energy charge ratio (AEC), nitrogen uptake (percent recovery of 15NH4(+) as N) and growth (leaf elongation). These responses were species-specific with a greater negative impact in the freshwater marsh species that naturally inhabit low-sulfide environments. These findings lend support to the hypotheses that ADH activity, as a measure of fermentative metabolism, is important in maintaining the root energy status of wetland plants under hypoxic-anoxic conditions; that there is a significant negative effect of H2S on the anoxic production of energy in these roots; and that an important negative effect of H2S on plant growth is an inhibition of the energy-dependent process of N uptake. (Author's abstract)
W91-01042

RAPID AMMONIUM CYCLING AND CONCENTRATION-DEPENDENT PARTITIONING OF AMMONIUM AND PHOSPHATE: IMPLICATIONS FOR CARBON TRANSFER IN PLANKTONIC COMMUNITIES.
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
C. A. Suttle, J. A. Fuhrman, and D. G. Capone.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 424-433, March 1990. 7 fig, 34 ref. NSF Grants OCE 84-10074, OCE 87-11132, OCE 84-17595, and OCE 85-15886.

Descriptors: *Ammonium, *Estuaries, *Eutrophic lakes, *Limiting nutrients, *Limnology, *Nutrient cycling, *Organic carbon, *Phosphates, *Plankton, Marine environment, Nitrogen compounds, Nitrogen cycle, Nutrients, Radioisotopes, Seasonal variation, Size classes.

A short-lived radioactive isotope of nitrogen (N13, half-life = 10 min) of very high specific activity (> 100 mCi/micromole) was used to study NH4+ uptake at near-ambient concentrations in natural planktonic communities. The turnover times of the dissolved NH4+ pool in Long Island Sound ranged from tens of hours between April and early June to a fraction of an hour between mid-June and late July. The NH4+ turnover time was also rapid in a nearby eutrophic lake. Up to 50% of the ambient NH4+ flux into particulate material from Long Island Sound was attributable to organisms passing 1.0-micron polycarbonate filters. However, partitioning of NH4+ uptake among size classes was very concentration-dependent. A 0.5 micromolar addition resulted in an increase in NH4+ uptake by the > 3 micron size class of from 33% to > 80% of the total. Similar results were obtained for phosphate uptake into particulate matter from the Sargasso Sea. Although <20% of the ambient phosphate uptake was into particles > 1 micron, a 100 nanomolar pulse resulted in about 50% of the uptake entering the > 1 micron fraction. Because slight increases in NH4+ and phosphate concentration result in greater uptake by larger organisms with higher C:N and C:P ratios, distributing these nutrients in 'patches' of elevated concentration results in more C being transferred to higher level consumers. (Author's abstract)
W91-01043

DISTRIBUTION OF LABILE DISSOLVED ORGANIC CARBON IN LAKE MICHIGAN.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
G. A. Laird, and D. Scavai.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 443-447, March 1990. 3 fig, 1 tab, 20 ref.

Descriptors: *Aquatic bacteria, *Carbon cycle, *Dissolved organic carbon, *Lake Michigan, *Limnology, *Nutrients, Lake stratification, Seasonal variation.

Identifying primary sources of labile dissolved organic carbon (LDOC) in pelagic systems has taken on new interest in light of recent evidence that a major portion of the C fixed via autotrophic production passes through heterotrophic bacteria and that much of the bacterial production is grazed. This transfer of LDOC to primary consumers captures C that might otherwise be lost. Bioassay-measured LDOC concentrations were compared in near-bottom and near-surface Lake Michigan water between April and October 1986. In five of seven experiments, the LDOC concentration was higher in near-bottom water. LDOC reached 40.2% of the total DOC pool in the near-bottom water in late May and 13.8% in the near-surface water in early July. Concentration in near-bottom water was highest during early stratification; concentration in surface water varied less but was highest in early July. The data suggest that an allochthonous source of labile organic C may be important. Annual buildup of LDOC in the deep regions, which becomes available to the surface waters during winter mixing, may not make as significant a contribution to the system as was previously believed. At least in spring, allochthonous sources focused by the spring thermal front movement may contribute significantly to the LDOC pool and may help account for some of the previously-noted imbalance between bacterial and phytoplankton production. (Author's abstract)
W91-01044

ALGAL USE OF SEDIMENTARY PHOSPHORUS FROM AN AMAZON FLOODPLAIN LAKE: IMPLICATIONS FOR TOTAL PHOSPHORUS ANALYSIS IN TURBID WATERS.
California Univ., Santa Barbara. Dept. of Biological Sciences.
D. L. Engler, and O. Sarnelle.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 483-490, March 1990. 6 fig, 1 tab, 23 ref.

Descriptors: *Algae, *Amazon River, *Lake sediments, *Phosphorus, *Turbidity, Bioassay, Bioavailability, Cycling nutrients, Laboratory methods, Nutrients, Sediment analysis.

Despite the potential influence of particulate-bound nutrients on the productivity of Amazon floodplain lakes, there is only one study addressing the bioavailability of particulate nutrients in this system. Chemical extraction techniques were coupled with a bioassay experiment to assess the types and amounts of bioavailable P present in the sediments of an Amazon floodplain lake. Chemical forms of P and their availabilities to Selenastrum capricornutum were measured in sediments collected from Lago Calado, an Amazon floodplain lake. Postbioassay analysis confirmed that Selenastrum used ca. 60-70% of the P in the NaOH-extracted fraction during a 9-d incubation. No evidence for algal use of Ca-bound P or organic P was found. Methodological comparisons revealed that persulfate digestion may not adequately recover algal-available particulate P in waters high in organic turbidity. An average of 26% of the algal-available P in Amazon River water was in particulate form. (Author's abstract)
W91-01047

ABIOTIC TRANSFORMATIONS OF IRON AND PHOSPHATE IN HUMIC LAKE WATER REVEALED BY DOUBLE-ISOTOPE LABELING AND GEL FILTRATION.
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. de Haan, R. I. Jones, and K. Salonen.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 491-497, March 1990. 5 fig, 1 tab, 19 ref.

Descriptors: *Chemical interactions, *Humic substances, *Iron, *Lakes, *Limnology, *Phosphates, Chemical complexes, Chromatography, Filtration, Finland, Iron radioisotopes, Laboratory methods, Phosphorus radioisotopes.

Abiotic transformations of Fe and phosphate in humic water from Finnish forest lakes were studied by Sephadex G-100 gel filtration following incubation of filtered (0.2 microns) epilimnetic water samples to which both Fe55Cl3-6H2O and P32O4(-3) had been added. The simultaneous movement of Fe55 and P32 to higher molecular weight fractions (10,000-20,000 MW) depended on the presence of dissolved humic substances (DHS). In the absence of DHS almost all Fe55, probably

as inorganic hydrolyzed iron particles, sorbed to the Sephadex. The binding of Fe55 by DHS was not affected by increasing the natural ionic strength (I = ca. .0003 M) by a factor of 100. In the absence of quasi-equilibrium between free and DHS-bound P32O4(-3), the DHS-Fe-PO4(-3) complex readily released P32O4(-3)-P. Compared to the P32 binding, Fe55 binding was rapid. More than 20% of the Fe had been bound after only 1 min, whereas for labeled PO4(-3) this percentage was reached only after 24 h. (Author's abstract)
W91-01048

VARIABILITY OF DIATOM CONCENTRATIONS AND ACCUMULATION RATES IN SEDIMENTS OF A SMALL LAKE BASIN.
University Coll., London (England). Palaeoecology Research Unit.
N. J. Anderson.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 497-508, March 1990. 7 fig, 4 tab, 36 ref.

Descriptors: *Cores, *Diatoms, *Eutrophic lakes, *Lake sediments, *Limnology, Dating, Distribution patterns, Fossils, Lead radioisotopes, Northern Ireland, Sediment analysis, Sedimentation.

The use of fossil diatom assemblages to assist in reconstructing lake history and monitoring environmental change is a well-established procedure, however few studies have examined the variability of diatom assemblages in space and time. Diatom biostratigraphy was analyzed for 10 sediment cores covering a range of water depths in Lough Augher, Northern Ireland. Cores were zoned to permit correlation and transfer of a Pb210 chronology and calculation of diatom accumulation rates. There were clear differences in relative frequency of planktonic microfossils between littoral (< 6-m water depths) and profundal cores, but all cores gave a similar history of the eutrophication of the lake. Deep-water cores, however, provided a clearer and higher resolution record. Diatom concentrations and percentages were horizontally nonuniform, contradicting the assumption that lake and sediment mixing creates homogeneous microfossil assemblages before deposition. Accumulation rates also showed considerable variation over time. Relative accumulation rates indicate that no single core accurately reflects the mean accumulation rate for the whole basin. Before 1900, diatoms were focused into deeper water, but after ca. 1940 the pattern of diatom deposition and accumulation rates began to change. Redistribution of diatoms into the deepest part of the basin was reduced, perhaps due to reduced resuspension from the increasing influence of fringing macrophyte beds. (Author's abstract)
W91-01049

GREIGITE AND THE MAGNETIC PROPERTIES OF SEDIMENTS.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
J. Hilton.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 509-520, March 1990. 7 fig, 1 tab, 29 ref.

Descriptors: *Eutrophic lakes, *Iron compounds, *Lake sediments, *Limnology, *Magnetic studies, *Paleolimnology, Chemical properties, Cores, England, Greigite, Lacustrine environment, Sediment analysis, Sulfides.

Measurements of the properties of magnetic minerals in lacustrine sediments have been used on many occasions to obtain information about relative accumulation rates in lakes and to study changes in erosion patterns in catchments. Data interpretation in such studies requires that an intensity extreme or direction change in one core is contemporary with a similar observation in another core. If magnetic minerals are formed in situ, this assumption could be invalid. X-ray diffraction spectra of freeze-dried sediments from a lake in the English Lake District positively identified the presence of greigite, a magnetic iron sulfide (Fe3S4) mineral. The sediments also show considerable loss of magnetic intensity when wet samples are allowed to oxidize. Several hypotheses have been proposed elsewhere to explain the intensity loss, but an assessment of the evidence suggests that oxidation of greigite is responsible in these sediments. Data from several lakes and from laboratory experiments are used to deduce the environmental requirements for greigite formation. These conditions of high labile C concentrations, good sources of labile Fe and S, and an oscillating oxycline depth in the sediments were likely to be found only in monomictic or dimictic eutrophic lakes, estuaries, and salt marshes and are unlikely to be found in meromictic lakes, unstratified lakes, oligotrophic lakes, or deep-sea sediments. (Author's abstract)
W91-01050

CONTRIBUTION OF ORGANIC ACIDS TO ALKALINITY IN LAKES WITHIN THE MOUNT ST. HELENS BLAST ZONE.
Washington Univ., Seattle. Coll. of Ocean and Fishery Sciences.
R. C. Wissmar, D. M. McKnight, and C. N. Dahm.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 535-542, March 1990. 3 fig, 4 tab, 27 ref. NSF Grants DEB 81-1307 and BSR 84-07429. U.S. Department of Agriculture Forest Service Agreement PNW-80-178.

Descriptors: *Alkalinity, *Geochemistry, *Limnology, *Mount St Helens, *Mountain lakes, *Organic acids, *Volcanoes, Alkaline water, Carbonates, Chemical properties, Chlorides, Dissolved organic carbon, Fulvic acids, Sulfates.

The volcanic eruption of Mount St. Helens in May 1980 severely affected lakes in the surrounding blast zone. Existing and newly formed lakes had high total alkalinities (TA) and concentrations of dissolved organic carbon (DOC). In Spirit Lake, TA and DOC were 36 and 64 times pre-eruption values. Dissolved organic acids, primarily ionized fulvic acids and hydrophilic acids constituted 80-90% of the dissolved organic material. High TA values during 1980 and 1981 included two major components, carbonate (CA) and surplus alkalinity. A comparison of minimal estimates for organic acid alkalinity from ionized fulvic acids and hydrophilic acids with values of surplus showed that the dissociation of organic acids contributed between 20 and 100% to alkalinity in 1980 and 1981. During 1981, surplus alkalinity and organic acid alkalinities relative to TA declined while CA increased. This increase in CA reflected the influence of dilution of lake volumes with runoff waters and a major decrease in organic acids due to dilution and microbial mineralization. CA appeared controlled by contributions of bicarbonate ions due to chemical weathering, possible anionic exchange and microbially mediated reactions. These reactions involving organic acids in combination with the geochemical characteristics of the eruption (e.g. moderate sulfate and chloride concentrations and massive loadings of inorganic and organic materials) led to well-buffered lakes that had a sizable proportion of the alkalinity being contributed by dissociated organic acids. (Author's abstract)
W91-01051

PHYTOPLANKTON BIOMASS, PRODUCTION AND GROWTH LIMITATIONS ON THE HUANGHE (YELLOW RIVER) CONTINENTAL SHELF.
Louisiana State Univ., Baton Rouge. Coastal Ecology and Fisheries Inst.
For primary bibliographic entry see Field 2L.
W91-01058

CADMIUM CONCENTRATIONS OF CRUSTACEAN ZOOPLANKTON OF ACIDIFIED AND NONACIDIFIED CANADIAN SHIELD LAKES.
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W91-01062

MERCURY SPECIATION IN SURFACE FRESHWATER SYSTEMS IN CALIFORNIA AND OTHER AREAS.
California Univ., Santa Cruz. Inst. of Marine Sciences.
For primary bibliographic entry see Field 2K.
W91-01063

ENVIRONMENTAL FACTORS AFFECTING THE PRODUCTION OF PEPTIDE TOXINS IN FLOATING SCUMS OF THE CYANOBACTERIUM MICROCYSTIS AERUGINOSA IN A HYPERTROPHIC AFRICAN RESERVOIR.
Council for Scientific and Industrial Research, Pretoria (South Africa). Div. of Water Technology.
R. J. Wicks, and P. G. Thiel.
Environmental Science and Technology ESTHAG, Vol. 24, No. 9, p 1413-1418, September 1990. 3 fig, 2 tab, 45 ref.

Descriptors: *Biological pollution, *Cyanophyta, *Eutrophication, *Peptides, *South Africa, *Toxins, *Water pollution sources, Chemical analysis, Chlorophyll a, Eutrophic lakes, Hartbeespoort Dam, Hydrogen ion concentration, Liquid chromatography, Oxygen, Pollutant identification, Primary productivity, Reservoirs, Seasonal variation, Solar radiation, Water temperature.

The presence of six cyclic, heptapeptide toxins in floating scums of Microcystis aeruginosa in Hartbeespoort Dam, South Africa, was monitored over 2.5 years. Separation of the six peptide toxins was achieved by reverse phase high pressure liquid chromatography. The six toxins were either not detectable or in very low concentrations during the summer. Combined concentrations of four of the toxins ranged from 5 to 415 micrograms/gram of dry scum and were strongly and positively correlated to primary production per unit of chlorophyll-a, solar radiation, surface water temperature, pH, and percent oxygen saturation ($r=0.52$-0.67, $n=16$-20, $p<0.001$) and weakly, negatively correlated to surface chlorophyll-a and orthophosphate concentrations ($r = -0.33$, $n = 16$-20, $p < 0.05$). No strong relationships were found between total toxin concentrations in scum samples and surface water organic and inorganic nutrient concentrations. The data from the subtropical reservoir indicated that the specific rate of photosynthesis of M. aeruginosa together with several environmental factors is closely coupled to the concentrations of peptide toxins in this cyanobacterium. (Author's abstract)
W91-01065

SEASONAL VARIATIONS OF POPULATION DENSITY AND ACTIVITY OF SULFATE-REDUCING BACTERIA IN OFFSHORE AND REED SEDIMENTS OF A HYPERTROPHIC FRESHWATER LAKE.
Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
M. Fukui, and S. Takii.
Japanese Journal of Limnology RIZAAU, Vol. 51, No. 2, p 63-71, April 1990. 8 fig, 1 tab, 22 ref.

Descriptors: *Eutrophic lakes, *Lake Teganuma, *Lake sediments, *Limnology, *Population density, *Seasonal variation, *Sulfur bacteria, Japan, Reeds, Sulfates, Water temperature.

Seasonal variations in population density of sulfate-reducing bacteria (SRB) and sulfate reduction rates were examined for sediments of an offshore and reed site of Lake Teganuma (freshwater, hypertrophic), Chiba Prefecture, Japan. The numbers of SRB (colony forming units/ml) in the surface sediments (0-2 cm) were at a level of 100,000 at the reed site and a level of 10,000 at the offshore one, and they remained relatively constant throughout the year. The activities at both sites increased from summer to autumn, and the reed sediments showed higher activities (1.08-16.6 times) than the offshore ones in this period; the maximum rates (September) (nmol/ml/day) in the offshore and reed sediments were 290 in the 0-3 cm layer and 1990 in the 3-6 cm layer. In situ temperature may have greatly affected sulfate reduction. (Author's abstract)
W91-01072

IMPORTANCE OF NATURAL PROCESSES IN UNDERSTANDING ECOSYSTEM CHANGE: A CASE STUDY OF LIMED LAKES.
Illinois State Water Survey Div., Champaign.
E. C. Krug, and A. S. Lefohn.
Journal of the Air & Waste Management Association, Vol. 40, No. 6, p 846-854, June 1990. 1 fig, 4

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tab, 56 ref.

Descriptors: *Acid rain, *Case studies, *Ecosystems, *Lake restoration, *Liming, *Limnology, Adirondack lakes, Chemical interactions, Dissolved organic carbon, Hydrogen ion concentration, Ion exchange, Lakes, Land use, Sphagnum moss, Sulfates, Water chemistry.

A review of the lake chemistry from six lakes studied has identified possible important areas for further investigation. First, weak acids in sediment that titrate the lime added to a lake may represent a potentially important process that requires further quantification. Second, the chemistry and biological processes involving Sphagnum or other ion exchange processes are of interest for assessing the potential importance of ecosystems to contribute strong acids to their watersheds. Third, independent sources of hydrogen and sulfate ions not associated with atmospheric deposition may exist in lakes. Fourth, DOC and pH appear to be positively correlated for the Adirondak lakes studied. Accordingly, if processes have recently acidified these Adirondak lakes, then concentrations of DOC may have been greater in the past. Thus, these Adirondak lakes may have been acidified by organic acids in the past to a greater degree than indicated by present-day water chemistry. A number of possible processes (land use, clear cutting, burning, forestry, and loss of alkaline nutrient substances from watersheds) may play important roles in acidifying surface waters. However, many of these processes are poorly understood and require further research. (Lantz-PTT)
W91-01073

BERSANI V. EPA: TOWARD A PLAUSIBLE INTERPRETATION OF THE 404(B)(1) GUIDELINES FOR EVALUATING PERMIT APPLICATIONS FOR WETLAND DEVELOPMENT.
For primary bibliographic entry see Field 5G.
W91-01092

EFFECTS OF LAKE ACIDIFICATION ON AQUATIC MACROPHYTES--A REVIEW.
Imperial Coll. at Silwood Park, Sunninghill (England). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-01105

NUTRIENT DYNAMICS IN A FLOATING MAT AND POND SYSTEM WITH SPECIAL REFERENCE TO ITS VEGETATION.
Kyoto Univ. (Japan). Lab. for Plant Ecological Studies.
A. Haraguchi, and K. Matsui.
Ecological Research (Kyoto) ECRSEX, Vol. 5, No. 1, p 63-79, April 1990. 12 fig, 1 tab, 29 ref.

Descriptors: *Cycling nutrients, *Floating plants, *Limnology, *Nutrient transport, *Ponds, *Sphagnum, Floating mat, Hydrogen ion concentration, Peat, Seasonal variation, Vegetation effects.

Chemical properties of waters and their seasonal changes were studied in Mizorogaike Pond, a system of pond and floating mat. The following six sites including contrasting habitats and water conditions were monitored to assess nutrient dynamics in the system: (1) a pool on the mat, (2) margin of a Sphagnum cuspidatum community, (3) an artificial 'well' (water layer beneath the floating mat), (4) a Menyanthes trifoliata community in a hollow, and (5) and (6) two sites in the open water. On the floating mat, the water around the Sphagnum community had lower pH values, while that in the M. trifoliata community had higher pH values. This difference was related to the influence of flood water, the extent of which was determined by the microtopography. Seasonal changes in water chemistry on the mat suggested that pond water flooding the mat in late autumn and winter is important for the nutrient supply to the mat surface vegetation in this system. Water chemistry of the 'well' suggested that the diffusion of inorganic nitrogen occurs from beneath the peat layer. Two types of cluster analysis based on the mean values for chemical variables and the patterns of fluctuation in these variables were performed. The six sites were classified into similar groups which were identified by water type (pool, hollow, well and open water) by both types of analysis. The results showed that a common kind of perturbation should operate in determining the status of nutrient dynamics in the various water types. (Author's abstract)
W91-01126

MACROINFAUNAL COMMUNITY OF A TROPICAL ESTUARINE LAGOON.
Center for Energy and Environment Research, Mayaguez, PR.
For primary bibliographic entry see Field 2L.
W91-01133

STRUCTURE AND FUNCTION OF DRY WEATHER MANGROVES ON THE PACIFIC COAST OF CENTRAL AMERICA, WITH EMPHASIS ON AVICENNIA BICOLOR FORESTS.
Universidad Nacional Autonoma de Heredia (Costa Rica). Escuela Ciencias Biologicas.
For primary bibliographic entry see Field 2L.
W91-01134

VARIABILITY OF MANGROVE ECOSYSTEMS ALONG THE BRAZILIAN COAST.
Sao Paulo Univ. (Brazil). Inst. Oceanografico.
For primary bibliographic entry see Field 2L.
W91-01136

MANGROVE ECOLOGY, AQUATIC PRIMARY PRODUCTIVITY, AND FISH COMMUNITY DYNAMICS IN THE TEACAPAN-AGUA BRAVA LAGOON-ESTUARINE SYSTEM (MEXICAN PACIFIC).
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ciencias del Mar y Limnologia.
F. Flores-Verdugo, F. Gonzalez-Farias, O. Ramirez-Flores, F. Amezcua-Linares, and A. Yanez-Arancibia.
Estuaries ESTUDO, Vol. 13, No. 2, p 219-230, June 1990. 6 fig, 4 tab, 51 ref.

Descriptors: *Fish populations, *Mangrove swamps, *Population dynamics, *Species diversity, Biomass, Coastal areas, Mexico, Primary productivity, Seasonal variation.

Aquatic primary productivity, mangrove ecology, and fish community dynamics were investigated in the Teacapan-Agua Brava lagoon-estuarine system, the most extensive mangrove ecosystem on the Pacific coast of Mexico with three species of mangroves distributed heterogeneously (Laguncularia racemosa, Rhizophora mangle, and Avicennia germinans). Tree density was 3,203 trees/ha and basal area was 14.0 sq m/ha. Litterfall was 1,417 g/sq m/yr, characteristic of a productive riverine forest. The degradation constant for Laguncularia racemosa leaves varied from 1.71 to 4.7/yr and mean annual net aquatic productivity was 0.41 g C/cu m/d. There were high concentrations of humic substances (up to 150 mg/l) early in the wet season. Seasonal variations of the above parameters seemed closely related to the ecology of fish populations. There were 75 fish species distributed in two principal assemblages associated with wet and dry seasons. Diversity and biomass analysis indicated 18 dominant species. Total biomass of the community in this coastal system was estimated at 10 g wet wt/sq m. The highest biomass occurred in the wet season. The most common fish species were Mugil curema, Achirus mazatlanus, Galeichthys caerulescens, Arius liropus, Diapterus peruvianus, Lile stolifera, Centropomus robalito, and Eucinostomus sp., all of which have fishery importance. Primary productivity and fish community ecology are controlled by habitat characteristics, river discharge, and climatic seasonality. (Author's abstract)
W91-01137

EVALUATION OF BIOLOGICALLY HARMFUL ULTRAVIOLET RADIATION IN ANTARCTICA WITH A BIOLOGICAL DOSIMETER DESIGNED FOR AQUATIC ENVIRONMENTS.
California Univ., San Francisco. Lab. of Radiobiology.
For primary bibliographic entry see Field 7B.
W91-01138

MICROALGAL GROWTH MODEL.
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W91-01140

DENITRIFICATION IN NITRATE-RICH STREAMS: DIURNAL AND SEASONAL VARIATION RELATED TO BENTHIC OXYGEN METABOLISM.
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
P. B. Christensen, L. P. Nielsen, J. Sorensen, and N. P. Revsbech.
Limnology and Oceanography LIOCAH, Vol. 35, No. 3, p 640-651, May 1990. 6 fig, 44 ref.

Descriptors: *Biodegradation, *Denitrification, *Eutrophic streams, *Fate of pollutants, *Limnology, *Model studies, *Streams, Chlorophyll, Diffusion, Nitrates, Oxygen, Photosynthesis.

Seasonal variation of chlorophyll content, photosynthesis, O2 respiration, and denitrification was measured under light and dark conditions in the sediment of a nutrient-rich Danish lowland stream. Exponential growth of benthic microalgae was observed in early spring (April-May) and photosynthetic capacity persisted until fall. The benthic algae were a major C source for heterotrophic activity as indicated by a close correlation between O2 respiration and Chl content in the sediment. Denitrification activity was related to Chl content, NO3-availability, and O2 conditions. Diffusion from the overlying water was always the major NO3-source for denitrification. Under lighted conditions, photosynthetic O2 production increased the oxic zone and reduced denitrification activity by up to 85% in spring. A simple diffusion-reaction model allowed denitrification rates to be estimated from O2 respiration rates and concentrations of O2 and NO3(-) in the stream water. Throughout the season, estimated denitrification rates correlated well with those actually measured. The model demonstrated that denitrification activity was controlled primarily by the thickness of the oxic surface layer which served as a diffusion barrier for NO3(-) to the denitrification zone. (Author's abstract)
W91-01142

COMPARISON OF THE ACIDIFICATION EFFICIENCIES OF NITRIC AND SULFURIC ACIDS BY TWO WHOLE-LAKE ADDITION EXPERIMENTS.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W91-01143

SEASONAL PATTERNS OF GRAZING AND NUTRIENT LIMITATION OF PHYTOPLANKTON IN A EUTROPHIC LAKE.
Wisconsin Univ.-Madison. Center for Limnology.
M. J. Vanni, and J. Temte.
Limnology and Oceanography LIOCAH, Vol. 35, No. 3, p 697-709, May 1990. 3 fig, 3 tab, 24 ref. Federal Aid in Sport Fish Restoration Act Project F-95-P.

Descriptors: *Eutrophic lakes, *Grazing, *Lake Mendota, *Limiting nutrients, *Limnology, *Phytoplankton, Biomass, Daphnia, Nitrogen, Phosphorus, Seasonal variation, Succession, Wisconsin.

Observations and experiments on zooplankton grazing and nutrient (N and P) limitation of phytoplankton of Lake Mendota, Wisconsin, revealed that the relative strength of the two factors varied markedly during the seasonal succession of phytoplankton. Furthermore, seasonal changes in grazing and nutrient limitation were caused not only by seasonal changes in zooplankton community structure and nutrient availability but also by changes in

phytoplankton community structure, which led to changes in edibility to zooplankton. The spring phytoplankton bloom of diatoms and small flagellates was highly vulnerable to grazing by both cyclopoid copepods and Daphnia, although Daphnia had a much stronger effect. Increased Daphnia grazing in late spring resulted in low phytoplankton biomass (the clear-water period) and a phytoplankton community dominated by colonial green algae--taxa vulnerable to grazing by Daphnia but not other zooplankton. Nutrients (N and P) did not limit phytoplankton growth during the spring bloom or the clear-water period. After the clear-water period, the summer phytoplankton community was dominated by blue-greens and Ceratium. Grazing effects by both Daphnia and copepods were low in summer, while nutrient limitation (both N and P) became severe. Reduced grazing impacts in summer may have resulted from prior intense grazing impacts, which led to dominance of grazing-resistant taxa. These results suggest that seasonal variation in the strength of grazing and nutrient controls in eutrophic lakes results from changes in zooplankton biomass and community structure, nutrient availability, and phytoplankton community structure interacting to determine phytoplankton seasonal succession. (Author's abstract)
W91-01144

EPIPHYTIC ALKALINE PHOSPHATASE ON NATURAL AND ARTIFICIAL PLANTS IN AN OLIGOTROPHIC LAKE: RE-EVALUATION OF THE ROLE OF MACROPHYTES AS A PHOSPHORUS SOURCE FOR EPIPHYTES.
North Carolina State Univ. at Raleigh. Dept. of Botany.
J. M. Burkholder, and R. G. Wetzel.
Limnology and Oceanography LIOCAH, Vol. 35, No. 3, p 736-747, May 1990. 2 fig, 1 tab, 46 ref.

Descriptors: *Enzymes, *Epiphytes, *Limnology, *Macrophytes, *Oligotrophic lakes, Chlorophyll a, Phosphates.

Alkaline phosphatase activity (APA) and Chl a concentrations of epiphytes were measured from two species of aquatic macrophytes (Potamogeton illinoensis and Scirpus subterminalis) and structurally similar artificial plants in a P-limited lake. The artificial substrata were incubated serially in situ to simulate the age of the natural plant leaves. Throughout the macrophyte growing season, APA per unit of algal Chl on both new and aging leaves was consistently greater for intact epiphytes on artificial plants. This enhancement increased 2-fold to 20-fold (mean 4.5-fold and 7.4-fold for epiphytes from natural and artificial plants) when epiphytes were removed from the plants and suspended before enzymatic assay, exposing more algal cells to the amended PO4(3-) substrate. Comparisons of APA for epiphytes on natural and artificial plants indicated that in this oligotrophic lake, submersed macrophytes were a source of P for epiphytes throughout the growing season and significantly influenced the P metabolism of the microflora. Epiphyte Chl was significantly greater from artificial than from natural plants in 6 of 11 comparisons, however, perhaps indicating a trade-off between improved P availability and some nonbeneficial factor associated with the macrophyte. (Author's abstract)
W91-01146

ANOMALOUS TEMPERATURE AND OXYGEN GRADIENTS UNDER THE ICE OF A HIGH-PLAINS LAKE IN WYOMING.
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
F. J. Rahel.
Limnology and Oceanography LIOCAH, Vol. 35, No. 3, p 751-755, May 1990. 3 fig, 17 ref. NSF Grant BSR 88-07200.

Descriptors: *Density stratification, *Iced lakes, *Limnology, *Mountain lakes, *Oxygen, *Environmental gradient, *Temperature gradient, Gelatt Lake, Wyoming.

Temperatures up to 7.0 C and unusual oxygen profiles were observed under the ice of Gelatt Lake, Wyoming. A layer of warm water near the lake bottom appeared to result from solar heating of bottom sediments. Local increases in the oxygen profile were present in association with a bed of rooted macrophytes (Chara spp.) and a layer of phytoplankton just above bottom. This unusual stratification appeared to be maintained by density differences imposed by a gradient of dissolved solids from surface to bottom. Persistence of a layer of elevated oxygen concentrations, maintained by the stable density stratification, may explain the successful overwintering of fish in this lake. (Author's abstract)
W91-01148

WATER QUALITY EVALUATION IN LAKES OF GREECE.
National Centre for Marine Research, Athens (Greece).
T. S. Koussouris, G. D. Photis, A. C. Diapoulis, and I. T. Bertahas.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 119-128, 5 fig, 4 tab, 14 ref.

Descriptors: *Eutrophication, *Greece, *Lakes, *Limnology, *Water quality, Agricultural runoff, Ammonia, Eutrophic lakes, Mesotrophic lakes, Nitrates, Nutrients, Oligotrophic lakes, Phosphorus, Trophic level.

Recent limnological investigations carried out by the Institute of Inland Waters in Greece provided information on the morphological features of the natural lakes, their physicochemical characteristics and nutrient framework. Water quality, trophic status and the natural background trophic level were evaluated with regard to the water bodies' uses. Based on the available physical, chemical and biological parameters, the Greek lakes could be categorized into: warm, monomictic and deep lakes with oligotrophic to oligomesotrophic and mesoeutrophic conditions mainly affected by nonpoint sources of nutrients; dimictic and shallow lakes with eutrophic to hypertrophic situations due to sewage discharges directly into the basin and oligomesotrophic with natural and agricultural enrichment of their waters; and warm, monomictic and shallow lakes with eutrophic to hypertrophic conditions resulting mainly from agricultural runoffs and point sources of pollution. High concentrations of ammonia, nitrate and phosphate are found in many lakes, while anaerobic hypolimnia are usually encountered in the shallow ones. Phosphorus is the main factor responsible for the eutrophication processes because it is the limiting factor in most examined lakes. The phosphorus, retention coefficient, loading and its permissible level have been also calculated in some of the Greek lakes. The oscillations of the water level, the runoffs from agricultural activities and the wastewater discharges, have an increasing deleterious effect on the water quality and interfere directly with the uses of water, such as fishery, irrigation, and amenities. (See also W91-01211) (Author's abstract)
W91-01212

EUTROPHICATION: ASSESSMENT, RESEARCH AND MANAGEMENT WITH SPECIAL REFERENCE TO SCOTLAND'S FRESHWATERS.
Institute of Terrestrial Ecology, Edinburgh (Scotland).
For primary bibliographic entry see Field 5C.
W91-01277

MACROINVERTEBRATE COMMUNITY RESPONSES TO COPPER IN LABORATORY AND FIELD EXPERIMENTAL STREAMS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5C.
W91-01312

DECOMPOSITION OF ROOTS IN A SEASONALLY FLOODED SWAMP ECOSYSTEM.
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
E. G. Tupacz, and F. P. Day.
Aquatic Botany AQBODS, Vol. 37, No. 3, p 199-214, August 1990. 3 fig, 3 tab, 35 ref. NSF Grant BSR-8405222.

Descriptors: *Decomposition, *Great Dismal Swamp, *Roots, *Swamps, *Wetlands, Annual floods, Decay rates, Detritus, Environmental effects, Forests.

Decomposition rates of roots to a depth of 40 cm were estimated by two methods in four plant communities in the periodically flooded Great Dismal Swamp. The community dominants were: (1) Chamaecyparis thyoides; (2) Taxodium distichum; (3) mixed Quercus spp. and (4) Acer rubrum -Nyssa spp. respectively. Modified litter bags and a core method were simultaneously employed on three flooded sites and an unflooded site. Long vertical litter bags were developed to measure root decay over a vertical soil profile with minimal disturbance to the soil. Reciprocal samples (litter from each of the other sites) were placed on each site to examine the effects of litter quality. Roots in the cores exhibited higher decay rates than in the litter bags; rates in the bags ranged from 0.48 to 1.00 mg/g/d and the range for the cores was 1.15-2.74 mg/g/d. The core method was ineffective in estimating decay rates for the >5 mm diameter roots because of high sample variability. Reciprocal samples revealed statistically significant differences between root types, with roots from the mixed Quercus site being most resistant to decay. Just as leaf litter quality has been shown to regulate aboveground decomposition, root quality appears to play a major role in belowground decay. The study also demonstrated the importance of environmental influences since root decay was slowest on the sites (Chamaecyparis and Acer-Nyssa) with the longest duration of soil saturation. Both techniques exhibited slow decay rates with increasing depth. The litter bag technique is the recommended approach; several problems make the core technique a less than satisfactory method. (Author's abstract)
W91-01331

DECOMPOSITION RATE, CHEMICAL COMPOSITION AND NUTRIENT RECYCLING OF NYMPHAEA ALBA L. FLOATING LEAF BLADE DETRITUS AS INFLUENCED BY PH, ALKALINITY AND ALUMINIUM IN LABORATORY EXPERIMENTS.
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
C. J. Kok, H. W. G. Meesters, and A. J. Kempers.
Aquatic Botany AQBODS, Vol. 37, No. 3, p 215-227, August 1990. 3 fig, 4 tab, 45 ref.

Descriptors: *Acid rain effects, *Alkalinity, *Aquatic plants, *Cycling nutrients, *Decomposition, *Hydrogen ion concentration, *Water pollution effects, Acidic water, Bicarbonates, Calcium, Detritus, Lake restoration, Lake sediments, Magnesium, Nitrogen, Organic matter, Phosphorus.

Decomposition experiments were carried out in chemostats, using synthetic media, to investigate the influence of pH, Al and HCO3(-) concentrations on the decomposition and chemical composition of floating leaf material of Nymphaea alba L. Low pH and elevated Al concentrations inhibited decay. High HCO3(-) concentrations stimulated decomposition. N concentration in the detritus increased in all media, but more so in the non-acid treatments. In media containing HCO3(-), Ca and Mg concentration rose in the decaying material. In acid media, these elements disappeared rapidly from the detritus. N and P recycling from the detritus was slower in acid media because of the lower overall decay rate. The low decay rate in acid waters will lead to a slow recycling of nutrients from the decomposing plant material. A relatively large part of the N and P in acid systems will be located in organic matter on the bottom and is therefore not available for primary production. This also has consequences for the restoration of acidified systems with accumulated organic matter deposits. Addition of lime or other acid-neutralizing substances can lead to a sharp increase

in decay rate and a rapid release of N and P from the detritus. Removal of the organic layer from the sediment may be a prerequisite for the restoration of an acidified water to the former oligotrophic situation. (White-Reimer-PTT)
W91-01332

SPIROGYRA SPECIES AND ACCOMPANYING ALGAE FROM POOLS AND DITCHES IN THE NETHERLANDS.
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
For primary bibliographic entry see Field 5C.
W91-01333

ADVANCES IN ESTIMATING BACTERIAL BIOMASS AND GROWTH IN AQUATIC SYSTEMS.
Vandkvalitetsinstitutet, Hoersholm (Denmark).
For primary bibliographic entry see Field 5A.
W91-01334

EPILIMNETIC CARBON FLUX AND TURNOVER OF DIFFERENT PARTICLE SIZE CLASSES IN OLIGO-MESOTROPHIC LAKE LUCERNE, SWITZERLAND.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland). Inst. of Aquatic Sciences.
For primary bibliographic entry see Field 5B.
W91-01335

PHOSPHATE (32P)-UPTAKE CAPABILITIES OF NATURAL PICOPLANKTON AND ULTRAPLANKTON COMMUNITIES IN LAKES OF DIFFERING DEGREES OF EUTROPHICATION.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Oekophysiologie.
For primary bibliographic entry see Field 5C.
W91-01336

LONG TERM PATTERNS IN NUTRIENTS, PHYTOPLANKTON AND ZOOPLANKTON OF LAKE KINNERET AND FUTURE PREDICTIONS FOR ECOSYSTEM STRUCTURE.
Kinneret Limnological Lab., Tiberias (Israel).
For primary bibliographic entry see Field 5C.
W91-01337

EPIPHYTIC ZOOBENTHOS DENSITY AND BIOMASS WITHIN LOW ALKALINITY, OLIGOTROPHIC LAKES ON THE CANADIAN SHIELD.
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5C.
W91-01338

MICRO-ARTHROPOD SEASONALITY IN STREAMS OF VARYING PH.
Queen Mary Coll., London (England). School of Biological Sciences.
S. D. Rundle.
Freshwater Biology FWBLAB, Vol. 24, No. 1, p 1-21, August 1990. 10 fig, 5 tab, 40 ref.

Descriptors: *Acidic water, *Aquatic animals, *Benthic fauna, *England, *Hydrogen ion concentration, *Stream biota, Aluminum, Biological samples, Calcium, Conductivity, Copepods, Population density, Seasonal variation, Species composition, Species diversity, Statistical analysis, Waterfleas, Watermites.

Micro-arthropods were sampled seasonally (January, May, August, and October) during 1986 from ten stony riffle sites on streams in the Ashdown Forest of southern England, using both standard benthic and interstitial samplers. Total densities peaked at most sites in summer. Species richness reached a maximum at acid sites in summer but at circumneutral sites in autumn, when Hydrachnellae and Cladocera were particularly species rich. Individual species showed no obvious differences in seasonality between sites; the majority peaking in summer or autumn, regardless of pH. However, cyclopoid copepods were particularly numerous at acid sites in summer, a pattern not observed at circumneutral sites. Multivariate ordination and classification of data sets from the separate seasons, and all four seasons combined, showed that mean site pH, conductivity, and aluminum and calcium concentrations were the most important variables explaining between-site variation in species composition. This clear distinction between the community structure at acidic and circumneutral sites was evident in all seasons except winter. Species composition was also more predictable throughout the year at low-pH sites. A number of species were taken consistently in interstitial samples and the cyclopoids Diacyclops languidus and D. languidiodes were restricted to the hyporheos at circumneutral sites. The similar faunal composition of the hyporheos and the epibenthos indicated that the separation of these communities was not well defined in Ashdown Forest streams. (Author's abstract)
W91-01339

DISSOLVED ORGANIC CARBON CONCENTRATIONS AND FLUXES ALONG THE MOISIE RIVER, QUEBEC.
University Coll. of North Wales, Bangor. School of Animal Biology.
For primary bibliographic entry see Field 2K.
W91-01341

REFUGE AVAILABILITY: A KEY TO UNDERSTANDING THE SUMMER DISAPPEARANCE OF DAPHNIA.
Minnesota Univ., Minneapolis. Limnological Research Center.
D. Wright, and J. Shapiro.
Freshwater Biology FWBLAB, Vol. 24, No. 1, p 43-62, August 1990. 9 fig, 1 tab, 64 ref.

Descriptors: *Animal behavior, *Daphnia, *Lake ecology, *Limnology, *Predation, *Waterfleas, *Zooplankton, Community structure, Dissolved oxygen, Fish, Light quality, Mortality, Natality, Refuge availability, Seasonal variation, Temperature.

The mid-summer declines of Daphnia species in three small lakes were investigated to examine the relative roles of reduced natality and increased mortality. Reduced natality (assessed by quantifying clutch size, lipid index, and available food) could not account for the decline in daphnid abundance in any of the populations examined. The role of increased mortality imposed by zooplanktivorous fish was assessed by estimating the sizes of the mid-water refuge areas where daphnids could escape fish predation. Mid-water refugia can be formed in lakes in either of two ways. (1) A physical or chemical gradient (e.g., temperature or dissolved oxygen) might act by restricting the vertical distribution of the predator so that spatial separation between predator and prey populations occurs. (2) Alternatively, a gradient in light intensity or cover density could act by reducing the rate of predation where overlap of the populations does occur. The boundaries of the refuge areas were estimated from field measurements and literature values and were based on gradients of temperature, dissolved oxygen and light. Observed decreases in refuge thicknesses correlated well with the mid-summer declines of large-bodied Daphnia species in all three lakes. Intermediate-sized daphnids were less affected as the refuges thinned and small-bodied species increased in abundance. The importance of refuge thickness in modifying zooplanktivore-induced mortality was further tested in large enclosures where refuge thickness was experimentally modified. In the presence of zooplanktivorous fish, large-bodied Daphnia, which used the refuge, persisted when the refuge was thick but disappeared when it thinned. Daphnia galeata mendotae, which did not occupy the refuge zone, was rapidly eliminated regardless of refuge thickness. It was concluded that refuge availability plays a major role in Daphnia population dynamics. (White-Reimer-PTT)
W91-01342

ECOLOGY OF TWO INTERMITTENT STREAMS IN VICTORIA, AUSTRALIA. I. MULTIVARIATE ANALYSES OF PHYSICO-CHEMICAL FEATURES.
Monash Univ., Clayton (Australia). Centre for Stream Ecology.
For primary bibliographic entry see Field 2E.
W91-01344

INHIBITORY EFFECTS OF HIGH MOLECULAR WEIGHT DISSOLVED ORGANIC MATTER UPON METABOLIC PROCESSES IN BIOFILMS FROM CONTRASTING RIVERS AND STREAMS.
University Coll. of North Wales, Bangor. School of Biological Sciences.
For primary bibliographic entry see Field 2K.
W91-01345

MODELLING BLACK FLY PRODUCTION DYNAMICS IN BLACKWATER STREAMS.
Alabama Univ., University. Aquatic Biology Program.
A. C. Benke, and K. A. Parsons.
Freshwater Biology FWBLAB, Vol. 24, No. 1, p 167-180, August 1990. 7 fig, 3 tab, 37 ref. NSF (DEB-8104427, BSR-8406630, BSR-8705745).

Descriptors: *Aquatic insects, *Black flies, *Georgia, *Model studies, *Population dynamics, *Productivity, *Stream ecology, Biomass, Black Creek, Flooding, Habitats, Hydrographs, Ogeechee River, Satilla River, Snags, Temperature.

Two predictive models were employed along with intensive field sampling to estimate production of black flies (Simulum spp.) on snags (submerged wood) in three blackwater streams on the Georgia Coastal Plain of the Southeastern U.S. One model predicts daily growth rate from temperature and hydrograph pattern; the other predicts habitat abundance (of snags) from river height. In the sixth order Ogeechee River, annual production was twice as high in 1982 (7.1 g dry mass(=DM)/sq m) as in 1983 (3.6 g DM/sq m). When converted to production per sq m of river bottom, values were 35-40% of the snag surface estimates. Annual production was much lower in fourth order Black Creek (1982, 1.3 g DM/sq m of snag surface) and much higher in the sixth order Satilla River (1975, 15.6-40.0 g DM/sq m). There was a distinct bimodal pattern of black fly production in the Ogeechee River in both years, with peaks occurring in winter and summer. Similar bimodal patterns of production were found in Black Creek and in the Satilla River. Although there appears to be an intrinsic component to the bimodal pattern, production peaks (growth rate and biomass) appear to be associated with initial stages of flooding. Annual production/biomass ratios (37-85) are the highest reported for black fly populations. The variation of annual P/B ratios among sites was more strongly dependent on the temporal distribution of standing stock biomass than on differences in growth rates. Variation in production among sites appears to be due to differences in current velocity, hydrograph variability, and abundance of coexisting consumers. (Author's abstract)
W91-01346

STONEFLY PREDATION ALONG A HYDRAULIC GRADIENT: A FIELD TEST OF THE HARSH--BENIGN HYPOTHESIS.
Cornell Univ., Ithaca, NY. Dept. of Entomology.
B. L. Peckarsky, S. C. Horn, and B. Statzner.
Freshwater Biology FWBLAB, Vol. 24, No. 1, p 181-191, August 1990. 5 fig, 3 tab, 39 ref. NSF Grant BSR86-04921.

Descriptors: *Aquatic insects, *Environmental gradient, *Germany, *Predation, *Stoneflies, *Stream ecology, Black Forest, Environmental effects, Hydraulic regime, Mayflies, Midges, Population dynamics.

Microhabitat preferences of predatory stoneflies and four prey taxa were assessed by taking benthic samples along a hydraulic gradient in a Black Forest stream in West Germany. Densities of pred-

ator and prey species were estimated at twenty-one hydraulic regimes. Enclosures containing the stonefly, Dinocras cephalotes, and control cages with no predators were placed in the substrate at hydraulic regimes favorable and unfavorable to predators. Cages received initial prey communities that were obtained from benthic samples taken at hydraulic regimes matching those intended for each cage. Population densities of the two most numerically important prey taxa, the mayfly, Baetis rhodani, and the Chironomidae, were reduced in the presence of Dinocras, but only when enclosures were placed in the hydraulic regimes favorable to the predator. Thus, predation effects increased as the hydraulic regime became more benign to the predators. Densities of two other prey species rare in the diets of Dinocras (Hydropsyche instabilis and Gammarus fossarum) were generally unaffected by predators regardless of the hydraulic regime. These data provide support for the hypothesis that perception of the abiotic regime as harsh or benign to predators is a good predictor of predator impact in densities of preferred prey species. In harsher abiotic regimes, impact will be low, while impact will be high in benign abiotic regimes. (Author's abstract)
W91-01347

MOST DILUTE LAKE IN THE WORLD.
E and S Environmental Chemistry, Inc., Corvallis, OR.
J. M. Eilers, T. J. Sullivan, and K. C. Hurley.
Hydrobiologia HYDRB8, Vol. 199, No. 1, p 1-6, July 17, 1990. 3 tab, 25 ref. EPA contract No. 69-03-3246.

Descriptors: *Acid rain, *Chemistry of precipitation, *Conductivity, *Limnology, *Oligotrophic lakes, *Oregon, *Weathering, Base cations, Cascade Mountains, Dilute lakes, Lake Notasha, Monitoring.

Lake Notasha, near the crest of the Oregon Cascade mountain range, is the most dilute lake known. The measured conductivity during two visits was 1.3 and 1.6 microS/cm, with a sum of base cations of 9 and 18 microeq/L; bicarbonate was the dominant anion. Most of the cations in the lake can be accounted for by evapoconcentration of precipitation, although input of weathering products cannot be excluded as a source. The topographic watershed has a mixed coniferous forest, but the physical setting of the lake apparently minimizes hydrologic and ionic contributions from the watershed. This makes lakes such as Notasha appropriate receptors for monitoring acidic and other atmospheric contaminants. (Author's abstract)
W91-01348

ASSOCIATIONS OF AQUATIC INSECTS (EPHEMEROPTERA, PLECOPTERA, AND TRICHOPTERA) IN A NETWORK OF SUBARCTIC LAKES AND STREAMS IN QUEBEC.
Montreal Univ. (Quebec). Dept. of Biological Sciences.
P. P. Harper.
Hydrobiologia HYDRB8, Vol. 199, No. 1, p 43-64, July 17, 1990. 5 fig, 5 tab, 35 ref.

Descriptors: *Aquatic insects, *Caddisflies, *Lake ecology, *Limnology, *Mayflies, *Quebec, *Stoneflies, *Stream ecology, Canada, Environmental impact, Habitats, Hydroelectric power, Monitoring, Seasonal variation, Species diversity, Succession.

As part of an impact assessment of large hydroelectric projects in the James Bay drainage in Northwestern Quebec, the aquatic insect communities were studied in a network of rivers, lakes and streams during the summer of 1975. Thirty-eight emergence traps operated over the ice-free season yielded 10,888 insects (5,509 Ephemeroptera, 2,817 Plecoptera, and 2,512 Trichoptera), representing 148 species (respectively 44, 18, and 86), most of temperate and boreal affinities. There was no arctic element. Similarity analyses and clustering procedures on the emergence series revealed the existence of distinct insect communities in the river (fast and slow sections), the streams (fast and slow), the lakes and the bogs; each characterized by a particular assemblage of species. Many of the species were more or less ubiquitous and differences between communities were marked more by changes in the dominance of the species and differences in the frequency distributions, than absolute shifts in the species lists. The yields in the traps set in fast water were much greater than those in slow running water, and these in turn greater than those of standing water. By comparison with more southerly sites, the seasonal succession of species was retarded in the spring and early summer, but was not shortened appreciably in the fall. The usual emergence patterns associated with these taxa was observed, namely those of spring, summer and autumn species. (Author's abstract)
W91-01349

OCCURRENCE OF LIMNIC MICRO-CRUSTACEANS IN RELATION TO PH AND HUMIC CONTENT IN SWEDISH WATER BODIES.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
B. Berzins, and J. Bertilsson.
Hydrobiologia HYDRB8, Vol. 199, No. 1, p 65-71, July 17, 1990. 5 fig, 13 ref.

Descriptors: *Acid rain effects, *Crustaceans, *Data collections, *Humic acids, *Hydrogen ion concentration, *Plankton, *Sweden, Correlation analysis, Data interpretation, Rotifers, Species distribution, Waterfleas.

A large quantity of planktonic and semiplanktonic microcrustacean data collected from a variety of waters in south and central Sweden was computerized. The more frequent species were listed according to pH and humic acid (measured by color as Pt/L) preference. Species indicative of oligotrophic conditions were most abundant just below the neutral pH point (5.5), eurytropic species at a similarly neutral pH, and the eutrophic species Daphnia cucullata and D. magna were positively correlated with higher pH levels (8.0). No extreme pH preferences were observed. No correlation was found between humic acid and trophic level. In most cases planktonic species occurred at lower humic acid levels and semiplanktonic species at higher levels. Rotifers were distributed over the widest pH range. (White-Reimer-PTT)
W91-01350

COMPARISON OF HISTORICAL AND RECENT DATA ON HYDROCHEMISTRY AND PHYTOPLANKTON IN THE RIJNLAND AREA (THE NETHERLANDS).
Hoogheemraadschap van Rijnland, Leiden (Netherlands).
For primary bibliographic entry see Field 5B.
W91-01352

CULTURAL EUTROPHICATION OF WEST POINT LAKE--A 10-YEAR STUDY.
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 5C.
W91-01354

ACCUMULATION OF SCANDIUM IN THE SHOOTS OF AQUATIC BRYOPHYTES IN ACID WATER.
National Inst. for Environmental Studies, Ibaraki (Japan).
K. Satke, and M. Nishikawa.
Hydrobiologia HYDRB8, Vol. 199, No. 3, p 173-177, July 31, 1990. 1 fig, 2 tab, 17 ref.

Descriptors: *Acidic water, *Aluminum, *Aquatic plants, *Bioaccumulation, *Bioindicators, *Bryophytes, *Scandium, *Trace metals, Chile, England, Hydrogen ion concentration, Inductively coupled plasma, Japan, New Caladonia, Solubility.

The content of scandium (Sc) was determined using inductively coupled plasma in the shoots of eighteen species of aquatic bryophytes collected from thirty-five freshwater sites (rivers, streams, lakes, and springs) located in Chile, England, Japan, and New Caladonia. The shoots of aquatic bryophytes were found to accumulate scandium in acid water, attaining a level of 33 microg/g in Scapania undulata in an acid stream with a pH of about 4.2. The content of scandium was highly correlated with that of aluminum in the shoots of S. undulata ($r=0.986, 0.967$; $p < 0.01$). The increase in Sc and Al in the basal shoot corresponded to the time of contact with the stream water. Little is known about the behavior of Sc in natural fresh water, but it is recognized that the value of the acid-base equilibrium coefficient of the aquoscandium ion in water is similar to that of the aquoaluminum ion which has a higher solubility in acid water than in non-acid water. The results demonstrated the accumulation of Sc by S. undulata and Jungermannia vulcanicola in acid water. However, the details of Sc accumulation by other aquatic bryophytes and the differences between the accumulation of Sc and Al in acid waters were not apparent. (White-Reimer-PTT)
W91-01355

SEASONAL CHANGES IN THE DISSOLVED FREE AMINO ACID AND DOC CONCENTRATIONS IN A HYPERTROPHIC AFRICAN RESERVOIR AND ITS INFLOWING RIVERS.
Council for Scientific and Industrial Research, Pretoria (South Africa). Div. of Water Technology.
R. D. Robarts, R. J. Wicks, and R. Gehr.
Hydrobiologia HYDRB8, Vol. 199, No. 3, p 201-216, July 31, 1990. 8 fig, 3 tab, 35 ref.

Descriptors: *Amino acids, *Dissolved organic carbon, *Eutrophication, *Reservoirs, *South Africa, Aquatic bacteria, Correlation analysis, Depth, Flow, Influent streams, Rivers, Seasonal variation.

While dissolved free amino acids (DFAA) in marine and fresh waters typically make up only a minor portion (0.1 to 0.5%) of the total pool of dissolved organic carbon (DOC), free amino acids can be important intermediaries in the flux of carbon in lakes. DFAA concentration and composition and DOC concentration were measured over 16 months at three depths in hypertrophic Hartbeespoort Dam, South Africa and its two perennially inflowing rivers. The range of DFAA concentrations in the reservoir and both rivers were similar with dominant DFAA consisting of serine, glycine, alanine and ornithine in all three systems. The range of DOC concentrations in the rivers was 1.5-11.1 mg/L, the major river (Crocodile) had about twice the DOC concentration of the Magalies River. The DFAA/DOC ratios ranged between 0.02-1.1% in the Crocodile River and 0.13-3.7% in the Magalies River. DFAA and DOC concentrations were positively correlated to the Magalies River flow, but for the Crocodile River, which received domestic and industrial effluents, DOC was inversely correlated to flow. The source of DFAA in both rivers was mainly terrestrial, in contrast to the main DOC source in the Crocodile River which was the effluents. The DFAA load of the Crocodile River ranged between 0.22 and 208 kg C/d. DOC (5.0-24.8 mg/L) in Hartbeespoort Dam generally decreased with depth but DFAA (15-4800 nmmol/L) concentration showed no clear trend. The DFAA/DOC ratios varied between 0.02 and 2.9%. DFAA concentrations were correlated with bacterial numbers at 0 and 10 m only, while no significant correlations were found with bacterial production at any depth. The rate of bacterial utilization of DFAA was low compared with data from other lakes. Diurnal phytoplankton production of DFAA in the euphotic zone of the whole lake was calculated to vary between 268 and 30,780 t C/d indicating autochthonous DFAA sources were dominant to allochthonous DFAA sources. The autochthonous production of DFAA was >2 x gross bacterial production of the euphotic zone indicating that although DFAA concentrations were frequently < 10 microg C/L, the rate of DFAA production exceeded bacterial requirements. (Author's abstract)
W91-01356

EFFECT OF HYDROPOWER PEAKING FLOW FLUCTUATIONS ON COMMUNITY STRUCTURE AND FEEDING GUILDS OF INVERTE-

BRATES COLONIZING ARTIFICIAL SUBSTRATES IN A LARGE IMPOUNDED RIVER.
Minnesota Univ., St. Paul. Dept. of Forest Resources.
For primary bibliographic entry see Field 4C.
W91-01357

SURVIVAL OF EARLY LIFE STAGES OF BROWN TROUT (SALMO TRUTTA L.) IN RELATION TO ALUMINIUM SPECIATION IN UPLAND WELSH STREAMS.
University Coll., Cardiff (Wales). School of Pure and Applied Biology.
For primary bibliographic entry see Field 5C.
W91-01362

MOLLUSCICIDAL AND PISCICIDAL PROPERTIES OF COPPER(II) TETRAOXOSULFATE(VI) ON BULINUS GLOBOSUS (MORELET) AND CLARIAS ANGUILLARIS (L).
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-01363

STRUCTURE-TOXICITY RELATIONSHIPS FOR SELECTED WEAK ACID RESPIRATORY UNCOUPLERS.
Tennessee Univ., Knoxville. Coll. of Veterinary Medicine.
For primary bibliographic entry see Field 5C.
W91-01364

EFFECT OF CADMIUM ON VITELLOGENIN METABOLISM IN ESTRADIOL-INDUCED FLOUNDER (PLATICHTHYS FLESUS (L.)) MALES AND FEMALES.
Odense Univ. (Denmark). Biological Inst.
For primary bibliographic entry see Field 5C.
W91-01365

METABOLIC RESPONSE OF GRASS SHRIMP PALAEMONETES KADIAKENSIS RATHBUN, TO ACUTE EXPOSURE OF SUBLETHAL CHANGES IN PH.
Texas A and M Univ., College Station. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-01366

EFFECTS OF SUBLETHAL EXPOSURE TO CHLORINE ON THE UPTAKE OF POLYCHLORINATED BIPHENYL CONGENERS BY RAINBOW TROUT, SALMO GAIRDNERI (RICHARDSON).
Tennessee Univ., Knoxville. Graduate Program in Ecology.
For primary bibliographic entry see Field 5C.
W91-01367

PHYTOPLANKTON DYNAMICS IN THREE ROCKY MOUNTAIN LAKES, COLORADO, U.S.A.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5C.
W91-01368

RELATIONSHIPS AMONG DEPTH TO FROZEN SOIL, SOIL WETNESS, AND VEGETATION TYPE AND BIOMASS IN TUNDRA NEAR BETHEL, ALASKA, U.S.A.
Gettysburg Coll., PA. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-01369

BIOSEDIMENTOLOGY AND PALEOHYDROLOGY OF HOLOCENE STROMATOLITES FROM LAKE TANGANYIKA (BIOSEDIMENTOLOGIE DES STROMATOLITES HOLOCENES DU LAC TANGANYIKA (BURUNDI). IMPLICATIONS HYDROLOGIQUES).
Quebec Univ., Montreal. Centre Geochimie Isotopique et Geochronologie.
For primary bibliographic entry see Field 2J.
W91-01372

ECOLOGICAL RELATIONSHIPS OF WILD RICE, ZIZANIA AQUATICA. 9. PRODUCTION IN ORGANIC-FLOCCULENT SEDIMENTS.
Lakehead Univ., Thunder Bay (Ontario). Dept. of Biology.
W. R. Day, and P. F. Lee.
Canadian Journal of Botany CJBOAW, Vol. 68, No. 7, p 1542-1548, July 1990. 6 fig, 2 tab, 19 ref.

Descriptors: *Ecosystems, *Limnology, *Organic matter, *Tag Lake, *Wild rice, Beavero Lake, Collins Lake, Comparison studies, No-Name Lake, Ontario.

Seasonal chemical trends and wild rice production were examined in unproductive organic-flocculent sediments from three lakes: Collins Lake, No-Name Lake, and Tag Lake, Ontario. Variations occurred in the level of organic matter and nutrient concentrations among these lakes. However, these among-lake variations were not as distinct as the differences that occurred between these lakes and a productive wild rice lake, Beavero Lake. Cluster analysis shows the interrelationships of the sediment variables in the three flocculent lakes. The sharpest change in the similarity index occurred after a value of 5, at which point five separate clusters could be defined: cluster 1, pH, P; cluster 2, BD, Fe; cluster 3, Zn, Cu; cluster 4, N, Ca; cluster 5, Mn, K, LOI, and Mg. The variation in the nutrient content between Beavero and the organic-flocculent lakes may reflect the origin of the organic material present in the two types of sediments. Detrital material within sediments acts as a source of nutrients that increase with microbial decomposition, adsorption, deposition, and mineralization of organic matter. Much of the organic matter within organic-flocculent sediments is believed to be peat detritus derived from the surrounding peat bogs and may be classified as sedimentary peat. Sediments derived from p eats tend to be resistant to decay and have low bacterial and nutrient content. Macrophytes, algae, and straw, on the other hand, decompose at a faster rate than peat, are likely the major source of sediment in Beavero Lake, and result in the generally higher nutrient levels present in the lake. Nitrogen concentrations were lower in Beavero sediments, but these were likely the result of cumulative nutrient depletion caused by years of wild rice cropping. Sediment density may also affect the release of nutrients from the sediments and accounts for some of the variations between the two types of sediment. (Lantz-PTT)
W91-01373

WETLAND IDENTIFICATION: A MEANS TO PREVENT POTENTIAL PUBLIC HEALTH PROBLEMS.
Enviram Environmental Consultants, Middlesex, NJ.
A. V. Agovino.
Journal of Environmental Health JEVHAH, Vol. 52, No. 5, p 280-281, March/April 1990. 14 ref.

Descriptors: *Classification, *Environmental protection, *Public health, *Water pollution control, *Wetlands, Hydrologic properties, Soil properties, Vegetation.

Development pressures across the nation, especially in the Northeast, have focused public attention on the protection and preservation of wetlands. Encroachment upon wetlands threatens a valuable natural resource, while the installation of on-site sewage disposal systems in soils with certain hydric characteristics may adversely affect public health. Although most health departments are not responsible for enforcing regulations related to wetlands, an understanding of wetlands and their characteristics will help the sanitarian or environmental health specialist, who is reviewing site development applications, to anticipate and eliminate potential problems before they occur. Wetlands are the most productive of habitats and are one of the most rapidly disappearing, with thousands of acres lost annually to filling related to development. Wetlands may be delineated using the multi-parameter approach employed by the Army Corps of Engineers and other federal agencies. This method requires that the following three parameters be assessed at individual points along the wetland/upland boundary: (1) vegetation; (2) soil; and (3) hydrology. The sanitarian who has knowledge and experience in soils and site evaluation can become a vital part of the growing effort to protect these ecosystems and can concurrently assist in the provision of safe treatment and disposal of sewage through proper siting of the septic systems. (Lantz-PTT)
W91-01380

COLONIZATION PROCESS OF A TYPICAL EPILITHIC ALGAL COMMUNITY--HOMOEOTHRIX JANTHINA-ACHNANTHES JAPONICA COMMUNITY--IN A LESS POLLUTED RIVER IN JAPAN (IN JAPANESE).
S. Tanaka, and T. Watanabe.
Japanese Journal of Phycology JJPHDP, Vol. 38, No. 2, p 167-177, June 20, 1990. 8 fig, 14 ref. English summary.

Descriptors: *Algae, *Cyanophyta, *Diatoms, *Japan, *Species composition, Ecosystems, Flow pattern, Model studies, Seasonal variation.

The Homoeothrix janthina (blue-green alga)-Achnanthes japonica (diatom) community is a typical epilithic algal community in less polluted rivers in Japan in all seasons except winter. The community development process was studied using substrates placed on the river bed of the River Takami. The study was conducted during the autumn and winter seasons and the transition between the two seasons in order to determine the effects of different water currents. The data indicated that the increase of Achnanthes japonica was caused by the decrease in water velocity near the surface of the substrate on which many trichomes of Homoeothrix janthina grew. A colonization model was also used to explain the change in dominant species and community structure. The model results indicated that the colonization of periphyton in less polluted rivers developed from a two-dimensional structure consisting of diatoms belonging to the prostrate type, sliding type, and upright type to a three-dimensional structure with both diatoms and blue-green algae. (Author's abstract)
W91-01383

RELATIONS BETWEEN BROOK TROUT STANDING STOCKS AND HABITAT FEATURES IN BEAVER PONDS IN SOUTHEASTERN WYOMING.
Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie.
For primary bibliographic entry see Field 8I.
W91-01387

POTENTIAL CHANGES IN THERMAL STRUCTURE AND CYCLE OF LAKE MICHIGAN DUE TO GLOBAL WARMING.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
M. J. McCormick.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 183-194, March 1990. 6 fig, 2 tab, 24 ref.

Descriptors: *Climatic changes, *Climatology, *Global warming, *Lake Michigan, *Limnology, *Model studies, *Temperature effects, Circulation patterns, Mixing, Seasonal variation, Sensitivity analysis, Stratification, Thermocline, Wind velocity.

A one-dimensional numerical model was used to estimate the present and possible future temperature structures in Lake Michigan. The estimates were based on model output from simulations of the 1981-1984 offshore temperature field. Three scenarios based on general circulation models in which atmospheric CO2 was doubled were used. The models were those of the Goddard Institute for Space Studies (GISS), the Geophysical Fluid Dynamics Laboratory (GJDL), and the Oregon

State University (OSU). In general, simulations based on these three scenarios suggested that winter and summer heat contents of the lake would be higher than at present; the summer increase would be less than that in winter. The higher winter heat content would cause an earlier onset of full thermal stratification, and the season of stratification would increase by up to two months. The earlier onset of stratification, coupled with little change in the wind stress pattern, would yield stronger stratification and less energy for large-scale vertical mixing. The GISS and GFDL scenarios suggest that the lake may not fully turn over in most winters, so a permanent thermocline may form in the deeper regions of Lake Michigan, below the shallow seasonal thermocline. Should future wind speeds be reduced from those used in the study, sensitivity analyses suggest that the true effect on the annual thermal cycle and structure may be underestimated. Furthermore, given all of the uncertainties surrounding estimates of future climate, these results are best viewed as a sensitivity study, wherein the scales selected for the sensitivity tests are based on the different circulation model scenarios. (Author's abstract)
W91-01389

THERMAL STRUCTURE OF THE LOWER GREAT LAKES IN A WARM YEAR: IMPLICATIONS FOR THE OCCURRENCE OF HYPOLIMNION ANOXIA.
National Water Research Inst., Burlington (Ontario).
W. M. Schertzer, and A. M. Sawchuk.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 195-209, March 1990. 11 fig, 1 tab, 46 ref.

Descriptors: *Anoxic conditions, *Climatology, *Global warming, *Great Lakes, *Hypolimnion, *Limnology, *Temperature effects, *Thermal stratification, Heat flux, Seasonal variation, Thermocline.

Surface heat flux, thermal structure and dissolved oxygen concentrations for the lower Great Lakes were examined for an anomalously warm year, 1983. The year was characterized by large reductions in surface heat losses in winter and above-average surface heat flux gains in summer. On an annual basis, the lakes buffered large surface heat gains in summer months through losses in other months. Observations indicated higher surface water temperatures, significant reductions in duration and extent of ice cover, and an earlier disappearance of the 4 C isotherm, signalling an earlier start to thermal stratification. In response to greater surface heating and low wind conditions, the thermocline formed higher in the water column, and stratification lasted longer than in other years. These conditions contributed to slight hypolimnetic anoxia in the central basin of Lake Erie in the latter half of September. A changed duration and distribution of thermal stratification during warm years has important consequences for water quality issues such as development of hypolimnetic anoxia. Based on conditions in 1983, anoxia may still occur in a warmer climate and factors such as duration of stratification, in addition to thermocline position, may become increasingly important for assessments of anoxia in susceptible lakes. (White-Reimer-PTT)
W91-01390

EFFECTS OF CLIMATE WARMING ON DISSOLVED OXYGEN CONCENTRATIONS IN LAKE ERIE.
HydroQual, Inc., Mahwah, NJ.
A. F. Blumberg, and D. M. Di Toro.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 210-223, March 1990. 9 fig, 2 tab, 33 ref. EPA Contract 68-01-7288.

Descriptors: *Climatic changes, *Climatology, *Dissolved oxygen, *Global warming, *Lake Erie, *Limnology, *Model studies, *Temperature effects, Anoxic conditions, Great Lakes, Mass balance, Stratification, Thermocline, Water circulation, Water quality.

A coupled hydrodynamic and water quality model was used to examine the response of dissolved oxygen concentrations to warming of the central basin of Lake Erie. An area-averaged hydrodynamic model was used to estimate the lake temperatures and thermocline variability as forced by surface heating and winds. Vertical turbulence mixing processes were incorporated by a second-moment, turbulence closure submodel. The water quality model comprised a set of 15 mass balance equations that predicted distributions of phytoplankton biomass, nutrient concentration, and dissolved oxygen. A synthesis of the results from the coupled model forced by climate warming scenarios from three atmospheric general circulation models suggested that there will be a substantial decline in oxygen concentrations in the central basin. Although forecasts of future conditions that are beyond established experiences are uncertain, it appears likely that climate warming will lead to such a decline regardless of details in changes of lake stratification dynamics. Losses of 1 mg/L of dissolved oxygen in the upper layers and of 1-2 mg/L in the lower layers of Lake Erie's central basin can be expected, along with an increase in the area of the lake that is anoxic. The decline in dissolved oxygen is predicted to be due to warmer lake temperatures, which increase the rate of bacterial activity in the hypolimnion waters and sediment, rather than to thermocline location and volume of water below the thermocline. (Author's abstract)
W91-01391

TEMPERATURE-OXYGEN HABITAT FOR FRESHWATER AND COASTAL STRIPED BASS IN A CHANGING CLIMATE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2B.
W91-01393

POTENTIAL CHANGES IN THE THERMAL HABITAT OF GREAT LAKES FISH AFTER GLOBAL CLIMATE WARMING.
Wisconsin Univ.-Madison. Center for Limnology.
For primary bibliographic entry see Field 2B.
W91-01394

POTENTIAL EFFECTS OF GLOBAL CLIMATE WARMING ON THE GROWTH AND PREY CONSUMPTION OF GREAT LAKES FISH.
Wisconsin Univ.-Madison. Center for Limnology.
For primary bibliographic entry see Field 2B.
W91-01395

EFFECT OF AIR TEMPERATURE ON GROWTH OF LARGEMOUTH BASS IN NORTH AMERICA.
Wilfrid Laurier Univ., Waterloo (Ontario). Dept. of Biology.
R. W. McCauley, and D. M. Kilgour.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 276-281, March 1990. 4 fig, 21 ref, append.

Descriptors: *Air temperature, *Black bass, *Fish populations, *Global warming, *North America, *Temperature effects, Climates, Climatic data, Correlation analysis, Distribution, Growth, Model studies, Thermal effects.

The relationship between air temperature and growth for geographically disparate populations of largemouth bass Micropterus salmoides were examined by using published data in conjunction with climatological records. The thermal component of climate best correlated with growth was accumulated day-degrees over 10 C. This measure of climate was suggested by a simple model in which growth rate is proportional to temperature in excess of 10 C. Correlations (0.79-0.84) between total mean lengths each year (years 3-8) and accumulated day-degrees were significant, and indicated that more than half the variability in growth may be attributed to environmental temperature. Theoretical growth curves reconstructed from these regression lines agreed well with those observed for natural populations. In addition to affecting growth rates, climate warming will extend the ranges of warmwater species northward. It has been suggested that the 18 C July isotherm may delineate the northern boundary of the range of several species, including largemouth bass. (Author's abstract)
W91-01396

SEA LAMPREY AS AN EARLY RESPONDER TO CLIMATE CHANGE IN THE GREAT LAKES BASIN.
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 2B.
W91-01398

SIZE-DEPENDENT WINTER MORTALITY OF YOUNG-OF-THE-YEAR WHITE PERCH: CLIMATE WARMING AND INVASION OF THE LAURENTIAN GREAT LAKES.
York Univ., Toronto (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 8I.
W91-01399

CLIMATE, POPULATION VIABILITY, AND THE ZOOGEOGRAPHY OF TEMPERATE FISHES.
Ontario Ministry of Natural Resources, Maple. Fisheries Branch.
For primary bibliographic entry see Field 2B.
W91-01400

INFLUENCE OF TEMPERATURE CHANGES ON AQUATIC ECOSYSTEMS: AN INTERPRETATION OF EMPIRICAL DATA.
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 2B.
W91-01403

GAS TRANSFER VELOCITIES IN LAKES MEASURED WITH SF6.
University of East Anglia, Norwich (England). School of Environmental Sciences.
R. C. Upstill-Goddard, A. J. Watson, P. S. Liss, and M. I. Liddocoat.
Tellus TELLAL, Vol. 42B, No. 4, p 364-377, September 1990. 8 fig, 2 tab, 49 ref.

Descriptors: *Air-water interfaces, *England, *Gas transfer velocity, *Lakes, *Limnology, *Wind velocity, Data interpretation, Physical properties, Water circulation, Wind, Wind-driven currents.

The experimentally-determined relationships between air-water gas transfer velocity and windspeed were examined for two small, rapidly wind mixed lakes in upland southwest England. High-precision estimates of the gas transfer velocity with daily resolution, were derived by monitoring the rate of evasion from the lakes of added sulfur hexafluoride, SF6, an inert, sparingly soluble, man-made gaseous tracer. Corresponding data on in situ wind speeds and directions, and surface water temperatures were automatically logged as a time series of 4 minute averages, using a battery-powered device. The results significantly extend the existing field database and show a strong dependence of gas transfer velocity, normalized to CO2 at 20 C, on windspeed in the range of about 2-13 m/second, corrected to a height of 10 m. No correlation was found between gas transfer velocity and wind direction. The data are fitted with two least-squares straight lines which intersect at a windspeed of 9.5 +/-3 m/second, beyond which significant steepening of the gas transfer velocity versus windspeed relationship implies a transition from the rough surface to breaking wave regime. This finding is in broad agreement with previous conclusions. Nevertheless, the data scatter about the fitted lines exceeds that which would be predicted from the associated analytical uncertainties. This implies the observed relationships between gas transfer velocities and windspeed are not unique, and therefore, that additional factors must be important in determining gas transfer velocities. (Author's abstract)
W91-01412

LIBRARY U. S. GEOLOGICAL SURVEY

PREDICTION OF PHOSPHATE COPRECIPITATION WITH CALCITE IN FRESHWATERS.
Freshwater Biological Association, Wareham (England). River Lab.
W. A. House.
Water Research WATRAG, Vol. 24, No. 8, p 1017-1023, August 1990. 3 fig, 3 tab, 29 ref.

Descriptors: *Calcite, *Chemical properties, *Lakes, *Limnology, *Nutrients, *Phosphates, *Precipitation, Chemical interactions, Chemical reactions, Coprecipitation, Epilimnion, Hydrogen ion concentration.

In lakes the coprecipitation of phosphorus is an important self-cleaning mechanism and can result in the removal of as much as 97% of the phosphorus from the epilimnion. It is estimated that about 35% of the total phosphorus removal from the epilimnion of a lake could be coprecipitated with calcite. The coprecipitation reaction is caused by the interaction between inorganic phosphorus and the calcite surface during crystal growth, followed by the incorporation of some of the surface phosphorus into the bulk structure as growth occurs. The application of a model to describe inorganic phosphate coprecipitation with calcite in freshwaters was investigated. An approximate form of the coprecipitation equation was developed and tested using data from studies of the coprecipitation kinetics in different river waters. The results indicate that within certain pH limits and phosphate concentration, the simplified equation describes the adsorption function and hence coprecipitation behavior reasonably well (within 10% of the value obtained using the full form of the coprecipitation equation). When the adsorption function is not significantly changed during the coprecipitation reaction, the phosphate coprecipitation rate is linearly related to the calcite precipitation rate. (Mertz-PTT)
W91-01423

SEASONAL AND LONG-TERM TRENDS IN TRUCKEE RIVER NUTRIENT CONCENTRATIONS AND TRUCKEE RIVER NUTRIENT CONCENTRATIONS AND LOADINGS TO PYRAMID LAKE, NEVADA: A TERMINAL SALINE LAKE.
Fish and Wildlife Service, Columbia, MO.
For primary bibliographic entry see Field 5B.
W91-01425

GEOGRAPHICAL DISTRIBUTION OF CONTAMINANTS AND PRODUCTIVITY MEASURES OF HERRING GULLS IN THE GREAT LAKES: LAKE ERIE AND CONNECTING CHANNELS 1978/79.
Canadian Wildlife Service, Burlington (Ontario). Ontario Region.
For primary bibliographic entry see Field 5B.
W91-01454

ENVIRONMENTAL IMPACTS OF DEVELOPMENT ON WETLANDS IN ARID AND SEMI-ARID LANDS.
University Coll., London (England). Dept. of Geography.
For primary bibliographic entry see Field 6G.
W91-01462

REAL-TIME MULTIPURPOSE RESERVOIR OPERATION: A CASE STUDY.
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W91-01464

PIRLA PROJECT (PALEOECOLOGICAL INVESTIGATION OF RECENT LAKE ACIDIFICATION): AN INTRODUCTION TO THE SYNTHESIS OF THE PROJECT.
Indiana Univ. at Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W91-01498

PALEOECOLOGICAL INVESTIGATION OF RECENT LAKE ACIDIFICATION IN THE ADIRONDACK MOUNTAINS, N.Y.
Indiana Univ. at Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W91-01499

SEQUENTIALLY EXTRACTED METALS IN ADIRONDACK LAKE SEDIMENT CORES.
Indiana Univ., Bloomington. School of Public and Environmental Affairs.
J. R. White, and C. P. Gubala.
Journal of Paleolimnology JOUPE8, Vol. 3, No. 3, p 243-252, 1990. 3 fig, 2 tab, 33 ref. Electric Power Research Institute fund RP-2174-10.

Descriptors: *Acid rain effects, *Adirondack Mountains, *Cores, *Lake sediments, *Limnology, *Metals, *New York, *Paleolimnology, *Sediment chemistry, Acid lakes, Aluminum, Biochemistry, Deposition, Diatoms, Geochemical cycles, Iron, Lead, Manganese, Watersheds, Zinc.

Metal deposition patterns have been examined in sediment cores from three lakes in the Adirondack region of New York as part of the Paleoecological Investigation of Recent Lake Acidification (PIRLA) project. Sequential chemical extraction of Al, Fe, Mn, Pb, and Zn has yielded information on their chemical nature and potential mechanisms involved in their deposition. Results indicate historical changes in watershed chemistry may have influenced metal chemistry in these lakes. Detailed descriptions of the chemical forms of metals in sediments is not possible due to the fact that extraction methods are only operational. However, in two systems known to have been acidified in recent time by acidic deposition, concentrations of labile Al increase after 1940-1950, corresponding with lake acidification as inferred from diatom assemblages. Temporal trends in the inputs of Pb in the Cl-C4 fraction are also consistent with known historical changes in atmospheric Pb inputs to the region. Chemical stratigraphies of Fe and Mn are most likely dominated by internal biogeochemical cycling within sediments. (See W91-01498, W91-01499, W91-01501, and W91-01502) (Author's abstract)
W91-01500

CALCULATION AND UNCERTAINTY ANALYSIS OF PB210 DATES FOR PIRLA PROJECT LAKE SEDIMENT CORES.
Harvard Univ., Cambridge, MA. Dept. of Landscape Architecture.
M. W. Binford.
Journal of Paleolimnology JOUPE8, Vol. 3, No. 3, p 253-267, 1990. 5 fig, 3 tab, 24 ref. Electric Power Research Institute fund RP-2174-10.

Descriptors: *Acid rain, *Error analysis, *Florida, *Lake sediments, *Lead radioisotopes, *Limnology, *Paleolimnology, *Radioactive dating, Acid lakes, Cores, Diatoms, Mathematical models, Metals, Monte Carlo method, Radioactivity, Uncertainty.

Lead-210 assay and dating are subject to several sources of error, including natural variation, the statistical nature of measuring radioactivity, and estimation of the supported fraction. These measurable errors are considered in calculating confidence intervals for Pb-210 dates. Several sources of error, including the effect of blunders or misapplication of the mathematical model, are not included in the quantitative analysis. First-order error analysis and Monte Carlo simulation of cores from Florida Paleoecological Investigation of Recent Lake Acidification (PIRLA) project lakes were used as independent estimates of dating uncertainty. It was found that constant-rate-of-supply (CRS) model dates average less than 1% older than Monte Carlo median dates, but the difference increases nonlinearly with age to a maximum of 11% at 160 years. First-order errors increase exponentially with calculated CRS model dates, with the largest 95% confidence interval in the bottommost datable section being 155 (+ or -) 90 years, and the smallest being 128 (+ or -) 8 years. Monte Carlo intervals also increase exponentially with age, but the largest 95% occurrence interval is 152 (+ or -) 44 years. Confidence intervals calculated by first-order methods and ranges of Monte Carlo dates agree fairly well until the Pb-210 date is about 130 years old. Older dates are unreliable because of this divergence. (See W91-01498 thru W91-01500 and W91-01502) (Author's abstract)
W91-01501

UTILITY OF SCALED CHRYSOPHYTES FOR INFERRING LAKEWATER PH IN NORTHERN NEW ENGLAND LAKES.
Queen's Univ., Kingston (Ontario). Dept. of Biology.
S. S. Dixit, J. P. Smol, D. S. Anderson, and R. B. Davis.
Journal of Paleolimnology JOUPE8, Vol. 3, No. 3, p 269-286, 1990. 7 fig, 6 tab, 74 ref. Electric Power Research Institute fund RP-2170-10; NSF Grant DEB7810641.

Descriptors: *Acid lakes, *Acid rain effects, *Chrysophyta, *Hydrogen ion concentration, *Lake acidification, *Limnology, *New England, *Paleolimnology, *Zooplankton, Biological studies, Correlation analysis, Model studies, Sediment analysis, Stratigraphy.

As part of the Paleoecological Investigation of Recent Lake Acidification (PIRLA) project, scaled chrysophytes in the surface sediments of 58 soft-water northern New England lakes were analyzed to assess their usefulness for inferring pH. The distributions of many taxa were correlated with lakewater pH and associated variables. Canonical correspondence analysis (CCA) and clustering allowed chrysophyte taxa to be grouped according to their distributions along the pH gradient. For example, Chrysodidymus synuroideus, Mallomonas hindonii, and M. hamata commonly occur in acidic water (pH<5.5), whereas M. caudata and M. pseudocoronata are common in circumneutral to alkaline waters. Of the five predictive models developed to infer pH, CCA-based calibration had the lowest standard error (0.35 pH units). A CCA-based predictive model was also developed to infer total alkalinity. There is strong evidence that, in the absence of past measured pH data, stratigraphic studies of sedimentary chrysophyte scales will provide accurate reconstructions of pH in northern New England lakes. (See W91-01498 thru W91-01501) (Author's abstract)
W91-01502

ANNUAL STONEFLY (PLECOPTERA) PRODUCTION IN A SECOND ORDER OKLAHOMA OZARK STREAM.
North Texas State Univ., Denton. Dept. of Biological Sciences.
K. M. Jop, and K. W. Stewart.
Journal of the North American Benthological Society JNASEC, Vol. 6, No. 1, p 26-34, March 1987. 1 fig, 6 tab, 32 ref. National Science Foundation Grants DEB 78-12565 and BSR 8308422.

Descriptors: *Aquatic insects, *Oklahoma, *Secondary productivity, *Stoneflies, *Stream biota, *Stream ecology, Aquatic habitats, Aquatic populations, Biomass, Energy, Organic matter, Particulate matter, Predation.

Knowledge of aquatic insect secondary production is of considerable ecological importance from both population (individual growth and population survivorship) and community (energy flow) perspectives. Total annual production by the stonefly assemblage (13 species in riffles) of a second-order Ozark foothills stream was 6.1/g dry weight or 25.5/g wet weight/sq m. The contribution of individual species to total stonefly production (dry weight) ranged from 0.01/g/sq m for Allocapnia rickeri to 2.57/g/sq m for Acroneuria evoluta. Over 50% of the stonefly production was contributed by the perlid predators Acroneuria evoluta and Agnetina capitata. Predators contributed 83% of the total stonefly biomass and 67% of the total production, even though they represented only 22% of the total abundance. Omnivores and shredders, which formed 78% of total stonefly density, contributed only 17% to the total biomass and 33% to total production. Stoneflies from samples

containing 6 g or more combined fine particulate organic matter and coarse particulate organic matter accounted for 67.2% of the total production. The high stonefly production of this Ozark foothills stream apparently contributes substantially to its total energy budget. (Author's abstract)
W91-01506

THERMAL AND TROPHIC STABILITY OF DEEPER MAINE LAKES IN GRANITE WATERSHEDS IMPACTED BY ACID DEPOSITION.
Maine Univ. at Orono. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5C.
W91-01530

STUDIES ON THE PHYSICO-CHEMICAL PROPERTIES OF WATER THEIR VARIATION IN THE ERHAI LAKE (IN CHINESE).
Research institute of Environmental Protection, Yunnan, China.
B. H. Du.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 20, No. 6, p 538-543, November 1989. 5 fig, 2 tab, 3 ref. English summary.

Descriptors: *China, *Er Hai (lake), *Lakes, *Limnology, *Water chemistry, Air temperature, Biological oxygen demand, Chemical oxygen demand, Chemical properties, Dissolved oxygen, Nitrogen, Phosphorus, Seasonal variation, Transparency, Water temperature, Yunnan Plateau, pH.

Lake Erhai is situated at the west end of the Yunnan plateau. Its catchment area is 2565 sq km and the area of the lake is 250 sq km with a mean depth of 10.5 m and a maximum depth of 20.5 m. The pH, DO, BOD5, COD, total nitrogen and total phosphorus along with their changes in two-month intervals from April 1985 to April 1986 were measured. In addition, the atmospheric temperature , the water temperature, precipitation, transparency and water level of the lake were also recorded. The variation of these physico-chemical properties was related to seasonal changes in the climate. In June and August, pH, BOD5, COD, and total-N are very high, while transparency and DO levels were low. These values are reversed in February, which is the month with the lowest precipitation and the lowest lake level. The average lake water values for this period are: water temperature, 16.9C; transparency, 3.4 m; pH, 8.54; DO, 7.33 mg/l; BOD5, 2.33 mg/l; COD, 2.54 mg/l; total N, 0.605 mg/l; and total P, 0.031 mg/l. (Author's abstract)
W91-01568

LAKESHORE SWAMPS OF BOSITENG LAKE IN THE XINJIANG AUTONOMOUS REGION (IN CHINESE).
Changchun Inst. of Geography (China).
X. H. Ma.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 20, No. 6, p 554-563, November 1989. 5 fig, 7 tab, 5 ref. English summary.

Descriptors: *Baseline studies, *Bositang Lake, *China, *Flora, *Limnology, *Marsh plants, *Swamps, *Wetlands, Arid climates, Eutrophication, Kaidu River, Peat, Reeds, Surveys, Typha, Xinjiang, Yangqi Basin.

The lakeshore swamps of Bositeng Lake in Xinjiang cover about 400 sq km and make up the largest areal swamp land in the arid zone of china. The climate of this region is temperate and arid. The Kaidu River with an origin in Tianshan Mountain and other creeks discharge a total of 4.16 billion cu m of water annually into the Yangqi basin. This stable water supply is the leading factor in swamp formation. The Yanqi basin is a good place for swamp formation and peat accumulation. The swamp is composed mainly of Typha and other reeds and herbaceous plants with an annual reed production that reaches 22.95 million tons. This provides an abundant raw material resource for the papermaking industry. Peat reserves in the swamps are nearly a hundred million tons, however peat in this area is unsuitable for large scale exploitation. Bositeng Lake and the lakeshore swamps are a special ecosystem under desert climate conditions, which plays an important role in maintaining the regional ecological balance. (Author's abstract)
W91-01569

ACCUMULATION OF HEAVY METALS AND THE VARIATION OF AMINO ACIDS AND PROTEIN IN EICHHORNIA CRASSIPES (MART.) SOLMS IN THE DIANCHI LAKE (IN CHINESE).
Academia Sinica, Beijing (China). Research Center for Eco-Environmental Sciences.
For primary bibliographic entry see Field 5B.
W91-01572

SODA LAKES ON INNER MONGOLIA PLATEAU, CHINA.
Qinghai Inst. of Salt Lake, Xining (China).
D. P. Sun.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 21, No. 1, p 44-54, January 1990. 4 fig, 6 tab, 6 ref. English summary.

Descriptors: *China, *Geochemistry, *Mongolia, *Saline lakes, *Salinity, *Water chemistry, Arid climates, Badanjiling Basin, Clays, Climates, Eerdusi Basin, Erlian Basin, Geohydrology, Hailer Basin, Hydrogen ion concentration, Minerals, Trona.

The inner Mongolian plateau is one of the most important areas of salt lakes in China with trona deposits known throughout the world. The soda lakes spread mainly over the northern region of the Eerdusi basin, the central Erlian basin, the southeastern Hailer basin and Badanjiling desert. Generally, they cover an area from several to several dozen sq km, and are surrounded by sand dunes. The salinity of soda lake brines is 200-350 g/L, with pH values of 9.09-10.67. The brines mainly consist of Na(+), K(+), Cl(-), SO4(--), CO3(--) and HCO3(-) ions and therefore, belong to the Na-CO2-SO3-Cl type of brine. These are usually two layers of trona deposits in the soda lakes on the plateau composed mainly of natron, mirabilite, halite, and trona, as well as interbeds of black mud which contains a lot of illite clay, and much less gaylussite, dolomite and calcite. The trona layers always occur in a type of 'bull's eye pattern' in various lakes. Commonly, the soda lakes on the plateau were formed on the basin of deflation depressions from the beginning of the early Holocene. However, those trona deposits were precipitated mostly during the low temperatures of the mid-late Holocene. This was proved by laboratory freezing experiments and sporo-pollen analysis. (Author's abstract)
W91-01574

WATER BODY EVAPORATION EXPERIMENT OF POYANG LAKE (IN CHINESE).
Hydrometerological Experiment Station of Poyang Lake, Xingzi (China).
Z. X. Yin, and Q. Min.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 21, No. 1, p 70-79, January 1990. 6 fig, 6 tab, 6 ref. English summary.

Descriptors: *China, *Lake evaporation, *Lakes, *Poyang Hu (lake), Climates, Precipitation, Seasonal variation.

Poyang Lake is the largest fresh water lake in China. A study was conducted to determine the empirical formula and converting coefficients of the evaporation capacity of the surface of the lake, and the spatial change features of evaporation for the water surface as well as the characteristics of the evaporation discharge. The multiannual average evaporation capacity of Poyang Lake is 1163.3 mm. It increases gradually from February to July and decreases from September to December. The annual change is single peaked which is consistent with hydrological and meteorological factors. The annual evaporation capacity changes slightly. A trend was observed indicating that the change of evaporation capacity in the 1980's was smaller than that in the 1970's, which was smaller than in the 1960's. The distribution of annual evaporation from the surface is in line with the change in wind velocity. The annual evaporation capacity and the change of wind velocity from the surface are greater in the middle of the lake and less near the lake shore. The multiannual average evaporation discharge from the lake is 2.704 billion cubic m, which constitutes 21.5% of the water generation capacity, 11.0% of the lake capacity and 1.8% of the inward flow from the valleys. The evaporation capacity is greater than the water generation capacity from August to October. The supply flowing from the valleys is the key problem which should be taken into account in projects concerned with the control of Poyang Lake. (Author's abstract)
W91-01576

ANALYSIS OF AIR TEMPERATURE EFFECT OF TAIHU LAKE (IN CHINESE).
Academia Sinica, Nanjing (China). Inst. of Geography.
H. B. Lu, and G. L. Wei.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 21, No. 1, p 80-87, January 1990. 9 fig, 5 tab, 8 ref. English summary.

Descriptors: *Air temperature, *China, *Lakes, *Limnology, *Tai Hu (lake), ChangJiang Plain, Climates, Meteorology, Surface area, Temperature effects.

Taihu Lake is a large shallow fresh water lake in the lower Changjiang Plain, China, with an area of 2,428 square km and an average depth of 1.9 m. Its air temperature effects were analyzed with the data obtained from 14 meteorological stations including six stations specially set up in the Taihu Lake area. The profile of maximum air temperature approximated a hyperbola and that of minimum air temperature a parabola in the Taihu lake area. The mean air temperature effect of Taihu Lake was calculated using the data obtained in 1983-1984. The results show that the annual mean air temperature effect was 0.81C for the lake surface, 0.56C for the islands, and 0.34C for the lake shores. The strongest effect appeared in November, reaching 1.79C, 1.39C and 0.92C, while the weakest effect occurred in June, 0.29C, 0.09C, and 0.06C. The annual mean maximum air temperature on the shores was 0.3-1.0C lower than that on the surrounding meteorological stations far from the lake. The extreme minimum air temperature on the lake surface was 3.0-5.0C higher than that on the meteorological station which is located NW far from the lake. The impact of prevailing winds on the Taihu Lake air temperature effect were estimated, and the diagrams and empirical formulae for the minimum air temperature in water and the mean minimum air temperature in January on the lake surface are presented. The air temperature effects of Taihu Lake can reduce low temperature disasters for the double rice harvest in the lake region. (Author's abstract)
W91-01577

RECORD-BREAKING RISE OF GREAT SALT LAKE IN 1981-1986 RELATED TO ANOMALOUS MID-TROPASPHERIC WIND PATTERNS.
Scripps Institution of Oceanography, La Jolla, CA.
J. Namias.
Wetter und Leben WTLBAR, Vol. 41, No. 1/4, p 85-94, 1989. 8 fig, 6 ref. NSF Grant ATM-8407891, US Nat. Pro. Office Grant NA81AA-D-00054, USGS, Dept. of Interior Award No. 14-08-0001-G1483.

Descriptors: *Climatology, *Great Salt Lake, *Precipitation, *Water level, *Weather patterns, Lake level, North America, Seasonal variation, Wind patterns.

The Great Salt Lake has experienced many periods of excessive rainfall leading to high lake levels. The latest and highest of these occurred during the years 1981-1986 when the lake reached an historical level of 1283.77 m. The normal level computed

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for a period of 140 years from 1847 on was 1280 m. Increased precipitation, 134% higher than normal, was the principal cause for the rise in lake level. While there was above normal precipitation over much of the year, the fall season (September, October, November) exhibited the greatest increase in precipitation. It was shown that upper level prevailing contour and wind patterns in the midtroposphere were responsible for these conditions. Anomalous wind systems dominated a large portion of the northern hemisphere indicating that the conditions at Salt Lake were not unique. This analysis suggests that the Salt Lake's levels and precipitation patterns are good indices of total U.S. precipitation. The physical reasons for this lay in the peculiar course of cyclones and their induced veritical motions, and in the siphoning of rich moisture supplies from the eastern North Pacific and the Gulf of Mexico. (King-PTT)
W91-01580

MEASUREMENT OF EXOENZYMATIC ACTIVITY IN STREAMBED SEDIMENTS USING METHYLUMBELLIFERYL-SUBSTRATES.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
For primary bibliographic entry see Field 2J.
W91-01587

METHOD OF MEASURING THE DEHYDROGENASE ACTIVITY OF SEDIMENTS.
Sofia Univ. (Bulgaria). Dept. of Ecology.
For primary bibliographic entry see Field 2J.
W91-01588

GROWTH OF BACTERIA ON ORGANIC MATTER PRODUCED BY ALGAE IN CONTINUOUS CULTURES.
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
V. Vyhnalek, and K. Simek.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 37-42, 1990. 2 fig, 16 ref.

Descriptors: *Algae, *Bacteria, *Culturing techniques, *Extracellular metabolism, *Limnology, *Organic matter, *Plankton, Analytical techniques, Bacterial physiology, Biomass, Phytoplankton, Primary productivity.

Quantification of the fluxes of organic material from phytoplankton to bacterioplankton is difficult in natural waters. Biomass of algal cells and accompanying bacteria was quantified in non-axenic steady-state cultures of the green alga Chlamydomonas geitleri. Bacterial biomass produced in cultures was used to estimate a release of organic matter from algal cells. The inflowing medium was inorganic, no herbivorous zooplankton was present and no mortality of the Chlamydomonas cells was found during steady-state conditions. Therefore organic exudates of living algae were assumed to be the sole source of carbon for bacterial growth. In steady-states where C. geitleri grew under phosphorus limitation, the estimated exudate production (EP) did not exceed 6% of the net primary production. In contrast, in steady-states with light limitation of algal growth, EP ranged from 11.5 to 68.5% of the net primary production of C. geitleri. Continuous cultures of algae can therefore be used to provide information about the release of organic matter from algal cells and its utilization by bacteria. (Author's abstract)
W91-01589

EFFECT OF EXTRACELLULAR ORGANIC CARBON (EOC) FROM PHYTOPLANKTON ON THE COMMUNITY STRUCTURE OF OLIGOTROPHIC BACTERIA.
Kyoto Univ. (Japan). Faculty of Agriculture.
K. Fukami, S. Ohara, and Y. Ishida.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 43-47, 1990. 2 fig, 1 tab, 5 ref.

Descriptors: *Aquatic bacteria, *Extracellular metabolism, *Lakes, *Limnology, *Oligotrophy, *Organic carbon, *Phytoplankton, *Species composition, Bacterial analysis, Bacterial physiology, Culture media, Culturing techniques, Japan, Lake Biwa, Oligotrophic bacteria, Seasonal variation.

The effect of phytoplankton, through their extracellular organic carbon (EOC), on the community structure of oligotrophic bacteria was studied. This was done by comparing the most-probable number (MPN) of oligotrophic bacteria, using filtered lakewater samples containing different dominant species of phytoplankton as MPN media. Water samples to be used for the counting of bacterial numbers were collected once a month at a depth of 6 m in the northern part of Lake Biwa, Japan. A part of each sample was sterilized by passage through a Millipore filter with a 0.22-micron pore size. When they were not used immediately, filtered water samples were kept frozen at -20 C until employed for experiments. Artificial peptone medium of low concentration was used as a reference medium. Bacterial MPNs from inocula cultured in water collected at the same time as the inoculum were compared with MPNs for inocula cultured in water collected in other months and for inocula cultured in the reference medium. In most cases, MPNs with simultaneously-collected lake water medium were remarkably higher than those with the other two media. However, MPN values were comparable when MPN media were prepared with lake water of different seasons which contained the same dominant species of phytoplankton as media prepared with simultaneously-collected lake water. Moreover, it was shown that media prepared with the filtrate of an axenic culture of Staurastrum dorsidentiferum gave much higher MPN values for bacterial communities that were present during seasons when this phytoplankton species predominated than did even simultaneously-collected lake water media. These results indicate that dominant species of phytoplankton affect, through their extracellular organic carbon, the community structure of oligotrophic bacteria in natural waters. (MacKeen-PTT)
W91-01590

CARBON FLUX FROM PHYTOPLANKTON TO FREE-LIVING BACTERIAL DNA.
Shinshu Univ., Matsumoto (Japan). School of Allied Medical Sciences.
K. Kato.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 49-52, 1990. 2 tab, 14 ref. The Ministry of Education, Science and Culture, Japan, Grants 60129034, 61134044 and 62124040.

Descriptors: *Aquatic bacteria, *DNA, *Dissolved organic carbon, *Eutrophic lakes, *Limnology, *Nutrients, *Phytoplankton, Bacterial DNA, Bacterial analysis, Bacterial physiology, Carbon cycle, Japan, Lake Suwa, Radioactive tracers.

Extracellularly released dissolved organic carbon (EDOC) from photosynthesizing phytoplankton is considered to be an effective source for the growth of bacteria in the euphotic zone of pelagic ecosystems. Measurement of planktonic bacterial DNA synthesis from algal excretion was carried out in a eutrophic lake, Lake Suwa, in spring 1986 using C-14 labeled bicarbonate tracer. The algal biomass ranged from several microg to 30 microg chl a/L. Up to 10% of added C-14 bicarbonate was fixed by planktonic organisms in 4 h, 1.8 to 8.4% of which was found in the free-living bacterial fraction. Direct fixation of C-14 bicarbonate by free-living bacteria amounted to only 13 +/-5% of the total cellular C-14 fixed into this fraction. Thus, more than 80% of C-14 fixed by free-living bacteria originated from phytoplankton via the dissolved organic phase, EDOC. The transformation constant of C-14 from phytoplankton to free-living bacterial DNA in the study was estimated at 1%. (MacKeen-PTT)
W91-01591

ALGAL EXUDATION AND ITS RELATION TO BACTERIAL PRODUCTION DURING VERNAL PHYTOPLANKTON BLOOMS.
Tvarminne Zoological Station (Finland).
R. Lignell.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 53-59, 1990. 1 fig, 1 tab, 22 ref.

Descriptors: *Algae, *Algal blooms, *Aquatic bacteria, *Bacterial productivity, *Dissolved solids, *Extracellular metabolism, *Phytoplankton, Bacterial physiology, Baltic Sea, Carbon cycle, Dissolved organic carbon, Marine bacteria, Organic compounds, Primary productivity, Radioactive tracers.

In pelagic waters, algal release of dissolved organic photosynthates is a major autochthonous pathway of substrates for bacteria. Phytoplankton primary production and release of extracellular organic compounds (exudation) were compared with measurements of bacterial production during spring bloom periods in the Baltic Sea. Net exudation (dissolved exudate pool) varied between 1 and 7% of the primary productivity. Nutrient enrichment caused a significant decrease in the percentage net exudation (PER) values. On the other hand, the net PER values decreased significantly during the decline of the bloom, probably due to a change of the dominant algal species. During the peak of the spring bloom in 1988, the total algal biomass, primary productivity and net exudation amounted to 1.8 g C/sq m, 1 g C/sq m/d and 30 mg C/sq m/d, respectively. Bacterial productivity, determined by means of (H-3)-thymidine incorporation, was about 40 mg C/sq m/d in the euphotic zone, and bacteria obtained about 20% of their carbon via (C-14)-exudate uptake. (Author's abstract)
W91-01592

FATE OF PHYTOPLANKTON PRIMARY PRODUCTION: LOSSES IN RELATION TO BACTERIAL METABOLISM IN A EUTROPHIC SHALLOW LAKE.
Akademie der Wissenschaften der DDR, Berlin. Dept. of Hydrology.
For primary bibliographic entry see Field 2K.
W91-01593

PRODUCTION AND UTILIZATION OF ORGANIC MATTER BY MICROPLANKTON IN AN EUTROPHIC LAKE.
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
W. Siuda, and R. Wcislo.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 67-73, 1990. 3 fig, 2 tab, 14 ref. Project CPBP 04.02.3.1.1. (Poland).

Descriptors: *Aquatic bacteria, *Dissolved organic carbon, *Eutrophic lakes, *Limnology, *Phytoplankton, Algae, Bacterial physiology, Carbon cycle, Dissolved solids, Lake Mikolajskie, Mazurian Lake District, Photosynthesis, Poland, Primary production, Radioactive tracers, Respiration.

Production and utilization of photosynthetic organic matter were studied in the pelagic zone of the highly eutrophic Lake Mikolajskie, Mazurian Lake District, Poland. About 97% of the total fixed (C-14)-carbon dioxide (TFC) was incorporated photosynthetically by algal cells, and 3% was fixed by microplankton in darkness. In the course of photosynthesis about 20% of TFC was released into the water, about 10% was respired, and about 70% remained in the microplankton particulate fraction (POC). The chemical composition of POC produced was strongly dependent on light conditions during photosynthesis. Radiocarbon was mainly incorporated into water soluble low molecular weight compounds (LMWC) and polysaccharide fractions. An increased contribution of proteins and lipids to POC was found when algal photosynthesis was light limited. Released organic carbon and the LMWC fraction of POC were preferentially utilized by aquatic bacteria. Supplementation of water samples with LMWC stimulated the bacterial growth rates and production. (Author's abstract)
W91-01594

AUTOTROPHIC AND HETEROTROPHIC ATP POOLS IN MICROBIAL COMMUNITIES: SUGGESTIONS FOR SEPARATION AND FOR BACTERIAL GROWTH RATE EVALUATION.
Parma Univ. (Italy). Ist. di Ecologia.
For primary bibliographic entry see Field 5A.
W91-01595

ECOLOGICAL ASPECTS OF ENZYME REGULATION IN AQUATIC BACTERIA.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
J. Overbeck, and Y. Sako.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 81-92, 1990. 5 fig, 3 tab, 32 ref.

Descriptors: *Aquatic bacteria, *Bacterial physiology, *Biochemical analysis, *Enzymes, *Limnology, *Physiological ecology, Bacterial analysis, Ecology, Enzyme regulation, Heterotrophic bacteria, Phosphoenolpyruvate carboxylase, Tricarboxylic acid cycle.

The development and structure of aquatic heterotrophic bacterial populations is to a great extent determined by the availability of carbon sources. Environmental changes in the supply and substrate diversity of dissolved organic matter may occur within seconds or minutes and therefore, survival may depend on biochemical adaptations which must occur at the same fast rates. Some ecological aspects of enzyme regulation in aquatic bacteria were reviewed. The two basic types of enzyme regulation are quantitative and qualitative regulation. The tricarboxylic acid (TCA) cycle is one of the most important regulatory networks of the cell for catabolic and anabolic pathways. Phosphoenolpyruvate (PEP) carboxylase is not only involved in modifications of photosynthetic pathways, but can be considered one of the most important carboxylating enzymes in plants and microorganisms with manifold functions. Without PEP as the carbon dioxide acceptor and with pyruvate, carbon dioxide fixation is negligible, suggesting the involvement of PEP carboxylase in the reaction. PEP carboxylase, a tetramer, is allosterically regulated in a cooperative manner. A model of PEP carboxylase regulation in the bacterial cell features PEP as a substrate used for production of oxaloacetate and pyruvate through different channels; allosteric regulation by PEP; acetyl-CoA as a strong activator of the enzyme, thus promoting TCA reactions; and feedback inhibition by aspartate and malate. (MacKeen-PTT)
W91-01596

SUBSTRATE-ECTOENZYME INTERACTION: SIGNIFICANCE OF BETA-GLUCOSIDASE ACTIVITY FOR GLUCOSE METABOLISM BY AQUATIC BACTERIA.
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
R. J. Chrost, and J. Overbeck.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 93-98, 1990. 2 fig, 12 ref. Project CPBP 04.02.3.1. (Poland).

Descriptors: *Algal blooms, *Aquatic bacteria, *Bacterial physiology, *Enzymes, *Eutrophic lakes, *Extracellular metabolism, *Glucose, *Limnology, Beta-glucosidase, Glucose metabolism, Heterotrophic bacteria, Phytoplankton, Secondary productivity, Substrates.

Activity of beta-glucosidase (beta-GlcA), the enzyme that hydrolyses beta-linked disaccharides of glucose and liberates free glucose, was studied in a eutrophic lake during the spring algal bloom. Beta-GlcA was produced by heterotrophic bacteria and its activity correlated positively with bacterial secondary production and glucose incorporation. The highest beta-GlcA was associated with the phytoplankton bloom breakdown. Beta-GlcA was under control of a repression/induction mechanism, and the synthesis became depressed when the level of easily assimilated substrates had fallen below a critically low level. The enzymatic liberation of glucose in close vicinity to the bacterium may create and sustain high glucose concentrations near the cell surface. The active transport system of the cell membrane can be exposed to an increased concentration gradient of glucose, which facilitates its rapid uptake. (Author's abstract)
W91-01597

ASSIMILATION OF FREE MONOSACCHARIDES AND AMINO ACIDS RELATIVE TO BACTERIAL PRODUCTION IN EUTROPHIC LAKE WATER.
Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Inst. of Microbiology.
N. O. G. Jorgensen.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 99-110, 1990. 7 fig, 32 ref.

Descriptors: *Aquatic bacteria, *Bacterial physiology, *Bacterial productivity, *Eutrophic lakes, *Limnology, *Nutrients, Amino acids, Fructose, Glucose, High performance liquid chromatography, Nutrient assimilation, Nutrient concentrations.

Bacterial assimilation of dissolved free glucose, fructose and amino acids was studied in two eutrophic lakes and in a laboratory experiment. The assimilation rates were related to the actual bacterial production. Natural concentrations of free glucose and fructose in the lakes were measured combining separation by high performance liquid chromatography with a post-column color reaction of the saccharides. Free amino acids were quantified as fluorescent derivatives. Concentrations of free glucose, fructose and amino acids in the lakes were 33-95 nM, 7-55 nM and 6-34 nM, respectively. In the three studies assimilation (respiration + incorporation) of the organic compounds on the average sustained 6.7, 11 and 61% of the bacterial carbon requirement. Glucose was the predominant compound assimilated, followed by either fructose or amino acids. A comparison of concentration changes and assimilation rates demonstrated that a large production of both monosaccharides and amino acids occurred during the experiments. Generally the bacterial production varied independently of concentrations and assimilation rates of the tested organic compounds. (Author's abstract)
W91-01598

APPLICATION OF THE ISOTOPE DILUTION PRINCIPLE TO THE DETERMINATION OF SUBSTRATE INCORPORATION BY AQUATIC BACTERIA.
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
R. J. Chrost.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 111-117, 1990. 3 fig, 2 tab, 13 ref. Project CPBP 04.02.3.1. (Poland).

Descriptors: *Aquatic bacteria, *Bacterial physiology, *Chemical analysis, *Eutrophic lakes, *Limnology, *Nutrients, Amino acids, Analytical methods, Glucose, Isotope studies, Isotopic tracers, Leucine, Nutrient assimilation, Nutrient concentrations, Phytoplankton.

Isotope dilution analysis was used for the estimation of incorporation of (C-14)-glucose, (H-3)-leucine and (C-14)-protein hydrolysate by bacterioplankton in eutrophic lakes. Unlabeled glucose, leucine, or leucine-containing peptides in lake water significantly lowered apparent incorporation of (C-14)-glucose and (H-3)-leucine, respectively. Similar results were obtained in experiments in which the effect of casein hydrolysate and peptides on (C-14)-protein hydrolysate uptake by aquatic bacteria were studied. The apparent incorporation of labeled substrates was lower because radiolabels were isotopically diluted (thus had lower specific activity) by unlabeled glucose, leucine or amino acids resulting from extracellular and/or intracellular hydrolysis of the naturally present macromolecules containing these compounds. In the photic zone of eutrophic lakes, natural pools of glucose and leucine varied strongly from 115 to 726 nM, and from 12 to 135 nM, respectively. The largest pools of glucose and leucine were observed during the phytoplankton mass development. (Author's abstract)
W91-01599

CLAY, DISSOLVED ORGANIC MATTER, AND BACTERIAL INTERACTIONS IN TWO RESERVOIRS.
Baylor Univ., Waco, TX.
O. T. Lind, and L. O. Davalos.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 119-125, 1990. 1 fig, 1 tab, 31 ref.

Descriptors: *Aquatic bacteria, *Bacterial productivity, *Clays, *Dissolved solids, *Limnology, *Reservoirs, Bacterial physiology, Organic matter, Phytoplankton, Regression analysis, Temperature, Texas, Turbidity.

The concentration of suspended clays as well as the concentration of dissolved organic matter (DOM) was shown to be an important variable in determining the rate of specific bacterial production (thymidine incorporation). Evidence for this conclusion comes from two subtropical Texas reservoirs. Sampling stations were selected to provide a range of inorganic turbidities, organic content, and trophic state. Stepwise multiple regression analysis was used to determine the percent variation in specific bacteria production that could be explained by a suite of environmental variables (turbidity, temperature, total and dissolved organic matter, and phytoplankton mass). For the composite data set (33 cases), phytoplankton mass (as chlorophyll a) explained 36% of the variation in bacterial production with DOC explaining an additional 3%. However, when data from the most turbid station were evaluated, 77% of the variation in bacterial production was explained by the turbidity with an additional 14% explained by the concentration of DOM. At the most turbid station, the number of clay-attached bacteria as a percent of total bacteria was directly related to the content of particulate organic carbon but not to DOC. The relationship of clay and DOM to bacterial production often may have been overlooked due to the low inorganic turbidities present in most of the marine and freshwater ecosystems investigated previously. This concept is important to the understanding of the trophic ecology of reservoirs, and other turbid ecosystems, where light limitation of phytoplankton occurs. (Author's abstract)
W91-01600

INPUT AND MINERALIZATION OF ORGANIC CARBON IN LAKES.
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
P. Casper.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 131-135, 1990. 2 fig, 2 tab, 9 ref.

Descriptors: *Decomposition, *Lakes, *Limnology, *Litter, *Mineralization, *Organic carbon, Carbon cycle, Germany, Lake Stechlin, Macrophytes, Microorganisms, Oligotrophic lakes, Organic matter.

The input of large airborne coarse particulate matter into the oligotrophic Lake Stechlin (East Germany) was investigated. In autumn 1985 this input reached 18.0 t of organic carbon and increased to about 125.0 t if decomposition of macrophytes was taken into account. The decomposition rate of beech litter (Fagus sylvatica) was about five-fold lower than the rate of the macrophyte Potamogeton lucens. The incubation of beech litter in other lakes (acidotrophic, eutrophic) or in Lake Stechlin during summer did not result in any change in decomposition rate. Dynamics of different parameters (bacterial numbers, uptake rate of glucose and acetate, dissolved organic carbon, ortho-phosphate and others) during the decomposition of beech litter and macrophytes showed a leaching loss of material up to 10% in the first hours, an increase of microbial activity in the first 10 days followed by a decrease up to day 35, and a relatively constant period. (Author's abstract)
W91-01601

STUDIES ON THE DECOMPOSITION OF LIGNOCELLULOSIC CARBON IN A FLOODED RICEFIELD SOIL.
Parma Univ. (Italy). Ist. di Ecologia.
P. Viaroli, I. Fumagalli, M. Cavalca, and F. Sartore.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 137-142, 1990. 2 fig, 5 tab, 10 ref.

Descriptors: *Artificial wetlands, *Carbon cycle, *Cellulose, *Decomposing organic matter, *Organic carbon, *Rice fields, *Saturated soils, *Wetlands, Adenosine triphosphate, Bacterial physiolo-

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gy, Decomposition, Limnology, Metabolism, Nitrogen, Organic matter, Sediments, Trophisms.

Research on the decomposition of raw cellulosic materials was carried out in a rice field during the submersion period. The experimental approach consisted of adding powdered wheat straw as recalcitrant matter to the surface sediment inside the enclosures. The decomposition rates and the amount of residual carbon seem to depend upon the initial C/N ratio. The higher the carbon concentration added, the higher the microbial respiratory metabolism and adenosine triphosphate, and the lower the pH and Eh values, both in water and sediments. The results indicated that nitrogen was an important factor in controlling straw decomposition, and that high inputs of organic matter may, at least initially, considerably modify the trophic status of the environment as a whole. (Author's abstract)
W91-01602

REACTION OF MICROBIAL PERIPHYTON TO SUBSTRATE CONCENTRATION CHANGES IN A RUNNING WATER MODEL.
Vyzkumny Ustav Vodohospodarsky, Prague (Czechoslovakia).
P. Puncochar.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 143-144, 1990. 1 tab, 7 ref.

Descriptors: *Aquatic bacteria, *Nutrients, *Periphyton, *Stream ecology, *Streams, Bacterial physiology, Bioindicators, Ecosystems, Heterotrophic bacteria, Nutrient concentrations.

Microbial attachment to submerged surfaces and the development of attached communities (periphyton) are of great importance for running water ecosystems. The response of attached microbial communities to changes of nutrient concentration in water was studied under natural stream conditions. The heterotrophic bacteria counts increased by 1-2 orders of magnitude in the periphyton within 24-48 h of peptone dosing (1-2 mg/L final concentration) and reached 1,400,000/sq cm and 1,050,000/sq cm in the experimental periphyton and in the epilithon, respectively. Thus, the average bacterial periphyton growth rate was estimated at 0.05/h during the first five days of peptone dosing. Significantly higher counts of heterotrophic bacteria were found 72-96 h after stopping treatment. After 25 days of phosphate dosing (0.1-0.5 mg/L phosphate-P), chlorophyll a in experimental periphyton reached approximately twice the control level, while heterotrophic bacteria counts were not substantially increased. The attached microbial communities proved to be both a sensitive and stable indicator of substrate and nutrient concentrations in running waters. (MacKeen-PTT)
W91-01603

EFFECT OF PERIODIC ILLUMINATION ON NITRIFICATION IN THE CONTINUOUS CULTIVATION.
South Bohemian Biological Centre, Ceske Budejovice (Czechoslovakia).
J. Vrba.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 145-150, 1990. 2 fig, 1 tab, 14 ref.

Descriptors: *Aquatic bacteria, *Light effects, *Limnology, *Nitrification, *Photoinhibition, Ammonia, Bacterial physiology, Culturing techniques, Kinetics, Nitrates, Substrates.

Light is a major factor influencing biological nitrification in natural waters. The effect of photoinhibition was studied in the laboratory in long-term continuous cultures of nitrifying bacteria from river water. The continuous culture was stabilized in the dark at 27 C. In all cultures, a successive development of ammonia and nitrate oxidation was observed. Ammonia was fully oxidized to nitrate by the 26th day, and the chemostat was changed to 12 h light/12 h dark cycles at the 27th day. An obvious increase of substrate concentration occurred during the next 8 days. Ammonia concentration decreased during dark periods and increased during light periods. When the light was discontinued, nitrification rates fully recovered in a few days. The course of photoinhibition of both nitrate and ammonia oxidation appeared to follow first-order reaction kinetics. Photoinhibition of autotrophic nitrification should be considered in field studies, especially in shallow transparent water. (MacKeen-PTT)
W91-01604

IMPROVED ASSESSMENT OF BACTERIAL PRODUCTION: COMBINED MEASUREMENTS OF PROTEIN SYNTHESIS VIA LEUCINE AND CELL MULTIPLICATION VIA THYMIDINE INCORPORATION.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
M. Simon.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 151-155, 1990. 23 ref.

Descriptors: *Analytical methods, *Aquatic bacteria, *Bacterial analysis, *Bacterial productivity, *Limnology, *Proteins, Bacterial physiology, Bacterial protein production, Biomass, Growth rates, Isotopic tracers, Leucine incorporation, Thymidine incorporation.

The recent introduction of the bacterial protein production (BPP) method using (H-3)-leucine incorporation has been shown to be a valuable complement to bacterial production measurements by the (H-3)-thymidine incorporation (TdR) method. It measures directly bacterial biomass production and provides an independent examination of the magnitude of TdR measurements, which are still somewhat controversial due to the variability of TdR-conversion factors not being completely understood. Variation in (H-3)-TdR intracellular isotope dilution which cannot be determined directly presumably affects this factor greatly. Since the BPP method allows measurement of (H-3)-leucine intracellular isotope dilution, leucine-BPP conversion factors can be determined directly. Thus, using both (C-14)-leucine and (H-3)-TdR in a double labeling technique, BPP and cell multiplication rates can be measured simultaneously in the same sample. Besides the direct determination of a BPP conversion factor, this allows indirect calculation of a conversion factor for TdR. It further allows calculation of the amount of protein per newly synthesized cell. This ratio, which is responsive to changing growth conditions of bacteria, may provide a more detailed insight into the growth dynamics of aquatic bacterial assemblages. (Author's abstract)
W91-01605

BACTERIAL NET PRODUCTION APPROACHING ZERO--A FREQUENT PHENOMENON IN PELAGIC ENVIRONMENTS.
Staatliches Inst. fuer Seenforschung und Fischereiwesen, Langenargen (Germany, F.R.).
H. Gude.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 165-169, 1990. 26 ref.

Descriptors: *Aquatic bacteria, *Bacterial physiology, *Bacterial productivity, *Growth rates, *Limnology, *Plankton, Analytical methods, Bacterial analysis, DNA, Lake Constance, Nucleic acids, Secondary productivity.

It has been suggested that bacterial populations represent a very productive part of planktonic communities. However, three independent estimates for Lake Constance show mean doubling times of epilimnic bacteria in excess of 10 d during the warm season. Low productivity was also indicated by very low bacterioplankton RNA/DNA ratios. High bacterial production also cannot be reconciled with the low bacterial growth efficiencies observed under natural conditions. This apparent disagreement with the current view may be mainly due to two reasons: (1) Because of morphological and physiological changes observed frequently during incubation, the suitability of dilution experiments for estimates of in-situ growth can be questioned. (2) As shown by starvation experiments, biosynthesis is not identical with growth. A thorough reconsideration of current in situ growth estimates is recommended. (Author's abstract)
W91-01606

MICROBIAL ACTIVITIES IN A NATURALLY ACIDOTROPHIC LAKE.
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
H. D. Babenzien, and C. Babenzien.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 175-181, 1990. 3 fig, 2 tab, 22 ref.

Descriptors: *Acid lakes, *Aquatic bacteria, *Bacterial physiology, *Carbon cycle, *Limnology, Bacterial analysis, Carbon dioxide, Carbon metabolism, Germany, Glucose, Hydrogen ion concentration, Isotopic tracers, Lake Fuchskuhle, Methane bacteria, Microbiological studies, Mineralization, Phytoplankton, Sediments.

Microbiological investigations were performed in Lake Fuchskuhle, a small acid forest lake (1.5 ha, 5.5 m maximum depth, 4.2-4.6 pH) in the Lake Stechlin area, East Germany. In view of a relatively constant number of bacteria (1,300,000/ml, acridine-orange direct count), an unexpectedly high amplitude of uptake rates (0.003-1.67 microg C/L/h, (C-14)-glucose) was observed in the water column. The uptake rates seemed to be closely correlated with phytoplankton primary production. Experiments with artificially-altered water resulted in a decrease in uptake rates with increasing pH values. The water-sediment interface showed oxic conditions. Carbon mineralization rates in the upper 5 cm of sediment were 10-100 times greater than those measured in the overlying water. Methylotrophic bacteria concentrations of up to 29,000,000/L were measured at the sediment surface. The bacterial carbon dioxide production was assumed to be an essential element of carbon metabolism in this extreme environment. (Author's abstract)
W91-01607

BACTERIAL PRODUCTIVITY IN SEDIMENTS.
Commonwealth Scientific and Industrial Research Organization, Cleveland (Australia). Marine Labs.
D. J. W. Moriarty.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 183-189, 1990. 1 fig, 24 ref.

Descriptors: *Analytical methods, *Bacterial physiology, *Bacterial productivity, *Heterotrophic bacteria, *Limnology, *Sediments, DNA, Growth rates, Isotopic tracers, Sediment analysis, Thymidine uptake.

The growth of heterotrophic bacteria can be determined with reasonable accuracy with the thymidine method, provided certain conditions are adhered to during the experiment. As this is a pulse label method, the incubation time must be kept short to ensure that DNA is the only macromolecule labeled and that its rate of synthesis is not changed by disturbance of the sediment. The concentration of added thymidine must be high enough to prevent isotope dilution: in water about 20 nM and in sediment about 20 microM. Although more accurate factors for converting rates of DNA synthesis to numbers of dividing bacteria need to be determined by further research, the factors seem to lie within the theoretical range (0.25 to 0.8 quintillion). Higher factors would indicate either a deficiency in the methods for measuring rates of thymidine incorporation into DNA or the presence of a rapidly growing population of bacteria that cannot take up thymidine. Values for bacterial productivity in sediments, determined by the thymidine method, agree well with estimates from other methods and also with the amount of carbon supplied by primary producers. (Author's abstract)
W91-01608

NUMBERS AND ACTIVITY OF BACTERIOPLANKTON IN VARIOUS TYPES OF WATERS IN CZECHOSLOVAKIA: RELATIONS TO CHLOROPHYLL CONCENTRATION.
Vyzkumny Ustav Vodohospodarsky, Prague

(Czechoslovakia).
J. K. Fuksa.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 203-208, 1990. 1 fig, 18 ref.

Descriptors: *Bacterioplankton, *Chlorophyll, *Czechoslovakia, *Fish ponds, *Lakes, *Limnology, *Reservoirs, Aquatic bacteria, Bacterial physiology, Biomass, Glucose uptake, Phytoplankton, Regression analysis, Stagnant water, Substrates, Trophic level.

Numbers, biomass, activity and production of bacterioplankton generally increase with the trophic state of water ecosystems in most of which phytoplankton is the primary source of substrates for bacterioplankton. Direct counts of bacteria (DC), maximal velocity of (C-14)-glucose uptake per liter (V(max)) and per unit of DC (V(max spec)) were related to chlorophyll a concentration (CHL) in 104 samples representing all types of stagnant waters in Czechoslovakia: alpine and subalpine lakes, various types of reservoirs and productive fishponds. Total range of CHL was 0.03-1098 microg/L. Linear regression equations were obtained showing good correlation of DC and V(max) to phytoplankton biomass; V(max spec), calculated per unit of bacterial count, was relatively independent of CHL. Results showed that activity in bacterioplankton is regulated at the cellular level and supply of substrates to an individual or 'mean' cell is a more important factor than the general trophic state of a water body. (Author's abstract)
W91-01610

BACTERIAL PRODUCTION AND RESPIRATION IN THE LAKES OF DIFFERENT TYPES.
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
V. G. Drabkova.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 209-214, 1990. 4 fig, 2 tab, 6 ref.

Descriptors: *Agricultural runoff, *Aquatic bacteria, *Bacterial physiology, *Bacterial productivity, *Bacterioplankton, *Lakes, *Limnology, *Nutrients, *Respiration, Agriculture, Biomass, Glucose uptake, Latgalian elevation, Latvia, Phosphorus, Trophic level, USSR.

Limnological surveys were conducted from 1977 to 1984 in 14 lakes of the Latgalian elevation in eastern Latvia. The principal aim of the investigation was to assess changes in lake productivity due to intensified agricultural transformations of the watersheds. Increased phosphorus loading was found to provoke a rise in lake bioproductivity. This resulted in the augmentation of the total number (N) and biomass (B) of bacterioplankton. The annual bacterial production (P) was well correlated with phosphorus loading at the lake. At the same time a direct dependence of the annual bacterial production on primary phytoplankton was not found. The intensity of bacterial respiration (R) increased with increasing trophy level, to a certain limit. In highly productive lakes the intensity of bacterial respiration was rather low. The specific activity of bacterioplankton (P/B, R/B) decreased with increasing trophic level. In highly productive lakes the maximal uptake rate of glucose per individual bacterial cell also decreased. (Author's abstract)
W91-01611

MODELLING SEASONAL CHANGES OF EPILIMNETIC BACTERIA ON THE BASIS OF PHYTO- AND ZOOPLANKTON DYNAMICS.
South Bohemian Biological Centre, Ceske Budejovice (Czechoslovakia).
V. Straskrabova, K. Simek, and J. Komarkova.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 229-235, 1990. 1 fig, 1 tab, 22 ref.

Descriptors: *Aquatic bacteria, *Limnology, *Model studies, *Phytoplankton, *Population dynamics, *Zooplankton, Bacterial physiology, Bacterial productivity, Biomass, Czechoslovakia, Meotrophic lakes, Primary productivity, Protozoans, Reservoirs, Rimov Reservoir.

In a mesotrophic reservoir, Rimov Reservoir in Czechoslovakia, the seasonal dynamics of bacteria in the surface layer were followed from April to October and related to phytoplankton biomass and production and to zooplankton biomass. Phytoplankton available for zooplankton grazing was distinguished according to the sizes of the cells and colonies (40 microm diameter). Bacterial production due to extracellular exudates from healthy phytoplankton cells was calculated from the early spring data and found to equal 1.4% of net primary production. Bacterial production from zooplankton excreta was correlated with both available phytoplankton and cladoceran biomasses. It corresponded to 10.5% of available phytoplankton biomass per day. Elimination of bacteria by protozoans was measured directly for the whole season and elimination by bacterivorous zooplankton (rotifers and cladocerans smaller than 710 microm) was calculated on the basis of several experiments. The clearance rates of zooplankton feeding on bacteria were 20% of those feeding on available phytoplankton. For the whole ten-month period, the epilimnetic bacterial production reached 2.08 g C/cu m, which equaled 7% of gross primary production; 12% of bacterial production originated from algal extracellular release, the rest was from zooplankton excreta. Of the total elimination, 8% was due to protozoans and 92% due to zooplankton. (Author's abstract)
W91-01612

NOTE ON THE MEASUREMENT OF PRODUCTION OF PHOTOTROPHIC BACTERIA IN DEEP LAYERS.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
C. L. M. Steenbergen, and P. van den Hoven.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 249-255, 1990. 2 fig, 1 tab, 19 ref.

Descriptors: *Analytical methods, *Aquatic bacteria, *Bacterial physiology, *Bacterial productivity, *Lakes, *Limnology, Anaerobic conditions, Biological samples, Biomass, Chlorophyll, Deep water, Lake stratification, Light intensity, Limiting factors, Oxygen, Photosynthesis, Phototrophic bacteria, Sample preparation, Sulfides.

Production measurements of deep phototrophic bacterial assemblages, found at the oxygen-sulfide interface of productive stratified lakes, are often frustrated by the simultaneous occurrence of oxygenic and anoxygenic forms which pose problems of the collection of samples and their manipulation. Also, contact of deep water samples with air needs to be avoided. The two types of photosynthesis were measured in separate samples using 3-3,4-dichlorophenyl-1,1-dimethylurea (DCMU) as an inhibitor of the oxygenic photosynthesis in one sample series. For reliable biomass determinations in terms of chlorophyll a and bacteriochlorophylls, chromatographic techniques were employed to isolate the various compounds enabling calculation of their concentrations separately. Ideally production values should be expressed in relation to other parameters such as biomass and light intensity. In addition, sulfide limitation of the anoxygenic photosynthesis should be considered also. (Author's abstract)
W91-01614

TROPHIC RELATION IN THE MICROZOOPLANKTON COMMUNITY.
Akademiya Nauk SSSR, Leningrad. Zoologicheskii Inst.
E. B. Pavelieva.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 257-261, 1990. 3 fig, 2 tab, 11 ref.

Descriptors: *Food chains, *Lakes, *Limnology, *Trophic level, *Zooplankton, Algal blooms, Aquatic bacteria, Copepods, Dalnee Lake, Detritus, Feeding rates, Kamchatka, Microzooplankton, Plankton, Primary productivity, Protozoa, Rotifers, Seasonal variation, Succession, USSR.

The differential estimation of participation by some microzooplankton groups in food consumption was given for a seasonal cycle of observation for Dalnee Lake, Kamchatka, USSR. The succession in the planktonic community of the lake has a two-phase character and passes through autotrophic and heterotrophic phases. The utilization of primary production by microzooplankton was possible only during the spring development of algae. Then, in the heterotrophic phase, detritus was utilized for the dissipation of organic matter in the food chain. The animals' daily ration increased 2-10 times as much as the production of phytoplankton and the summer biomass of food resources was considerably higher than its consumption. During 5 months, the harvest of heterotrophic organisms comprised: bacteria, 50 g C/sq m; flagellates, 5 g C/sq m; ciliates, 10 g C/sq m; herbivorous rotifers, 2 g C/sq m; and nauplii of copepods, 3 g C/sq m. The efficiency of utilization of the potential food objects by the microzooplankton community was 7%, and by the whole filtering plankton, 17%. (Author's abstract)
W91-01615

HETEROTROPHIC MICROPLANKTON IN PLANKTON SUCCESSIONS AND SELF PURIFICATION PROCESSES ALONG THE YENISEI RIVER.
Oceanology Dept, Gelendzhik, Krasnodar, 353470 USSR.
Y. I. Sorokin.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 267-273, 1990. 4 fig, 2 tab, 8 refs.

Descriptors: *Dam effects, *Food chains, *Hydroelectric plants, *Plankton, *Rivers, *Stream ecology, *Succession, *Tenisey River, Aquatic bacteria, Biomass, Decomposition, Dilution, Ecosystems, Microplankton, Organic matter, Protozoa, Self-purification, USSR, Zooplankton.

The self-purification processes in aquatic environments proceed as the result of functioning of an intact ecosystem, which includes all the components of the food chain. During the study of these processes in the Yenisei River, from the Krasnoyarsk hydropower station to the port of Igarka, the roles of heterotrophic microplankton as a component of the river ecosystem were investigated. The river water below the gate of the Krasnoyarsk hydropower station was extremely poor in microplankton, possibly due to the destruction of plankton by the cavitation process in turbines. The decrease in zooplankton biomass inhibited the self-purification process. The nongrazed microbial biomass accumulated in the river water between Krasnoyarsk up to the Angara River mouth, was then actively grazed and decomposed in the middle part of the river below Yartzevo, where a mass development of microzooplankton (mainly ciliates) took place. Below the Angara River mouth, a mass bloom of diatoms occurred and the primary production soon reached its maximum (up to 400 mg C/cu m/d). In the lower part of the river a mature and rich planktonic community was formed, which provided decomposition of about 8 g/sq m/d of organic matter. The processes of self-purification in the plankton community of the Yenisei River proceeded mainly within the food chain: bacteria-zooflagellates-ciliates. (MacKeen-PTT)
W91-01616

UPTAKE OF BACTERIA-SIZED FLUORESCENT PARTICLES BY NATURAL PROTOZOAN ASSEMBLAGE IN A RESERVOIR.
Ceskoslovenska Akademie Ved, Ceske Budejovice. Inst. of Landscape Ecology.
K. Simek, M. Macek, and V. Vyhnalek.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 275-281, 1990. 2 fig, 2 tab, 23 ref.

Descriptors: *Bacterioplankton, *Flagellates, *Food chains, *Limnology, *Protozoa, *Reservoirs, Aquatic bacteria, Czechoslovakia, Fluorescent particles, Ingestion, Rimov Reservoir, Seasonal variation.

The potential impact of ciliates and heterotrophic nanoflagellates (HNF) on bacterioplankton in the Rimov Reservoir was studied from April until October 1987 using inert fluorescent particles (FP). HNF (500-1280/ml) were the dominant micrograzers during the spring period and grazed 3 to

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9% of bacterial standing stock daily. The average ingestion rate based on HNF with ingested FP (3.3-48% of the total) ranged from 7-28 bacteria/cell/h. During the spring, <25% of the total ciliates ingested FP, with average ingestion rates of 7-44 bacteria/cell/h. A drastic decrease in protozoan density occurred during the clearwater phase. Ciliates (15-142/ml) became the dominant micrograzers during summer with average ingestion rates ranging from 22-111 bacteria/cell/h (based on ciliates ingesting FP). During the period of peak ciliate abundance, the protozoan community grazed up to 21% of the bacterial standing stock daily. Egestion of FP by ciliates was insignificant. (Author's abstract)
W91-01617

SPHAGNUM-DOMINATED PEATLANDS OF THE HYPEROCEANIC BRITISH COLUMBIA COAST: PATTERNS IN SURFACE WATER CHEMISTRY AND VEGETATION.
Alberta Univ., Edmonton. Dept. of Botany.
D. H. Vitt, D. G. Horton, N. G. Slack, and N. Malmer.
Canadian Journal of Forest Research CJFRAR, Vol. 20, No. 6, p 696-711, June 1990. 8 fig, 3 tab, 61 ref. Natural Sciences and Engineering Research Council of Canada Grants A6390 and U0015.

Descriptors: *British Columbia, *Peat, *Peatlands, *Sphagnum, *Water chemistry, *Wetlands, Bogs, Canada, Classification, Coastal wetlands, Fens, Vegetation, Water level.

Vegetation from 133 releves representing a broad spectrum of peatland types from the Prince Rupert area, British Columbia were divided into six releve groups. The 210 taxa found in these releve groups were classified into six species groups. In general, the species groups are related to one another along shade and height (above water level) gradients. Chemical and physiographic gradients that correlate with the releve distribution pattern on a detrended correspondence analysis ordination are: surface water chemistry, shade and height. In particular, the major gradient influencing the first axis of the ordination is shade. The second axis of the ordination is related to a complex chemical gradient in which hydrogen ion, calcium, and sulfate are the most important components. These chemical changes are influenced by ombrotrophy. Surface water chemistry patterns show enriched ionic conditions on Graham Island (Queen Charlotte Islands), with a decrease inland. Especially important is the decrease of sodium and chloride ions. The peatland studied include ombrotrophic bogs and soligenous fens. Raised bogs were found in basins, while blanket bogs occurred on gentle slopes at the most oceanic site. Pinus contorta Loud. var. contorta is most abundant at ombrotrophic sites, while Chamaecyparis nootkatensis Spach is dominant in soligenous fens. Soligenous poor fens, characterized by high Sphagnum abundance in lawns and forest islands, and a pH of 4.4-6.6, is the peatland type most frequently encountered in the study area. (Author's abstract)
W91-01692

STANDING-WATER DEPOSITS AS INDICATORS OF LATE QUATERNARY DUNE MIGRATION IN THE NORTHWESTERN NEGEV, ISRAEL.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2J.
W91-01695

ROLE OF AMMONIUM AND NITRATE RETENTION IN THE ACIDIFICATION OF LAKES AND FORESTED CATCHMENTS.
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 5B.
W91-01718

METHANE EMISSIONS FROM FEN, BOG AND SWAMP PEATLANDS IN QUEBEC.
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W91-01719

SPATIAL AND TEMPORAL PATTERNS IN THE HYDROGEOCHEMISTRY OF A POOR FEN IN NORTHERN WISCONSIN.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
L. E. Marin, T. K. Kratz, and C. J. Bowser.
Biogeochemistry BIOGEP, Vol. 11, No. 1, p 63-76, September 1990. 11 fig, 3 tab, 27 ref. NSF Grant BSR8514330.

Descriptors: *Fens, *Geochemistry, *Geohydrology, *Spatial distribution, *Temporal distribution, *Water chemistry, *Wetlands, *Wisconsin, Bogs, Conductivity, Dissolved organic carbon, Groundwater, Interstitial water, Peat, Seasonal variation.

The factors causing spatial and temporal patterning of interstitial water chemistry in Crystal Bog, a 7 ha northern Wisconsin kettle-hole peatland was studied. Over the course of the snow-free season Crystal Bog exhibited spatial and temporal patterns in chemistry, especially hydrogen-ion, dissolved organic carbon, and specific conductance. The peatland contains a 0.5 ha pond that has water more dilute than the interstitial water of the surrounding peatland. The direction of groundwater flow between the lake and the peatland was seasonally dependent. In the spring and early summer, flow was from the lake into the peatland, especially on the eastern side of the lake. This flow resulted in a plume of relatively dilute surface interstitial water in the peatland. In mid and late summer direction of groundwater flow was from the peatland into the lake and the dilute plume was reduced in areal extent. By fall the direction of water flow was again from the lake to the peatland. The spatial and temporal heterogeneity in water chemistry produced by the seasonal variation in the direction of horizontal water flow was substantial. Minimum and maximum observed concentrations of dissolved organic carbon (DOC) in the interstitial water of the peatland, for example, differed by more than a factor of three, and the pH ranged between 3.8 and 5.0. Correlations of DOC with anion deficit and hydrogen ion concentration and experiments of photo-oxidation of water samples showed that organic acids were the primary cause of acidity in the peatland. Specific conductance was highly correlated with DOC, probably because of DOC's correlation with the very conductive hydrogen ion. In Crystal Bog it was possible to use the relatively simple measure of specific conductance to estimate the temporal and spatial distribution of the more difficult to determine DOC. (Author's abstract)
W91-01720

RESPONSES OF PLANKTON AND NUTRIENTS TO METHYLENE BLUE-PHOTOSENSITIZED LAKE RESTORATION.
Nevada Univ., Reno. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-01736

INFLUENCE OF ORGANIC SEDIMENT AMENDMENTS ON GROWTH AND TUBER PRODUCTION BY POTAMOGETON PECTINATUS L.
Agricultural Research Service, Davis, CA. Aquatic Weed Control Research Lab.
For primary bibliographic entry see Field 2I.
W91-01740

FATE OF ADDED N-15 LABELLED NITROGEN IN A SAGITTARIA LANCIFOLIA L. GULF COAST MARSH.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. D. DeLaune, and C. W. Lindau.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 3, p 265-268, June 1990. 2 fig, 1 tab, 8 ref. NSF Grant BSR-8414006.

Descriptors: *Coastal marshes, *Emergent aquatic plants, *Gulf of Mexico, *Nitrogen cycle, *Wetlands, Arrowheads, Biomass, Detritus, Louisiana, Nitrogen compounds, Path of pollutants, Radioisotopes, Tracers.

Response of Sagittaria lancifolia L. to added N-15 labeled nitrogen was studied in a Louisiana Gulf Coast freshwater marsh. The amount of the added labeled NH4(+)-N remaining in the soil or plant tissue was determined several times during the growing season. Above-ground biomass increased by approximately 100 percent following the addition of 10 g NH4(+)-N per square meter. There was no significant nitrogen loss from the soil during the growing season after the labeled inorganic nitrogen was apparently immobilized into the soil organic nitrogen pool. The N-15 balance data obtained from this study demonstrates that following the initial loss prior to the first sampling there is little nitrogen loss from the soil. Nitrogen losses were likely from the plant, either through leaching or physical transport of detritus remaining as a result of die-back that resulted from the growth cycles occurring during the season. The nitrogen loss reported is greater than previous nitrogen studies conducted in other marsh types in coastal Louisiana. Plant biomass response of Sagittaria lancifolia to added nitrogen was greater than that reported for other Louisiana coastal wetland plant species. (Agostine-PTT)
W91-01741

EFFECT OF NUTRIENT CONTENT ON LEAF DECOMPOSITION IN A COASTAL PLAIN STREAM: A COMPARISON OF GREEN AND SENESCENT LEAVES.
Savannah River Ecology Lab., Aiken, SC.
L. G. Leff, and J. V. McArthur.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 3, p 269-277, June 1990. 4 fig, 1 tab, 26 ref. U.S. D.O.E. Grant DE-AC09-76SR00-819.

Descriptors: *Coastal plains, *Coastal streams, *Decomposing organic matter, *Leaves, *Nutrients, Bacteria, Biomass, Invertebrates, Maple trees, Riparian vegetation, Seasonal variation, Toxins.

Studies on leaf processing in temperate lotic environments have emphasized the importance of input of senescent leaves in the fall because of the large, obvious influx of riparian biomass at this time. Differences in processing have been found between species of leaves, and these differences have been attributed to thickness of the cuticle, presence of toxic or inhibitory compounds, and nutrient content. The decomposition of fresh-green and autumn-shed (senescent) red maple leaves (Acer rubrum) were compared in a low-gradient blackwater stream. When the two types of leaves were incubated in the stream during the fall, there was no significant difference in processing rate. The invertebrate fauna was similar on the two leaf types and did not appear to affect decomposition. However, higher densities of invertebrates were found on green leaves during the final stage of decomposition. Bacterial densities were higher on senescent leaves than on green leaves during the initial phase of decomposition, although green leaves were richer in nutrients. Toxic or inhibitory compounds in the green leaves may override effects of nutrient enhancement on bacterial growth and leaf decomposition. (Agostine-PTT)
W91-01742

EFFECT OF SUBMERSED AQUATIC VEGETATION ON PHYTOPLANKTON AND WATER QUALITY IN THE TIDAL FRESHWATER POTOMAC RIVER.
George Mason Univ., Fairfax, VA. Dept. of Biology.
R. C. Jones.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 3, p 279-288, June 1990. 2 fig, 1 tab, 24 ref.

Descriptors: *Phytoplankton, *Potomac River, *Submerged aquatic plants, *Tidal rivers, *Vegetation effects, *Water quality, Aquatic weeds, Biomass, Chlorophyll a, Dissolved oxygen, Hydrilla, Hydrogen ion concentration, Macrophytes, Seasonal variation.

Phytoplankton biomass and water quality were determined at two sites in the tidal freshwater Potomac River. At each site three plant treatments were sampled twice each during the summer and the fall. Phytoplankton biomass, as measured by chlorophyll a, was negatively related to macrophyte density. High density Hydrilla beds harbored the least phytoplankton chlorophyll, while low density mixed beds were most similar to the open water areas. This effect was more pronounced in summer than in fall. Variation in dissolved oxygen and pH reflected the standing crop of both phytoplankton and macrophytes. Phytoplankton were the dominant influence in the open water; macrophytes were more important in the dense weedbeds. Greatest variation in temperature was observed in the dense weedbeds. (Author's abstract)
W91-01743

COMPARISON OF DETRITUS PROCESSING BETWEEN PERMANENT AND INTERMITTENT HEADWATER STREAMS.
Central Michigan Univ., Mount Pleasant. Dept. of Biology.
W. B. Richardson.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 3, p 341-357, June 1990. 6 fig, 5 tab, 55 ref. U.S. D.O.E. Contract DE-AC-09-76SR00819.

Descriptors: *Decomposing organic matter, *Detritus, *Headwaters, *Intermittent streams, *Perennial streams, Alder trees, Ash trees, Biomass, Comparison studies, Food habits, Invertebrates, Leaves, Nitrogen, Seasonal variation.

The pattern of leaf pack decomposition and density and biomass of the associated invertebrate detritivore community of an intermittent and a perennially flowing headwater stream were compared in autumn and spring. Leaf packs of high (Alnus rugosa) and low (Fraxinus americana) nitrogen content were used. Leaf litter was processed at similar rates in both streams during autumn (-k: 0.015 g/d). In spring the decomposition rates more than doubled in the permanent stream (-k>0.03) and only slightly increased in the intermittent stream (e.g. Fraxinus: -k: 0.017). Differences in decomposition rates between leaf species were seen only in the fall in the intermittent stream where Fraxinus litter decomposed slowed than Alnus. Shredder biomass was greater than other invertebrate guilds in both streams, was reduced in the intermittent stream, and varied with season (spring > fall), particularly in the permanent stream. Shredder biomass was greater in Alnus leaf packs. Shredder densities were significantly lower in the intermittent stream, during both seasons, compared with the permanent stream. Greater densities of shredders occurred on Alnus leaf packs. Collectors outnumbered other guilds. The intermittent stream had a depauparate shredder fauna and was numerically dominated by collectors. Lack of shredding detritivores, combined with decreased duration of submersion, resulted in reduced potential for processing of particulate carbon relative to the permanently flowing stream. (Author's abstract)
W91-01744

NEW APPROACH FOR MEASURING COVER IN FISH HABITAT STUDIES.
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
T. D. Kinsolving, and M. B. Bain.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 3, p 373-378, June 1990. 2 fig, 1 tab, 20 ref.

Descriptors: *Aquatic habitats, *Fish, Analytical techniques, Mathematical studies.

The most common method for measuring fish cover in fish habitat studies, percent area with cover, produces data that are difficult to analyze, incompatible with data on other habitat variables, frequently subjective, and limited in content. Alternative cover measurement methods used in marine habitats can be more widely used but retain some of the disadvantages of the percent area method. A new approach to measuring cover is based on counting the number of surfaces within a planer section of a water column. Rules for counting surfaces were: (1) solid objects with a diameter greater than 10 cm were counted as two surfaces; (2) objects thinner than 10 cm were counted as a single surface; (3) objects located closer than 3 cm to each other were considered part of the same surface; (4) portions of a cover object which were geometrically separate were counted separately; (5) undercut banks were considered to be cover objects. These rules were designed for quantifying shallow, shoreline microhabitats primarily inhabited by numerous species of small fishes and the rules should be altered to accommodate different study objectives, target fish sizes and microhabitat types. This method is easy, fast, and produces data that can be used to compute three continuously distributed cover parameters: density, complexity, and heterogeneity. Field results are presented to demonstrate how this approach can be used to differentiate species in their use of cover in freshwater basins. (Agostine-PTT)
W91-01746

BENTHIC MACROPHYTE COMMUNITY CORE SAMPLER.
Wayne State Univ., Detroit, MI. Dept. of Biological Sciences.
For primary bibliographic entry see Field 7B.
W91-01747

ISOLATION AND CHARACTERIZATION OF HEPATOTOXIC MICROCYSTIN HOMOLOGS FROM THE FILAMENTOUS FRESHWATER CYANOBACTERIUM NOSTOC SP. STRAIN 152.
Helsinki Univ. (Finland). Dept. of Microbiology.
K. Sivonen, W. W. Carmichael, M. Namikoshi, K. L. Rinehart, and A. M. Dahlem.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 9, p 2650-2657, September 1990. 6 fig, 1 tab, 26 ref. USAMRIDD Contract DAMD-17-87-C-7-19. Public Health Service Grants AI04769 and GM27029.

Descriptors: *Cyanophyta, *Eutrophic lakes, *Finland, *Lakes, *Limnology, *Pollutant identification, *Toxins, High performance liquid chromatography, Mass spectrometry, Nostoc, Nuclear magnetic resonance.

A strain of the filamentous cyanobacterium Nostoc sp. isolated from a lake in Finland was found to produce at least nine hepatotoxic peptides with chemical and toxicological properties similar to those of the hepatotoxic hepta-and pentapeptides produced by other cyanobacteria. Toxins were isolated and purified by high-performance liquid chromatography. Amounts available for five of the purified toxins (P6, P14, P15, P16, and P18) were adequate for high-performance liquid chromatography amino acid analysis and determination of molecular weight by fast-atom bombardment-mass spectrometry (FAB-MS). Quantities of three toxins (P14, P15, and P16) were adequate for further analysis by high-resolution FAB-MS, FAB-MS/MS, and H1-nuclear magnetic resonance. Analysis showed that the toxins are new types of microcystin-LR homologs, Microcystin-LR contains equimolar amounts of D-alanine, L-leucine, D-erythro-beta-methylaspartic acid, L-arginine, ADDA (3-amino-9-methoxy-2,6,8-trimethyl-10-phenyl-4,6-decadienoic acid), D-glutamic acid, and N-methyldehydroalanine (molecular weight (MW), 994). Nostoc sp. strain 152 was found to produce the following microcystin-LR homologs: (1) P6 contains an extra methylene group most probably due to the presence of N-methyldehydrobutyrine instead of N-methyldehydroalanine (MW, 1008); (2) P14 is O-acetyl-O-demethyl ADDA-microcystin-LR (MW, 1,022); (3) P15 is 3-demethyl-O-acetyl-lADDA-homoarginine-microcystin-LR (MW, 1,036); (4) P16 is 3-demethyl-O-acetyl-O-demethyl-lADDA-microcystin-LR (MW, 1,008); (5) P18 is 3-demethyl-O-acetyl-O-demethylADDA-homoarginine-microcystin-LR (MW, 1,022). The toxicities of the new microcystin homologs were not significantly different from those of microcystin-LR or demethylmicrocystin-LR. (Author's abstract)
W91-01761

DISTRIBUTION AND RATE OF METHANE OXIDATION IN SEDIMENTS OF THE FLORIDA EVERGLADES.
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
G. M. King, P. Roslev, and H. Skovgaard.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 9, p 2902-2911, September 1990. 6 fig, 2 tab, 41 ref. NASA Grant NAGW-1406.

Descriptors: *Everglades, *Florida, *Marsh plants, *Methane, *Oxidation, *Sediments, *Wetlands, Light penetration, Marl, Oxygen, Path of pollutants, Peat, Photosynthesis, Roots.

Rates of methane emission from intact cores were measured during anoxic dark and oxic light and dark incubations. Rates of methane oxidation were calculated on the basis of oxic incubations by using the anoxic emissions as an estimate of the maximum potential flux. This technique indicated that methane oxidation consumed up to 91% of the maximum potential flux in peat sediments but that oxidation was negligible in marl sediments. Oxygen microprofiles determined for intact cores were comparable to profiles measured in situ. Thus, the laboratory incubations appeared to provide a reasonable approximation of in situ activities. This was further supported by the agreement between measured methane fluxes and fluxes predicted on the basis of methane profiles determined by in situ sampling of pore water. Methane emissions from peat sediments, oxygen concentrations and penetration depths, and methane concentration profiles were all sensitive to light-dark shifts as determined by a combination of field and laboratory analyses. Methane emissions were lower and oxygen concentrations and penetration depths were higher under illuminated than under dark conditions; the profiles of methane concentration changed in correspondence to the changes in oxygen profiles, but the estimated flux of methane into the oxic zone changed negligibly. Sediment-free, root-associated methane oxidation showed a pattern similar to that for methane oxidation in the core analyses: no oxidation was detected for roots growing in marl sediment, even for roots of Cladium jamaicense, which had the highest activity for samples from peat sediments. The magnitude of the root-associated oxidation rates indicated that belowground plant surfaces may not markedly increase the total capacity for methane consumption. However, the data collectively support the notion that the distribution and activity of methane oxidation have a major impact on the magnitude of atmospheric fluxes from the Everglades. (Author's abstract)
W91-01763

ALGAE, OTHER THAN DIATOMS, AFFECTING THE DENSITY, SPECIES RICHNESS AND DIVERSITY OF DIATOM COMMUNITIES IN RIVERS.
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
F. Elber, and F. Schanz.
Archiv fuer Hydrobiologie AHYBA4, Vol. 119, No. 1, p 1-14, July 1990. 5 fig, 1 tab, 50 ref.

Descriptors: *Algal growth, *Diatoms, *Periphyton, *River ecology, *Species diversity, Chlorophyta, Chrysophyta, Cyanophyta, Population density, Rivers, Species composition, Succession, Water pollution effects.

The influence on diatom communities of algae of other groups, including the chrysophyte Hydrurus foetidus, as well as green and blue-green algae, was examined by comparing the algal periphyton of river bottom stones with that of stones imported to the river bed. In spring, H. foetidus biomasses were higher on these imported stones than on river bottom stones; in contrast statistically greater densities of green and blue-green algae on river bottom stones were observed during the investigation period. The mass development of Hydrurus on imported stones diminished the densities of diatoms by reducing their growth rates as a consequence of less available light. According to the dynamic equilibrium hypothesis of Huston (1979), a higher diversity was therefore expected on imported

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stones than on river bottom stones; this was indeed the case. An increase in the species richness, evenness and diversity was observed. If H. foetidus was absent, the diatom communities on river bottom stones showed higher diversity values than those on imported stones. The much longer exposure time obviously enabled the biological systems to reach a more complex level. In order to avoid undesired effects in future investigations on the structure of diatom communities, sampling substrata lacking mass developments of algae other than diatoms should be selected. (Author's abstract)
W91-01765

STUDY OF AQUATIC COMMUNITY DYNAMICS IN A KARSTIC SYSTEM BY THE USE OF ARTIFICIAL SUBSTRATES.
Lyon-1 Univ., Villeurbanne (France). Lab. d'Hydrobiologie et Ecologie Souterraines.
P. Vervier.
Archiv fuer Hydrobiologie AHYBA4, Vol. 119, No. 1, p 15-33, July 1990. 10 fig, 2 tab, 61 ref.

Descriptors: *Aquatic populations, *Artificial substrates, *France, *Karst, *Karst hydrology, *Population dynamics, *Species diversity, Aquifers, Colonization, Crustaceans, Flooding, Groundwater, Hydrologic data collections, Sampling.

The use of artificial substrates to study aquatic community dynamics in underground environments is more recent than in aquatic surface systems. An artificial substrate consisting of a synthetic rope (0.5 cm in diameter) stuffed into a 20-cm long polyvinyl chloride pipe (10 cm in diameter) containing 1-cm holes was placed in the Foussoubie karstic system of southeast France. Artificial substrates immersed during a one month period or, with less efficiency, during a two month period, showed that karst hydrology plays an important role in the dynamics of karstic system communities. The duration of immersion was less important than the hydrological period during which the artificial substrates were immersed. The importance of floods in the colonization process was demonstrated by the use of the artificial substrates. The artificial substrates placed in the sediments of the stream had higher population densities after a flood than during the low-water period. The use of artificial substrates showed that the number of organisms that settle in the bottom differed according to the facies of the stream (e.g. riffles and pools). Moreover, the artificial substrates method made the study of the migration of epigean organisms into the karstic system possible. (Geiger-PTT)
W91-01766

BENTHIC COMMUNITY STRUCTURE AND THE EFFECT OF ROTENONE PISCICIDE ON INVERTEBRATE DRIFT AND STANDING STOCKS IN TWO PAPUA NEW GUINEA STREAMS.
Hong Kong Univ. Dept. of Zoology.
D. Dudgeon.
Archiv fuer Hydrobiologie AHYBA4, Vol. 119, No. 1, p 35-53, July 1990. 7 fig, 3 tab, 27 ref, append.

Descriptors: *Benthos, *Macroinvertebrates, *Piscicides, *Rotenone, *Species composition, *Stream ecology, Mayflies, Population density, Population dynamics, Stoneflies.

Standing stocks and drift of macroinvertebrates from reaches treated with rotenone piscicide were compared with untreated reaches of two low-altitude streams within the Sepik-Ramu River drainage, Papua New Guinea. Total macrobenthic population densities were similar in both streams, although community composition showed significant inter-stream differences. In addition, certain lotic taxa (e.g. Plecoptera) characteristic of the Asian mainland were absent while others (e.g. naucorid bugs) had diversified in their absence. Rotenone induced immediate catastrophic drift: total drift densities peaked after 30 minutes and declined subsequently, showing similar trends in both streams. Taxa varied with respect to both the degree and timing of their response to rotenone, but Baetidae (Ephemeroptera) were rapidly affected and were the most numerous drifting taxa. Certain baetid mayflies declined in abundance in rotenone-treated reaches, although not all morphospecies were affected equally. Standing stocks of leptophlebiid mayflies, by contrast, were unaffected by rotenone application and total invertebrate standing stocks in both streams were unchanged. Overall, rotenone induced catastrophic drift but did not cause large-scale mortality and declines in benthic invertebrate abundance. (Author's abstract)
W91-01767

STUDIES ON THE CHEMISTRY OF INTERSTITIAL WATER TAKEN FROM DEFINED HORIZONS IN THE FINE SEDIMENTS OF BIVALVE HABITATS IN SEVERAL NORTHERN GERMAN LOWLAND WATERS: I. SAMPLING TECHNIQUES.
Tieraerztliche Hochschule Hannover (Germany, F.R.). Inst. fuer Zoologie.
V. Buddensiek, H. Engel, S. Fleischauer-Roessing, S. Olbrich, and K. Waechtler.
Archiv fuer Hydrobiologie AHYBA4, Vol. 119, No. 1, p 55-64, July 1990. 25 ref.

Descriptors: *Fluvial sediments, *Germany, *Interstitial water, *Lake sediments, *Mussels, *Sampling, *Stream biota, Aquatic habitats, Endangered species, Hydrologic data collections, Mollusks.

In the course of sediment studies of freshwater bivalve habitats, a sampling technique for interstitial water, as originally described for rocky beds of running waters by Husmann in 1971 was modified for long term use in sand and gravel sediments of both running and standing lowland waters. The mobile unit allows sampling of 100 ml of interstitial water by means of a safety pipette filler or hand vacuum pump. A partial vacuum is built up in a suction flask connected to one tube of a sampling bottle. The second tube from this bottle leads to the stationary unit to which it is fitted by suitable plastic couplings, so that samples from defined levels can be drawn, after the water standing in the tubes has been discarded. O2-content, conductivity and pH are determined immediately in the sampling bottle. For the laboratory determination of NH4(+), NO3(-), and PO4(3-), samples were chloroform-fixed in the field and then either processed immediately or stored frozen at -20 C until use. The stationary unit allows sampling from defined depths. Interstitial water was taken from 0, 1, 2, 3, 4, 5, 7, 9, 15, 20, 30, and 35 cm sediment depth in a German lowland stream with a population of Unio crassus, a German lowland stream with a Margaritifera margaritifera population, and a lake in the German lowlands with populations of Unio pictorum and Unio tumidus. In running waters some additional levels above 0 had to be sampled to adapt the sampling levels to possible variation of the sediment surface by drifting sand or organic debris. Results of these long-term studies provided data on O2, NH4(+), NO3(-), PO4(3-), pH and conductivity levels in the sediments at various depths and horizon specific seasonal changes in the concentration of several parameters that might affect survival of endangered mussel species in these microhabitats. (Geiger-PTT)
W91-01768

DECREASING CHLORIDE TRENDS OBSERVED AT LAKE ERIE MUNICIPAL WATER INTAKES.
Lake County Dept. of Health, Waukegan, IL.
For primary bibliographic entry see Field 5G.
W91-01793

EXPERIMENTAL USE OF DIALYSIS CHAMBER ARRAYS TO STUDY P-FLUXES IN THE BAY OF QUINTE, 1987.
National Water Research Inst., Burlington (Ontario).
P. G. Sly.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 2, p 258-270, 1990. 4 tab, 18 fig, 14 ref.

Descriptors: *Bay of Quinte, *Cycling nutrients, *Dialysis, *Lake Ontario, *Phosphorus, *Pollution load, *Sediment contamination, *Sediment-water interfaces, *Water analysis, *Water pollution control, Analytical techniques, Experimental data, Nitrogen compounds, Organic carbon, Sediment analysis.

Dialysis chamber arrays were used to estimate proportions of the internal phosphorus load derived from degradation of fresh particulates at or near the base of the water column and partly aged bed material in the Bay of Quinte, Lake Ontario. Phosphorus released from partly aged lake bed sediment provided about 20% of the internal load at Hay Bay but the bed acted as sink for much of the time at Picton. At Hay Bay, sediment oxygen consumption rates were high averaging more than 0.6 gO2/sq m/d. Higher oxygen consumption rates characterized Picton sediments during the late summer and early fall and these were accompanied by a slight increase in the rate of phosphorus release. Combined mean P-reflux values derived from these experiments were higher than expected from model predictions based on past Bay of Quinte studies. The higher values may be caused by very rapid degradation of trapped material in the up-facing tubes due to the presence of excessive numbers of benthic invertebrates. (Author's abstract)
W91-01796

ESTIMATING THE VARIATION OF BUOY WIND AND WAVE DATA BIASES.
Atmospheric Environment Service, Downsview (Ontario).
S. Clodman.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 2, p 288-298, 1990. 5 tab, 4 fig, 8 ref.

Descriptors: *Buoys, *Calibrations, *Data acquisition, *Data analysis, *Error analysis, *Great Lakes, *Instrumentation, *Wind waves, Model studies, Statistical analysis, Variability, Waves, Wind velocity.

The bias variations of the U. S. National Data Buoy Center buoys located on the Great Lakes were quantitatively estimated by statistical comparisons of wind, speed, wave height and wave period. This was done by direct comparison and by using a wave model to estimate the wave parameters from the wind. The data seem to be consistent for any given station and year. Wave height and period biases remain constant but the wind speed bias does vary up to about plus or minus 15%. The wind speed bias is probably affected by changes in buoy instrumentation. These bias variations can be routinely estimated. The approach allows calibration information to be found from the actual data, replacing or improving calibrations done before or after the data period. (Miller-PTT)
W91-01797

INORGANIC CONTAMINANTS IN SUSPENDED SOLIDS FROM HAMILTON HARBOUR.
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
For primary bibliographic entry see Field 5B.
W91-01798

PLANKTONIC PROTOZOA IN LAKES HURON AND MICHIGAN: SEASONAL ABUNDANCE AND COMPOSITION OF CILIATES AND DINOFLAGELLATES.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
H. J. Carrick, and G. L. Fahnenstiel.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 2, p 319-329, 1990. 3 tab, 3 fig, 64 ref.

Descriptors: *Dinoflagellates, *Lake Huron, *Lake Michigan, *Limnology, *Protozoa, Biomass, Ecosystems, Population density, Seasonal variation.

The abundance and biomass of surface and deep ciliate and dinoflagellate protozoa in the offshore waters of Lakes Huron and Michigan were determined from December 1986 to November 1987. Protozoan abundance (4 to 15 cells/mL) and biomass (13-140 microg/L) were comparable between

lakes and similar to those reported form other oligitrophic environments. Ciliates comprised the majority of protozoan abundance (80%) and biomass (73%). The mean size of these communities was small (20.6 microm) due to the numerical dominance of small choreotrichs, oligotrichs, and species of Gymnodinium. Total biomass in both lakes peaked during late June-July and again during October-November. These seasonal changes in biomass were accompanied by species replacements. Deep and surface communities were comparable in terms of abundance and biomass of ciliates, although deep community biomass decreased as stratification intensified. Because the biomass of ciliates alone represents about 30% of crustacean zooplankton biomass, protozoa may be more important grazers than once thought. (Author's abstract)
W91-01799

EFFECTS OF VARIOUS BIOPHYSICOCHEMICAL CONDITIONS ON TOXIGENICITY OF VIBRIO CHOLERAE 01 DURING SURVIVAL WITH A GREEN ALGA, RHIZOCLONIUM FONTANUM, IN AN ARTIFICIAL AQUATIC ENVIRONMENT.
London School of Hygiene and Tropical Medicine (England). Dept. of Tropical Hygiene.
M. S. Islam.
Canadian Journal of Microbiology CJMIAZ, Vol. 36, No. 7, p 464-468, July 1990. 1 fig, 5 tab, 26 ref.

Descriptors: *Algae, *Aquatic environment, *Bacterial toxins, *Pathogenic bacteria, *Survival, *Toxicity, *Toxins, *Vibrio, Competition, Fate of pollutants, Hydrogen ion concentration, Light intensity, Rhizoclonium, Temperature effects, Tissue analysis.

Toxigenic and nontoxigenic strains of Vibrio cholerae 01 occur in the natural aquatic environment. It is not clear whether V. cholerae 01 lose toxigenicity and become nontoxigenic during survival in the aquatic environment as a result of the effect of various biophysicochemical conditions (e.g., sunlight, pH, temperature, competition with other bacteria for nutrients, etc.) Five toxigenic strains were exposed to artificial aquatic environments in the presence of a filamentous green alga, Rhizoclonium fontanum, and recovered after different time intervals (0 and 0.5 h, 3, 6, 9, and 15 days). This experimental system was exposed to sunlight and the V. cholerae 01 were in competition for nutrients with resident bacterial flora from R. fontanum. The toxigenicity of Vibrio cholerae 01 that were recovered at different time intervals was assessed by tissue culture assay using Vero cells. The toxigenicity of recovered strains was compared with that of the parent strains. The results demonstrated the toxigenic V. cholerae 01 are unlikely to lose their toxigenicity in aquatic environments as a result of the effects of various biophysicochemical conditions. These results are consistent with the hypothesis of environmental reservoirs of V. cholerae. (Author's abstract)
W91-01801

SELENIUM AS A NUTRIENT FOR FRESHWATER BACTERIOPLANKTON AND ITS INTERACTIONS WITH PHOSPHORUS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
U. Eriksson, and C. Pedros-Alio.
Canadian Journal of Microbiology CJMIAZ, Vol. 37, No. 7, p 475-483, July 1990. 6 fig, 1 tab, 40 ref.

Descriptors: *Bacteria, *Eutrophic lakes, *Lakes, *Nutrient concentrations, *Oligotrophic lakes, Phosphorus, *Plankton, *Selenium, *Sulfates, Bacterioplankton, Hypereutrophic lakes, Lake Banyoles, Lake Erken, Lake Vallentunasjon, Limnology, Spain, Sweden.

The influence of selenite on the growth of bacterioplankton present in samples of three lakes was analyzed; these samples were collected in sulfate-rich, oligiotrophic Lake Banyoles, moderately eutrophic Lake Erken, and hypereutrophic Lake Vallentunasjon. The addition of P to samples from the lakes Banyoles and Erken enhanced cell yields. Strong effects of phosphate on growth rates were found in samples from lakes Banyoles and Vallentunasjon. Selenite had a significant positive effect on cell yield on samples from lakes Banyoles and Vallentunasjon, whereas the effect on cell yield in samples form Lake Erken was slightly negative. The addition of the selenite alone to samples from Lake Banyoles doubled the biovolume if bacterioplankton within 37 h during the spring. Among winter bacteria from Lake Banyoles, selenite increased the number of bacteria, but only when the phosphate level was high. A high inorganic phosphorus level was also necessary to stimulate the effect of selenite on bacterial growth in samples from Lake Vallentunasjon. The negative effect of selenite on samples from Lake Erken was most obvious when phosphate had been added simultaneously. Cell yields were always greater at the highest temperatures. (Author's abstract)
W91-01802

EFFECTS OF ACIDIFICATION ON LEAF DECOMPOSITION IN STREAMS.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W91-01803

INTERSTITIAL DISSOLVED ORGANIC CARBON IN SEDIMENTS OF A SOUTHERN APPALACHIAN HEADWATER STREAM.
Georgia Univ., Athens. Dept. of Zoology.
M. T. Crocker, and J. L. Meyer.
Journal of the North American Benthological Society JNASEC, Vol. 6, No. 3, p 159-167, September 1987. 2 fig, 3 tab, 31 ref. NSF Grant No. BSR 85-14328.

Descriptors: *Biomass, *Decomposition, *Dialysis, *Dissolved organic carbon, *Interstitial water, *Limnology, *Organic matter, *Seasonal variation, *Streams, Bacterial productivity, Benthic environment, Chemical analysis, Hyporheos, Sampling, Spatial distribution.

This study had two objectives: (1) to compare seasonal and spatial patterns of water-column dissolved organic carbon (DOC) and sediment interstitial DOC (IDOC) concentrations at a headwater spring seep, and (2) to explore interactions between sediment organic matter content, benthic bacterial biomass and production, water column DOC concentrations, and sediment IDOC concentration and composition (high versus low molecular weight components). For the first objective, sediment organic matter content, IDOC concentration (sampled from small wells by dialysis or by pipet), water column DOC concentration, and benthic bacterial biomass were measured at a spring seep in Coweeta Hydrologic Laboratory, Macon Co. North Carolina USA, for two years. For the second objective, organic matter content was increased or decreased in experimental sediments. The same variables listed above were measured within three weeks of sediment manipulation and again after five and a half month. Benthic bacterial production was measured one week after sediment manipulation. Results indicate benthic organic matter is a source of IDOC, the concentration of which depends on sediment organic matter content, the relative proportion of high and low molecular weight IDOC compounds, and the exchange of interstitial and water column DOC. High molecular weight IDOC (>50,000) concentrations are lower than high molecular weight IDOC concentrations and are independent of sediment organic matter content. However, low molecular weight IDOC concentrations are generally greater than water column total DOC concentrations. Low molecular weight IDOC concentrations are greater during the dominant season than during the growing season. (Author's abstract)
W91-01804

DISTRIBUTION AND PRIMARY PRODUCTIVITY OF THE EPIZOIC MACROALGA BOLDIA ERYTHROSIPHON (RHODOPHYTA) IN A SMALL ALABAMA STREAM.
Alabama Univ., University. Aquatic Biology Program.
M. S. Stock, T. D. Richardson, and A. K. Ward.
Journal of the North American Benthological Society JNASEC, Vol. 6, No. 3, p 168-174, September 1987. 3 fig, 2 tab, 20 ref.

Descriptors: *Algae, *Algal growth, *Epizoic algae, *Limnology, *Primary productivity, *Rhodophyta, *Seasonal variation, *Snails, *Streams, Animal behavior, Autochthonous carbon, Biological samples, Boldia, Gastropods, Sampling, Spatial distribution.

The contribution of autochthonous carbon to a small stream by the epizoic red macroalga Boldia erythrosiphon was determined from December 1985 through April 1986 in Little Schultz Creek, Alabama. Boldia grew almost exclusively on the snail species Elimia clara and E. cahawbensis. A mean of 323 snails/sq m was found in the stream, 49% of which had the alga attached. Elimia clara was nearly four times as abundant as E. cahawbensis and Boldia was significantly more associated with the former than with the latter snail. The differential distribution of the alga may be due to behavioral differences, E. clara preferring erosional sites with higher current rather than depositional sites. Boldia on snails contributed a mean of 37 mg C/sq m/d from January through April 1986 and a total of nearly 2 g C/sq m for the season. The latter value is one third of the seasonal primary production of epilithic algae on cobble measured in a previous study, and, when added to it, changes the annual pattern of autochthonous production in this stream. The productivity of the macroalga illustrates the importance of animals in providing substrata for algae in streams. In addition, to the presence of snails, a combination of factors including total light input, the chemical nature of substrata, differential grazing pressure, and substratum availability may affect colonization and growth of Boldia. (Author's abstract)
W91-01805

EFFECTS OF HERBIVORE TYPE AND DENSITY ON TAXONOMIC STRUCTURE AND PHYSIOGNOMY OF ALGAL ASSEMBLAGES IN LABORATORY STREAMS.
Oregon State Univ., Corvallis. Dept. of Botany and Plant Pathology.
A. D. Steinman, C. D. McIntire, S. V. Gregory, G. A. Lamberti, and L. R. Ashkenas.
Journal of the North American Benthological Society JNASEC, Vol. 6, No. 3, p 175-188, September 1987. 24 fig, 3 tab, 45 ref. NSF Grant Nr. BSR-8318386.

Descriptors: *Algae, *Algal growth, *Algal morphology, *Biomass, *Caddisflies, *Diatoms, *Grazing, *Laboratory equipment, *Laboratory methods, *Limnology, *Lotic environment, *Snails, *Taxonomy, Aquatic insects, Gastropods, Laboratory streams.

Four densities of a snail (Juga silicula) and a caddisfly (Dicosmoecus gilvipes) were introduced into separate laboratory streams, and their effects on algal biomass and community structure were monitored for 32 d. Tiles in an ungrazed control stream were covered by thick algal mats by day 32, and were composed primarily of Scenedesmus spp., Characium, and a variety of diatoms. Biomass and community structure of algal assemblages in the stream with the lowest density of snails were very similar to those in the control stream. In the other streams with snails, an inverse relationship developed between algal biomass and snail density after day 16. By day 32, the algal assemblages in the streams with high snail densities were dominated by adnate diatoms (e.g., Achnanthes lanceolata), and basal cells and short filaments of Stigeoclonium tenue. In contrast to the streams with snails, algal biomass was relatively low in all streams with caddisflies. The differences in algal biomass and structure between the streams with the lowest and highest densities of caddisflies were much smaller than those between streams with the lowest and highest densities of snails. On day 32, the taxonomic and physiognomic structure of the algal assemblages in all the streams with caddisflies resembled that in the streams with higher densities of snails. Scanning electron micrographs showed that even at the highest densities, neither snails nor caddis-

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flies could completely remove the algal assemblage. It is concluded that grazing can substantially influence algal growth form and assemblage physiognomy in lotic ecosystems. (See also W91-01807) (Author's abstract)
W91-01806

EFFECTS OF HERBIVORE TYPE AND DENSITY ON CHEMICAL COMPOSITION OF ALGAL ASSEMBLAGES IN LABORATORY STREAMS.
Oregon State Univ., Corvallis. Dept. of Botany and Plant Pathology.
A. D. Steinman, C. D. McIntire, and R. R. Lowry.
Journal of the North American Benthological Society JNASEC, Vol. 6, No. 3, p 189-197, September 1987. 5 tab, 34 ref. NSF Grant Nr. BSR-8318386.

Descriptors: *Algae, *Amino acids, *Biochemistry, *Biomass, *Caddisflies, *Fatty acids, *Laboratory equipment, *Laboratory methods, *Lotic environment, *Snails, Algal growth, Aquatic insects, Chemical composition, Gastropods, Grazing, Laboratory streams.

The chemical composition of algal assemblages in laboratory streams was determined 3 and 27 d after adding snail (Juga silicula) and larval caddisfly (Dicosmoecus gilvipes) grazers. Three days after the herbivores were introduced (day 8 of algal growth), the fatty acid and amino acid profiles among algal assemblages were similar. Substantial differences were noted after 4 wk (day 32 of algal growth), however, especially with respect to the 16:0, 16:1, 16:3, 18:3, and 20:5 fatty acids. On day 32, algal assemblages subjected to zero or 125 snails/stream (66/sq m) had higher levels of glycine, leucine, isoleucine, tyrosine, and the 16: and 18:3 fatty acids than assemblages exposed to 500 snails/stream (250/sq m), 50 caddis/stream (25/sq m), or 200 caddis/stream (100/sq m). On the other hand, assemblages subjected to high grazing pressure (i.e., 500 snails/stream, 50 and 200 caddis/stream) had higher levels of alanine, glutamic acid/glutamine, and the 16:0, 16:1, and 20:5 fatty acids than algae exposed to zero or 125 snails/stream. These data provide detailed information on the food quality of lotic algae and may serve as a starting point for future research on this field. (See also W91-01806) (Author's abstract)
W91-01807

EMPIRICAL EVIDENCE FOR DIFFERENCES AMONG METHODS FOR CALCULATING SECONDARY PRODUCTION.
Montreal Univ. (Quebec). Dept. of Biological Sciences.
For primary bibliographic entry see Field 7C.
W91-01808

RATES OF PROTOZOAN BACTERIVORY IN THREE HABITATS OF A SOUTHEASTERN BLACKWATER RIVER.
Georgia Univ., Sapelo Island. Marine Inst.
L. A. Carlough, and J. L. Meyer.
Journal of the North American Benthological Society JNASEC, Vol. 9, No. 1, p 45-53, March 1990. 2 fig, 3 tab, 50 ref. NSF Grant Nr. BSR-8705744.

Descriptors: *Aquatic bacteria, *Bacterivory, *Flagellates, *Food chains, *Grazing, *Limnology, *Lotic environment, *Microorganisms, *Protozoa, *Secondary productivity, Aquatic environment, Ciliates, Filter feeders, Fluorescent tracers, Particle size.

Although protozoa have been largely disregarded in the trophic structure of lotic systems, they have been shown to be important in lentic and marine environments. As part of a larger study concerning the basis of secondary production in the Ogeechee River, GA, preliminary experiments were done using fluorescently-labelled bacteria to directly measure bacterial grazing by protozoa. Protozoan grazing rates can be as high in moving lotic waters as in still waters as demonstrated by comparing a main channel site, a backwater, and a floodplain pond. In the main channel site during April and May 1988, flagellates and ciliates ingested an average of 17 and 420 bacteria/individual/hr, respectively. When this is multiplied by the high protozoan densities present, an average of 47% of the water-column in the main channel is estimated to be cleared of bacteria by protists each day. Protozoan bacterivory could facilitate carbon flow to higher trophic levels by turning bacteria into larger parcels of carbon and nutrients which are available to a greater portion of the filter-feeding members of communities. (Author's abstract)
W91-01809

TIMING OF WAVE DISTURBANCE AND THE RESISTANCE AND RECOVERY OF A FRESHWATER EPILITHIC MICROALGAL COMMUNITY.
Louisville Univ., KY. Dept. of Biology.
C. G. Peterson, K. D. Hoagland, and R. J. Stevenson.
Journal of the North American Benthological Society JNASEC, Vol. 9, No. 1, p 54-67, March 1990. 5 fig, 4 tab, 58 ref.

Descriptors: *Algae, *Algal growth, *Algal populations, *Chlorophyll a, *Diatoms, *Fragilaria, *Limnology, *Nitzschia, *Oscillatoria, *Periphyton, *Phaeophyta, *Wave action, *Waves, Epilithic algae, Lake McConaughy.

Microalgal communities on clay tiles in Lake McConaughy (Nebraska, USA) were subjected to simulated wave disturbance after 6, 12, 18, or 24 d of development to examine the effects of community age on resistance and recovery in these communities. Six-day communities were less resistant than older communities; diatom standing crops in 6-d communities were reduced 47.6% by disturbance. Resistance of older communities was apparently a function of increased mat stabilization by diatom mucilages and overlying Oscillatoria surface layers. Diatom density reductions in 6-d communities were due to differential removal of large, chain-forming species of Fragilaria, and solitary, motile Navicula and Nitzschia. Sediment-trap data showed that Fragilaria and Navicula resettled quickly, but that once removed, many Nitzschia were not readily replaced through immigration. Differential removal of diatom taxa by disturbance at 6 d, as well as differential settling of taxa following disturbance affected community recovery patterns. Simulated wave disturbance also caused short-term increases in growth rates of four common taxa in 6-d communities. After 24 d, phaeophytin content of control communities exceeded chlorophyll a concentrations, indicating senescence of algal cells. Communities disturbed after 18 or 24 d had chlorophyll a concentrations similar to controls, but significantly lower phaeophytin content, suggesting that wave disturbance delayed senescence within algal mats. It was concluded that wave disturbance can affect resistance and recovery of epilithic algal communities in lentic systems and that timing of disturbance influences community response. (Author's abstract)
W91-01810

PERSPECTIVE ON EL NINO AND LA NINA: GLOBAL IMPLICATIONS FOR STREAM ECOLOGY.
New Mexico Univ., Albuquerque. Dept. of Biology.
For primary bibliographic entry see Field 2B.
W91-01811

VOLATILIZATION OF SELENIUM FROM AGRICULTURAL EVAPORATION POND SEDIMENTS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5G.
W91-01814

INVERTEBRATE COMMUNITIES OF SMALL STREAMS IN NORTHEASTERN WYOMING.
Geological Survey, Cheyenne, WY. Water Resources Div.
D. A. Peterson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 85-4287, 1990. 45p, 17 fig, 1 tab, 32 ref. USGS Project No. WY057.

Descriptors: *Invertebrates, *Mine wastes, *Powder River Basin, *Water pollution effects, *Wyoming, Aquatic habitats, Benthic fauna, Benthic flora, Ephemeral streams, Intermittent streams, Perennial streams.

Invertebrate communities of small streams in an energy-mineral-development area in the Powder River structural basin of northeastern Wyoming were studied during 1980-81. The largest average density of benthic invertebrates among 11 sites was 983 invertebrates/sq ft at a site on a perennial stream, the Little Powder River at State Highway 59. The smallest average densities were 3.4 invertebrates/sq ft in Salt Creek and 16.6 invertebrates/sq ft in the Cheyenne River, two streams where the invertebrates were stressed by degraded water quality or inadequate substrate or both. The rates of invertebrate drift were fastest in three perennial streams, compared to the rates in intermittent and ephemeral streams. Analysis of the invertebrate communities using the Jaccard coefficient of community similarity and a cluster diagram showed communities inhabiting perennial streams were similar to each other, because of the taxa adapted to flowing water in riffles and runs. Communities from sites on ephemeral streams were similar to each other, because of the taxa adapted to standing water and vegetation in pools. Communities of intermittent streams did not form a group; either they were relatively similar to those of perennial or ephemeral streams or they were relatively dissimilar to other communities. The communities of the two streams stressed by degraded water quality or inadequate substrate or both, Salt Creek and the Cheyenne River, were relatively dissimilar to communities of the other streams in the study. (USGS)
W91-01850

SOLUTION-COLLAPSE DEPRESSIONS AND SUSPENSATES IN THE LIMNOCRENIC LAKE OF BANYOLES (NE SPAIN).
Barcelona Univ. (Spain).
For primary bibliographic entry see Field 2J.
W91-01876

REVISED ESTIMATE OF THE LIFE SPAN FOR LAKE NASSER.
Florida Univ., Gainesville. Dept. of Civil Engineering.
S. E. Smith.
Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 2, p 123-129, March/April 1990. 5 fig, 2 tab, 11 ref.

Descriptors: *Aswan High Dam, *Lake Nasser, *Lakes, *Nile River, *Reservoir silting, *Sedimentation, Egypt, Forecasting, Hydrologic data collections, Hydrology, Mathematical studies, Reservoir operation, Sudan, Suspended sediments.

A number of estimates of the potential life span of Lake Nasser located in Egypt and Sudan have been made in the past several years. Published estimates range from as little as 20 years to over 1500 years. The wide range of differing values is a function of many variables, including computation method, input data, and theoretical assumptions underlying the mathematical approach taken. Such a broad range of values is typical of sedimentation studies performed for areas that lack an adequate historic data base. One of the chief constraints to development of a reliable estimate of Lake Nasser's case has been lack of sufficient historical data on which to construct a useful data base. Enough information of this type has been collected since the reservoir's formation in 1964 to permit a realistic assessment of its life span. Granted the obvious need to determine the useful lifetime of this or any other reservoir, it is now possible to assess the reliability of the current official estimate for Lake Nasser. By applying appropriate modifications and additional data to the official estimate, an improved estimate was made. The time forecasted for filling of the reservoir by the official estimate is

362 years, somewhat less than the original design life of 500 years. By taking into account changes in the hydrological regime of the Nile after 1964 and another compaction factor, an estimate of 535 years was made. The additional time before filling estimated in the revision is significant for decision rules governing operation of the Aswan High Dam. (Author's abstract)
W91-01884

ACIDIFICATION IN NORWAY - LOSS OF FISH POPULATIONS AND THE 1000 LAKE SURVEY 1986.
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5C.
W91-01889

NUTRIENT EXCHANGES BETWEEN THE WATER COLUMN AND A SUBTIDAL BENTHIC MICROALGAL COMMUNITY.
Virginia Inst. of Marine Science, Gloucester Point.
W. M. Rizzo.
Estuaries ESTUDO, Vol. 13, No. 3, p 219-226, September 1990. 5 fig, 29 ref.

Descriptors: *Benthic environment, *Estuaries, *Estuarine environment, *Nutrient transport, *River sediments, Algae, Ammonium, Nitrates, Nitrites, Phosphates, Virginia, Water column, York River.

The exchange of nutrients between the shallow (ca. 1 m) sediments and the water column in the York River, Virginia, were measured during 1983 using transparent and opaque plexiglass hemispheres. The exchange of nitrates and phosphates were not significantly different between dome treatments, but ammonium release was significantly reduced within the transparent domes. Within the dark domes, ranges of hourly rates of ammonium and phosphate exchange were -21 to 364 N micromol/sq m and -3 to 76 micromol P/sq m, while those in the transparent domes were -162 to 44 and -6 to 80, respectively. Negative values denote uptake by the sediment. Nitrate + nitrite exchanges averaged only 15% of the total dissolved inorganic nitrogen exchange in the dark domes and 17% of the total dissolved inorganic nitrogen exchange in the transparent domes. (Author's abstract)
W91-01897

BAROTROPIC, SUBTIDAL EXCHANGE BETWEEN CALCASIEU LAKE AND THE GULF OF MEXICO.
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
M. Lee, W. J. Wiseman, and F. J. Kelly.
Estuaries ESTUDO, Vol. 13, No. 3, p 258-264, September 1990. 6 fig, 3 tab, 13 ref.

Descriptors: *Barotropic flow, *Calcasieu Lake, *Estuaries, *Gulf of Mexico, *Saline-freshwater interfaces, *Wind tides, *Wind-driven currents, Estuarine environment, Flow characteristics, Mathematical models, Model studies, Water level, Wind.

Long-term measurements of flow through Calcasieu Pass, Louisiana, are compared to water level variations within Calcasieu Lake, Louisiana. Except during periods of freshets driven by local rainfall, the exchange is shown to be predominantly barotropic. A simple wind driven model accounts for the observed phase relations between wind, current, and water level. Calcasieu Lake is a broad, shallow estuary characterized by minor freshwater runoff, moderate tidal energy, and, except in summer, strong wind stress events. This situation is conducive to barotropic subtidal exchanges with the coastal ocean on time scales of 3 to 10 d. These exchanges are important for the recruitment of larval fish to the estuarine nursery grounds, and may be adequately monitored without costly current meter deployments, using only tide gage measurements. During low wind and high runoff events, stratification and a baroclinic flow regime may develop. These are times when water exchange with the shelf can not be predicted from tide gauge data. A simple linear wind-driven model of the barotropic exchange has been successful in hindcasting the energy containing exchanges when cold fronts are the dominant synoptic weather pattern. The model assumes, without supportive data, that the coastal sea level rise is a significant fraction of that occurring within Calcasieu Lake. (Lantz-PTT)
W91-01901

GROWTH OF SUBMERGED MACROPHYTES UNDER EXPERIMENTAL SALINITY AND LIGHT CONDITIONS.
University of Southwestern Louisiana, Lafayette. Dept. of Biology.
R. R. Twilley, and J. W. Barko.
Estuaries ESTUDO, Vol. 13, No. 3, p 311-321, September 1990. 8 fig, 1 tab, 48 ref.

Descriptors: *Light intensity, *Macrophytes, *Salinity, Biomass, Chlorophyll a, Comparison studies, Estuaries, Nitrogen, Plant growth, Plant physiology, Sodium, Solar radiation, Tissue analysis.

The growth, morphology, and chemical composition of Hydrilla verticillata, Myriophyllum spicatum, Potamogeton perfoliatus, and Vallisneria americana were compared among different salinity and light conditions. Plants were grown in microcosms (1.2 cu m) under ambient photoperiods adjusted to 50% and 8% of solar radiation. The culture solution in 5 pairs of tanks was gradually adjusted to salinities of 0, 2, 4, 6 and 12%. With the exception of H. verticilla, the aquatic macrophytes examined may be considered eurysaline species that are able to adapt to salinities one-third the strength of sea water. With increasing salinity, the inflorescence production decreased in M. spicatum and P. perfoliatus, yet asexual reproduction in the latter species by underground buds remained constant. Stem elongation increased in response to shading in M. spicatum, while shaded P. perfoliatus had higher concentrations of chlorophyll-a. In association with high epiphytic mass, chlorophyll-a concentrations in all species were greatest at 12%. The concentration of sodium increased in all four species of aquatic macrophytes examined, indicating that these macrophytes did not possess mechanisms to exclude this ion. The nitrogen content (Y) of the aquatic macrophytes tested increased significantly with higher sodium concentration (X), suggesting that nitrogen may be utilized in osmoregulation (Y = X x 0.288 + 6.10, r sq = 0.71). The tolerance of V. americana and P. perfoliatus to salinity was greater in this study compared to other investigations. This may be associated with experimental methodology, whereby macrophytes were subjected to more gradual rather than abrupt changes in salinity. The two macrophytes best adapted to estuarine conditions in this study by exhibiting growth up to 12%, included M. spicatum and V. americana, which also exhibited a greater degree of response in morphology, tissue chemistry (including chlorophyll content and total nitrogen), and reproductive output in response to varying salinity and light conditions. (Author's abstract)
W91-01907

STABILITY OF PERIPHYTON AND MACROINVERTEBRATES TO DISTURBANCE BY FLASH FLOODS IN A DESERT STREAM.
Arizona State Univ., Tempe. Dept. of Zoology.
N. B. Grimm, and S. G. Fisher.
Journal of the North American Benthological Society JNASEC, Vol. 8, No. 4, p 293-307, December 1989. 7 fig, 2 tab, 63 ref. NSF grant BSR 84-06891.

Descriptors: *Arizona, *Deserts, *Macroinvertebrates, *Periphyton, *River ecology, *Streams, *Succession, Flooding effects, Life cycles, Limiting nutrients, Nitrogen, Seasonal variation.

Resistance, resilience, and patterns of succession were evaluated for periphyton and macroinvertebrates of Sycamore Creek, Arizona, between 1984 and 1987. During this period, 35 flash-flood disturbances occurred, ranging in magnitude (peak discharge) from 0.2 meters cubed per second to 58 meters cubed per second; peak discharge of the largest flash floods exceeded base flow by 3-4 orders of magnitude. Macroinvertebrates and algal assemblages dominated by diatoms were more resistant, i.e., showed less change in response to spates, than macroalgae (filamentous Chlorophyta) and cyanobacterial mats, but resistance of all groups declined with increasing disturbance magnitude. Biota showed little resistance to events large enough to move substrata. Twenty sequences of postflood succession were analyzed to characterize resilience and patterns of recovery. Resilience was very high compared with other streams and other ecosystems, because of high rates of biotic production in this desert stream. Resilience of periphyton (as indicated by recovery of total chlorophyll a) was highest in summer and autumn, while macroinvertebrate resilience (in terms of density or biomass) did not differ among seasons. In many sequences, recovery curves of macroinvertebrate and algal standing crops were linear or asymptotic; however, macroinvertebrates declined precipitously during later stages of five successional sequences, primarily because of declines in the dominant collector-gatherers. These organisms reproduce continuously and have short life cycles, so declines cannot be explained by synchronous emergence. Instead, declines may be caused by food quality limitation. Sustained high rates of macroinvertebrate consumption and use of autochthonous detritus are possible only if bacterial conditioning (and immobilization of nitrogen) can increase the N content of this material, which is halved with each gut passage. During many sequences, bacterial conditioning is probably limited by nitrogen, which is known to limit autotrophic processes in this stream. This suggests that productivity at higher trophic levels may be influenced by availability of a limiting nutrient not only to primary producers but to microconsumers. (Author's abstract)
W91-01924

DISCHARGE-EXPORT RELATIONSHIPS IN HEADWATER STREAMS: THE INFLUENCE OF INVERTEBRATE MANIPULATIONS AND DROUGHT.
Georgia Univ., Athens. Dept. of Entomology.
T. F. Cuffney, and J. B. Wallace.
Journal of the North American Benthological Society JNASEC, Vol. 8, No. 4, p 331-341, December 1989. 6 fig, 4 tab, 28 ref. NSF grants BSR 83-16082 and BSR 87-18005.

Descriptors: *Appalachian Mountains, *Drought effects, *Flow discharge, *Invertebrates, *Organic matter, *Particulate matter, *Streams, Drought, Headwaters, Insecticides, Methoxychlor.

The role of physical (discharge) and biological (macroinvertebrate communities) factors in the control of coarse (greater than 4 mm) and fine (less than or equal to 4 mm and greater than 0.5 micrometers) particulate organic matter (FPOM) transport was studied in three headwater streams of the southern Appalachian Mountains. The role of discharge was determined by relating two years of continuous measurements obtained over discrete (ca. 2-wk) time intervals. The role of macroinvertebrates was examined by treating one of the three streams, C 54, with an insecticide during Year 2 to reduce populations and alter community structure. Maximum discharge was the only discharge parameter which adequately predicted (linear regressions) FPOM export during a sampling interval (r squared > or -0.70). These regressions were unique for each stream and were constant between years for the untreated streams, despite a record drought during the second year. Relationships between discharge and export of coarse particulate organic matter (CPOM) were not as strong nor as consistent as those for FPOM. CPOM export was very sensitive to timing of CPOM inputs and storms (e.g., 78 to 88% of CPOM export during Year 2 occurred during a single fall storm). Consequently, CPOM export-discharge relationships differed not only among streams but also between years and did not show treatment effects. Treating C 54 with methoxychlor during Year 2 resulted in massive invertebrate drift and drastically reduced populations of macroinvertebrates, practically eliminating shredders and collector-filterers. Maximum discharge continued to be a good predictor of FPOM export (r squared = 0.83) for C 54

during the treatment year, but the yield of export per unit of maximum discharge (slope of the discharge-FPOM export regression) decreased by 65%. This contrasts with the untreated streams in which the slopes were constant between years despite the greater than 50 year drought during Year 2. Most (75%) of the decrease in FPOM yields from C 54 is directly attributable to the reduction in macroinvertebrates. Only 25% is attributable to the drought even though stream flows dropped by ca. 40% during Year 2. (Author's abstract)
W91-01925

SPATIAL AND TEMPORAL DISPERSION PATTERNS OF GOLDEN PERCH, MACQUARIA AMBIGUA, LARVAE IN AN ARTIFICIAL FLOODPLAIN ENVIRONMENT.
New South Wales Dept. of Agriculture, Narrandera (Australia). Inland Fisheries Station.
P. C. Gehrke.
Journal of Fish Biology JFIBA9, Vol. 37, No. 2, p 225-236, August 1990. 5 fig, 6 tab, 25 ref.

Descriptors: *Fish, *Flood plains, *Perch, *Ponds, *Spatial distribution, *Temporal distribution, Aquatic habitats, Fish stocking, Larvae, Thermal stratification, Water quality.

Golden perch larvae were stocked into a pond and inundated floodplain system in south-eastern Australia to determine movement patterns of the larvae onto and off the floodplain area. A total of 428 larvae were caught moving from the floodplain into the pond whereas only 18 were collected moving in the reverse direction. Thirty one larvae were caught at open water sites in the pond and floodplain, but only three were collected from sites on the floodplain which provided shade, timber or water flow. Transect samples from the pond also yielded more larvae than samples from floodplain transects, indicating a distinct spatial dispersion pattern in favor of the pond. Spatial dispersion patterns of golden perch larvae appear to correspond with gradients in water quality between the pond and floodplain habitats. Stratification occurred in the pond but did not develop on the floodplain. Water on the floodplain was cooler, harder and contained less oxygen than surface water from the pond. Diel oscillations occurred in water temperature, pH, dissolved oxygen, carbon dioxide and acidity, but there was no significant corresponding pattern in the distribution of larvae. Dispersion of golden perch larvae between pond and floodplain habitats is not random, and may be actively influenced by local-scale variations in water quality. (Author's abstract)
W91-01957

ECOLOGICAL MECHANISMS IMPORTANT FOR THE BIOTIC CHANGES IN ACIDIFIED LAKES IN SCANDINAVIA.
Goeteborg Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-02015

PHYSIOLOGICAL RESPONSES TO SEVERE ACID STRESS IN FOUR SPECIES OF FRESHWATER CLAMS (UNIONIDAE).
Helsinki Univ. (Finland). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-02026

BIOACCUMULATION OF SELENIUM IN BIRDS AT KESTERSON RESERVOIR, CALIFORNIA.
Patuxent Wildlife Research Center, Davis, CA. Pacific Coast Field Station.
For primary bibliographic entry see Field 5C.
W91-02029

HEAT CONTENTS, THERMAL STABILITIES AND BIRGEAN WIND WORK IN DYSTROPHIC TASMANIAN LAKES AND RESERVOIRS.
University of New England, Armidale (Australia). Dept. of Botany.
L. C. Bowling.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 3, p 429-441, 1990. 5 fig, 3 tab, 23 ref.

Descriptors: *Dystrophic lakes, *Enthalpy, *Limnology, *Reservoirs, *Tasmania, *Thermal stratification, *Wind effects, Energy cycle, Heat budget, Mixing.

Values of whole-lake standard energy parameters (heat content, thermal stability, and Birge's work of the wind) for ten dystrophic standing waters from western Tasmania were lower than expected for lakes of their depth and area. Although controlled principally by morphometric factors, the degree of shelter from wind and the extent of each lake's dystrophy also had considerable effects. These factors allowed only surface waters to contribute to the annual heat exchange cycle, thereby reducing the magnitude of each lake's heat budgets and influencing stability and wind work values. The lakes show considerable short term and long term fluctuations in heat content, stability and wind work in response to the capricious maritime meteorological conditions of the area. However, long periods between successive sampling may have caused some underestimation of the ranges of these three parameters. Despite this, the study reveals that these standard energy parameters are effective in describing the annual energy input and resistance to wind-induced mixing of these dystrophic Tasmanian lakes. (Author's abstract)
W91-02043

2I. Water In Plants

PHYSIOLOGICAL RESPONSE OF YELLOW-POPLAR SEEDLINGS TO SIMULATED ACID RAIN, OZONE FUMIGATION, AND DROUGHT.
Agricultural Research Service, Delaware, OH.
For primary bibliographic entry see Field 5C.
W91-01068

EVAPOTRANSPIRATION, WATER USE EFFICIENCY, MOISTURE EXTRACTION PATTERN AND PLANT WATER RELATIONS OF RAPE (BRASSICA CAMPESTRIS) GENOTYPES IN RELATION TO ROOT DEVELOPMENT UNDER VARYING IRRIGATION SCHEDULES.
Haryana Agricultural Univ., Hissar (India).
For primary bibliographic entry see Field 2D.
W91-01114

CLIMATE AND VEGETATION IN CHINA. III. WATER BALANCE AND DISTRIBUTION OF VEGETATION.
Osaka Univ. (Japan). Faculty of Science.
J. Y. Fang, and K. Yoda.
Ecological Research (Kyoto) ECRSEX, Vol. 5, No. 1, p 9-23, April 1990. 7 fig, 5 tab, 49 ref.

Descriptors: *China, *Climatology, *Moisture profiles, *Soil-water-plant relationships, *Vegetation effects, *Water budget, Coniferous forests, Deciduous forests, Deserts, Evapotranspiration, Steppes.

Distributions of 29 vegetation types in China as a function of climatic humidity or aridity were analyzed using Thornthwaite's system, by employing meteorological records from 671 stations in China. The annual potential evapotranspiration and the humidity/aridity indices were calculated for every station, and distribution maps of water deficiency, water surplus and moisture index (Im) were constructed. The Im map showed that arid areas ($Im<0$) occupied about 56% of the country. The effect of the difference in soil water storage capacity on Thornthwaite's indices was examined, and Im values were found to differ little, although some differences were observed in actual annual evapotranspiration, water deficiency and water surplus values. Correlations between Im values and distributions of 29 vegetation types, identified from a vegetation map with a scale of 1/4,000,000, were investigated. The distributions of desert, steppe, woodland, deciduous forest and evergreen forest corresponded to Im values of below -40, -40 to -20, -20 to 0, 0 to 60 and over 60, respectively. In addition, climatic factors delimiting the northern distribution of evergreen broadleaf forest were investigated, and it was clarified that the northern limit was restricted by combined hydrothermal conditions, and not by the low temperature in winter. (Author's abstract)
W91-01125

NUTRIENT DYNAMICS IN A FLOATING MAT AND POND SYSTEM WITH SPECIAL REFERENCE TO ITS VEGETATION.
Kyoto Univ. (Japan). Lab. for Plant Ecological Studies.
For primary bibliographic entry see Field 2H.
W91-01126

EFFECTS OF SALINE WATER IRRIGATION ON GROWTH AND MINERAL DISTRIBUTION IN GUAR (CYAMOPSIS TETRAGONOLOBA (L.) TAUB).
Karachi Univ. (Pakistan). Dept. of Botany.
For primary bibliographic entry see Field 3C.
W91-01149

CANOPY TEMPERATURE AS AN INDICATOR OF DIFFERENTIAL WATER USE AND YIELD PERFORMANCE AMONG WHEAT CULTIVARS.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 3F.
W91-01407

DYNAMICS OF ROOT AND SHOOT GROWTH OF BARLEY UNDER VARIOUS LEVELS OF SALINITY AND WATER STRESS.
Agriculture and Water Resources Research Centre, Baghdad (Iraq). Dept. of Soil and Land Reclamation.
For primary bibliographic entry see Field 3F.
W91-01409

CLIMATIC CONTROL OF VEGETATION DISTRIBUTION: THE ROLE OF THE WATER BALANCE.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
For primary bibliographic entry see Field 2B.
W91-01684

HEAT STRESS, PLANT-AVAILABLE SOIL MOISTURE, AND CORN YIELDS IN IOWA: A SHORT- AND LONG-TERM VIEW.
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W91-01703

CLIPPING DATE EFFECTS ON SOIL WATER AND REGROWTH IN CRESTED WHEATGRASS.
Oregon State Univ., Union. Eastern Oregon Agricultural Research Center.
For primary bibliographic entry see Field 2G.
W91-01706

EFFECT OF SOIL WATER, NITROGEN, AND GROWING DEGREE-DAYS ON MORPHOLOGICAL DEVELOPMENT OF CRESTED AND WESTERN WHEAT-GRASS.
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
A. B. Frank, and R. E. Ries.
Journal of Range Management JRMGAQ, Vol. 43, No. 3, p 257-260, May 1990. 2 fig, 4 tab, 14 ref.

Descriptors: *Grasses, *Nitrogen, *Soil chemistry, *Soil water, *Soil-water-plant relationships, *Wheat, Morphology, Plant growth, Vegetation.

Production of total forage dry matter is mainly a function of available soil water and soil nitrogen (N), whereas plant morphological development from spring greenup to anthesis is primarily controlled by air temperature. There is a lack of

information on the effects of soil water and soil N on plant morphological development. A study was conducted in a rain-out shelter at Mandan, North Dakota, over a three year period to determine the effect of 2 fertilizer N rates (11 and 110 kg N/ha) and three rates of applied water (50, 100, and 150% of long-term April-November rainfall at Mandan, North Dakota) on the morphological development of initial spring growth and fall regrowth of crested wheatgrass (Agropyron desertorum) and western wheatgrass (Pascopyrum smithii). Regression analysis of plant development stage with accumulated growing degree days (GDD) was linear for both initial and regrowth forage. There were no differences in the rate of plant development for the three rates of applied water or the 2 rates of N fertilizer. Initial growth forage of crested and western wheatgrass required 82 and 98 GDD to produce a leaf, respectively. Regrowth forage of crested wheatgrass required 372 and western wheatgrass 135 more GDD than initial growth to produce a leaf. These data confirm that plants develop primarily in response to air temperature and not added water or N, which enhances the utility of using the accumulation of GDD for predicting development of crested and western wheatgrass under different growing conditions. This information can be useful for predicting plant development of these species in growth models, and for farmers and ranchers in predicting grazing readiness. (Author's abstract)
W91-01707

INFLUENCE OF ORGANIC SEDIMENT AMENDMENTS ON GROWTH AND TUBER PRODUCTION BY POTAMOGETON PECTINATUS L.
Agricultural Research Service, Davis, CA. Aquatic Weed Control Research Lab.
D. F. Spencer.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 3, p 255-263, June 1990. 3 fig, 2 tab, 19 ref.

Descriptors: *Aquatic plants, *Aquatic soils, *Plant growth, *Sago pondweed, *Sediments, *Soil amendments, *Soil-water-plant relationships, Macrophytes, Nutrients, Organic compounds, Organic matter, Peat, Sugars.

Results from experiments with Potamogeton pectinatus L. grown in an artificial substrate amended with various combinations of peat and glucose or sucrose suggest that plant weight and the number of tubers produced per plant increased significantly when plants were grown in sediment amended with peat. Contrary to expectations, the addition of labile organic components, glucose or sucrose, to the substrate (up to 15%, w/w) did not influence plant growth. Plants grown in sediment amended with peat had higher levels of tissue Fe. The weight of tubers produced per gram of non tuber tissue was not influenced by sediment properties. These results support the hypothesis that the mechanism by which sediment organic matter affects macrophyte growth is by altering sediment density. (Author's abstract)
W91-01740

STRENGTH OF SCLEROPHYLLOUS CELLS TO RESIST COLLAPSE DUE TO NEGATIVE TURGOR PRESSURE.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Plant Sciences.
J. J. Oertli, S. H. Lips, and M. Agami.
Acta Oecologica, Vol. 11, No. 2, p 281-289, 1990. 2 fig, 1 tab, 19 ref.

Descriptors: *Desert plants, *Drought, *Drought resistance, *Moisture deficiency, *Plant physiology, *Plant tissues, *Plant water potential, *Turgidity, *Water stress, Adaptation, Cytology, Cytorrhysis, Hydrostatic pressure, Plant growth, Plant morphology, Plant populations, Sclerophylly.

When the hydrostatic pressure within the protoplast drops below 1 bar (0.1 MPa), i.e., when the turgor pressure becomes negative while the external pressure is atmospheric at one bar, the plant cell is exposed to a compressive stress and will collapse if the stress is sufficiently great. A method is described to measure the strength of cell walls to resist such a collapse. Pressure differences of much less than 0.1 MPa suffice to cause collapse of cells in mesophyllic tissues. In contrast, some Mediterranean and desert plants contain cells with thickened walls that exhibit considerable resistance to collapse. Smaller cells, as are often observed under drought also improve the resistance to collapse. Ephemeral desert plants or organs again show mesophyllic tissues with only nominal resistance. The hypothesis is forwarded that sclerophylly is a mechanism of adaptation to drought if a sufficient quantity of water is available to the plant to survive year round. This is the case for Mediterranean shrubs and trees growing in the desert along ground water courses where the available water is increased by an influx of water from other areas. Desert plants that have to rely solely on local precipitation show a phenological adaptation with mesophyllic tissues. (Author's abstract)
W91-01800

NEW GENE SOURCES FOR DEVELOPMENT OF AGRONOMIC PLANTS WITH TOLERANCE TO DROUGHT AND OTHER ABIOTIC STRESSES.
New Mexico State Univ., Las Cruces. Dept. of Chemistry
For primary bibliographic entry see Field 3B.
W91-01859

2J. Erosion and Sedimentation

DISSOLVED AND SUSPENDED SOLIDS TRANSPORT FROM COASTAL PLAIN WATERSHEDS.
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W91-01011

VARIATIONS IN SUSPENDED SEDIMENT AND ASSOCIATED TRACE ELEMENT CONCENTRATIONS IN SELECTED RIVERINE CROSS SECTIONS.
Geological Survey, Doraville, GA.
A. J. Horowitz, F. A. Rinella, P. Lamothe, T. L. Miller, and T. K. Edwards.
Environmental Science and Technology ESTHAG, Vol. 24, No. 9, p 1313-1320, September 1990. 7 tab, 10 ref.

Descriptors: *Path of pollutants, *River sediments, *Sampling, *Sediment transport, *Suspended sediments, *Trace elements, River mechanics, Spatial variation, Temporal distribution, Time series analysis.

Detailed sampling and subsequent analyses of riverine suspended sediment obtained from six rivers in the US (Cowlitz River, San Joaquin River, Arkansas River, West Fork Big Blue River, Des Plaines River, North Fork Kentucky River) indicate substantial differences in suspended sediment concentrations and possibly in some associated trace elements, depending on whether depth and width-integrated, point, or pumping samples are used. In addition, the data from time series, depth-integrated sampling indicate that there can be substantial short-term (on the order of 20-30 minutes) spatial and/or temporal variations in suspended sediment concentrations. Despite this, major element concentrations are remarkably stable both spatially and temporally. Trace element concentrations are generally stable; however, some spatial and temporal variations may occur. (Author's abstract)
W91-01061

FLOODPLAIN DYNAMICS OF A WANDERING RIVER, DENDOCHRONOLOGY OF THE MORICE RIVER, BRITISH COLUMBIA, CANADA.
Northwest Community Coll., Terrace (British Columbia).
For primary bibliographic entry see Field 2E.
W91-01070

FLOW AND PARTICLE PATHS AT A NATURAL RIVER CONFLUENCE WITH COARSE BED MATERIAL.
Montreal Univ. (Quebec). Dept. of Geography.
A. G. Roy, and N. Bergeron.
Geomorphology GEMPEZ, Vol. 3, No. 2, p 99-112, June 1990. 8 fig, 23 ref.

Descriptors: *Channel morphology, *Geomorphology, *River beds, *River flow, *River sediments, *Sediment transport, Flow velocity, Gravel, River mechanics.

An investigation of flow and particle trajectories was conducted at a gravel bed confluence where the junction angle is gradually reduced from 60 to 20 degrees as the tributary joins the main channel. A shallow and elongated scour zone is present at the mouth of the tributary. Three flow stages ranging from 1/7 to 1/2 bankfull were recorded. Flow velocity vectors were measured from 5 bridges installed across the channels. Sediment transport paths were determined by following the progression of seeded marked particles through the confluence from May to October 1986. The results show that flow structure is responsive to stages. At lower stages (less than 1/3 bankfull) flow velocity vectors are controlled by local bed topography and specifically by the steeper slopes around the scour zone. At higher stages, velocity vectors become aligned with the plain geometry of the confluence. For all stages, surface flow velocities are higher in the scour zone. Bed shear stress computed from the law of the wall for the deepest flow is higher at the bottom of the scour zone compared to its side, head and exit. The trajectories of the particles seeded on the tributary pass through the scour zone. Particles coming from the main channel displayed a dual pattern first moving laterally towards the scour zone early in the season then following paths that are consistent with the palin geometry of the confluence. The shift in pattern reflects an increase in the peak discharges during the survey period. These results highlight the role of siege in controlling the flow dynamics and particle paths at the confluence. (Author's abstract)
W91-01071

VARIABILITY OF WATER REPELLENCE IN THE DUNES ALONG THE DUTCH COAST.
Amsterdam Univ. (Netherlands). Lab. for Physical Geography and Soil Science.
P. D. Jungerius, and J. H. de Jong.
Catena, Vol. 16, No. 3, p 491-497, June 1989. 2 fig, 3 tab, 15 ref.

Descriptors: *Erosion, *Soil water, *The Netherlands, *Water repellent soils, Organic matter, Soil profiles, Spatial distribution, Temporal distribution, Wind erosion.

The grey dunes along the Dutch coast are more sensitive to erosion by slope wash than erosion by wind, because the grey sand is extremely water repellant when dry. On the other hand, slope wash triggers wind erosion because the removal of the grey sand exposes the yellow sand which is sensitive to wind erosion. Water repellance of dune soils can best be measured with the waterdrop penetration time (WDPT); however, temporal and spatial variability of the WDPT values is high. There is a complex relationship between water repellance and organic matter content; age of organic matter appears to be more important than type of vegetation cover. Surface water repellance is generally much lower than the water repellance of the A horizon below the depth of a few millimeters, possibly due to the presence of algae. (Author's abstract)
W91-01081

CHEMICAL AND PHYSICAL SPECIATION OF TRACE METALS IN FINE GRAINED OVERBANK FLOOD SEDIMENTS IN THE TYNE BASIN, NORTH-EAST ENGLAND.
Newcastle upon Tyne Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W91-01082

LIBRARY U. S. GEOLOGICAL SURVEY

VARIABILITY OF PARTICLE SIZE CHARACTERISTICS OF SHEETWASH SEDIMENTS AND FLUVIAL SUSPENDED SEDIMENT IN A SMALL SEMIARID CATCHMENT, KENYA.
Toronto Univ. (Ontario). Dept. of Geography.
R. A. Sutherland, and R. B. Bryan.
Catena, Vol. 16, No. 4/5, p 189-204, August/October 1989. 5 fig, 5 tab, 51 ref.

Descriptors: *Erosion, *Particle size, *Sediment transport, *Sedimentation, *Semiarid climates, *Suspended sediments, *Watersheds, Catchments, Kenya, Mathematical models, Pollution load, Soil types, Storms.

The variability of particle size characteristics for sheetwash sediments and fluvial suspended sediments are investigated in three representative storm events in a small 0.30 sq km erodible semiarid catchment. Suspended sediment output per event ranged from 340 to 810 t/sq km. Ninety-eight percent of the suspended sediment was less than 63 microm, and was supplied from remobilization of stored coluvium. Discharge and particle size class relationships were complex for various storm events, but were best described by third-order polynomial functions. Results of a one-way analysis of variance showed that concentrations of total suspended sediment, silt and sand varied significantly between storm events. Temporal variation of clay concentration in runoff waters were not significant, suggesting that a single hillside source area contributed to the channel subsystem. The mean grain size and sorting of sheetwash sediments were significantly different from fluvial suspended sediment for individual storm events. Sheetwash sediments were coarser and more poorly sorted than fluvial suspended sediments. Enrichment ratios indicated selective erosion and transport of silt and clay, and preferential deposition of sands. If continuous measurements of suspended sediment concentrations are not available, rating curves must be established to predict catchment sediment loads and transport of contaminants from discharge data. Development of individual rating curves for the geochemically active fractions, silt and primarily clay-sized particles, would improve the estimates of nutrients and contaminant loads transported from drainage basins. (Brunone-PTT)
W91-01084

SPATIAL SCALE DEPENDENCE OF SEDIMENT DYNAMICS IN A SEMI-ARID BADLAND DRAINAGE BASIN.
Alberta Univ., Edmonton. Dept. of Geography.
D. H. de Boer, and I. A. Campbell.
Catena, Vol. 16, No. 4/5, p 277-290, August/October 1989. 6 fig, 2 tab, 29 ref.

Descriptors: *Drainage area, *Geomorphology, *Runoff, *Sediment transport, *Sedimentation, *Semiarid climates, *Watersheds, Hysteresis, Rainfall, Sandstones, Sediment concentration, Sediment discharge, Shales, Topography.

Problems of spatial scale transference are of key interest in drainage basin research. The objective of this study was to investigate the spatial scale dependence of sediment dynamics in semi-arid badland drainage basins. Simulated rainfall experiments indicated that on microscale plots runoff generation and sediment entrainment occurred when total rainfall exceeded 0.5 to 6 mm on pediment surfaces, 1.5 to 4 mm on sandstone surfaces, and 8 to 25 mm on shale surfaces. The sediment concentration/discharge relationship for two mesoscale basins displayed a change from clockwise to counterclockwise hysteresis when total rainfall for the initiation of flow in deep tunnel systems. The initiation of tunnel flow causes counterclockwise hysteresis due to a delayed increase in sediment concentrations during a runoff event. This state contrasts with the clockwise hysteresis caused by flushing in the early stages of runoff for smaller rainstorms. Comparison of microscale and mesoscale sediment dynamics indicates that microscale thresholds are not by necessity in evidence at the mesoscale. In addition, at the mesoscale, elements exist which are non-existent at the microscale, e.g. a deep tunnel system. The behavior of the mesoscale basin is dominated by these elements rather than by the microscale components it contains. (Author's abstract)
W91-01085

LABORATORY EXPERIMENTS ON CRUST DEVELOPMENT AND RAINSPLASH EROSION OF LOESS SOILS, CHINA.
Toronto Univ. (Ontario). Dept. of Geography.
S. H. Luk, and Q. G. Cai.
Catena, Vol. 17, No. 3, p 261-276, June 1990. 7 fig, 2 tab, 48 ref.

Descriptors: *China, *Crust development, *Erosion, *Loess, *Rainfall impact, *Soil compaction, *Soil crusts, Soil morphology, Soil strength, Soil water.

Loess soil samples obtained from Wangjiagou, Lishi, China were subjected to laboratory simulated rainfall at intensities of 72 mm/hr for a range of durations from 1 to 30 minutes. Measured splash loss was found to relate to a soil strength index 1/(Psub20) squared. In this index, Psub20 is defined as penetration by a standard fall cone penetrometer at a moisture content of 20% and estimated from penetration-soil moisture regression equations. Similarly, subsequent splash loss of crust samples over a 10-minute period is significantly related to the antecedent soil strength index. As a result of crust development, strength of the surface soil is increased by as much as eleven times, while splash loss is reduced by a maximum of 76%. Data on splash loss and crust strength were used to infer that crust and seal development, while tending towards increasing stability as has been suggested previously, appear to follow a cyclic process of crust formation and disruption. This inference is supported by micromorphological observations. (Author's abstract)
W91-01087

HEAVY METAL DISTRIBUTION IN SEDIMENTS OF KRISHNA RIVER BASIN, INDIA.
McGill Univ., Montreal (Quebec). Dept. of Geological Science.
For primary bibliographic entry see Field 5B.
W91-01100

LONGITUDINAL DISPERSION PROCESSES IN THE UPPER TAMAR ESTUARY.
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W91-01127

TEMPORAL VARIABILITY OF REMOTELY SENSED SUSPENDED SEDIMENT AND SEA SURFACE TEMPERATURE PATTERNS IN MOBILE BAY, ALABAMA.
New Orleans Univ., LA. Center for Research in Ocean and Space Sciences.
For primary bibliographic entry see Field 2L.
W91-01131

DETERMINATION OF THE ORIGIN OF SUSPENDED MATTER AND SEDIMENTS IN THE ELBE ESTUARY USING NATURAL TRACERS.
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
For primary bibliographic entry see Field 2L.
W91-01132

SIMPLE PORE-WATER SAMPLER FOR COARSE, SANDY SEDIMENTS OF LOW POROSITY.
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 7B.
W91-01147

EQUILIBRIUM PARTITIONING AND BIOACCUMULATION OF SEDIMENT-ASSOCIATED CONTAMINANTS BY INFAUNAL ORGANISMS.
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W91-01267

PRODUCTION AND CARBON ISOTOPIC COMPOSITION OF BACTERIAL CO2 IN DEEP COASTAL PLAIN SEDIMENTS OF SOUTH CAROLINA.
Geological Survey, Columbia, SC. Water Resources Div.
P. B. McMahon, D. F. Williams, and J. T. Morris.
Ground Water GRWAAP, Vol. 28, No. 5, p 693-702, September/October 1990. 7 fig, 3 tab, 32 ref.

Descriptors: *Carbon dioxide, *Carbon isotopes, *Coastal plains, *Diagenesis, *Geochemistry, *Marine sediments, *Water chemistry, Bacteria, Organic matter, South Carolina.

Geochemical data accumulated since the 1940s have provided indirect evidence that bacterial CO2 can significantly impact the chemical evolution of groundwater. Recent data strongly suggest that bacterial CO2 is an important reactant in groundwater. Rates of bacterial CO2 production in laboratory incubations ranged from 0 to 2,750 nanomoles of CO2 per gram of South Carolina Coastal Plain sediment per day. On average, CO2 production was greater in downdip sediments than in updip sediments. There was no relation between CO2 production and total organic carbon content of the sediment. The carbon isotopic composition of bacterial CO2 ranged from -29.7 to -18.0 per mil and is controlled in part by the isotopic composition of the sedimentary organic matter from which the CO2 is derived. The isotopic composition of CO2 from downdip sediments was enriched in 13-carbon by 5% on average, relative to CO2 from updip sediments. Measurements of the production and carbon isotopic composition of bacterial CO2 given here provide evidence linking bacterial CO2 to dissolved inorganic carbon in Coastal Plain aquifers of South Carolina. (Author's abstract)
W91-01297

POLYCHLORINATED BIPHENYLS IN HOUSATONIC RIVER SEDIMENTS IN MASSACHUSETTS AND CONNECTICUT, USA: DETERMINATION, DISTRIBUTION, AND TRANSPORT.
Connecticut Agricultural Experiment Station, New Haven.
For primary bibliographic entry see Field 5B.
W91-01328

SUSPENSION AND SETTLEMENT OF PARTICLES IN FLOWING WATER: COMPARISON OF THE EFFECTS OF VARYING WATER DEPTH AND VELOCITY IN CIRCULATING CHANNELS.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
C. S. Reynolds, M. L. White, R. T. Clarke, and A. F. Marker.
Freshwater Biology FWBLAB, Vol. 24, No. 1, p 23-34, August 1990. 4 fig, 2 tab, 16 ref.

Descriptors: *Flow channels, *Flow velocity, *Sediment transport, *Sedimentation rates, *Suspended solids, *Water depth, Club mosses, Ecological distribution, Plankton, Sinking rate, Spores, Suspension.

An experimental study was designed to test the hypothesis that the loss of particles from suspension in flowing water follows an exponential decay function (the exponent is influenced more by water depth than water velocity). Successive experiments used suspensions of Lycopodium spores which were introduced into one of the circulating channels maintained at its Waterston site, Dorset, under different combinations of water depth and pumping rate. In each experiment the concentration of introduced spores declined exponentially through time. The bulked, transformed data-set also conformed well to a single regression against a common time scale which explained over 94% of the accumulated variances. The variance unexplained by the regression was apportioned among the components distinguishing between experiments: experimental differences in starting concen-

tration, water depth and pumping rate (velocity). This analysis revealed that, after elimination of different initial concentrations, only water depth produced a significant effect, through its relation to the settling velocity of the Lycopodium. Therefore, water depth and not flow velocity proved to be the main controlling variable determining the rate of sinking loss in these experiments. Nevertheless, flow velocity is an important component in the sense that it influences the horizontal distance traveled by the residual spore suspension through the time period required for complete settlement. In applying the findings to the maintenance of planktonic diatoms in rivers, it was found that both the survival of a potential growth inoculum and its downstream dispersion are strongly time-dependent and are enhanced by greater channel depths. (Author's abstract)
W91-01340

SILTATION OF STONE-SURFACE PERIPHYTON IN RIVERS BY CLAY-SIZED PARTICLES FROM LOW CONCENTRATIONS IN SUSPENSION.
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
A. A. Graham.
Hydrobiologia HYDRB8, Vol. 199, No. 2, p 107-115, July 24, 1990. 2 tab, 43 ref.

Descriptors: *Clays, *New Zealand, *Periphyton, *Rivers, *Silting, *Suspended sediments, Food chains, Macroinvertebrates, Particle size, Sediment deposition, Streambeds, Turbidity.

The observation that deposits of fine sediment are found on stream beds only in areas of slower water velocity promotes a common misunderstanding of the depositional behavior of fine suspensoids in flowing water and a disregard for the potential for siltation effects on the biota on the surface of stones in fast flowing water. A model for deposition from turbulent water, whereby particles are lost from suspension where water currents are slowed by boundary friction, provides an explanation for silt infiltration into epilithic periphyton. Theoretically calculated deposition rates of clay sized mineral particles at low suspended concentrations (2 to 5 g/cu m) were found to account for observed rates of silt accumulation in epilithic periphyton in a braided river in the South Island of New Zealand. At concentrations between 1 and 10 g/cu m of suspended mineral silt during normal flow, silt accumulation in epilithic periphyton accounted for about 50% of its dry weight. This caused a reduction in the mean organic content of the periphyton to 22% of the dry weight compared to 52% in a reference stream where the concentration of suspended mineral particles was less than 1.0 g/cu m during non-freshet flow. Siltation of periphyton reduces its value/availability as food for the aquatic macroinvertebrates that unselectively consume periphyton. Food value can be a major influence on several aspects of invertebrate production: density, growth rate, survival, size at pupation, emergence success, and fecundity. The effect of fine silt deposition on the organic-inorganic proportions of the periphyton will vary, depending on the growth rate of the periphyton standing crop relative to the rate of accumulation of inorganic silt. (White-Reimer-PTT)
W91-01353

ESTIMATE OF SNOW AVALANCHE DEBRIS TRANSPORT, KAGHAN VALLEY, HIMALAYA, PAKISTAN.
Waterloo Univ. (Ontario). Dept. of Geography.
I. Bell, J. Gardner, and F. de Scally.
Arctic and Alpine Research ATLPAV, Vol. 22, No. 3, p 317-321, August 1990. 2 fig, 2 tab, 12 ref.

Descriptors: *Avalanches, *Pakistan, *Sediment transport, *Snow, Kaghan Valley, Sediment load.

Debris transport by snow avalanches in the front ranges of the Himalaya in northern Pakistan is described using estimates of sediment concentration in avalanche snow deposits. Data were collected from two end-of-season avalanche deposits in the Kaghan Valley. Sediment concentration estimates and measurements of avalanche deposit volumes were used to produce estimates of total sediment load. From these, deposit area accretion values of 0.74 and 0.21 mm for the two deposits representing the 1986/87 avalanche season were derived. The estimates reported here are within the range of avalanche debris transport and deposition values reported in previous research. (Author's abstract)
W91-01371

BIOSEDIMENTOLOGY AND PALEOHYDROLOGY OF HOLOCENE STROMATOLITES FROM LAKE TANGANYIKA (BIOSEDIMENTOLOGIE DES STROMATOLITES HOLOCENES DU LAC TANGANYIKA (BURUNDI). IMPLICATIONS HYDROLOGIQUES).
Quebec Univ., Montreal. Centre Geochimie Isotopique et Geochronologie.
J. Casanova, and C. Thouin.
Bulletin de la Societe Geologique de France, Vol. 8, No. 4, p 647-656, July 1990. 3 fig, 1 tab, 2 plates.

Descriptors: *Algae, *Climatology, *Lake Tanganyika, *Limnology, *Paleohydrology, *Sedimentology, *Stromatolites, Biological studies, Copper, History, Lake Kivu, Light intensity, Salinity.

Lake Tanganyika stromatolites occur at depths ranging from 6 to 60 m. They mark former low lake levels and document the recent hydroclimatic history of the basin from 3,500 to 1,300 B.P. During this period, conditions more arid than today closed the Tanganyika basin, and the water level dropped to 10 m below the present depth. Stromatolites developed continuous planar encrustations on vertical surfaces, as well as thick encrustacians around blocks and pebbles. Biological competition in benthic microbial communities favored columnar growth; the resulting structures show digitate, dendroid and anastomosed branching styles. Stromatolites occurrence depends on limnological parameters such as salinity, light, Ca concentration, and turbidity, and their growth is partly controlled by sporadic discharges of eutrophic waters from Lake Kivu. Lake Tanganyika stromatolites illustrate the complexity of freshwater stromatolites ecological requirements that explains their relative scarcity in East African rift. (Author's abstract)
W91-01372

ANCIENT CHANNELS OF THE SUSQUEHANNA RIVER BENEATH CHESAPEAKE BAY AND THE DELMARVA PENINSULA.
Geological Survey, Woods Hole, MA.
S. M. Colman, J. P. Halka, C. H. Hobbs, R. B. Mixon, and D. S. Foster.
Geological Society of America Bulletin BUGMAF, Vol. 102, No. 9, p 1268-1279, September 1990. 11 fig, 45 ref.

Descriptors: *Chesapeake Bay, *Delmarva Peninsula, *Glaciation, *Paleohydrology, *River channels, *Sea level, *Sedimentology, *Stratigraphy, *Susquehanna River, Channels, Glaciohydrology.

Three generations of the ancestral Susquehanna River system have been mapped beneath Chesapeake Bay and the southern Delmarva Peninsula. Closely spaced seismic reflection profiles in the bay, and boreholes in the bay and on the southern Delmarva Peninsula allow detailed reconstruction of each paleochannel system. The channel systems were formed during glacial low sea-level stands, and each contains a channel-fill sequence that records the subsequent transgression. The trunk channels of each system are 2 to 4 km wide and are incised 30 to 50 m into underlying strata; they have irregular longitudinal profiles and very low gradients within the Chesapeake Bay area. The three mainstem channels diverge from the head of the bay toward the southeast. The channels are rarely coincident, although they commonly intersect. All three main channels pass beneath the southern Delmarva Peninsula forming an age progression from north (oldest) to south (youngest) beneath the peninsula, and from east (oldest) to west (youngest) beneath Chesapeake Bay. Southward progradation of the tip of the peninsula during interglacial high sea-level stands caused southward migration of the mouth of the bay, so that the next generation of channels were incised progressively further toward the southwest. The youngest paleochannel is clearly of late Wisconsonian age, about 18 ka, and the intermediate one appears to be late Illinoian in age, or about 150 ka. The age of the oldest paleochannel is not well constrained, but it is in the range of about 200 to 400 ka. The three paleochannel systems imply a dynamic coastal-plain environment and at least two previous generations of the Chesapeake Bay. Both the Chesapeake Bay and the Delmarva Peninsula have changed considerably in the past half million years. (Author's abstract)
W91-01378

PITFALLS OF SEQUENTIAL EXTRACTIONS.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 2K.
W91-01428

PECULIARITIES OF THE FORMATION OF BOTTOM DEPOSITS IN A CLOSED-COOLING POND.
For primary bibliographic entry see Field 8C.
W91-01444

MONITORING THE EROSION OF AN EXPRESSWAY DURING ITS CONSTRUCTION: PROBLEMS AND LESSONS.
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
S. J. Riley.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 4, p 365-381, August 1990. 7 fig, 29 ref. NSW Department of Main Roads, funds administered by the Soil Conservation Service of NSW.

Descriptors: *Road construction, *Sediment erosion, *Soil erosion, Accelerated erosion, Australia, Catchment areas, Data acquisition, Drainage patterns, Electronic equipment, Electronic recorders, Monitoring, Sediment discharge, Sediment load, Sediment sampler.

Road construction sites are major sources of sediment and without careful control large quantities of sediment can be moved off-site during erosional events and cause significant economic and environmental damage. The dynamic nature of the catchment materials and drainage network require intensive and repetitive monitoring. The quick response times of the floods present problems of monitoring and gaging. The large quantities of sediment eroded from the F3 Expressway extension in the northern suburbs of Sydney, NSW, Australia, and the lack of defined channels within the catchment presented several problems of discharge and sediment load sampling. The monitoring equipment at the catchment outlet, namely pump samplers and capacitance-based water level sensors, was computer controlled, but for partial area monitoring manual methods were used together with Gerlach traps and erosion pins. The monitoring at the catchment outlet was cost-effective because of the use of electronic equipment. The experience on the F3 Expressway in NSW showed that the frequency of sensor sampling had to be on the order of 30 seconds. The high sediment loads, with coarse sediment concentrations in excess of 100 g/L, demanded frequent maintenance of equipment, particularly the pump samplers, and the need to install backup samplers to reduce the loss of data. In the future, use should be made of radio transmission of data from sensors to data logger to minimize the problems of disturbance. Low level photogrammatic surveys need to be undertaken after each storm event in order to record the detail of erosion and source areas. (Fish-PTT)
W91-01459

RAIN SCAVENGING OF TEPHRA AEROSOLS FROM MOUNT ST. HELENS 1980 ERUPTIONS.
Arkansas Univ., Fayetteville. Dept. of Geology.
For primary bibliographic entry see Field 2B.
W91-01468

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DEVELOPMENT, CALIBRATION AND FIELD TESTING OF A SOIL LOSS AND A RUNOFF MODEL DERIVED FROM A SMALL-SCALE PHYSICAL SIMULATION OF THE EROSION ENVIRONMENT ON ARABLE LAND IN ZIMBABWE.
Institute of Agricultural Engineering, Harare (Zimbabwe).
H. A. Elwell.
Journal of Soil Science JSSCAH, Vol. 41, No. 2, p 239-253, June 1990. 11 tab, 18 ref.

Descriptors: *Agriculture, *Data interpretation, *Land loss, *Rainfall-runoff relationships, *Runoff forecasting, *Soil erosion, *Zimbabwe, Arable soils, Calibrations, Cropland, Field tests, Mathematical models, Model studies, Model testing, Rill erosion, Sheet erosion.

Measured soil losses from field plots under natural rainfall are the traditional data source for building farm-oriented prediction models. An exploratory investigation was made into the potential of small-scale physical mimicry in the development of mathematical models which, after calibration, would yield predictions of field-scale runoff and soil losses arising from sheet erosion (interrill) processes. Soil loss and runoff prediction models were developed for a clay soil in Zimbabwe from a five-factor small-scale physical simulation of the field environment by following a central composite rotatable experimental design. The uncalibrated models efficiently ranked observed annual soil losses and runoff over a 4-year period between nine field treatments. Each treatment consisted of two bare fallows, two weed fallows and five plots cropped to soybeans. When calibrated against the field data, the soil loss model predicted the 4-year mean losses from cropped and bare fallow treatments to within 6% for two of the plots, to within 12% for five of the plots, and to within 14% for all seven treatments. Over the same period, the runoff model predicted mean annual runoff for the cropped and bare fallow treatments to within 4% for four of the plots and to within 16% for all seven treatments. Percentage of vegetal cover proved to be an adequate parameter for describing the role of the soybean crop in runoff and soil loss processes for a wide range of planting densities of the crop. However, it did not prove to be an efficient index for weed fallows and it was apparent that factors other than simple above-ground cover became important soon after germination. (Author's abstract)
W91-01478

DEVELOPMENT OF BED FEATURES.
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
A. J. Raudkivi, and H. H. Witte.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 9, p 1063-1079, September 1990. 10 fig, 3 tab, 12 ref, append.

Descriptors: *Alluvial channels, *Channel morphology, *Geomorphology, *Mathematical models, *Model studies, *River beds, *Sediment transport, *Streambeds, Flow models, Numerical analysis, Uniform flow.

The concept of unification, the opposite of branching theories used in biological sciences, has been introduced as a new avenue to investigate the behavior of bed features in alluvial channels under unidirectional flow. The approach starts with the theoretical concepts according to which the features propagate at speeds inversely proportional to their heights. This leads to coalescence and rearrangement of the general pattern of bed features. Numerical experiments show that an initial large number of arbitrary bed disturbances rapidly reduces to a small number. If one feature reaches the maximum height for given flow conditions, smaller features pass through it. An initial uniform distribution of heights of disturbances slowly changes into a broad distribution of heights with some at the maximum height, similar to what is observed in nature. (Author's abstract)
W91-01491

MODELING EROSION OF SAND AND SILT BED RIVER.
Barnett Consultants, Hamilton (New Zealand).
H. L. MacMurray, and M. N. R. Jaeggi.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 9, p 1080-1089, September 1990. 6 fig, 11 ref.

Descriptors: *Hydraulic models, *Model studies, *River sediments, *Sediment erosion, *Sediment transport, *Stream erosion, Alluvial plains, Channel erosion, Lake sediments, Sand, Silt, Wash load.

A conventional numerical river model that failed to adequately reproduce the erosion of a 20-km stretch of a sand-bed river, was modified to allow a substantial proportion of the eroded material to be designated as transported in the form of wash load. This reflects the formation of the river plain from proglacial lake sediments, which commonly have a large silt fraction. Because wash load has practically no effect on the transport capacity, except at very high concentrations, less of the transport capacity is devoted to transport of already eroded material, and more to further erosion. By assuming the proportion of silt to be 40%, the observed erosion could be satisfactorily reproduced. The average wash-load concentration that follows from this assumption is quite small. (Author's abstract)
W91-01492

THREE-DIMENSIONAL COMPUTATION OF FLOW AND BED DEFORMATION.
Civil Engineering Research Inst., Sapporo (Japan).
Y. Shimizu, H. Yamaguchi, and T. Itakura.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 9, p 1090-1108, September 1990. 11 fig, 28 ref, append.

Descriptors: *Channel morphology, *Data interpretation, *Flow models, *Model studies, *Numerical analysis, *River beds, *Three-dimensional model, Bed load, Channel flow, Dimensional analysis, Flow equations, Flow velocity, Sediment transport, Suspended load.

Several studies have been made to evaluate flow and bed variation in curved channels. Numerical models are useful in that they can be applied to channels with various plane geometries and boundary conditions. A three-dimensional (3D) flow model was developed to improve the defects of a two-dimensional (2D) model. Calculated results were compared with experiments as well as with results calculated by the 2D model. It was found that the flow field is predicted more closely by the 3D model than the 2D model. A simplification of the full 3D model assumes the depthwise profile of the velocity to be logarithmic. This approach was favorably tested in the calculation of flow in a meandering bend. The simplified 3D model was applied to the computation of bed deformation by bed load as well as suspended load transport in meandering channels. Good agreements were found in comparison with the experimental results. A definite difference between the 3D and 2D models was found in the predicted bed deformation with suspended load. Evaluations of the flow and bed deformation by the proposed model were clearly demonstrated through application examples, and the validity of the new calculation model was verified. (Author's abstract)
W91-01493

CHANGES IN STREAM MORPHOLOGY AND STORM TRANSPORT OF SESTON FOLLOWING WATERSHED DISTURBANCE.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
S. W. Golladay, J. R. Webster, and E. F. Benfield.
Journal of the North American Benthological Society JNASEC, Vol. 6, No. 1, p 1-11, March 1987. 4 fig, 6 tab, 49 ref. National Science Foundation Grants BSR 8316000 and BSR 8012093.

Descriptors: *Appalachian Mountains, *Channel morphology, *Forest watersheds, *Sediment transport, *Seston, *Storm runoff, *Streams, Flow discharge, Headwaters, North Carolina, Organic matter, Particulate matter, Seasonal variation, Storms.

Headwater streams are closely linked to the areas they drain, thus watershed disturbance can cause severe disruption within streams. Surveys of stream morphology and measurements of particulate organic matter (seston) transport were made in four streams to examine response to forest disturbance. Seston was sampled during baseflows and stormflows in streams draining an 8-year-old clearcut, a 25-year-old clearcut, and two reference watersheds in the southern Appalachian Mountains of North Carolina. The surveys indicated that there were fewer debris dams and organic matter accumulations in disturbed streams. Baseflow seston concentrations varied seasonally (0.5 to 1.0 mg/L in winter and 3.0 to 7.0 mg/L during summer). Baseflow seston concentrations did not differ consistently between streams. In all streams, seston concentration increased with increasing discharge during storms and was positively correlated with the rate of change of discharge during rising flows. Seston concentrations decreased during peak flows and gradually declined as discharge returned to baseflow. Average seston concentrations during storms were generally highest in streams draining disturbed watersheds, and export was significantly higher in streams draining disturbed watersheds. Storm transport varied with season, storm intensity, and storm duration. Baseflow seston concentrations in streams draining disturbed areas may return to normal levels within a few years following disturbance; however, concentrations during storms may remain elevated for many years. (Author's abstract)
W91-01505

NUMERICAL SIMULATION OF GRAVEL RIVER WIDENING.
Delaware Univ., Newark. Dept. of Geology.
J. E. Pizzuto.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 1971-1980, September 1990. 14 fig, 1 tab, 35 ref.

Descriptors: *Alluvial channels, *Bank erosion, *Channel morphology, *Erosion, *Gravel, *Model studies, *River widening, *Stream banks, Bank failure, Flumes, Sediment transport.

A numerical model, which simulates bank erosion in a straight channel composed of noncohesive sediment, predicts the distribution of boundary shear stress, cross-channel sediment transport rates and the evolution of the bed topography. When erosion produces a bank slope which exceeds the angle of repose, widening occurs by a planar bank failure. Equilibrium channels produced by the model have flat beds and curved bank regions which are similar to the classical cosine stable bank profile. Equilibrium values of dimensionless depth are inversely proportional to the slope, as suggested by previous studies. The model also reproduces the exponential cross sections created during laboratory experiments. However, as the computations proceed, the exponential profiles slowly develop a flat bed and a curved bank region, suggesting that past flume experiments of channel widening may have frequently been terminated before a stable equilibrium form had evolved. (Author's abstract)
W91-01516

THEORETICAL MODEL OF OPTIMAL DRAINAGE NETWORKS.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2E.
W91-01526

STATISTICAL CHARACTERISTICS OF SOME ESTIMATORS OF SEDIMENT AND NUTRIENT LOADINGS.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
R. T. Clarke.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2229-2233, September 1990. 4 fig, 1 tab, 8 ref.

Descriptors: *Model studies, *Nonpoint pollution sources, *Probability distribution, *Sediment load, *Sediment yield, *Statistical analysis, Estimating, Mathematical models, Sediment discharge.

Some of the statistical characteristics of estimators of sediment load which require the integration over time of the product of a concentration (c) with a discharge (q) were examined. Using a bivariate lognormal distribution for the discrete variables approximate confidence intervals were calculated for an unbiased estimator of sediment yield, and the exact sampling distribution of the estimator was obtained by numerical integration of a Fourier transform. This permits an investigation of the rapidity with which the estimator tends to normality. Provided the data sequences are serially independent, the same technique can be used to obtain the distribution of an estimator without the assumption of bivariate lognormality. Some characteristics of an 'extrapolation' estimate of sediment yield were derived, in which power law regression is used to estimate concentration from discharge when measurements of the latter are more plentiful than the former. Subject to model assumptions, the extrapolation estimate was found to underestimate the true sediment load, although its variance is smaller; this confirms previously published results obtained by empirical sampling and alternative theoretical approaches. (Author's abstract)
W91-01538

DEPRESSIONAL STORAGE FOR MARKOV-GAUSSIAN SURFACES.
National Soil Erosion Lab., West Lafayette, IN.
C.H. Huang, and J. M. Bradford.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2235-2242, September 1990. 12 fig, 2 tab, 13 ref.

Descriptors: *Depression storage, *Erosion, *Markov process, *Mathematical analysis, *Ponding, *Rainfall-runoff relationships, *Soil erosion, Roughness, Soil physical properties, Storage, Topography.

Processes during rain events, such as infiltration, runoff, soil erosion, and crust formation, are influenced in part by depressional storage and surface roughness. If the surface topography is known, its potential depressional storage can be calculated. A study was conducted to relate the statistical parameters for quantifying surface roughness to depressional storage. Analysis of topographic data sets digitized at millimeter grids by a laser scanner showed that soil roughness can be quantified by a Markov-Gaussian (M-G) type random process. A Monte Carlo simulation procedure was used to find the mean ponding characteristics from simulated M-G surfaces. Depressional storages were found to be functions of two M-G parameters, two sample length scales, and the slope steepness. The Markov parameters are the global variance and the correlation length scale (L), and the sample length scales are grid spacing (delta x) and side length (L sub s). After proper scaling, all storage functions collapsed into two nondimensional relationships: 1) storage at zero slope as a function of relative sample length scale, and (2) storage as a function of scaled slope. When L = O, simulated surfaces followed the random Gaussian model and the nondimensional storage was only a function of scaled slope. Storages calculated from digitized elevation data sets with M-G type statistics agreed well with results obtained from simulated surfaces. (Author's abstract)
W91-01539

STUDY ON GEOCHEMISTRY AND GEOCHEMICAL CLASSIFICATION OF ELEMENTS B, F, RB AND SR IN YELLOW SEA (HUANG HAI) SEDIMENTS.
Academia Sinica, Qingdao (China). Inst. of Oceanology.
T. Wang.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 20, No. 6, p 517-527, November 1989. 6 fig, 5 tab, 13 ref.

Descriptors: *Boron, *Calcium, *Fluorine, *Geochemistry, *Marine sediments, *Rubidium, *Strontium, *Yellow Sea, Clay minerals, Cluster analysis, Marine pollution, Metals, Particle size, Sediment distribution, Spatial distribution, Statistical analysis.

The abundance of the boron, fluorine, rubidenum, and strontium through distribution characteristics, correlative relationships, and other geochemical characteristics were studied. Elemental compositions were correlated to the grain size of the sediment. It was found that concentrations of B, F, and Rb increased with decreasing sediment grain size, while Sr levels decreased. Further, B, F, and Rb were found in greater association with clay minerals. Levels of B and F in heavy minerals were much higher than in lighter minerals. Geochemically, B and Rb were found to have a close relationship with Al, and F with siderophile elements. Concentrations of Sr relate directly to Ca levels, and become further enriched in carbonates. R-cluster analysis showed that the 19 elements analyzed in the Yellow Sea sediments can be divided into two groups: one primarily from terrigenous materials, and the other from authigenic and biogenic accumulation. Q-cluster analysis suggested that these same Yellow Sea sediments be divided into three types: (1) composed of fine and current sediments containing more B, F, Rb and other philo-clay elements. This type of sediment is formed in weakly hydrodynamic and reducing environments; (2) large grain and residual sediments, which enrich Sr and Ca, and form in strongly hydrodynamic and residual sedimentary environments; and (3) large grain and current sediments which have characteristically low levels of Sr, Ca, B, F, Rb, and other elements. This type of sediment is formed mainly in strong hydrodynamic and temporal sedimentary environments. The major controlling factors for the geochemical characteristics of elements found in Yellow Sea sediments are: elemental properties, material sources, sediment types, hydrodynamic conditions, and physicochemical conditions. (Author's abstract)
W91-01566

LATERAL DISTRIBUTION OF SUSPENDED SEDIMENTS IN NEARSHORE WATER OF MUDDY COAST OF LIANYUNGANG HARBOUR (IN CHINESE).
East China Normal Univ., Shanghai. Inst. of Estuarine and Coastal Research.
D. S. Chen, L. Jin, Y. D. Tang, and A. Y. Yu.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 20, No. 6, p 544-553, November 1989. 10 fig, 2 tab, 3 ref. English summary.

Descriptors: *China, *Sediment distribution, *Sediment transport, *Statistical models, Lianyungang, Mathematical models, Model studies, Spatial distribution, Tidal currents, Wave action, Wave energy, Wave height, Yangshan Island.

The lateral distribution of sediments in waters of the Lianyungang Harbor were modeled using the statistical distribution of wave heights from the wave energy method. The mathematical expression for the region beyond the breaking wave zone was derived by superimposing data describing several lines of sediment dispersal. Sediment concentrations beyond the breaking zone were calculated from the wave energy and the position of the breaking wave zone. This model can calculate the distribution of sediment levels both inside and outside the breaking wave zone. The values calculated from the model match sediment concentrations actually measured offshore. The mixing and suspension of sediments inside the breaking zone and the dispersion of sediments by tidal currents offshore are described. The concentration of sediments inside the breaking zone increased with wave height at Yangshan island. Data correlating wave energy with wave height are also given. (King-PTT)
W91-01567

MICROORGANISMS IN MARINE SEDIMENTS: CONSIDERATIONS CONCERNING ACTIVITY MEASUREMENTS.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
L.-A. Meyer-Reil.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 1-6, 1990. 3 fig, 9 ref.

Descriptors: *Analytical methods, *Marine bacteria, *Marine ecology, *Marine sediments, *Microbiological studies, *Microorganisms, Bacterial analysis, Benthic environment, Enzymes, Sediment analysis, Sediments.

The measurement of microbial metabolic activity in marine sediments suffers from an insufficient knowledge of benthic microbial life and from an uncritical application of analytical methods to the sediment environment. Disturbance of the sediments causes a considerable stimulation of microbial metabolism. In sediments with high adsorption capacities and/or low microbial activity, extrapolated metabolic rates may vary considerably, depending on the choice of controls to account for the non-biological activity. Although of fundamental importance for the evaluation of the oxidation of organic substrates in sediments, the measurement of extracellular enzymatic activity still suffers from a number of drawbacks. Hydrolysis rates depend on the nature and the concentration of model substrates used to measure activity. New approaches based upon a critical application of methods, and taking into account the basic characteristics of benthic microbial life, are needed to study microbial metabolism in sediments. (MacKeen-PTT)
W91-01585

MEASUREMENT OF CO2-FIXATION IN SEDIMENTS: SOME THEORETICAL AND TECHNICAL ASPECTS.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
W. Reichardt.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 7-16, 1990. 9 fig, 2 tab, 15 ref.

Descriptors: *Analytical techniques, *Benthic environment, *Carbon dioxide, *Diagenesis, *Sediment analysis, *Sediment chemistry, *Sediments, Carbon dioxide fixation, Energy transfer, Marine sediments, Microbiological studies, Microorganisms.

To assess the contribution of dark fixation of carbon dioxide to benthic energy flow, rate measurements have to be specified in terms of 'autotrophic primary biosynthesis'. Determination of rates of aerobic chemoautotrophic carbon dioxide fixation in marine sediments was attempted with iodoacetamide as an inhibitor of ribulose 1,5-biophosphate carboxylase dependent pathways. Techniques established for phytoplankton primary productivity studies became very complicated when applied to sediments. In acidified sediment samples, the larger fraction of assimilated carbon was found in the dissolved, acid-soluble pool. To avoid artificial stimulation of carbon dioxide incorporation, core injection of small volumes of the substrate solution is recommended; however, control of its distribution during minimal incubation periods is desirable. (Author's abstract)
W91-01586

MEASUREMENT OF EXOENZYMATIC ACTIVITY IN STREAMBED SEDIMENTS USING METHYLUMBELLIFERYL-SUBSTRATES.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
J. Marxsen, and K.-P. Witzel.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 21-28, 1990. 4 fig, 1 tab, 17 ref.

Descriptors: *Analytical techniques, *Biodegradation, *Enzymes, *Microbial degradation, *Sediment chemistry, *Sediments, *Streams, *Substrates, Beta-D-glucosidase, Enzyme activity, Europe, Extracellular metabolism, Sediment analysis, Streambed sediments.

The microbial degradation of macromolecular organic compounds in aquatic environments involves a combination of processes, including extracellular enzymatic hydrolysis, the uptake of monomeric and oligomeric molecules into cells, and respiration. Methodological investigations of extracellular enzymatic hydrolysis were undertaken in differing stream habitats. 4-Methylumbelliferyl substrates

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were used to measure the activity of extracellular beta-D-glucosidase and phosphatase in small central European streams. The substrates could be used for stream water, sandy sediments, and coarser artificial substrata. Although beta-D-glucosidase activity per unit surface area was about ten times higher in coarse particulate sediments than in sandy sediments, maximum activity per unit volume was observed in sandy sediments. This means that for the streams as a whole, the greater proportion of the exoenzymatic cleavage activity occurs in the sandy streambed deposits. (MacKeen-PTT)
W91-01587

METHOD OF MEASURING THE DEHYDROGENASE ACTIVITY OF SEDIMENTS.
Sofia Univ. (Bulgaria). Dept. of Ecology.
B. B. Boyanovsky.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 29-31, 1990. 1 fig, 1 ref.

Descriptors: *Dehydrogenase activity, *Enzymes, *Microbiological studies, *Microorganisms, *Sediment chemistry, *Sediments, *Water chemistry, Anoxic conditions, Bacterial physiology, Benthic environment, Bottom sediments, Eutrophic lakes, Lake sediments, Sediment analysis.

A new modification of the dehydrogenase activity (DHA) test, using 2,3,5-triphenyl tetrazolium chloride (TTC) for the estimation of benthic microbial community metabolism in oxic and anoxic sediment is described. Suggestions for use include: a preliminary quantification of interstitial water in sediment samples in order to obtain a definite concentration of TTC and other chemicals; a one-hour incubation time; strict maintenance of anoxic conditions (even in primary oxic sediment samples); use of blanks, treated like other samples, but poisoned with formaldehyde; and measurement of TT-formazan extract absorbance at 520 nm instead of 485 nm. In a moderately eutrophic lake at the depth of 3 m, a 63% higher DHA was measured in the surface oxic sediment layer than in the anoxic layer 20 cm deep. Such activities are higher than in some activated sludges and approximately 10 times higher than in 1 cu m of the most-active river periphyton studied. Further examination of the effect of redox potentials is necessary and the results should eventually be related to the biomass and compared to other activity tests, especially in oxygen uptake. (MacKeen-PTT)
W91-01588

BACTERIAL PRODUCTIVITY IN SEDIMENTS.
Commonwealth Scientific and Industrial Research Organization, Cleveland (Australia). Marine Labs.
For primary bibliographic entry see Field 2H.
W91-01608

CAUSES AND CHARACTER OF MOVEMENTS OF THE LOAMY SAND MORAINE IN THE FOUNDATION OF THE PLYAVINYAS HYDROELECTRIC STATION POWERHOUSE.
For primary bibliographic entry see Field 8D.
W91-01651

NONLINEAR SOLUTION OF AGGRADATION AND DEGRADATION IN CHANNELS.
Detroit Water and Sewerage Dept., MI.
M. A. Gill.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 5, p 537-547, 1987. 4 fig, 8 ref.

Descriptors: *Aggradation, *Alluvial channels, *Degradation, *Mathematical analysis, *Sedimentation, Mathematical studies, River mechanics, Sediment supply, Sediment transport, Streamflow.

Channel aggradation and degradation are important in river control engineering. Aggradation occurs in an alluvial river when the imposed sediment supply exceeds the sediment transport capacity of the flow. The flow tends to degrade the river channel when its sediment transport capacity exceeds the sediment supply rate. A perturbation solution was presented for the non-linear aggradation/degradation problem. The first order solution was the linear solution published previously. The second order solution was believed to account for the non-linear character of the aggradation/degradation equation. A non-linear correction was needed when the ratio of the initial and final sediment supply rates was very small. For the degradation problem, non-linear correction was needed in most cases. (Miller-PTT)
W91-01668

COMPARISON BETWEEN MEASURED WAVE PROPERTIES AND SIMPLE WAVE HINDCASTING MODELS IN SHALLOW WATER.
North Carolina Univ. at Morehead City. Inst. of Marine Sciences.
For primary bibliographic entry see Field 8B.
W91-01671

SCOURHOLE DEVELOPMENTS IN SHALLOW TAILWATER.
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Civil and Systems Engineering.
For primary bibliographic entry see Field 8B.
W91-01674

MODELLING OF SANDWAVE EVOLUTION RESULTING FROM SUSPENDED AND BED LOAD TRANSPORT OF SEDIMENT.
Reading Univ. (England). Dept. of Meteorology.
For primary bibliographic entry see Field 8B.
W91-01675

STANDING-WATER DEPOSITS AS INDICATORS OF LATE QUATERNARY DUNE MIGRATION IN THE NORTHWESTERN NEGEV, ISRAEL.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
M. Magartiz, and Y. Enzel.
Climatic Change CLCHDX, Vol. 16, No. 3, p 307-318, June 1990. 5 fig, 1 tab, 27 ref.

Descriptors: *Dunes, *Geomorphology, *Negev Region, *Paleohydrology, *Playas, *Soil water, *Standing waters, *Surface-groundwater relations, Drainage systems, Glaciation, History, Israel.

Late Quaternary playa (Stand-water) deposits are present in river channels upstream from dune fields in the northwest Negev, Israel, and represent a drainage disordering caused by dune migration during periods of aridity. These deposits are associated with modifications in the drainage system, including course changes and piracy, caused by dunes blocking drainage networks. Radiocarbon dates from the standing water sediments indicate the occurrence of two periods of aridity: (1) 20,900 to 16,000 years B.P.; and (2) 11,680 to 10,300 years B.P. These two periods indicate a correlation between glacial advances in Europe and dry intervals in the Near East during the Upper Pleistocene. The authors suggest that spatial and temporal associations between standing water deposits, modifications in stream direction, soil formation and the dunes themselves can serve as a good indicator for the timing of dune migration. (Author's abstract)
W91-01695

RIVER DISCHARGE AND TIDAL CONTROLS ON SALT-WEDGE POSITION AND IMPLICATIONS FOR CHANNEL SHOALING: FRASER RIVER, BRITISH COLUMBIA.
Guelph Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2L.
W91-01722

INTERSTITIAL DISSOLVED ORGANIC CARBON IN SEDIMENTS OF A SOUTHERN APPALACHIAN HEADWATER STREAM.
Georgia Univ., Athens. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-01804

HILLSLOPE EROSION AT THE MAXEY FLATS RADIOACTIVE WASTE DISPOSAL SITE, NORTHEASTERN KENTUCKY.
Geological Survey, Louisville, KY. Water Resources Div.
W. P. Carey, M. A. Lyverse, and C. R. Hupp.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigation Report 89-4199, 1990. 37p, 11 fig, 11 tab, 20 ref.

Descriptors: *Erosion rates, *Geomorphology, *Kentucky, *Mass wasting, *Radioactive waste disposal, Dendrochronology.

Maxey Flats, a disposal site for low level radioactive waste, is on a plateau that rises 300 to 400 ft above the surrounding valleys in northeastern Kentucky. Hillslope gradients average 30% to 40% on three sides of the plateau. The shortest distance from a hillslope to a burial trench is 140 ft on the west side of the site. Rates of hillslope retreat were determined through a combination of direct erosion measurements during the 2-year study and through dendrogeomorphic techniques. Because the dendrogeomorphic rates are average rates during the last 90 years, they were used to estimate the amount of time required for the hillslopes to retreat into the trenches. Rates of hillslope retreat determined from dendrogeomorphic evidence range from 3.8 to 9.1 in/century, so that time to exposure of the trenches ranges from 35,000 to 65,000 years. The minimum estimate of 35,000 years is for the most actively eroding southern slope. Throughout tens of thousands of years, the rate of hillslope retreat is determined more by the occurrence of infrequent extreme events such as slope failure than by the continuous processes of slope wash observed in this study. These slope failures cause as much erosion in one event as hundreds or even thousands of years of slope wash. Periods of tens of thousands of years are also sufficiently long for significant changes in climate and tectonic activity to occur. Rates of erosion observed during this 2-year study are highly unlikely to be indicative of rates averaged over periods of tens of thousands of years during which many extreme events can occur. Thus, the long-term geomorphic stability of the Maxey Flats disposal site will be highly dependent upon the magnitude and frequency of extreme erosive events and upon trends in climate change and tectonic activity. (USGS)
W91-01831

SEDIMENT TRANSPORT AND ACCRETION AND THE HYDROLOGIC ENVIRONMENT OF GROVE CREEK NEAR KENANSVILLE, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
T. C. Stamey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4086, 1989. 30p, 10 fig, 6 tab, 12 ref.

Descriptors: *Grove Creek, *Hydrologic data, *North Carolina, *Sedimentation, Channel improvement, Coastal plains, Drainage, Wetlands.

The Grove Creek basin includes an area of about 42 sq mi in Duplin County, southeastern North Carolina. This report evaluates sediment transport and accretion rates in the lowermost 9-mile reach of Grove Creek using hydrologic, dendrologic, and radioisotopic data collected at seven sites along the study reach. The sediment that is transported in Grove Creek is predominately silt and clay. Suspended-sediment concentrations at discharges less than 100 cu ft/sec are less than 15 mg/L; concentrations at higher discharges did not exceed 67 mg/L. Calculated suspended-sediment loads ranged from 75 to 444 ton/yr at the various data collection sites on Grove Creek. Sediment-accretion rates estimated from dendrologic data ranged from 0.03 to 0.06 ft/yr. The highest accretion rates occur in the downstream swampy reaches and are due to channel braiding, low gradients and flow velocities, and large percentages of overbank flow, which result in the deposition of

clay and silt over wide areas of the flood plain. Sediment-accretion rates along Grove Creek were also estimated by cesium-137 and lead-210 radioisotopic analyses. Sediment cores from the flood plain analyzed for cesium-137 indicate a maximum accretion rate of about 0.024 ft/yr for the period 1952-87. Lead-210 analysis from these same sediment cores indicates an average accretion rate of 0.026 ft/yr to a depth of about 2 ft. The maximum age of the flood-plain sediment at the 2-ft level is about 80 years. (USGS)
W91-01839

SEDIMENT-SOURCE DATA FOR FOUR BASINS TRIBUTARY TO LAKE TAHOE, CALIFORNIA AND NEVADA, AUGUST 1983-JUNE 1988.
Geological Survey, Sacramento, CA. Water Resources Div.
B. R. Hill, J. R. Hill, and K. M. Nolan.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-618, 1990. 42p, 8 fig, 30 tab, 17 ref.

Descriptors: *California, *Erosion, *Lake Tahoe, *Lake Tahoe Basin, *Nevada, *Sediment load, *Sediment transport, *Suspended sediments, Sediment discharge, Slope erosion, Stream banks, Stream-channel inventories.

Data were collected during a 5-year study of sediment sources in four drainage basins tributary to Lake Tahoe, California-Nevada. The study areas include the Blackwood Creek, General Creek, Edgewood Creek, and Logan House Creek basins. Data include changes in bank and bed positions at channel cross sections; results of stream-channel inventories; analyses of bank and bed material samples; tabulations of bed-material pebble counts; measured rates of hillslope erosion; dimensions of gullies; suspended-sediment data collected during synoptic snowmelt sampling; and physiographic data for the four study basins. (USGS)
W91-01847

EVALUATE A SOIL LOSS PREDICTION MODEL COMBINED WITH AN INFILTRATION MODEL FOR TILLED SOILS.
South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W91-01861

SUSPENDED SEDIMENT AND BED LOAD PROBLEMS OF THE UPPER RHINE.
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 4D.
W91-01871

MINIMUM FROUDE NUMBER AND THE EQUILIBRIUM OF ALLUVIAL SAND RIVERS.
Victoria Univ. of Manchester (England). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-01874

CHANNEL SEDIMENT VARIABILITY ALONG A RIVER: A CASE STUDY OF THE SIRET RIVER (ROMANIA).
Statiunea de Cercetari Stejarul, Piatra-Neamt (Romania). Geomorphology Lab.
For primary bibliographic entry see Field 2E.
W91-01875

SOLUTION-COLLAPSE DEPRESSIONS AND SUSPENSATES IN THE LIMNOCRENIC LAKE OF BANYOLES (NE SPAIN).
Barcelona Univ. (Spain).
M. Canals, H. Got, R. Julia, and J. Serra.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 3, p 243-254, May 1990. 6 fig, 3 tab, 19 ref.

Descriptors: *Banyoles Lake, *Geomorphology, Karst, *Lake morphology, *Limnology, *Seismology, *Spain, Geology, Sediments, Seismic properties, Stratification.

A high resolution seismic reflection survey in the Banyoles limnocrenic solution lake allowed penetration of dense suspensates occupying cone-like bottom depressions of different sizes. The depressions result from the dissolution and collapse of underlying Eocene calcareous and gypsiferous materials over which lacustrine sediments of varying thicknesses have accumulated. The suspensates occupying the depressions present three main types of seismic signatures: stratified, semistratified, and transparent. The densities of the suspensates and the water depths of their tops, which fluctuate continuously, vary from one depression to another. The maximum seismically recorded suspensate thickness is 44 meters. Morphological and structural features, seismic characters, and variable degrees of hydraulic activity, point to the existence of different stages of maturity in the lake bottom depressions. Recent instability of the lake bottom and subbottom is apparent in the seismic records, indicating that depression formation processes may continue in a short geological time scale. (Stoehr-PTT)
W91-01876

RATES AND MECHANISMS OF DISCONTINUOUS GULLY EROSION IN A RED-BROWN EARTH CATCHMENT, NEW SOUTH WALES, AUSTRALIA.
Soil Conservation Service, Gunnedah (Australia).
R. J. Crouch.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 3, p 277-282, May 1990. 5 fig, 2 tab, 3 ref.

Descriptors: *Australia, *Gully erosion, *Sediment discharge, *Sediment yield, *Soil erosion, Drainage systems, New South Wales, Rainfall, Runoff.

Rainfall, runoff, sediment discharge, and gully expansion were measured for five years in a small catchment in central New South Wales. Sixty percent of the sediment produced from this catchment originated from gully erosion. Gully head erosion was episodic depending on pipe development, cracking, and soil detachment during small runoff events which prepared the heads for rapid soil movement from infrequent large runoff events. On the average each year 5.5 tons of soil were released from the gully heads, 2.5 tons were deposited in the drainage line, and 6.4 tons passed over the weir. In some years very little erosion occurred, in others a large quantity of soil was moved. In this environment erosion from both sources occurred during the same runoff events, particularly after there had been a considerable period of soil detachment with little or no runoff to cause soil movement. In other words, most soil movement occurred in the early stages of some very large runoff events. Soil was detached, both in the gullies and on the ground surface by a variety of mechanisms (soil shrinkage, stock trampling, short duration or low intensity rain) and was then flushed into and along the drainage by large runoff events. (Stoehr-PTT)
W91-01877

LONG FLUME STUDY OF THE DYNAMIC FACTORS AFFECTING THE RESISTANCE OF A LOAMY SOIL TO CONCENTRATED FLOW EROSION.
Katholieke Univ. Leuven (Belgium). Lab. voor Experimentele Geomorfologie.
G. Govers, W. Everaert, J. Poesen, G. Rauws, and J. De Ploey.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 5, p 313-328, August 1990. 7 fig, 2 tab, 31 ref.

Descriptors: *Erosion, *Flumes, *Loam, *Rainfall, *Rill erosion, *Runoff, *Runoff rates, *Soil compaction, *Soil erosion, Experimental data, Geomorphology, Infiltration, Sediments, Silt, Soil moisture retention.

Experiments were carried out in a 20 meter long flume to assess the variation of the runoff erosion resistance of a loamy soil as a function of initial moisture content and compaction. The results of seven experimental runs show that the runoff erosion resistance of a loamy soil is extremely sensitive to variations in initial moisture content and, to a somewhat lesser extent, in bulk density. The very low resistance to runoff erosion of initially dry material is explained by structural changes which take place at the time of wetting. Slaking and microfissuration cause a considerable decrease of the soil's shear strength and therefore of its resistance to runoff erosion. A first analysis shows that, during a given rainfall event, initially dry soils may well show significantly more erosion than initially wet soils, despite the increase of infiltration with decreasing initial moisture content. (Author's abstract)
W91-01878

CHANNEL AVULSION AND RIVER METAMORPHOSIS: THE CASE OF THE THOMSON RIVER, VICTORIA, AUSTRALIA.
Melbourne Univ., Parkville (Australia). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-01879

DEVELOPMENT OF ARMOUR IN THE TAMBO RIVER, VICTORIA, AUSTRALIA.
Monash Univ., Clayton (Australia). Dept. of Geography.
D. L. Dunkerley.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 5, p 405-412, August 1990. 3 fig, 1 tab, 17 ref.

Descriptors: *Armoring, *Bed load, *Channel armoring, *Gravel, *Particle size, *River beds, *Sediment transport, *Sediments, *Streambeds, Australia, Deposition, Flow characteristics, Scour, Sediment load, Tambo River, Victoria.

Present understanding of armor formation and the dynamics of grain entrainment and movement, especially in natural environments with coarse and poorly-sorted bed material, is still incomplete. There are many details which require further field observation for clarification and hypothesis testing, including aspects of grain interaction during bedload transport. Evidence from the Tambo River suggests that there may be mechanisms of armour development which have significance in certain field situations but which have been relatively neglected in the literature. The particular mechanism envisaged for the Tambo River involves the accumulation on the bed surface of large clasts which had been moving as an overpassing traction carpet. These clasts are not genetically related to the underlying subarmor sediments, but nonetheless act as an armor which protects them from scour, and which hence affects grain mobility and bedload transport rates. (Author's abstract)
W91-01880

BLANKET PEAT EROSION IN A MID-WALES CATCHMENT DURING TWO DROUGHT YEARS.
University Coll. of Wales, Aberystwyth. Dept. of Geography.
I. S. Francis.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 5, p 445-456, August 1990. 4 fig, 2 tab, 39 ref.

Descriptors: *Catchment basins, *Drought, *Erosion, *Peat soils, *Sediment yield, *Soil erosion, *Suspended sediments, Organic soils, Runoff, Sediment discharge, Sediment sampling, Stream discharge, Wales.

The rate of blanket peat erosion was measured at an upland site in central Wales during the 1983-1984 drought years. Erosion pins, a peat surface sediment trap, and sediment sampling in the effluent stream, were used to estimate the rate of peat surface recession and the rate of organic sediment loss from the catchment. An overall rate of surface recession of 16 mm per year on exposed peat faces was recorded with the greatest recession on southwest faces. Eroding peat surfaces exhibited maxi-

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mum recession during the summer, but the peat surface sediment trap indicated that the highest rates of sediment loss from peat faces due to rain wash occurred during the autumn and early winter. Stream sediment sampling showed that the yield of organic sediment from the catchment was 34.4 sq km/yr, with greatest losses also during the autumn and early winter. The evidence suggested that the surface recession, as measured on erosion pins, included a shrinkage component, which might have accounted for as must as 80% of the apparent loss. Direct and circumstantial evidence suggested that peat wastage during the summer months was the most important agent of surface recession in the study period. Desiccation provided available sediment during the autumn, but organic sediment supply became limited as the winter progressed, despite the occurrence of frost heave. (Author's abstract)
W91-01881

INFLUENCE OF DEBRIS FLOWS ON CHANNELS AND VALLEY FLOORS IN THE OREGON COAST RANGE, U.S.A.
Washington Univ., Seattle. Dept. of Geological Sciences.
L. Benda.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 5, p 457-466, August 1990. 6 fig, 22 ref.

Descriptors: *Aggradation, *Channel flow, *Channel morphology, *Debris flow, *Detritus, *Erosion, *Geomorphology, *Oregon, *Sediment erosion, Aggrading rivers, Alluvial channels, Alluvial plains, Bedrock, Channels, Flow characteristics, Gravel, Mountain streams, Sediments.

Debris flows are one of the most important processes which influence the morphology of channels and valley floors in the Oregon Coast Range. Debris flows that initiate in bedrock hollows at heads of first-order basins erode the long accumulated sediment and organic debris from the floors of headwater, first-order and second-order channels. This material is deposited on valley floors in the form of fans, levees, and terraces. In channels, deposits of debris flows control the distribution of boulders. The stochastic nature of sediment supply to alluvial channels by debris flows promotes cycling between channel aggradation which results in a gravel-bed morphology, and channel degradation which results in a mixed bedrock and boulder-bed morphology. Temporal and spatial variability of channel-bed morphology is expected in other landscapes where debris flows are an important process. (Author's abstract)
W91-01882

HYDROGRAPHIC SURVEYS AND SEDIMENTATION IN DEEP BAY, HONG KONG.
Hong Kong Polytechnic, Kowloon. Dept. of Civil and Structural Engineering.
S. H. Wong, and Y. S. Li.
Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 2, p 111-118, March/April 1990. 5 fig, 2 tab, 5 ref.

Descriptors: *Bays, *Hong Kong, *Hydrography, *Sediment distribution, *Sedimentation, *Sedimentation rates, *Surveys, *Suspended solids, Flocculation, Mathematical models, Particle size, Pearl Estuary, Sediment transport, Tides.

Three hydrographic surveys were carried out in Deep Bay, which is located in the eastern part of Pearl estuary between Shenzhen and Hong Kong. Data on current, size distributions of bottom sediment, suspended solids, and some water quality parameters were obtained. This information is of value for mathematical modeling of tidal circulation and sediment transport in the bay, and also useful in the planning of further development in this area. The sedimentation rate in Deep Bay was estimated by two different approaches, comparison of historical navigation maps and Pb210 dating. Information obtained from the maps indicated that the average sedimentation rate between 1898 and 1949 was about 8 mm/yr, while recent years showed a 15 mm/yr sedimentation rate. The average suspended solids concentrations were 10 mg/L in the wet season survey and 50 mg/L in the dry season survey. There was no significant difference in the size distribution of suspended solids in the vertical direction. The particle size distribution of bottom sediment (composed mostly of silt and clay) was uneven, which is a result of the tidal movement in the estuary. Flocculation is thought to play an important role in sedimentation in Deep Bay. (Stoehr-PTT)
W91-01883

REVISED ESTIMATE OF THE LIFE SPAN FOR LAKE NASSER.
Florida Univ., Gainesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W91-01884

MUD BALANCE FOR BELGIAN-DUTCH COASTAL WATERS BETWEEN 1969 AND 1986.
Rijkswaterstaat, Rijswijk (Netherlands). North Sea Directorate.
J. S. L. J. Van Alphen.
Netherlands Journal of Sea Research NJSRBA, Vol. 25, No. 1/2, p 19-30, May 1990. 7 fig, 1 tab.

Descriptors: *Belgium, *Coastal waters, *Mud, *Sediment transport, *The Netherlands, Erosion, Mud-water interfaces, Sedimentation, Suspended solids.

Mud transport and mud-balances are usually calculated from multipication of suspended matter concentrations and depth-averaged residual water transport. The results are assumed to underestimate the actual mud transport because the suspended matter concentrations are measured at sea surface, mostly during calm weather. In addition, these kinds of budgets are sensitive to small variations in the estimated residual current velocity. These problems can be overcome by comparing the calculated transports with the fluxes that result from balancing amounts of erosion and deposition. The last figures integrate spatial differences in transport over time to a large extent. Following this approach it is shown that between 1969 and 1986 variations in the mud budget occurred as a result of large-scale human interference (deepening the approach channel to Zeebrugge, closure of Dutch Delta estuaries). The variations were small compared with the annual longshore mud transport, which is dominated by the amount of mud that passes from Dover Strait to Belgian-Dutch waters (c. 8.5 times 10 to the 6th power per year), but were relatively large when compared with the mud transport in the 20 km wide coastal zone. The fluctuations in the annual frequency and duration of gales can cause the annual flux of mud to double in some years. (Author's abstract)
W91-01934

SUPPLY AND DEPOSITION OF SEDIMENT ALONG THE NORTH BANK OF HANGZHOU BAY, CHINA.
East China Normal Univ., Shanghai. Inst. of Estuarine and Coastal Research.
B. C. Wang, and D. Eisma.
Netherlands Journal of Sea Research NJSRBA, Vol. 25, No. 3, p 377-390, June 1990. 14 fig, 4 tab, 11 ref.

Descriptors: *China, *Hangzhou Bay, *Sediment distribution, *Sediment transport, *Sedimentation, Tidal currents, Tidal flats, Tidal range, Wave direction, Wave height.

Sediment transport and deposition processes were studied on the tidal flats along north Hangzhou Bay (P.R. China) because of the large tidal range, abundant sediment supply and strong seasonal variations. Tidal currents reach a maximum of 8.9 meters per second. The flood is stronger but of shorter duration than the ebb. Waves come from S-SE during the summer (wet season) and from NE-NW during the winter (dry season). Average waves are 40 cm high, but may reach 4 m during storms. Sediment is largely supplied from the Chang Jiang, small amounts also from the Qiantang Jiang. Sediment supply is largest during the winter. The tidal flats consist of clay, silt and some fine sand; they are 0.6 to 2km wide. Deposition on the high parts of the flats is enhanced by tidal asymmetry while up-slope transport of sediment is increased by a turbulent front that develops during the flood. Erosion on the flats takes place mainly during summer storms (typhoons), when wave-cut puddles and scarps are formed. In the upper part, vegetation reduces the effect of storms and mainly laminated sediment is present. (Author's abstract)
W91-01942

APPLICATIONS OF MAGNETIC MEASUREMENTS TO SEDIMENT TRACING IN URBAN HIGHWAY ENVIRONMENTS.
Middlesex Polytechnic, Enfield (England). Urban Pollution Research Center.
For primary bibliographic entry see Field 5A.
W91-01997

HEAVY METALS IN SEDIMENTS OF THE YAMUNA RIVER (A TRIBUTARY OF THE GANGES), INDIA.
Oil and Natural Gas Commission, Anklesvar (India).
For primary bibliographic entry see Field 2K.
W91-02005

IRON AND MANGANESE GEOCHEMISTRY AND THE DISTRIBUTION OF 239, 240 PU AND 241 AM IN THE SEDIMENTS OF THE NORTH EAST IRISH SEA.
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Directorate of Fisheries Research.
For primary bibliographic entry see Field 5B.
W91-02006

DISTRIBUTION OF ZINC, LEAD, CADMIUM AND COPPER BETWEEN DIFFERENT SIZE FRACTIONS OF SEDIMENTS I. THE LIMSKI KANAL (NORTH ADRIATIC SEA).
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 5B.
W91-02009

DISTRIBUTION OF ZINC, LEAD, CADMIUM AND COPPER BETWEEN DIFFERENT SIZE FRACTIONS OF SEDIMENTS II. THE KRKA RIVER ESTUARY AND THE KORNATI ISLANDS (CENTRAL ADRIATIC SEA).
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 5B.
W91-02010

2K. Chemical Processes

PRECIPITATION NUTRIENT INPUTS IN SEMIARID ENVIRONMENTS.
Agricultural Research Service, Tucson, AZ. Arid-land Watershed Management Research Unit.
For primary bibliographic entry see Field 2B.
W91-01030

BIOGEOCHEMISTRY OF CARBON IN THE AMAZON RIVER.
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 5B.
W91-01039

VARIATIONS IN SEDIMENTARY CARBON REMINERALIZATION RATES IN THE WHITE OAK RIVER ESTUARY, NORTH CAROLINA.
North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.
For primary bibliographic entry see Field 2L.
W91-01040

FLUXES AND TRANSFORMATION OF AQUATIC PIGMENTS IN LAKE MENDOTA, WISCONSIN.

Wisconsin Univ.-Madison. Water Chemistry Program.
For primary bibliographic entry see Field 2H.
W91-01041

OCEANIC AND ESTUARINE AMMONIUM OXIDATION: EFFECTS OF LIGHT.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 2L.
W91-01046

ALGAL USE OF SEDIMENTARY PHOSPHORUS FROM AN AMAZON FLOODPLAIN LAKE: IMPLICATIONS FOR TOTAL PHOSPHORUS ANALYSIS IN TURBID WATERS.
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-01047

ABIOTIC TRANSFORMATIONS OF IRON AND PHOSPHATE IN HUMIC LAKE WATER REVEALED BY DOUBLE-ISOTOPE LABELING AND GEL FILTRATION.
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 2H.
W91-01048

CONTRIBUTION OF ORGANIC ACIDS TO ALKALINITY IN LAKES WITHIN THE MOUNT ST. HELENS BLAST ZONE.
Washington Univ., Seattle. Coll. of Ocean and Fishery Sciences.
For primary bibliographic entry see Field 2H.
W91-01051

MERCURY SPECIATION IN SURFACE FRESHWATER SYSTEMS IN CALIFORNIA AND OTHER AREAS.
California Univ., Santa Cruz. Inst. of Marine Sciences.
G. A. Gill, and K. W. Bruland.
Environmental Science and Technology ESTHAG, Vol. 24, No. 9, p 1392-1400, September 1990. 4 fig, 5 tab, 59 ref.

Descriptors: *California, *Chemical speciation, *Freshwater, *Geochemistry, *Mercury, *Path of pollutants, *Water chemistry, Bioaccumulation, Chemical analysis, Chemical interactions, Chemical reactions, Fish, Lakes, Rivers, Sediment contamination, Surface water, Suspended sediments, Tissue analysis.

Mercury concentrations and speciation were determined in surface water samples from lakes and rivers in California and other areas. The freshwater systems studied ranged from a pristine alpine lake to a system with Hg-contaminated sediments. Total Hg levels spanned between 2.4 to 500 pM, while dissolved Hg levels ranged from 2 to 60 pM. Dissolved organo-Hg compounds accounted for a majority (up to 89%) of the dissolved Hg in some lakes. Interestingly, those lakes in which highly dissolved organo-Hg levels were observed also had high levels of Hg in fish tissues. A significant portion of the total Hg was usually in the particulate fraction, indicating that suspended particles can be important in influencing Hg cycling in lakes. The total Hg levels obtained, using clean sampling and analytical technologies, were considerably lower than most historical reports. (Author's abstract)
W91-01063

VARIABILITY AND DYNAMICS OF LEACHING OF THE FLYSCH CARPATHIAN SLOPE.
Polish Academy of Sciences, Krakow. Inst. of Geography and Spatial Organization.
For primary bibliographic entry see Field 2G.
W91-01078

DIURNAL VARIATIONS IN THE INORGANIC SOLUTE CONTENT OF WATER DRAINING FROM AN ALPINE SNOWPATCH.
Heidelberg Univ. (Germany, F.R.). Geographisches Inst.
N. Caine.
Catena, Vol. 16, No. 4/5, p 153-162, August/October 1989. 3 fig, 3 tab, 21 ref.

Descriptors: *Colorado, *Diurnal variation, *Drainage, *Flow discharge, *Snowmelt, *Solutes, *Water chemistry, Solute transport, Water quality.

The results of short-interval sampling of water quality over seven diurnal flow cycles from the Martinelli Basin, site of a long-lasting snowpatch in the Colorado Front Range show an inverse relationship between discharge and the concentration of most solute species. This relationship reflects varying proportions of melt water transferred to the channel through different routes, and suggests that variations in water quality over the diurnal cycle might be used to partition the flow hydrograph. Bias exists in mass yield estimates that are based upon water samples taken with a daily (or longer) interval at the same point in the flow cycle. On the Martinelli site, this bias is less than 5% for most solutes, but is much greater than that in the case of chloride, silicon, and suspended sediments. (Author's abstract)
W91-01083

MULTIVARIATE STATISTICAL ANALYSES OF SEDIMENT GEOCHEMISTRY.
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2L.
W91-01161

COPPER TOXICITY TO PARATYA AUSTRALIENSIS: I. INFLUENCE OF NITRILOTRIACETIC ACID AND GLYCINE.
Chisholm Inst. of Tech., Melbourne (Australia). Center for Stream Ecology.
For primary bibliographic entry see Field 5C.
W91-01258

COPPER TOXICITY TO PARATYA AUSTRALIENSIS: II. INFLUENCE OF BICARBONATE AND IONIC STRENGTH.
Chisholm Inst. of Tech., Melbourne (Australia). Center for Stream Ecology.
For primary bibliographic entry see Field 5C.
W91-01259

COPPER TOXICITY TO PARATYA AUSTRALIENSIS: III. INFLUENCE OF DISSOLVED ORGANIC MATTER.
Chisholm Inst. of Tech., Melbourne (Australia). Center for Stream Ecology.
For primary bibliographic entry see Field 5C.
W91-01260

HAILSTONES AS CLOUD WATER COMPOSITION PROBES: AN INITIAL ASSESSMENT.
Washington State Univ., Pullman. Lab. for Atmospheric Research.
L. MacGregor, H. G. Marshall, N. C. Knight, C. A. Knight, and J. C. Farmer.
Atmospheric Environment ATENBP, Vol. 24A, No. 8, p 2247-2251, August 1990. 2 fig, 1 tab, 18 ref.

Descriptors: *Acid rain, *Chemical analysis, *Chemistry of precipitation, *Cloud liquid water, *Hail, *Path of pollutants, Chlorides, Chromatography, Convective precipitation, Nitrates, Nitrites, Oxalates, Sulfates.

This is a preliminary exploration of using hailstones as natural probes of cloud droplet chemistry. Big hailstones grow primarily in the strongest updraft regions of the most severe convective storms, so that if their chemical contents are representative of the cloud droplets from which they grow, they could be useful probes of chemical transport from the lower troposphere to the tropopause, where the anvils form and then evaporate. Results from chromatographic analysis of chloride, nitrate, nitrite, sulfate and oxalate are presented from individual growth layers of hailstones collected from several different storms. In spite of considerable variability, and the possibility of contamination from the ground, the results appear consistent enough to warrant further investigation of this possible source of data on cloud chemistry. Contamination of hailstone layers, especially on the ground, remains a problem. If this method is to be applied, the hailstones should be caught in nets, and experiments should be done with a hail tunnel to determine the extent of fractionation involved in layer formation, as a function of growth conditions. When hail growth is so wet that it is accompanied by shedding, for instance, then the ice is expected to be purer than cloud water. However, the character of the layers can be used to eliminate those most likely to be misleading. (Lantz-PTT)
W91-01289

PRODUCTION AND CARBON ISOTOPIC COMPOSITION OF BACTERIAL CO2 IN DEEP COASTAL PLAIN SEDIMENTS OF SOUTH CAROLINA.
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2J.
W91-01297

PH AND REDOX BUFFERING MECHANISMS IN A GLACIAL DRIFT AQUIFER CONTAMINATED BY LANDFILL LEACHATE.
Western Michigan Univ., Kalamazoo. Center for Water Research.
For primary bibliographic entry see Field 5B.
W91-01300

DECOMPOSITION RATE, CHEMICAL COMPOSITION AND NUTRIENT RECYCLING OF NYMPHAEA ALBA L. FLOATING LEAF BLADE DETRITUS AS INFLUENCED BY PH, ALKALINITY AND ALUMINIUM IN LABORATORY EXPERIMENTS.
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 2H.
W91-01332

MICRO-ARTHROPOD SEASONALITY IN STREAMS OF VARYING PH.
Queen Mary Coll., London (England). School of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-01339

DISSOLVED ORGANIC CARBON CONCENTRATIONS AND FLUXES ALONG THE MOISIE RIVER, QUEBEC.
University Coll. of North Wales, Bangor. School of Animal Biology.
T. E. Ford, S. A. Ford, M. A. Lock, and R. J. Naiman.
Freshwater Biology FWBLAB, Vol. 24, No. 1, p 35-42, August 1990. 2 fig, 2 tab, 25 ref.

Descriptors: *Canada, *Dissolved organic carbon, *Moisie River, *Quebec, *Rivers, *Water chemistry, Abiotic factors, Biotic factors, Conductivity, Hydrogen ion concentration, Optical density, Temperature.

The main stream and tributaries of a 145 km reach of the Moisie River, Quebec, were examined for temperature, conductivity, pH, dissolved organic carbon (DOC), %DOC $>$100,000 nominal molecular weight (NMW), optical density (OD350), and the ratio of OD400 to OD600 (E4:E6). Dissolved organic carbon concentrations correlated closely with OD350 ($r^2=0.92$, $P<0.001$). However, %DOC $>$100,000 NMW did not correlate with the E4:E6 ratio. Except for a slight increase in %DOC $>$100,000 NMW ($r^2=0.37$, $P<0.05$) no change in any characteristic occurred down the length of the Moisie River, despite consistently higher levels of DOC in the tributaries. The results suggest that high concentrations of DOC in tributary waters are rapidly removed within the main river channel. There are a number of mechanisms by which the main channel of a large river can

influence its dissolved organic matter load. Removal pathways may be biotic (e.g. mineralization by heterotrophic microorganisms) or abiotic (adsorption, precipitation, chemical oxidation or complexation). Only low levels of heterotrophic activity have been measured in boreal rivers relative to temperate rivers with lower DOC, and DOC that has reached the Moisie River might be expected to be microbially recalcitrant. Biotic activity may be responsible for regulating composition of DOC whereas abiotic processes are likely to predominate in regulation of DOC concentration and flux. (White-Reimer-PTT)
W91-01341

INHIBITORY EFFECTS OF HIGH MOLECULAR WEIGHT DISSOLVED ORGANIC MATTER UPON METABOLIC PROCESSES IN BIOFILMS FROM CONTRASTING RIVERS AND STREAMS.
University Coll. of North Wales, Bangor. School of Biological Sciences.
C. Freeman, M. A. Lock, J. Marxsen, and S. E. Jones.
Freshwater Biology FWBLAB, Vol. 24, No. 1, p 159-166, August 1990. 1 fig, 3 tab, 24 ref.

Descriptors: *Biofilms, *Dissolved organic matter, *Metabolism, *Molecular weight, *Rivers, England, Enzymes, Germany, Inhibitory effects, Phenols.

The effect of removal of organic matter >1000 apparent molecular weight (AMW) on biofilm processes was determined in three contrasting streams in West Germany and three contrasting rivers in the U.K. This process removed 66-85% of the dissolved organic matter supply. Elevations in extracellular enzyme activity (beta-glucosidase, phosphatase and esterase), metabolic heat-output, bacterial density and poly-beta-hydroxy alkanoate (PHA) content (a prokaryote storage product) were noted throughout the study in response to the removal of organic matter. This suggests that there are inhibitory substances present in the dissolved organic matter pool >1000 AMW. It is probable that phenolics play a role in this inhibition. Decreases in metabolic heat output, beta-glucosidase activity and PHA content were noted at four sites in response to the removal of >1000 AMW material. The divergent responses of the six river/stream biofilms are indicative of radically differing metabolic/catabolic processes, on a spatial and/or temporal basis, to a major organic supply perturbation. (Author's abstract)
W91-01345

NITROGEN CYCLING IN LOUISIANA GULF COAST BRACKISH MARSHES.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 2L.
W91-01351

SEASONAL CHANGES IN THE DISSOLVED FREE AMINO ACID AND DOC CONCENTRATIONS IN A HYPERTROPHIC AFRICAN RESERVOIR AND ITS INFLOWING RIVERS.
Council for Scientific and Industrial Research, Pretoria (South Africa). Div. of Water Technology.
For primary bibliographic entry see Field 2H.
W91-01356

EFFECT OF HARDNESS AND SALINITY ON SURVIVAL OF STRIPED BASS LARVAE.
Maryland Univ. at Baltimore. Dept. of Pathology.
For primary bibliographic entry see Field 8I.
W91-01386

GAS TRANSFER VELOCITIES IN LAKES MEASURED WITH SF6.
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W91-01412

SURFACE IONIZATION OF POLYNUCLEAR SPECIES IN AL(III) HYDROLYSIS--I. TITRATION RESULTS.
Syracuse Univ., NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W91-01413

SURFACE IONIZATION OF POLYNUCLEAR SPECIES IN AL(III) HYDROLYSIS--II. A CONDITIONAL EQUILIBRIUM MODEL.
Syracuse Univ., NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W91-01414

OXIDATION OF PHENOLS IN WATER BY HYDROGEN PEROXIDE ON ALUMINE SUPPORTED IRON (OXYDATION DES PHENOLS PAR LE PEROXYDE D'HYDROGENE EN MILIEU AQUEUX EN PRESENCE DE FER SUPPORTE SUR ALUMINE).
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
N. Al-Hyek, and M. Dore.
Water Research WATRAG, Vol. 24, No. 8, p 973-982, August 1990. 8 fig, 1 tab, 19 ref. English summary.

Descriptors: *Aluminum, *Chemical reactions, *Hydrogen peroxide, *Iron, *Oxidation, *Phenols, *Wastewater treatment, *Water treatment, Alumina, Aqueous solutions, Catalysts, Chemical interactions, Copper, Spectroscopy, Water chemistry.

In order to specify its reaction mechanism, the oxidation by hydrogen peroxide of phenols in an aqueous medium in the presence of various heterogeneous catalysts and in particular alumina supported iron was studied. The Fenton reactant (H_2O_2 + Fe(2+)) on phenols and on organic acids was used to compare this system to the catalytic oxidation on a solid catalyst (iron/alumina, iron-copper/alumina) by hydrogen peroxide. The structure of the supported metal was determined by Mossbauer Spectroscopy which established on the one hand the relationships between the structure and the mode of preparation of the catalyst and on the other the modifications of the catalyst surfaces after an oxidation reaction of organic compounds in an aqueous medium. The results showed that the catalytic oxidation of phenol is very weak. In contrast to phenol, polyhydroxybenzenes are readily degraded in heterogeneous catalysis by hydrogen peroxide. The reaction rate is a function on the one hand of the catalytic properties and on the other of the reaction conditions (pH, temperature, presence of bicarbonates in the solution). In general, the reaction rate in heterogeneous catalysis always seems to be a function of the degree of hydroxylation of the organic compounds in contact with the catalyst in the presence of H_2O_2. Two types of oxidation mechanisms in heterogeneous catalysis can be envisaged: radical mechanism--the radicals formed by the decomposition of H_2O_2 on the active sites of the catalyst react with the organic compounds; and non-radical mechanism. (Mertz-PTT)
W91-01418

PREDICTION OF PHOSPHATE COPRECIPITATION WITH CALCITE IN FRESHWATERS.
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2H.
W91-01423

PITFALLS OF SEQUENTIAL EXTRACTIONS.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
P. M. V. Nirel, and F. M. M. Morel.
Water Research WATRAG, Vol. 24, No. 8, p 1055-1056, August 1990. 13 ref.

Descriptors: *Analytical techniques, *Sediment analysis, *Sediment chemistry, *Separation techniques, *Trace elements, *Water analysis, *Water chemistry, Chemical properties, Data interpretation, Extraction procedures, Kinetics, Physical properties, Sediments.

Sequential extraction procedures consist of subjecting a given sediment sample to a series of increasingly strong reagents under specified conditions. An increasing number of researchers are using sequential extractions to determine the speciation of trace elements in sediments. Unfortunately, sequential extraction methods have not been successfully validated. The results are simply taken as providing operational definitions of the phases one is trying to measure. Sequential extraction procedures do not provide actual particulate speciation. Moreover, the physicochemical conditions used during extraction procedures (strong reagents and fast kinetics) cannot be extrapolated to naturally occurring processes (weak reagents, slow kinetics). Sequential extraction procedures have demonstrated only one incontrovertible distinction among fractions: the residual fraction of trace elements remains unaffected by short-term natural, anthropogenic, or experimental changes in the total element concentrations. It is suggested that it is necessary to elucidate particulate material speciation since it governs geochemical fate and bioavailability of trace elements. However, when a recipe for an extraction procedure is indiscriminately applied to a sediment sample, it is very unlikely that the results have scientific meaning or usefulness. The development and validation of an appropriate analytical method to determine the speciation of trace elements in a sediment sample must precede its application. The necessity that many environmental chemists and geochemists feel to characterize the speciation of trace elements in sediments does not justify using an unvalidated technique or hiding behind operational definitions that have no chemical meaning. (Mertz-PTT)
W91-01428

COMMENTS ON THE HYDROCHEMICAL REGULATION OF THE HALOGEN ELEMENTS IN RAINFALL, STEMFLOW, THROUGHFALL AND STREAM WATERS AT AN ACIDIC FORESTED AREA IN MID-WALES.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5B.
W91-01447

CHEMICAL COMPOSITION AND ACIDITY OF RAINFALL IN THE ALLIGATOR RIVERS REGION, NORTHERN TERRITORY, AUSTRALIA.
Office of the Supervising Scientist for the Alligator Rivers Region, Sydney (Australia).
For primary bibliographic entry see Field 5B.
W91-01449

CHEMISTRY OF CARBONYL COMPOUNDS IN PO VALLEY FOG WATER.
Consiglio Nazionale delle Ricerche, Bologna (Italy). Ist. FISBAT.
For primary bibliographic entry see Field 5B.
W91-01451

RELEASE OF CATIONIC ALUMINIUM FROM ACIDIC SOILS INTO DRAINAGE WATER AND RELATIONSHIPS WITH LAND USE.
University Coll. of Wales, Aberystwyth. Soil Science Unit.
For primary bibliographic entry see Field 5B.
W91-01479

SOIL AND SOIL SOLUTION CHEMICAL COMPOSITION AT THREE SITES WITHIN THE LOCH DEE CATCHMENT, SW SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
I. C. Grieve.
Journal of Soil Science JSSCAH, Vol. 41, No. 2, p 269-277, June 1990. 1 fig, 5 tab, 28 ref.

Descriptors: *Acid rain, *Aluminum, *Ion exchange, *Leaching, *Scotland, *Soil chemistry, *Soil solution, *Soil water, *Solute transport, Acidic soils, Calcium, Geohydrology, Hydrogen

ion concentration, Igneous rocks, Magnesium, Peat soils, Water chemistry.

The interaction of acid deposition with soils has been the subject of considerable interest in the past decade. However, there have been no systematic comparisons of soil water chemistry on different parent materials within catchments. Soil solution chemical composition was monitored over a 2-year period at three plots near the edge of an igneous intrusion in southwest Scotland. Soil solutions were all strongly acidic with a mean pH of approximately 4.0 at 0.20 m depth, and 4.5 at 0.60 m. Chemical composition of the deeper soil solutions varied with geology. Greatest acidity and aluminum concentrations were found over metamorphosed Ordovician sedimentary rocks, with mean pH of 4.3 and Al concentration of 22 mmol/cu m at 0.60 m. At a site on similar rocks nearer the intrusion, mean pH at 0.60 m was 4.8, with very low Al (3 mmol/cu m) and correspondingly greater Ca. At a peaty site on igneous rocks, increased pH with depth was associated with no change in base cations and Al but a reduction in mean SO4 from 41 mmol/cu m at 0.20 m to 10 mmol/cu m at 0.60 m. Ion-exchange selectivity coefficients calculated from soil and solution chemistry differed slightly from currently used values for peaty upland soils, with larger coefficients for Al/K exchange and smaller coefficients for Al/Ca and Al/Mg exchange. Relations between Al and H ion concentrations confirmed under-saturation of solutions with respect to gibbsite at 0.20 m. The differences between plots were consistent in different seasons, despite significant seasonal variability in Na, Cl, dissolved organic carbon and Fe. (Author's abstract)
W91-01480

LITHIUM IN DRINKING WATER AND THE INCIDENCES OF CRIMES, SUICIDES, AND ARRESTS RELATED TO DRUG ADDICTIONS.
California Univ., San Diego, La Jolla. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W91-01483

GEOCHEMICAL MODELING OF THE MADISON AQUIFER IN PARTS OF MONTANA, WYOMING, AND SOUTH DAKOTA.
Geological Survey, Reston, VA.
L. N. Plummer, J. F. Busby, R. W. Lee, and B. B. Hanshaw.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 1981-2014, September 1990. 19 fig, 12 tab, 89 ref.

Descriptors: *Aquifers, *Geochemistry, *Groundwater quality, *Madison Aquifer, *Model studies, *Water chemistry, Carbonates, Dolomite, Groundwater dating, Hydraulic conductivity, Isotope studies, Montana, South Dakota, Stable isotopes, Sulfates, Sulfides, Wyoming.

Stable isotope data for dissolved carbonate, sulfate, and sulfide were combined with water composition data to construct geochemical reaction models along eight flow paths in the Madison aquifer in parts of Wyoming, Montana, and South Dakota. All reaction models reproduce the observed chemical and carbon and sulfur isotopic composition of the final waters and are partially validated by predicting the observed carbon and sulfur isotopic compositions of dolomite and anhydrite from the Madison Limestone. The geochemical reaction models indicate that the dominant groundwater reaction in the Madison aquifer is dedolomitization (calcite precipitation and dolomite dissolution driven by anhydrite dissolution). Sulfate reduction, (Ca(2+) + Mg(2+))/Na(+) cation exchange, and halite dissolution are locally important, particularly in central Montana. The groundwater system was treated as closed to CO2 gas from external sources such as the soil zone or cross-formational leakage but open to CO2 from oxidation of organic matter coupled with sulfate reduction and other redox processes occurring within the aquifer. Carbon 14 groundwater ages, adjusted for the modeled carbon mass transfer, range from modern to about 23,000 years B.P. and indicate flow velocities of 2.1-26.5 m/yr. Most horizontal hydraulic conductivities calculated from Darcy's Law using the average 14C flow velocities are within a factor of 5 of those based on digital simulation. The calculated mineral mass transfer and adjusted 14C groundwater ages permit determination of apparent rates of reaction in the aquifer. The apparent rate of organic matter oxidation is typically 0.12 micromol/L/yr. Sulfate and, to a lesser extent, ferric iron are the predominant electron acceptors. The (kinetic) biochemical fractionation of 34S between sulfate and hydrogen sulfide is approximately -44 ppt at 25 C, with a temperature variation of -0.4 ppt/C. The rates of precipitation of calcite and dissolution of dolomite and anhydrite typically are 0.59, 0.24, and 0.95 micromol/L/yr, respectively. (Author's abstract)
W91-01517

SOLUTE TRANSPORT WITH MULTISEGMENT, EQUILIBRIUM-CONTROLLED REACTIONS: A FEED FORWARD SIMULATION METHOD.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-01520

MASS ARRIVAL OF SORPTIVE SOLUTE IN HETEROGENEOUS POROUS MEDIA.
Royal Inst. of Tech., Stockholm (Sweden).
For primary bibliographic entry see Field 5B.
W91-01521

STUDY ON GEOCHEMISTRY AND GEOCHEMICAL CLASSIFICATION OF ELEMENTS B, F, RB AND SR IN YELLOW SEA (HUANG HAI) SEDIMENTS.
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 2J.
W91-01566

SODA LAKES ON INNER MONGOLIA PLATEAU, CHINA.
Qinghai Inst. of Salt Lake, Xining (China).
For primary bibliographic entry see Field 2H.
W91-01574

EXISTING FORMS OF PHOSPHORUS IN SEDIMENT FROM MIDDLE AND NORTHERN TAIWAN STRAIT (IN CHINESE).
Fujian Inst. of Oceanology, Xiamen (China).
For primary bibliographic entry see Field 2L.
W91-01575

MEASUREMENT OF CO2-FIXATION IN SEDIMENTS: SOME THEORETICAL AND TECHNICAL ASPECTS.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 2J.
W91-01586

CARBON FLUX FROM PHYTOPLANKTON TO FREE-LIVING BACTERIAL DNA.
Shinshu Univ., Matsumoto (Japan). School of Allied Medical Sciences.
For primary bibliographic entry see Field 2H.
W91-01591

FATE OF PHYTOPLANKTON PRIMARY PRODUCTION: LOSSES IN RELATION TO BACTERIAL METABOLISM IN A EUTROPHIC SHALLOW LAKE.
Akademie der Wissenschaften der DDR, Berlin. Dept. of Hydrology.
B. Nixdorf.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 61-65, 1990. 2 fig, 14 ref.

Descriptors: *Aquatic bacteria, *Dissolved organic carbon, *Eutrophic lakes, *Limnology, *Phytoplankton, *Primary productivity, Algae, Bacterial physiology, Carbon cycle, Germany, Grosser Muggelsee, Radioactive tracers.

In 1987, the carbon flow from phytoplankton to bacteria in a eutrophic shallow lake, Grosser Muggelsee (Berlin), was calculated from measurements of extracellular organic carbon (EOC) release, respiration, and grazing by herbivorous zooplankton. The bacterial production amounted to approximately one half of the primary production and had a similar time course. Net release of EOC due to exudation was smaller than 3% of the particulate primary production. In order to investigate the discrepancy between the relatively high bacterial production and the small amounts of released EOC, the exudate incorporation was estimated by fractional filtration. The radioactivity in the <3 microm fraction was only 3% of the total primary productivity and that in the <12 microm fraction was only 8%. This indicates either a close morphological coupling between algae and bacteria or, in the case of the dominance of suspended bacteria, dissolved organic carbon sources for bacterial production other than phytoplankton exudation. From measurements of algal losses, calculations indicated that an average of 22% of the primary product was respired and 23% was grazed. It was assumed, therefore that a considerable part is lost due to lysis and serves as a carbon source for bacterial production. (Author's abstract)
W91-01593

CLAY, DISSOLVED ORGANIC MATTER, AND BACTERIAL INTERACTIONS IN TWO RESERVOIRS.
Baylor Univ., Waco, TX.
For primary bibliographic entry see Field 2H.
W91-01600

NUMBERS AND ACTIVITY OF BACTERIOPLANKTON IN VARIOUS TYPES OF WATERS IN CZECHOSLOVAKIA: RELATIONS TO CHLOROPHYLL CONCENTRATION.
Vyzkumny Ustav Vodohospodarsky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 2H.
W91-01610

CONTRIBUTION OF BENTHIC BIOMASS TO OVERALL METABOLISM IN NEW CALEDONIA LAGOON SEDIMENTS.
Museume National d'Histoire Naturelle, Paris (France). Biologie des Invertebres Marins.
For primary bibliographic entry see Field 2L.
W91-01659

SOIL SOLUTION CHEMISTRY OF AN ADIRONDACK SPODOSOL: LYSIMETRY AND N DYNAMICS.
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
J. P. Shepard, M. J. Mitchell, T. J. Scott, and C. T. Driscoll.
Canadian Journal of Forest Research CJFRAR, Vol. 20, No. 6, p 818-824, June 1990. 3 fig, 3 tab, 35 ref. EPRI Integrated Forest Study RP2621-2.

Descriptors: *Adirondack Mountains, *Huntington Forest, *Lysimeters, *Soil chemistry, *Soil solution, *Soil types, *Soil water, *Water analysis, *Water chemistry, Acidity, Ammonia, Calcium, Chemical analysis, Data acquisition, Magnesium, New York, Nitrates, Nitrogen, Spatial variation, Sulfates.

Solutes were monitored from the soil of a beech-maple forest and an adjacent lake at the Huntington Forest in the Adirondack Mountains of New York. The predominant ions were Ca and SO4. For soil solutions collected by lysimeters, the highest concentration of most ions (H, NH4, Ca, Mg, and NO3) occurred in O horizon leachates, and the lowest concentrations beneath the spodic B horizon. However, Al and SO4 concentrations were highest beneath the B horizon. Concentrations of NO3 showed distinct seasonal variation. Values reached 60 microequiv/L in the spring and decreased to near zero late in the growing season. Coefficients of variation (CV) differed among horizons. The E horizon was generally the most variable (CV, 17-199%) and the B horizon the least

(CV 19-166%). Variation was especially high for NO3 and NH4, which had minimum CVs of 124% and 122%, respectively. Variation in these ions was likely due to the dominant role of biological processes in affecting nitrogen dynamics. Differences in soil solution concentrations among six soil pits were due to the spatial variation in soil properties rather than differences among the four types of lysimeters (tension, zero tension, fritted glass, and ceramic plate). Nitrogen species showed the greatest response to the installation of lysimeters, with elevated concentrations of NO3 (120-160 micro equiv/L) observed during the first two years after installation. (Author's abstract)
W91-01693

GC-MS IDENTIFICATION OF GASEOUS VOLATILES IN WASTEWATER.
National Univ. of Singapore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W91-01696

ROLE OF AMMONIUM AND NITRATE RETENTION IN THE ACIDIFICATION OF LAKES AND FORESTED CATCHMENTS.
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 5B.
W91-01718

SPATIAL AND TEMPORAL PATTERNS IN THE HYDROGEOCHEMISTRY OF A POOR FEN IN NORTHERN WISCONSIN.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2H.
W91-01720

RATE OF DEGRADATION OF 1,1,1-TRICHLOROETHANE IN WATER BY HYDROLYSIS AND DEHYDROCHLORINATION.
Solvay and Cie S.A., Brussels (Belgium). Central Lab.
For primary bibliographic entry see Field 5B.
W91-01729

FATE OF CATIONIC SURFACTANTS IN THE MARINE ENVIRONMENT, II: PHOTOOXIDATION OF LONG-CHAIN ALKYLAMINES IN AQUEOUS MEDIA.
Centro de Investigacion y Desarrollo, Barcelona (Spain). Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 5B.
W91-01733

KINETIC STUDY OF THE DECOMPOSITION OF METHYL (1-(BUTYLCARBAMOYL)-1H-BENZIMIDAZOL-2-YL)CARBAMATE (BENOMYL) TO METHYL 1H-BENZIMIDAZOL-2-YLCARBAMATE (MBC).
Brock Univ., St. Catharines (Ontario). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W91-01739

MODELING THE FATE AND TRANSPORT OF ORGANIC CONTAMINANTS IN LAKE ST. CLAIR.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W91-01792

INORGANIC AND ORGANIC GROUNDWATER CHEMISTRY IN THE CANAL CREEK AREA OF ABERDEEN PROVING GROUND, MARYLAND.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-01837

GEOLOGY AND GROUND-WATER RESOURCES OF THE MEMPHIS SAND IN WESTERN TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01851

GROUND-WATER LEVELS, FLOW, AND SPECIFIC CONDUCTANCE IN UNCONSOLIDATED AQUIFERS NEAR LAKE ERIE, CLEVELAND TO CONNEAUT, OHIO, SEPTEMBER 1984.
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01855

COMPARING THE EFFECTS OF ACIDIC DEPOSITION ON THE CHEMISTRY OF SMALL STREAMS IN THE SOUTH ISLAND OF NEW ZEALAND WITH THOSE IN THE FICHTELGEBIRGE, F.R.G.
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
For primary bibliographic entry see Field 5B.
W91-01870

SPECIFIC CHEMICAL COMPOSITION OF KARST GROUNDWATER IN THE OPHIOLITE BELT OF THE YUGOSLAV INNER DINARIDES: A CASE FOR COVERED KARST.
Belgrade Univ. (Yugoslavia). Faculty of Mining and Geology.
For primary bibliographic entry see Field 2F.
W91-01885

ACIDIFICATION IN NORWAY - LOSS OF FISH POPULATIONS AND THE 1000 LAKE SURVEY 1986.
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5C.
W91-01889

ARE MATHEMATICAL MODELS USEFUL FOR UNDERSTANDING WATER ACIDIFICATION.
Oslo Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W91-01894

SUPERCRITICAL FLUID EXTRACTION AND ITS APPLICATION TO ENVIRONMENTAL ANALYSIS.
Mid-Pacific Environmental Lab., Mountain View, CA.
For primary bibliographic entry see Field 5A.
W91-01916

RAPID METHOD FOR THE SIMULTANEOUS ANALYSIS OF CHLORPYRIFOS, ISOFENPHOS, CARBARYL, IPRODIONE, AND TRIADIMEFON IN GROUNDWATER BY SOLID-PHASE EXTRACTION.
Massachusetts Pesticide Analysis Lab., Amherst.
For primary bibliographic entry see Field 5A.
W91-01917

REVERSED-PHASE LIQUID CHROMATOGRAPHIC COLUMN SWITCHING FOR THE TRACE-LEVEL DETERMINATION OF POLAR COMPOUNDS. APPLICATION TO CHLOROALLYL ALCOHOL IN GROUND WATER.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Organic-Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W91-01918

TRACE DETERMINATION OF LOWER VOLATILE FATTY ACIDS IN SEDIMENTS BY GAS CHROMATOGRAPHY WITH CHEMICALLY BONDED FFAP COLUMNS.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
For primary bibliographic entry see Field 5A.
W91-01919

ATMOSPHERIC INPUT OF INORGANIC NITROGEN SPECIES TO THE KIEL BIGHT.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 5B.
W91-01921

PHOSPHATE LIMITATION IN ESTUARINE AND COASTAL WATERS OF CHINA.
British Columbia Univ., Vancouver. Dept. of Botany.
For primary bibliographic entry see Field 2L.
W91-01923

INCORPORATION OF THYMIDINE, ADENINE AND LEUCINE INTO NATURAL BACTERIAL ASSEMBLAGES.
Vandkvalitetsinstitutet, Hoersholm (Denmark).
For primary bibliographic entry see Field 2L.
W91-01931

WINTER DISTRIBUTION OF NUTRIENTS IN THE SOUTHERN BIGHT OF THE NORTH SEA (1961-1978) AND IN ESTUARIES OF THE SCHELDT AND THE RHINE/MUESE.
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 2L.
W91-01936

GAS CHROMATOGRAPHY IN ENVIRONMENTAL ANALYSIS: AIMS AND CHALLENGES.
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.). Aktiengesellschaft labor fuer Umweltanalytik und Okologie.
For primary bibliographic entry see Field 5A.
W91-01954

TRACE GAS ANALYSIS USING THERMOANALYTICAL METHODS.
Gesamthochschule Wuppertal (Germany, F.R.). Fachbereich 9 - Analytische Chemie.
For primary bibliographic entry see Field 5A.
W91-01955

GC-FTIRS: APPLICATIONS IN ORGANIC TRACE ANALYSIS.
Johannes Kepler Univ., Linz (Austria). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W91-01956

DETERMINATION OF ORTHO-AND PYROPHOSPHATES IN WATERS BY EXTRACTION CHROMATOGRAPHY AND FLOW-INJECTION ANALYSIS.
Akademiya Nauk SSSR, Moscow. Inst. Geokhimii i Analiticheskoi Khimii.
For primary bibliographic entry see Field 5A.
W91-01962

HEAVY METALS IN SEDIMENTS OF THE YAMUNA RIVER (A TRIBUTARY OF THE GANGES), INDIA.
Oil and Natural Gas Commission, Anklesvar (India).
P. K. Jha, V. Subramanian, R. Sitasawad, and R. Van Grieken.
The Science of the Total Environment STENDL, Vol. 95, p 7-27, June 1990. 10 fig, 6 tab, 45 ref.

Descriptors: *Geochemistry, *Heavy metals, *India, *Rivers, *Sediment analysis, *Sediment distribution, *Sediment transport, Copper, Iron, Lead, Manganese, Particulate matter, Regression analysis, Yamuna River, Zinc.

Yamuna River sediments are more enriched in metals than those of the Ganges and average

Indian river sediments. Variations of metals in suspended, bed, and core sediment are due to the varying proportions of grain size and mineral content. Iron, manganese and lead show a preference for the oxide fraction, whereas copper and zinc are predominant inorganic and carbonate fractions of sediments. Of the total elemental content, 80 percent manganese, 78 percent iron, 69 percent lead, 67 percent copper and 55 percent zinc are available to chemically mobile phases of the sediments. The high partition coefficient of metals with respect to manganese suggests similar chemical mobility and preferences for solid phases. River sediments in the vicinity of Delhi show an increase in sorption of metals downstream, consequently metals are retained in sediments. The high correlation coefficient and significant regression relation among the metals indicate their similar behavior during transport. At Allahabad, the contribution of the Yamuna to the Ganges is 3200 tons of lead per year, 12,100 tons of zinc per year and 8500 tons of copper per year in particulate form. (Author's abstract)
W91-02005

2L. Estuaries

ESTIMATION OF AMMONIFICATION AND AMMONIUM ASSIMILATION IN SURFICIAL COASTAL AND ESTUARINE SEDIMENTS.
Tokyo Univ. (Japan). Ocean Research Inst.
T. Sumi, and I. Koike.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 270-286, March 1990. 5 fig, 7 tab, 40 ref.

Descriptors: *Ammonification, *Ammonium, *Coasts, *Estuarine sediments, *Japan, *Marine sediments, *Nutrients, Mathematical analysis, Model studies, Nitrates, Nitrogen cycle, Seasonal variation.

Coastal marine sediments are sites of biological processes closely coupled with nutrient regeneration of deposited organic materials. Ammonification and ammonium assimilation in slurries of surface sediments from Japanese coastal and estuarine areas were studied with 15NH4(+) tracers. In completely aerobic sediments, where NO3-, reduction is negligible, the Blackburn 15NH4(+) dilution model can be applied to estimate the ammonification rate after a correction for nitrification is made. In semiaerobic sediments, where significant nitrate reduction occurs, a mathematical model based on the change of 15NH4(+) and 15NH4(-) with time was successfully applied to estimate the ammonification rate. The rate of NH4+ assimilation can be obtained directly from the incorporation of 15NH4(+) into particles in the sediments after correcting for 15NH4(+) dilution during incubation. The rate of ammonification ranged from 5.8 to 220 ng-atoms N /(g sediment) /h and that of NH4+ assimilation ranged from 6.2 to 114, indicating both large seasonal and local variations. Both NH4+ assimilation and ammonification were significantly correlated with ATP biomass, NH4+, and organic N contents in sediments. Several lines of evidence also suggested that NH4+ assimilation is primarily an aerobic microbial process. (Author's abstract)
W91-01035

MICROBIAL BIOMASS IN THE COASTAL PLUME OF CHESAPEAKE BAY: PHYTOPLANKTON-BACTERIOPLANKTON RELATIONSHIPS.
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
T. C. Malone, and H. W. Ducklow.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 296-312, March 1990. 11 fig, 5 tab, 61 ref.
NSF Grants OCE 84-06526 and OCE 84-06524.

Descriptors: *Biomass, *Chesapeake Bay, *Estuaries, *Marine bacteria, *Organic matter, *Phytoplankton, Carbon cycle, Coastal waters, Copepods, Organic carbon, Predation, Seasonal variation.

Temporal variations in the contributions of phytoplankton and bacterioplankton to the pool of suspended organic matter (POC) were studied in the coastal plume of Chesapeake Bay. A combination of Eulerian and Lagrangian approaches was used to determine the spatial structure of the plume and to obtain time series of biological properties and rates within the plume. Plume structure was determined from areal surveys (mapping), and time series were conducted while following surface drifters. The turnover rate of POC increased seasonally with temperature as the proportions of POC accounted for by bacterioplankton increased relative to phytoplankton. The proportion of phytoplankton productivity that cycled through bacterioplankton averaged 13% and showed little seasonal variability. These results imply changes in the pathways and rates by which phytoplankton and bacterioplankton production were consumed or exported from the plume. Time series of 1-3 d next to surface drifters within the plume provided some insight into the nature of these changes. In February, when the turnover rate of POC was low, phytoplankton biomass declined relative to bacterioplankton due to sedimentation of large diatoms. Low bacterioplankton biomass was associated with high rates of predation by heterotrophic microflagellates. In August, when POC was turning over rapidly, phytoplankton biomass declined relative to bacterioplankton due to selective grazing by copepods. High bacterioplankton biomass appeared to be a consequence of enhanced DOC flux associated with high copepod grazing and POC turnover rates as well as with low predation by heterotrophic microflagellates. (Author's abstract)
W91-01036

PERIODIC BACTERIVORE ACTIVITY BALANCES BACTERIAL GROWTH IN THE MARINE ENVIRONMENT.
Umea Univ. (Sweden). Dept. of Microbiology.
J. Wikner, F. Rassoulzadegan, and A. Hagstrom.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 313-324, March 1990. 5 fig, 4 tab, 55 ref.

Descriptors: *Food chains, *Marine bacteria, *Marine environment, *Predation, Biomass, Diurnal variation, Grazing, Laboratory methods, Organic matter, Protozoa.

Information on spatial and temporal patterns in bacterivory are central to understanding the cycling of organic matter in the sea. The grazing rate of pelagic bacteria was repeatedly determined during 36-h time-course experiments with the minicell recapture technique. Diel variation in the rate of grazing occurred in all water masses investigated. Maximal rates reached 200,000 cells/ml /h, whereas minimal values were 20 times lower. Highest grazing rates were found during the day in most cases, but grazing could also dominate at night as found in one study. Diel periodicity was mainly due to variation in the per-cell feeding rate of bacterivorous flagellates. Accumulation of the bacterial biomass into the 1-3 micron size fraction was positively correlated with changes in bacterial grazing. The transfer efficiency to organisms > 10 microns was low. On average, the daily grazing rate equaled 60% of the bacterial standing stock, exceeding bacterial growth by a factor of 2.6, as estimated from H3-thymidine incorporation. (Author's abstract)
W91-01037

VARIATIONS IN SEDIMENTARY CARBON REMINERALIZATION RATES IN THE WHITE OAK RIVER ESTUARY, NORTH CAROLINA.
North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.
C. A. Kelley, C. S. Martens, and J. P. Chanton.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 372-383, March 1990. 8 fig, 3 tab, 43 ref.
NASA Grants NAGW-593, NAGW-1455 and NAGW-834.

Descriptors: *Estuarine sediments, *Mineralization, *North Carolina, *Nutrients, *Organic carbon, *River sediments, *Sediment chemistry, Carbon cycle, Estuarine environment, Macrophytes, Methanogenesis, Microbial degradation, Saline-freshwater interfaces, Sediment analysis, Sulfates.

Rates of microbially mediated sedimentary organic carbon remineralization vary along the salinity gradient of the White Oak River estuary, N.C. A direct comparison of two sites, one upriver dominated by methanogenesis and one downriver dominated by sulfate reduction, indicates a more rapid rate of remineralization upriver. Measurements of diffusive sigma CO2 flux plus CH4 diffusive (56%) and bubble (44%) fluxes at the upriver freshwater site from June 1986 to March 1988 yield an average yearly flux of 1.35 +/-0.35 mmol/square m/h. At the downriver midestuarine site, the dominant sigma CO2 flux for the same period is 0.46 +/-0.02 mmol/square m/h. The uncertainties in these yearly fluxes are calculated from observed ranges in duplicate flux measurements. About 43% of the incoming organic C is remineralized at both sites. The greater remineralization upriver, of which 47% can be attributed to methanogenesis, appears to be supported by rapid decomposition of detritus derived from freshwater, emergent and submersed macrophytes, including Pontederia, Ceratophyllum, and Najas in surficial sediments. The high organic C content of these upriver sediments may, however, result from the long-term storage of slower degrading plants, such as Typha and Taxodium. (Author's abstract)
W91-01040

RAPID AMMONIUM CYCLING AND CONCENTRATION-DEPENDENT PARTITIONING OF AMMONIUM AND PHOSPHATE: IMPLICATIONS FOR CARBON TRANSFER IN PLANKTONIC COMMUNITIES.
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
For primary bibliographic entry see Field 2H.
W91-01043

EPISODIC CHANGES IN LATERAL TRANSPORT AND PHYTOPLANKTON DISTRIBUTION IN SOUTH SAN FRANCISCO BAY.
Geological Survey, Menlo Park, CA.
L. M. Huzzey, J. E. Cloern, and T. M. Powell.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 472-478, March 1990. 5 fig, 23 ref.

Descriptors: *Coastal waters, *Estuarine environment, *Phytoplankton, *San Francisco Bay, *Tidal effects, Biomass, Distribution patterns, Nutrients, Seasonal variation, Tidal energy, Wind tides.

Observations in South San Francisco Bay during 1982 showed that substantial cross-channel, nontidal flows accompanied episodic increases in the longitudinal, nontidal flows. Along the channel the nontidal circulation was enhanced during the monthly minima in tidal energy or as a result of wind forcing, producing up-estuary flows 2-3 times greater than normal. These longitudinal pulses modified the horizontal and vertical salinity distributions and generated cross-channel flows of up to 0.07 m/s that persisted for several days. The increased lateral flows were directed to the west and may explain the large fluctuations in phytoplankton biomass observed over the broad eastern shoal during spring. These findings apply to other constituents, such as planktonic larvae, nutrients, or suspended sediments, which also can have large horizontal gradients in estuaries. (Author's abstract)
W91-01045

OCEANIC AND ESTUARINE AMMONIUM OXIDATION: EFFECTS OF LIGHT.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
S. G. Horrigen, and A. L. Springer.
Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 479-482, March 1990. 2 fig, 1 tab, 26 ref.

Descriptors: *Ammonium, *Bacterial physiology, *Chesapeake Bay, *Nitrification, Biological oxidation, Estuarine environment, Marine bacteria, Marine environment, Nitrogen cycle, Photoinhibition.

Photoinhibition of nitrification has been demonstrated in cultures of soil and marine bacteria as

well as in field samples from marine environments. The effects of light on the oxidation of ammonium to nitrite by cultures of oceanic and marine bacteria which are ammonium oxidizers were studied. Inhibition of ammoium oxidation by light was more pronounced in the oceanic isolates. The estuarine bacteria, isolated from Chesapeake Bay, produced nitrite at a rate faster than the oceanic isolates. Rates of ammonium oxidation in estuaries are generally greater than those in coastal seas and are much greater than those in the opean ocean for several reasons: higher levels of ammonium in estuaries would lead to faster rates of ammonium oxidation; greater turbidity in estuaries decreases light penetration and the particles may provide a substratum for ammonium-oxidizing bacteria; and the shallow depth of most estuaries allows occasional injection of sedimentary bacteria into the water column during major mixing events, which may increase the population of ammonium oxidizers in the water column. The results further indicate that reduced sensitivity to light may be an additional factor contributing to higher rates of ammonium oxidation in estuaries. (Author's abstract)
W91-01046

PHYTOPLANKTON BIOMASS, PRODUCTION AND GROWTH LIMITATIONS ON THE HUANGHE (YELLOW RIVER) CONTINENTAL SHELF.
Louisiana State Univ., Baton Rouge. Coastal Ecology and Fisheries Inst.
R. E. Turner, N. N. Rabalais, and Z. Z. Nan.
Continental Shelf Research CSHRDZ, Vol. 10, No. 6, p 545-571, 22 fig, June 1990. 6 tab, 42 ref.

Descriptors: *Biomass, *Coastal waters, *Growth, *Huang He River, *Phytoplankton, *Productivity, Growth rates, Light intensity, Nitrogen, Nutrients, Phosphorus, Pigments, Population dynamics, Salinity.

Phytoplankton populations were examined in coastal waters of the Huanghe estuary during two cruises in the annual high and normal discharge periods: August 1986 and October 1987, respectively. Strong salinity, nutrient and phytoplankton pigment concentration gradients occur along the 5 m isobath. Landward of these gradients, the phytoplankton growth potential (PGP) appears strongly phosphorous limited, while light limitation of PGP, paradoxically, appears less significant than it does offshore where the euphotic zone depth is greater. Phytoplankton pigments are sparse both in the river and far off shore, and the peak accumulation is centered broadly between 20 and 25 ppt, thus straddling the region of the hypopycnal plume from the hypopycnal plunge point to where Secchi disk depth exceeds 1 m. As the suspended matter falls out (sharply) near the 25 ppt isohaline, light conditions improve, the N:P ratio drops to below 100, and nitrate concentrations continue to decrease in an offshore direction. Phytoplankton production rates reach a maximum, and large algal cells accumulate, where the suspended particulate matter concentration drops to less than 10 mg/L. Both phytoplankton biomass production declines beyond approximately 32 ppt. Sedimentary pigment accumulations increase going from land to sea. Phosphorous and nitrogen dominate the suite of nutrients tested to determine which nutrients limit PGP. Phosphorous is probably the major nutrient limiting phytoplankton growth (not necessarily biomass accumulation) in most of the Huanghe estuary. This conclusion is based on the very high N:P ratios of dissolved nutrients, the results of an extensive array of addition and deletion bioassay experiments, and the results of P addition experiments. Where trace metals and EDTA limit PGP, they are usually limiting in concert with other nutrients and do not act alone. Comparison with other large river plumes are made. (Author's abstract)
W91-01058

HYDRODYNAMIC MODEL FOR WIND-DRIVEN AND TIDAL CIRCULATION IN THE ARABIAN GULF.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
A. H. Al-Rabeh, N. Gunay, and H. M. Cekirge.
Applied Mathematical Modelling AMMODL, Vol. 14, No. 8, p 410-419, August 1990. 8 fig, 2 tab, 57 ref.

Descriptors: *Arabian Gulf, *Hydrodynamics, *Hydrologic models, *Mathematical models, *Tidal currents, *Wind-driven currents, Eddies, Topography, Water circulation, Water currents, Wind velocity.

The vertical/horizontal splitting (VHS) model was extended and adapted to simulate tidal and wind-driven circulation in the Arabian Gulf. The extensions included the use of finite differences for the depth-averaged equations, the use of the depth following coordinate in the vertical, and relating the bottom friction to the bottom velocity. The VHS model was adapted to the Persian Gulf (Arabian Gulf) using two implementations. The first, HYDRO1, simulated wind-driven and/or tidal circulation in the Arabian Gulf. A two-block grid system in cartesian coordinates was used with a finer grid on the western coast of the gulf. The second, HYDRO2, simulated wind-driven and/or tidal circulation in any user-defined area in the Arabian Gulf. HYDRO2 enables the user to study in detail a specific region of interest in the gulf. HYDRO2 was used to simulate tidal and wind-driven circulation in the region of Abu Ali, represented by a 10 by 10 grid with a grid size of approximately three km. A northwesterly synthetic wind with a maximum speed of 10 m/sec was applied. Wind direction was considered constant, and wind speed was computed as a Gaussian function of time. Both implementations carry out three-dimensional computation when the conventional two-dimensional hypotheses are locally inadequate and when specified by the user. Elsewhere, two-dimensional computation is employed. Implementation and testing details include specification of appropriate eddy viscosity profile, wind drag coefficient, and Chezy coefficient. (Brunone-PTT)
W91-01077

PROCESSES GOVERNING MARSH FORMATION IN A RAPIDLY SUBSIDING COASTAL ENVIRONMENT.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. D. DeLaune, W. H. Patrick, and N. Van Breeman.
Catena, Vol. 17, No. 3, p 277-288, June 1990. 4 fig, 2 tab, 23 ref.

Descriptors: *Coastal marshes, *Deltas, *Mississippi River, *Salt marshes, *Subsidence, *Wetlands, Accretion, Decomposing organic matter, Oxidation, Plant growth, Plant nutrients, Plant physiology, Sediments, Soil compaction, Water level fluctuations.

Processes governing the stability of marshes in Louisiana's Mississippi River delta plain were examined. An accretionary budget was developed for Barataria Basin fresh, brackish-intermediate, and salt marshes located along a salinity gradient extending inland from the coast. The marshes represent a thin veneer overlying sediment strata deposited by the Mississippi River and its predecessors. At many location rates of vertical marsh accretion were not sufficiently rapid to keep pace with increased water depth accompanying rapid subsidence due to compaction. The life span of salt marshes of the Mississippi River deltaic plain are estimated to be approximately 100 years. The mineral sediment and organic carbon requirement of individual marsh units in response to water level was determined. Organic matter is an important component of accretionary processes and helps the marsh surface to keep pace with water level increases. An estimated 600 to 700 g of carbon/sq m per year must be supplied to maintain marsh accretion to balance soil oxidation-decomposition losses and organic carbon accretion (peat formation). Even though subsidence is the primary factor in marsh deterioration, accompanying factors (soil water intrusion, excess waterlogging) stress vegetation and thus reduce the organic carbon source below minimum aggradation requirements. Inorganic sediment input is also necessary for maintenance of viable marshes. Many of the marshes within the basin are not receiving sufficient nutrients from sediment sources to maintain significant plant growth necessary for organic matter production. Barataria Basin marsh will likely continue disappearing unless means are implemented for reintroducing sediment from the Mississippi River (Author's abstract)
W91-01088

DIRECT IMPACTS OF OUTER CONTINENTAL SHELF ACTIVITIES ON WETLAND LOSS IN THE CENTRAL GULF OF MEXICO.
Louisiana State Univ., Baton Rouge. Center for Energy Studies.
R. H. Baumann, and R. E. Turner.
Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 3, p 189-198, May/June 1990. 2 fig, 6 tab, 13 ref.

Descriptors: *Continental shelf, *Gulf of Mexico, *Louisiana, *Resource management, *Wetlands, Aerial photography, Field surveys, Navigation canals, Pipelines, Right-of-way.

The direct impacts of outer continental shelf (OCS) development on recent wetland loss in the northern Gulf of Mexico were quantified using aerial imagery, field surveys, and literature review. The total direct impacts accounted for an estimated 25.6% of total net wetland loss within the Louisiana portion of the study area from 1955/1956 to 1978. Of the total direct impacts of 73,905 ha, OCS-related activities accounted for 11,589 to 13,631 ha of the wetland loss during the same interval. Although this is a substantial areal loss, it represents only 4.0 to 4.7 percent of the total Louisiana wetland loss from 1955/1956 to 1978, and 15.7 to 18.4 percent of direct impacts. Direct impacts from OCS pipelines averaged 2.49 ha/km, lower than published guidelines, and totalled 12,012 ha. Lowest impacts are for backfilled pipelines in the Chenier Plain of western Louisiana and for small young pipelines built in clustered rights-of-way. Widening of OCS pipeline canals does not appear to be an important factor for total net wetland loss in the coastal zone because few pipelines are open to navigation and, for the examples found, the impact width was not significantly different than for open pipelines closed to navigation. Navigation channels account for a minimum of 16,902 ha of habitat change. Direct impacts per unit length of navigation channel average 20 times greater than pipelines. (Author's abstract)
W91-01099

ENVIRONMENTAL EVALUATION PROCEDURE FOR COASTAL DEVELOPMENTS IN SOUTH AFRICA.
Cape Town Univ. (South Africa). Environmental Evaluation Unit.
For primary bibliographic entry see Field 6B.
W91-01122

LONGITUDINAL DISPERSION PROCESSES IN THE UPPER TAMAR ESTUARY.
Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, R. J. Uncles, J. A. Stephens, and K. Shiono.
Estuaries ESTUDO, Vol. 13, No. 2, p 118-124, June 1990. 5 fig, 25 ref.

Descriptors: *Dispersion, *Estuaries, *Salinity, *Sediment transport, *Solute transport, *Tamar Estuary, *Tidal hydraulics, Saline-freshwater interfaces, Suspended sediments, Temporal distribution.

Measurements of velocity, salinity, and suspended solids concentration across a section of the upper Tamar Estuary for a spring and neap tidal cycle have been used to investigate the intra-tidal variation of vertical and transverse shear-induced dispersion. The interaction of vertical shear and longitudinal salinity-induced gradient leads to fairly well-mixed flood tide conditions and stable ebb tide conditions. Sediment transport is associated with active vertical momentum transport; the dispersive flux is generally $<10\%$ of the advective flux. The dispersive particulate flux is landward

during the ebb and seaward during the flood; the tidal average dispersal is very small compared with tidal average advective effects. The fluvial and dispersive fluxes of solute are approximately equivalent; the solute dispersive flux is important for the study of salinity intrusion problems. The transverse shear solute dispersion coefficient was found to be about 10% of the maximum values of vertical shear dispersion coefficient. The tidal pumping mechanism is a significant contribution to tidally averaged fluxes in the upper reaches of estuaries and are probably inappropriate where tidal range is greater than low water depth. The asymmetry of the temporal variation may be used to postulate causative mechanisms for landward and seaward fluxes that have previously been suggested as evidence of gravitational circulation effects. (See also W91-01129) (Author's abstract)
W91-01127

TIDAL STRAINING, DENSITY CURRENTS, AND STIRRING IN THE CONTROL OF ESTUARINE STRATIFICATION.
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
J. H. Simpson, J. Brown, J. Matthews, and G. Allen.
Estuaries ESTUDO, Vol. 13, No. 2, p 125-132, June 1990. 6 fig, 16 ref.

Descriptors: *Density currents, *Density stratification, *Estuaries, *Stratification, *Tides, Buoyancy, Liverpool Bay, Saline-freshwater interfaces, Stirring.

Buoyancy input as fresh water exerts a stratifying influence in estuaries and adjacent coastal waters. Predicting the development and breakdown of such stratification is an inherently more difficult problem than that involved in the analogous case of stratification induced by surface heating because the buoyancy input originates at the lateral boundaries. In the approach adopted here, the energy considerations were used in the surface heating problem to describe the competition between the stabilizing effect of fresh water and the vertical mixing brought about by tidal and wind stirring. Freshwater input induces horizontal gradients which drive the estuarine circulation in which lighter fluid at the surface is moved seaward over heavier fluid moving landward below. This contribution to stratification is expected to vary in time as the level of turbulence varies over the tidal cycle. The density gradient also interacts directly with the vertical shear in the tidal current to induce a periodic input to stratification which is positive on the ebb phase of the tide. Comparison of this input with the available stirring energy leads to a simple criterion for the existence of strain-induced stratification. Observations in a region of Liverpool Bay satisfying this criterion confirm the occurrence of a strong semidiurnal variation in stratification with complete vertical mixing apparent around high water except at neap tides when more permanent stratification may develop. A simulation of the monthly cycle based on a model including straining, stirring, and the estuarine circulation is in qualitative agreement with the main features of the observations. (Author's abstract)
W91-01128

COMPUTED AND OBSERVED CURRENTS, ELEVATIONS, AND SALINITY IN A BRANCHING ESTUARY.
Plymouth Marine Lab. (England).
R. J. Uncles, and J. A. Stephens.
Estuaries ESTUDO, Vol. 13, No. 2, p 133-144, June 1990. 7 fig, 1 tab, 23 ref.

Descriptors: *Dispersion, *Estuaries, *Saline-freshwater interfaces, *Salinity, *Salt balance, *Tidal hydraulics, Seasonal variation, Tamar Estuary.

A one-dimensional, hydrodynamical model of the Tamar Estuary shows good agreement with measured tidal elevations and currents. Computed currents are used to drive a one-dimensional, moving-element model of the salt balance. The moving-element model overcomes the numerical difficulties associated with strong tidal advection. Axial distributions of salinity at high water, computed using the moving-element model, compare well with measurements. The modelled and observed high water salinity distributions in this macrotidal estuary show little dependence on tidal range. The major variability in salinity is due to runoff. This strong and rapid dependence on runoff is a consequence of short residence (or flushing) times. Typically, residence times are less than one day throughout the year in the upper 10 km of estuary. The residence times maximize in summer, reaching 14 d for the whole estuary. During high runoff winter periods residence times are less than 5 d. Mixing coefficients for the moving-element salinity model are deduced from salinity measurements. Dispersion coefficients at fixed locations along the estuary are deduced from solutions of the salinity model. The spatially-averaged coefficients at mean spring and neap tides are 180 and 240 sq m/s, respectively, for average runoff. Therefore, spring-neap variations in dispersion are fairly small and show a negative correlation with tidal range. The spatially-averaged dispersion coefficients at mean tides vary from 150 to 300 sq m/s for typical summer and winter runoff, respectively. The increase in dispersion with runoff and the decrease with tidal range implies that buoyancy-driven currents generate an important component of the shear dispersion in this estuary. (See also W91-01127) (Author's abstract)
W91-01129

SALINITY STRATIFICATION IN A RIVER-DOMINATED ESTUARY.
Alabama Marine Resources Lab., Dauphin Island.
W. W. Schroeder, S. P. Dinnel, and W. J. Wiseman.
Estuaries ESTUDO, Vol. 13, No. 2, p 145-154, June 1990. 8 fig, 1 tab, 38 ref. DOC NOAA Office of Sea Grant No. NA81AA-D-0050 (Project R/ER-14PD).

Descriptors: *Estuaries, *River flow, *Saline-freshwater interfaces, *Salinity, *Stratification, Alabama, Mobile Bay.

Analysis of salinity data from Mobile Bay indicates that stratification-destratification events within this broad, shallow estuary are not uncommon. These events are related to the strength of the winds, through their influence on wave generation and subsequent bottom drag coefficient increases, and to the strength of river discharge. They do not appear to be due to the strength of tidal currents, as has been observed elsewhere. Furthermore, river flow appears to be the dominant control, the winds being important only in the absence of large freshwater discharges. The annual spring freshet can flush most of the salt from the bay. During other times of the year the relative strengths of river discharge and wind stress change the bay from highly stratified to nearly homogeneous and back on a variety of time scales ranging from daily to seasonal. (See also W91-01130) (Author's abstract)
W91-01130

TEMPORAL VARIABILITY OF REMOTELY SENSED SUSPENDED SEDIMENT AND SEA SURFACE TEMPERATURE PATTERNS IN MOBILE BAY, ALABAMA.
New Orleans Univ., LA. Center for Research in Ocean and Space Sciences.
J. B. Rucker, R. P. Stumpf, and W. W. Schroeder.
Estuaries ESTUDO, Vol. 13, No. 2, p 155-160, June 1990. 5 fig, 9 ref. DOC NOAA Office of Sea Grant No. NA81AA-D-0050 (Project R/ER-14PD).

Descriptors: *Estuaries, *Mobile Bay, *Remote sensing, *River discharge, *Suspended sediments, *Temperature, Alabama, Infrared imagery, Satellite technology, Temporal variation.

Distribution patterns of suspended sediments and sea surface temperatures in Mobile Bay were derived from algorithms using digital data from the visible, near infrared, and infrared channels of the Advanced Very High Resolution Radiometer (AVHRR) on the NOAA-TIROS-N satellite. Closely spaced AVHRR scenes for January 20, 24, and 29, 1982, were compared with available environmental information taken during the same period. A complex interaction between river discharge, winds, and astronomical tides controlled the distribution patterns of suspended sediments. These same variables, coupled with air temperatures, also governed the distribution patterns of sea surface temperatures. (See also W91-01130) (Author's abstract)
W91-01131

DETERMINATION OF THE ORIGIN OF SUSPENDED MATTER AND SEDIMENTS IN THE ELBE ESTUARY USING NATURAL TRACERS.
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
J. H. Schoer.
Estuaries ESTUDO, Vol. 13, No. 2, p 161-172, June 1990. 11 fig, 2 tab, 34 ref.

Descriptors: *Carbonates, *Elbe Estuary, *Estuaries, *Sediment transport, *Suspended load, *Suspended sediments, *Suspended solids, *Tracers, Clays, Hafnium, Kaolinite, Saline-freshwater interfaces, Zircon.

The clay mineral composition, the concentrations of carbonates, the proportions of carbon and oxygen isotopes in carbonates and organic matter, as well as the concentrations of different nonanthropogenic metals were used to determine the origin of different grain size fractions of sediments and suspended matter in the Elbe estuary. Analysis of the smectite/kaolinite proportion revealed that solid material <// = 2 micron from the North Sea is transported up the river, about 40 km beyond the most upstream position of the salt wedge. In the 2-20 micron fraction, the 16O/18O ratio in carbonates and the kaolinite/chlorite proportion demonstrate a transport of North Sea material between 40 and 20 km upstream of the marine water limit. The transport behavior of the 20-63 micron grain size fraction could be determined by the hafnium concentration, representative for the heavy mineral zircon. In this case, the transport distance beyond the salt wedge was up to 20 km. No information was available on the origin of the fine organic matter, whereas the coarser fractions were derived primarily from debris of salt marsh vegetation. The results demonstrate that in the Elbe estuary mixing between marine and fluvial solid material occurs upstream of the salt wedge and is significantly responsible for the observed decrease in the concentration of various pollutants in sediments and suspended matter along the estuary. The cause of the upstream particle transport is probably a scour lag mechanism based on asymmetries of the flood-tide and ebb-tide current distribution, especially their differing maximum velocities. (Author's abstract)
W91-01132

MACROINFAUNAL COMMUNITY OF A TROPICAL ESTUARINE LAGOON.
Center for Energy and Environment Research, Mayaguez, PR.
A. W. Stoner, and C. Acevedo.
Estuaries ESTUDO, Vol. 13, No. 2, p 174-181, June 1990. 4 fig, 5 tab, 40 ref. NOAA Office of Sea Grant No. R/A-01-2 and NSF Grant No. R-II-8610677.

Descriptors: *Benthic fauna, *Coastal lagoons, *Estuaries, *Estuarine environment, *Puerto Rico, *Species composition, *Tropical regions, Laguna Joyuda, Oligochaetes, Polychaetes, Seasonal variation.

The benthic macroinfauna of Laguna Joyuda, a coastal lagoon in Puerto Rico, was surveyed for two years. Seven hundred fifty core samples yielded 23 macrobenthic taxa. The oligochaete Thalassodrilides gurwitschi comprised 43.4% of the number of individuals collected. Polychaetes comprised 35.4% of the individuals, including Capitella cf. capitata, Dasybranchus lumbricoides, and Steninonereis martini in approximately equal numbers. The amphipod Grandidierella bonnieroides made up 11.5% of the community. The lagoon yielded fewer species than other tropical estuaries in the

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Caribbean and Atlantic, but the trophic composition, mostly deposit feeders, was similar. Seasonal patterns in the abundance of individuals were most pronounced in the central basin, with maximum number of organisms during the wet season, and a minimum in the dry season. Responses to rainfall events, however, were variable and probably related to migration patterns in predators. Macrofaunal biomass demonstrated a high degree of annual variation at all sampling stations with a marked increase in 1987. Low macrofaunal biomass, lack of temporal association with physical-chemical conditions, and inverse relationships with predator populations suggest that patterns of macrofaunal abundance in Laguna Joyuda are mediated primarily by biotic mechanisms. (Author's abstract)
W91-01133

STRUCTURE AND FUNCTION OF DRY WEATHER MANGROVES ON THE PACIFIC COAST OF CENTRAL AMERICA, WITH EMPHASIS ON AVICENNIA BICOLOR FORESTS.
Universidad Nacional Autonoma de Heredia (Costa Rica). Escuela Ciencias Biologicas.
J. A. Jimenez.
Estuaries ESTUDO, Vol. 13, No. 2, p 182-192, June 1990. 7 fig, 4 tab, 25 ref.

Descriptors: *Central America, *Mangrove swamps, *Semiarid climates, *Wetlands, Coastal areas, Rainfall, Runoff, Soil water.

Mangrove forests along the Pacific Coast of Central America cover around 4,000 sq km. Most of this coast is occupied with tropical dry forest mangroves where basal areas range between 6 and 20 sq. m/ha and canopy heights rarely exceed 20 m. Rainfall and runoff alter structure and floristic composition from site to site. Reproductive phenology and mortality appear to be related to soil water availability. Avicennia bicolor forests reach a density of 4,350 plants that are taller than 0.50 m/ha, with 769 trees above 5 cm diameter at breast height. A total basal area of 41 sq m/ha together with a canopy height of about 23 m place these forests among the most developed in the western hemisphere. Growth rate (0.38 sq m/ha/yr) is surprisingly high for mangrove forests under a seasonal dry climate. (Author's abstract)
W91-01134

CANANEIA LAGOON ESTUARINE SYSTEM, SAO PAULO, BRAZIL.
Sao Paulo Univ. (Brazil). Inst. Oceanografico.
Y. Schaeffer-Novelli, H. S. L. Mesquita, and G. Cintron-Molero.
Estuaries ESTUDO, Vol. 13, No. 2, p 193-203, June 1990. 2 fig, 50 ref.

Descriptors: *Coastal lagoons, *Estuaries, *Estuarine environment, *Mangrove swamps, *Subtropic zone, Brazil, Photosynthesis, Primary production, Water budget.

The Cananeia Lagoon estuarine system lies at 25 degrees S, near the latitudinal limit for mangroves. It is 110 km long, consisting of 1-3 km wide channels behind a barrier island, with narrow inlets at the southern and northern ends. Average and maximum depths are 6 m and 12 m. The system is microtidal and subtropical. Mean annual temperature is 21.4 degrees C (annual amplitude = 7.0 degrees C). When the area receives sporadic frosts, temperatures close to 2 degrees C occur in the estuary. Annual precipitation (2,270 mm) exceeds annual potential evapotranspiration (1,656 mm). The water budget of the 1,339 sq km watershed is controlled primarily by local rainfall. Before 1978, a large river discharged a significant portion of its flow into the lagoon, but closure of the diversionary channel has since caused changes in salinity, phytoplankton populations, and mangrove coverage. About 90 sq km of intertidal habitat is occupied by mangroves and tidal marsh; mangroves are dominant. Fringe and riverine forests (dominated by Rhizophora) are more structurally developed than the basins dominated by Laguncularia and have higher litterfall rates (2.08 g/sq m/d, fringes; 1.04 g/sq m/d, basins). Primary production exhibits pronounced seasonal pulses; heterotrophic processes lag photosynthetic production and are partially driven by particulate matter inputs. Synthetic models must consider the spatial and temporal heterogeneity of this region. (Author's abstract)
W91-01135

VARIABILITY OF MANGROVE ECOSYSTEMS ALONG THE BRAZILIAN COAST.
Sao Paulo Univ. (Brazil). Inst. Oceanografico.
Y. Schaeffer-Novelli, G. Cintron-Molero, R. R. Adaime, and T. M. de Camargo.
Estuaries ESTUDO, Vol. 13, No. 2, p 204-218, June 1990. 15 fig, 34 ref.

Descriptors: *Brazil, *Coastal areas, *Forest ecosystems, *Mangrove swamps, Climates, Distribution patterns, Evapotranspiration.

Brazilian mangroves extend from 4 degrees 30 min N to 28 degrees 30 min S, varying greatly in growth form, species distribution patterns, and stand structure, in spite of a limited floristic diversity. The Brazilian coastline was divided into eight units, within which physiographic and climatic conditions are relatively uniform, and described mangrove occurrence, species distribution and structural attributes characteristic of each segment. In general, greatest mangrove coverage and greatest forest stature are found in area with a large surplus of rainfall over potential evapotranspiration and macrotidal regimes. An exception was the segment containing the mouth of the Amazon river, where freshwater systems dominate over brackish or marine associations. The variability in species associations and the dominance of each in a given environment is predominantly determined by the characteristics of the landforms that can be colonized by each species in a given region. The type, size, and frequency of occurrence of available landforms is a function of the particular mix of fluvial, tidal, and wave energies found in a region. Different species colonize these sites depending on their adaptations and edaphic preferences. Climate affects mangrove colonization and growth. It is suggested that Brazilian mangroves play a minor role in modifying the geomorphic setting; the spatial arrangement of the various forest types is a response to the underlying topography and edaphic conditions, and to the constraints imposed by climatic and hydrologic factors. The spatial arrangement of species does not necessarily show successional processes, but may be the result of direct and differential colonization on appropriate substrates. (Author's abstract)
W91-01136

MANGROVE ECOLOGY, AQUATIC PRIMARY PRODUCTIVITY, AND FISH COMMUNITY DYNAMICS IN THE TEACAPAN-AGUA BRAVA LAGOON-ESTUARINE SYSTEM (MEXICAN PACIFIC).
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ciencias del Mar y Limnologia.
For primary bibliographic entry see Field 2H.
W91-01137

TEST OF THE ASSUMPTIONS AND PREDICTIONS OF RECENT MICROALGAL GROWTH MODELS WITH THE MARINE PHYTOPLANKTER PAVLOVA LUTHERI.
Hawaii Univ., Honolulu. Dept. of Oceanography.
M. S. Chalup, and E. A. Laws.
Limnology and Oceanography LIOCAH, Vol. 35, No. 3, p 583-596, May 1990. 11 fig, 2 tab, 50 ref. Solar Energy Research Institute Subcontract XK-4-04109.

Descriptors: *Algal growth, *Marine algae, *Model studies, *Phytoplankton, Carbon, Chlorophyll a, Irradiation, Nitrogen, Nutrients.

The marine phytoplankter Pavlova lutheri was grown in both batch and continuous culture under various conditions of light and nitrate limitation in order to examine the accuracy of certain assumptions and predictions of microalgal growth models. The N:C ratio of the cells was found to be uniquely related to their relative growth rate. There was no unique relationship, however, between Chl a:C ratios and relative growth rate. Optical absorption coefficients normalized to Chl a were negatively correlated with relative growth rate at a fixed irradiance and positively correlated with irradiance at a fixed relative growth rate when light intensity was varied with neutral-density filters. Quantum yields were positively correlated with relative growth rate at a fixed irradiance and negatively correlated with irradiance at a fixed relative growth rate. Certain parameters or combinations of parameters which appear in nutrient-saturated growth models were found to be either independent of relative growth rate at a fixed irradiance or uniquely correlated with relative growth rate. This discovery facilitates extension of nutrient-saturated growth models to nutrient-limited conditions. (See also W91-01140) (Author's abstract)
W91-01139

MICROALGAL GROWTH MODEL.
Hawaii Univ., Honolulu. Dept. of Oceanography.
E. A. Laws, and M. S. Chalup.
Limnology and Oceanography LIOCAH, Vol. 35, No. 3, p 597-608, May 1990. 7 fig, 1 tab, 29 ref. Solar Energy Research Institute Subcontract XK-4-04109.

Descriptors: *Algal growth, *Limiting nutrients, *Limnology, *Model studies, *Photosynthesis, Carbon, Chlorophyll a, Irradiation, Nitrogen.

Recent experimental evidence has made it clear that effects of irradiance and nutrient limitation on light absorption and photosynthetic quantum yields of microalgae and the relationship between cellular N:C ratios and nutrient-limited growth rates are inconsistent with the assumptions and predictions of current models of algal growth. A new algal growth model was therefore developed to overcome these inconsistencies. The new model predicts a hyperbolic relationship between nutrient-saturated growth rates and irradiance and a linear relationship between growth rate and both respiration rate and Chl a:C ratios. The correlation between growth rate and Chl a:C is positive under nutrient-limited conditions and negative under nutrient-saturated (light-limited) conditions. The requirement that N:C ratios be linearly related to relative growth rates leads to the conclusion that the product of the Chl a-specific absorption coefficient and the quantum yield coefficient be hyperbolically related to nutrient-limited growth rates, a result consistent with experimental observations. The equations relating respiration rate and compositional ratios to absolute and relative growth rates appear to be insensitive to photoperiod. (See also W91-01139) (Author's abstract)
W91-01140

BACTERIAL MEDIATION IN THE UTILIZATION OF CARBON AND NITROGEN FROM DETRITAL COMPLEXES BY CRASSOSTREA VIRGINICA.
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
M. P. Crosby, R. I. E. Newell, and C. J. Langdon.
Limnology and Oceanography LIOCAH, Vol. 35, No. 3, p 625-639, May 1990. 8 tab, 76 ref. NSF Grant OCE 84-000200.

Descriptors: *Bacterial physiology, *Cycling nutrients, *Oysters, *Salt marshes, Carbon radioisotopes, Detritus, Nitrogen radioisotopes.

Unattached, cellulolytic bacteria isolated from a salt marsh were cultured on (15N)ammonium sulfate and (14C)glucose and fed to the American oyster Crassostrea virginica. Oysters were able to digest and assimilate bacterial C with an assimilation efficiency of 52.5%. It is estimated that free-living bacteria may be capable of supplying up to about 9.5% of the total C requirements of oysters in their natural habitat. Cellulolytic bacteria were also cultured on 14C-labeled refractory Spartina alterniflora particles as the sole C source and (15N)ammonium sulfate as a source of N. These labeled bacteria, together with the S. alterniflora, were fed to the oysters. The refractory C from these detrital complexes was assimilated by the oysters with an efficiency of 10.3%. It was significantly ($P=0.0007$) greater than the assimilation

efficiency of 2.7% measured in a previous study for oysters feeding on the refractory S. alterniflora substrate alone. This result provides direct experimental evidence that cellulolytic bacteria in the environment can contribute to the transfer of C from refractory detritus to an ecologically important suspension-feeding macroinvertebrate. C. virginica, when fed detrital complexes, assimilated bacterial N with an efficiency of 57.2% but that assimilation of total N present in the detrital complexes was only 3.4%. We speculate that this low assimilation efficiency was due to most (94%) of the N being in the form of condensation products such as humic geopolymers and extracellular polymeric substances secreted by bacteria which could not be digested and absorbed by the oysters. Calculations show that detrital complexes in the natural environment may provide a significant contribution to an oyster's C demand. The magnitude of this contribution can increase from 1.3 to 60% as both absolute bacterial abundance and proportion of bacteria attached to detrital particles increase, raising the oysters' efficiency of filtration for these substrates. (Author's abstract)
W91-01141

ROLE OF NUTRITION IN REGULATING THE POPULATION DYNAMICS OF OPPORTUNISTIC, SURFACE DEPOSIT FEEDERS IN A MESOHALINE COMMUNITY.
Maryland Univ., Solomons. Chesapeake Biological Lab.
A. G. Marsh, and K. R. Tenore.
Limnology and Oceanography LIOCAH, Vol. 35, No. 3, p 710-724, May 1990. 9 fig, 3 tab, 48 ref. NSF Grant No. OCE-85-16-751.

Descriptors: *Bivalves, *Brackish water, *Chesapeake Bay, *Estuarine environment, *Limiting nutrients, *Nutrition, *Population dynamics, Polychaetes.

The role of food resources in regulating seasonal population dynamics was determined in a benthic community typical of mesohaline regions in Chesapeake Bay. Four macroinvertebrates dominated the community: the bivalve Macoma balthica, the polychaetes Streblospio benedicti and Nereis succinea, and the amphipod Leptocheirus plumulosus. Several factors seem to regulate population dynamics at different times of the year. In March, growth and reproduction rates accelerated as temperature and phytodetrital sedimentation increased. In April, invertebrate growth rates plateaued while estimated community N requirements were equivalent to estimated N availability. In May, invertebrate growth and reproduction rates rapidly declined while estimated community energy requirements were greater than sedimenting energy supplies. In June, larval recruitment was heavy for S. benedicti and L. plumulosus; however, these juveniles showed no apparent growth during June and their densities rapidly declined. The sudden appearance and disappearance of these juveniles was solely responsible for the boom-and-bust dynamics of S. benedicti and L. plumulosus. Essential W3-polyunsaturated fatty acids and essential amino acids were present at high levels in spring but were present in only trace amounts during summer. Growth of juvenile S. benedicti and L. plumulosus recruits was most likely limited by food supply in June and July, especially by the availability of essential nutrients. Estimates of predation rates could not account for these population declines. (Author's abstract)
W91-01145

MULTIVARIATE STATISTICAL ANALYSES OF SEDIMENT GEOCHEMISTRY.
University of East Anglia, Norwich (England). School of Environmental Sciences.
A. Grant.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 6, p 297-298, June 1990. 2 fig, 3 tab, 5 ref.

Descriptors: *Geochemistry, *Marine pollution, *Marine sediments, *Mineralogy, *Pollutant identification, *Statistical methods, *Water analysis, *Water chemistry, Australia, Calcium, Clays, Contaminated sediments, Copper, Heavy metals, Humber Estuary, Lead, Nickel, Silicon.

The effects of sediment mineralogy are often confounded by the effects of concentration differences caused by contamination. Multivariate statistical methods were used to identify locally elevated concentrations of elements in sediments which are usually attributed to man-made contamination, and not to sediment mineralogy. The commonest multivariate method used to identify man-made contamination involves the calculation of intersample similarities and the use of cluster analysis to identify similar groups. This approach is better suited for the identification of gross mineralogical differences than for identifying contamination. An example, copper levels in uncontaminated mud, is shown to be higher than copper levels in contaminated sand where both mud and sand came from the Humber estuary. Forty-five samples from New South Wales subjected to cluster analysis divided into three groups: one, high in clay minerals, represented by high levels of Ni, Cu and Pb; two, high in quartz, represented by high Si levels; and three, high in shell gravel, represented by high Ca levels. From these, and other related, data it is clear that the first group is relatively high in clay minerals, with which Ni, Cu, and Pb are usually associated; the second group represents sediments rich in quartz; while the third group represents sediment containing shell gravel. So, cluster analysis applied in this way does not achieve the desired purpose. An alternative method is principal component analysis (PCA), which determines new additive variables with account for a maximum proportion of the variance. (King-PTT)
W91-01161

BIOFILM CHARACTERISTICS IN COASTAL WATERS OF BOMBAY.
Naval Chemical and Metallurgical Lab., Bombay (India).
R. B. Srivastava, S. N. Gaonkar, and A. A. Karande.
Proceedings of the Indian Academy of Sciences (Animal Sciences) PIANDR, Vol. 99, No. 2, p 163-173, March 1990. 4 fig, 8 tab, 22 ref.

Descriptors: *Biofilms, *Bombay, *Coastal waters, *Fouling, *Heavy metals, Copper, India, Marine pollution, Nickel, Toxicity.

The generation of biofilms on metal and non-metal coupons which were immersed in Bombay coastal waters was studied in the field and in the laboratory. The nature of the biofilm formed varied from substrate to substrate, influenced by the quality of water, flow conditions, and the biotic status of the seawater. The biofilms, depending upon the degree of entrapment of the inorganic detritus, have varying weights. The biofilms formed on metallic surfaces, when compared with perspex surfaces, are both qualitatively and quantitatively richer. Cupronickel, despite its toxicity, supports denser films than those which developed on inert perspex surfaces. The metallic coupons, both inert and toxic, support thicker films in polluted waters than in clean waters. (Author's abstract)
W91-01170

PRODUCTION AND CARBON ISOTOPIC COMPOSITION OF BACTERIAL CO2 IN DEEP COASTAL PLAIN SEDIMENTS OF SOUTH CAROLINA.
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2J.
W91-01297

ENVIRONMENTAL IMPACT OF NORTH SEA OIL.
Dundee Univ. (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-01329

NITROGEN CYCLING IN LOUISIANA GULF COAST BRACKISH MARSHES.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. D. DeLaune, and W. H. Patrick.
Hydrobiologia HYDRB8, Vol. 199, No. 1, p 73-79, July 17, 1990. 5 fig, 1 tab, 21 ref. NSF grant BSR-8413006.

Descriptors: *Brackish water, *Louisiana, *Nitrogen, *Nitrogen cycle, *Nitrogen fixation, *Salt marshes, *Wetlands, Ammonium, Nitrogen budget, Seasonal variation, Sediments, Soil profiles, Spartina.

Nitrogen fixation and nitrogen accumulation were measured in a Louisiana Spartina patens brackish marsh. Using the acetylene reduction technique calibrated with direct 15N2 assimilation, an equivalent of 90.0 microg N/g/yr was fixed. Fixation was greater in the summer months and in the upper portion of the soil profile. Extractable ammonium increased with depth and was negatively correlated with ethylene production. Average ammonium concentration in the sediment was 39 microg NH4(+) as N/g sediment. Cesium-137 dating of the soil profile showed the marsh was vertically accreting at a rate of 0.60 cm/yr. Calculations using verticai accretion rate, bulk density, and total nitrogen content of sediment indicate that the marshes are accumulating 7.2g N/sq m/yr, thus serving as a major nitrogen sink. By incorporating measured nitrogen fluxes with existing flux measurement a nitrogen budget was developed for the marsh. The data suggest that nitrogen fixation is the primary source of nitrogen in this marsh. These results are in contrast to the salt marshes nearer the coast where sediment input was definitely the primary source of nitrogen. (Author's abstract)
W91-01351

TEMPERATURE SELECTION BY STRIPED BASS IN A GULF OF MEXICO COASTAL RIVER SYSTEM.
Georgia Cooperative Wildlife Research Unit, Athens.
For primary bibliographic entry see Field 8I.
W91-01385

MATHEMATICAL MODEL OF BACTERIAL CONTAMINATION OF THE MORLAIX ESTUARY (FRANCE).
IFREMER, Paris (France).
For primary bibliographic entry see Field 5B.
W91-01419

PROPERTIES OF UNSTABLE WAVES IN THE LOWER ST. LAWRENCE ESTUARY.
Quebec Univ., Rimouski. Dept. of Oceanography.
G. Mertz, Y. Gratton, and J. A. Gagne.
Atmosphere - Ocean ATOCDA, Vol. 28, No. 2, p 230-240, June 1990. 5 fig, 18 ref.

Descriptors: *Eddies, *Estuaries, *Fluid dynamics, *Oscillatory waves, *St Lawrence Estuary, *Waves, Canada, Mathematical analysis, Mathematical models, Mathematical studies, Model studies, Wave direction, Wave velocity.

The lower St. Lawrence estuary is an interesting case among estuaries in that it is wide enough to accommodate the development of mesoscale unstable waves and eddies. These features are generated by the runoff-driven jet along this body's south shore. Data are presented yielding estimates of the length, time and velocity scales of these unstable disturbances. To relate these quantities to the dynamics employed, a 2-layer quasigeostrophic instability model featuring realistic lateral shear. All model runs show short time and length scales, e-folding periods of less than 10 days and wavelengths of less than 50 km. The lower St. Lawrence estuary is an unusual domain for mesoscale unstable waves since it is semi-enclosed. The northern lateral boundary prevents eddies that are shed from the south-shore jet from migrating far offshore. This may imply re-interaction of the eddy with the south-shore jet, perhaps yielding a merging event or alternatively a new cycle of wave growth. (Author's abstract)
W91-01431

TIDAL DYNAMICS OF THE WATER TABLE IN BEACHES.

Sydney Univ. (Australia). Ocean Technology Group.
For primary bibliographic entry see Field 2F.
W91-01528

LATERAL DISTRIBUTION OF SUSPENDED SEDIMENTS IN NEARSHORE WATER OF MUDDY COAST OF LIANYUNGANG HARBOUR (IN CHINESE).
East China Normal Univ., Shanghai. Inst. of Estuarine and Coastal Research.
For primary bibliographic entry see Field 2J.
W91-01567

CLASSIFICATION OF ESTUARIES IN CHINA (IN CHINESE).
East China Normal Univ., Shanghai.
Y. H. Jin, H. T. Shen, and J. Y. Chen.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 21, No. 2, p 132-143, March 1990. 5 fig, 6 tab, 8 ref. English summary.

Descriptors: *China, *Estuaries, Changjiang River, Classification, Cluster analysis, Data interpretation, Huang He River, Qiantang River, River sediments, Sheyang River, Stream classification, Yangtze River, Yellow River, Zhujiang River.

The estuaries of China were classified into four basic types, by using data from 27 large rivers which were analyzed using fuzzy cluster analysis for those factors which influence the deformation, erosion-accumulation and evolution of an estuary. The comprehensive classification principle treats an estuary as a complex physiographic system including estuarine hydraulic behavior, sediment concentration and source and plane features. The four estuary types determined using this method are: 1) Qiantang river Estuary type, funnel-shaped, laterally inhomogeneous, sediment from the sea: 2) Transitional estuary type, subdivision one, Sheyang River Estuary type, meander type, partially mixed, sediment primarily from the sea; subdivision two, Changjiang River (Yangtze River) Estuary type, branched type, partially mixed, sediment from both sea and land; 3) Zhujiang River Estuary type, network type, partially mixed, sediment primarily from the land; and 4) Huanghe River (Yellow River), wandering type, highly stratified, sediment from the land. The different classifications of estuaries are described in terms of the ratio of mean flood tidal discharge to the mean river discharge into the sea (QR), and the ratio of the rate of the mean flood tidal sediment transportation to the rate of the mean river sediment transportation (SR). The tidal range and plane feature of an estuary are the primary classification indexes when QR and SR are unknown. The classification system has been satisfactorily applied to foreign rivers. (Author's abstract)
W91-01570

EXISTING FORMS OF PHOSPHORUS IN SEDIMENT FROM MIDDLE AND NORTHERN TAIWAN STRAIT (IN CHINESE).
Fujian Inst. of Oceanology, Xiamen (China).
J. S. Xu, and L. G. Li.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 21, No. 1, p 62-69, January 1990. 9 fig, 8 ref. English summary.

Descriptors: *Cycling nutrients, *Marine sediments, *Phosphorus, *Sediment chemistry, *Taiwan, Aluminum, Copper, Hydrogen ion concentration, Indicators, Iron, Organic carbon, Taiwan Straits, Water quality, Zinc.

The distribution of phosphorus species and their concentrations in sediments from middle and northern parts of Taiwan Strait are presented. In the area surveyed, the concentration of phosphorus bound up in calcium-based matrices (Pca) makes up 90% of the total content of inorganic phosphorus (Pinorg). The level of Pca concentration is closely related to hydrodynamics, sea water temperature, and pH values, as well as others. The level of phosphorus in aluminum-based matrices (Pal) and the level of phosphorus in iron-based matrices (Pfe) is positively correlated with the levels of organic carbon, copper, and zinc. Pal and Pfe could also be used as an indicator of pollution in the marine environment. The level of soluble phosphorus is correlated with environmental oxidation-reduction, and it increases in reductive condition. (Author's abstract)
W91-01575

TWO-DIMENSIONAL NUMERICAL CALCULATION OF RESIDUAL CURRENT AND SALINITY AT THE CHANGJIANG RIVER ESTUARY (IN CHINESE).
Academia Sinica, Qingdao (China). Inst. of Oceanology.
K. J. Yu.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 21, No. 1, p 92-112, January 1990. 6 fig, 5 ref, 4 plates. English summary.

Descriptors: *China, *Estuaries, *Mathematical models, *Salinity, *Yangtze River, Changjiang River, Model studies, Water currents, Wind-driven currents.

The distribution of residual current and salinity in the Changjiang River (Yangtze River) estuary were compared for summer and winter by using a finite-difference method based on two-dimensional nonlinear equations of motion and salinity diffusion equations. The results show that the residual currents flow northeastward because of the influence of south winds in summer, but, in winter, they flow southwestward or southeastward because of the influence of the north wind. The salinity distribution corresponds to that of the residual currents. The salt tongue tends to be northeastward in summer, but southeastward in winter. The distributions of equal-salinity lines outside of the Changjiang River estuary were usually westward as a result of less discharge during the winter season. The analyses of residual currents and salinity were used to predict the possible effects of the Three Gorges project. (Author's abstract)
W91-01578

MICROORGANISMS IN MARINE SEDIMENTS: CONSIDERATIONS CONCERNING ACTIVITY MEASUREMENTS.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 2J.
W91-01585

GROWTH OF BACTERIA ON ORGANIC MATTER PRODUCED BY ALGAE IN CONTINUOUS CULTURES.
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
For primary bibliographic entry see Field 2H.
W91-01589

ALGAL EXUDATION AND ITS RELATION TO BACTERIAL PRODUCTION DURING VERNAL PHYTOPLANKTON BLOOMS.
Tvarminne Zoological Station (Finland).
For primary bibliographic entry see Field 2H.
W91-01592

DELAYED DEVELOPMENT OF BACTERIOPLANKTON WITH RESPECT TO PHYTOPLANKTON: A CLUE FOR UNDERSTANDING THEIR TROPHIC RELATIONSHIPS.
Universite Libre de Bruxelles (Belgium). Groupe de Microbiologie des Milieux Aquatiques.
G. Billen.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 191-201, 1990. 7 fig, 33 ref. Services de Programmation de la Politique Scientifique (Brussels) Contract ARC, ANTARO5 and EEC Contract ENV-522-B.

Descriptors: *Bacterioplankton, *Marine environment, *Mathematical models, *Model studies, *Phytoplankton, *Population dynamics, Algal blooms, Antarctica, Aquatic bacteria, Bacterial physiology, Dissolved solids, Growth rates, Marine bacteria, North Sea, Nutrients, Organic matter, Simulation analysis, Substrates.

Bacterioplankton development is mainly dependent on the release of dissolved organic matter by phytoplankton and is expected in aquatic systems receiving major inputs of allochthonous organic matter. A distinct delay is observed in the response of bacteria to phytoplankton development, both during spring bloom in temperate marine systems and during the summer months in the Antarctic ecosystem (about 10 d in the North Sea, about 1 mo in Antarctica). Use of mathematical simulation of bacterial dynamics showed that such delays cannot be explained if phytoplankton exudation of low molecular weight substrates was the dominant process supplying dissolved organic matter to bacteria. Instead, these delays are correctly simulated assuming that the major source of organic substrates used for bacterial growth consists in the release of macromolecular compounds by post mortem lysis of algal cells. (Author's abstract)
W91-01609

DYNAMICS OF PELAGIC CILIATES IN EUTROPHIC ESTUARINE WATERS: IMPORTANCE OF FUNCTIONAL GROUPS AMONG CILIATES AND RESPONSES TO BACTERIAL AND PHYTOPLANKTON PRODUCTION.
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
H. Arndt, G. Jost, and N. Wasmund.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 239-245, 1990. 3 fig, 19 ref.

Descriptors: *Aquatic productivity, *Bacterial productivity, *Ecosystems, *Estuaries, *Eutrophication, *Food habits, *Phytoplankton, *Population dynamics, *Protozoa, Algal blooms, Aquatic bacteria, Baltic Sea, Darss-Zingst Estuary, Food chains, Mineralization, Nutrient transport, Seasonal variation, Species composition.

The planktonic ciliate community was investigated during field studies and enclosure experiments in the shallow eutrophic Darss-Zingst estuary (southern Baltic). The functional groups of ciliates were separated according to their main food items known from literature and from observations. In response to temporal changes in the production of bacteria and phytoplankton, changes in the composition of the ciliate community appeared. Algivores dominated during the spring bloom and in early summer and early autumn, corresponding to the pulses of small phytoflagellates and green algae, respectively. Bactivorous ciliates were of the highest importance during summer and autumn. Estimates of the feeding rates of functional groups revealed no significant impact of algivores but bactivores should be able to consume one third of annual bacterial production and can control bacterial production during certain periods. At high concentrations of ciliates, their density seemed to be regulated within the pelagic ciliate community itself by the impact of omnivores. Nutrient loading into enclosures during summer did not lead to considerable changes in ciliate community. The most important function of pelagic ciliates within the matter flux of this estuarine community seems to be the mineralization of bacterial production. (Author's abstract)
W91-01613

RESPONSE OF COASTAL ZONE MANAGEMENT PROGRAMS TO SEA LEVEL RISE IN THE UNITED STATES.
Washington Univ., Seattle. Inst. for Marine Studies.
For primary bibliographic entry see Field 6B.
W91-01619

EYE TO EYE WITH HURRICANE GLORIA ON VIRGINIA'S TANGIER ISLAND.
Old Dominion Univ., Norfolk, VA.
For primary bibliographic entry see Field 6B.
W91-01620

PERMIT REFORM THROUGH COASTAL CONSISTENCY PREVIEW: AN ANALYSIS OF ALASKA'S COORDINATED PROCESS.
Alaska Univ., Fairbanks.

For primary bibliographic entry see Field 6F.
W91-01621

TRIBUTYLTIN AND INVERTEBRATES OF A SEAGRASS ECOSYSTEM: EXPOSURE AND RESPONSE OF DIFFERENT SPECIES.
Cornell Univ., Ithaca, NY. Ecosystems Research Center.
For primary bibliographic entry see Field 5C.
W91-01625

ENVIRONMENTAL FACTORS AFFECTING BENTHIC INFAUNAL COMMUNITIES OF THE WESTERN ARABIAN GULF.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
S. L. Coles, and J. C. McCain.
Marine Environmental Research MERSDW, Vol. 29, No. 4, p 289-315, 1990. 4 fig, 9 tab, 39 ref.

Descriptors: *Benthic environment, *Benthic fauna, *Coastal environment, *Coasts, *Species diversity, *Water pollution effects, Fate of pollutants, Hydrocarbons, Persian Gulf, Petroleum products, Population density, Salinity, Sea grasses, Sediments.

Species composition and abundances of benthic organisms >0.5 mm in size were determined in seagrass and sand/silt substrata along the Saudi Arabian Gulf coastline. Synoptic measurements were made of environmental and pollution-related parameters. Numbers of species and individuals were significantly greater in seagrass than in sand/silt substrata, indicating that the finer grained sediments of the seagrass areas support more diverse and abundant benthic communities. In both seagrass and sand/silt, abundances of species and individuals decrease significantly with increasing salinity, resulting in substantially reduced benthic communities in the Gulf of Salwah at the southern extent of the western Gulf where salinities average up to 56.5 ppt. In contrast, biomass of the total benthos in the sand/silt substratum increases significantly with salinity. All pollution-related parameters tested indicated relatively low concentrations in sediments. The only significant relationship found with the benthos was an increase in numbers of individuals with sediment petroleum hydrocarbons, resulting in significantly lower species diversities in areas of higher sediment petroleum. The most abundant organism in the area increases significantly with sediment petroleum hydrocarbons within the relatively low concentrations that do occur, indicating that this species is primarily responsible for the observed relationship between petroleum hydrocarbons, numbers of individuals and species diversity. (Author's abstract)
W91-01626

CONTRIBUTION OF BENTHIC BIOMASS TO OVERALL METABOLISM IN NEW CALEDONIA LAGOON SEDIMENTS.
Museume National d'Histoire Naturelle, Paris (France). Biologie des Invertebres Marins.
G. Boucher, and J. Clavier.
Marine Ecology Progress Series MESEDT, Vol. 64, No. 3, p 271-280, July 12, 1990. 5 fig, 4 tab, 63 ref.

Descriptors: *Benthic environment, *Benthic fauna, *Benthic flora, *Benthos, *Dissolved oxygen, *Dissolved solids, *Lagoons, *New Caledonia, *Nitrogen, *Sediment-water interfaces, Bottom sampling, Bottom sediments, Mud, Regression analysis, Sand, Sediment analysis.

Granulometric parameters, benthic biomasses of living organic matter, and oxygen and nitrogen fluxes at the water-sediment interface were investigated on triplicate samples, or in dark experiments, at 12 stations in the lagoon in SW New Caledonia. Analysis of functional characteristics of 3 bottom types revealed significant differences in the benthic food-webs. Onshore muddy bottoms had the lowest respiration, related to the lowest adenotriphosphate (ATP) pool and meiofauna density, in spite of high organic and pigment content. Near-reef white-sand bottoms were a sink for dissolved organic nitrogen (DON), exported no significant dissolved inorganic nitrogen (DIN), and supported the highest living biomass (ATP) via meiofauna and active microphytes. Intermediate grey-sand bottoms had the highest respiration, related to macrophyte cover and to a lesser extent to larger macrobenthos biomass, and were a source of nutrients for the water-column (DIN and DON). Partitioning of benthic biomass was investigated using non-linear multiple regression. Oxygen consumption was mainly related to ATP content, considered as representative of microfauna and meiofauna biomass, then to macrophyte biomass and to a lesser extent to macrofauna biomass. Pigment content did not improve the relationship. Depletion of inorganic nitrogen efflux, when compared to high respiration rates, increased from muddy bottoms to white-sand bottoms. Organic nitrogen (DON) exchanges were an order of magnitude greater than DIN exchanges indicating a considerable nitrogen demand in the sediment. (Author's abstract)
W91-01659

EFFECTS OF SUNLIGHT AND AUTOCHTHONOUS MICROBIOTA ON ESCHERICHIA COLI SURVIVAL IN AN ESTUARINE ENVIRONMENT.
Virginia Inst. of Marine Science, Gloucester Point. Dept. of Biological and Fisheries Sciences.
For primary bibliographic entry see Field 5B.
W91-01663

USE OF THE MUSSEL WATCH AND MOLECULAR MARKER CONCEPTS IN STUDIES OF HYDROCARBONS IN A TROPICAL BAY (TODOS OS SANTOS, BAHIA, BRAZIL).
Centro de Investigacion y Desarrollo, Barcelona (Spain). Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 5A.
W91-01690

RIVER DISCHARGE AND TIDAL CONTROLS ON SALT-WEDGE POSITION AND IMPLICATIONS FOR CHANNEL SHOALING: FRASER RIVER, BRITISH COLUMBIA.
Guelph Univ. (Ontario). Dept. of Geography.
R. A. Kostaschuk, and L. A. Atwood.
Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 3, p 452-459, June 1990. 7 fig, 22 ref.

Descriptors: *British Columbia, *Channels, *Estuaries, *Rivers, *Sedimentation, *Shoals, *Tidal effects, *Tidal hydraulics, Regression models, Saline water intrusion, Statistical analysis.

Salinity and current surveys in the Main Channel of the Fraser River estuary, British Columbia, show that a well-defined salt-wedge intrusion migrates along the channel. Bivariate statistical analyses reveal that when discharge is nearly constant, the position of the salt-wedge is controlled by tidal height. Multivariate analyses of data with large ranges in discharge and tidal height indicate that intrusion location is a function of both discharge and tides. Multiple regression models were derived to predict salt-wedge position from river discharge and tidal height, for combined high and low tides, and for high tides and low tides separately. The high-tide model is the most precise, followed by the combined and then the low-tide models. The lower precision for the combined and low-tide models is probably due to the difficulty in accurately locating the salt-wedge tip at low tide. An analysis of channel bathymetric surveys and dredging records and application of the low-tide regression model reveals that the low-tide position of the salt-wedge is responsible for channel shoaling near the river mouth at Sand Heads. Shoaling produces a navigation hazard and is linked to submarine slope failures. (Author's abstract)
W91-01722

POLYCHLORINATED DIBENZOFURAN (PCDF) AND DIBENZO-P-DIOXIN (PCDD) LEVELS IN ORGANISMS AND SEDIMENTS FROM THE FRIERFJORD, SOUTHERN NORWAY.
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5B.
W91-01726

PERSISTENT METABOLITES OF ALKYLPHENOL POLYETHOXYLATES IN THE MARINE ENVIRONMENT.
Venice Univ. (Italy). Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W91-01754

TRENDS IN THE HEAVY METAL LEVELS IN THE DISSOLVED AND PARTICULATE PHASE IN THE DUTCH RHINE-MEUSE (MAAS) DELTA.
Warsaw Univ. (Poland). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W91-01817

SPATIAL AND SEASONAL DIFFERENCES IN THE PCB CONTENT OF THE MUSSEL MYTILUS EDULIS.
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 5B.
W91-01819

HYDROGRAPHIC SURVEYS AND SEDIMENTATION IN DEEP BAY, HONG KONG.
Hong Kong Polytechnic, Kowloon. Dept. of Civil and Structural Engineering.
For primary bibliographic entry see Field 2J.
W91-01883

NUTRIENT EXCHANGES BETWEEN THE WATER COLUMN AND A SUBTIDAL BENTHIC MICROALGAL COMMUNITY.
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2H.
W91-01897

INTERPRETATION OF METAL CONCENTRATIONS IN ESTUARINE SEDIMENTS OF FLORIDA USING ALUMINUM AS A REFERENCE ELEMENT.
Florida State Dept. of Environmental Regulation, Tallahassee.
S. J. Schropp, F. G. Lewis, H. L. Windom, J. D. Ryan, and F. D. Calder.
Estuaries ESTUDO, Vol. 13, No. 3, p 227-235, September 1990. 6 fig, 1 tab, 27 ref.

Descriptors: *Aluminum, *Biscayne Bay, *Data interpretation, *Estuarine sediments, *Florida, *Metals, *Path of pollutants, Estuaries, Miami River, Sediment contamination.

Metal contamination of estuarine sediments is an increasing problem in Florida, and elsewhere, as urbanization extends into previously undeveloped areas. Effective estuarine management practices require scientifically valid tools to assess the extent of estuarine contamination. Interpretation of anthropogenic metal contributions has been hampered by the fact that natural metal concentrations in sediments vary by orders of magnitude in different sediments. Normalization of metal concentrations to a reference element, aluminum, appears to be a promising method for comparing estuarine sediment metal concentrations on a regional basis. The description is presented of an interpretive method based on the relationship between sediment metals and aluminum, derived from statewide data on natural estuarine sediments in Florida. Examples from the Miami River and Biscayne Bay show how this method can be used to interpret metal concentrations. This interpretive tool provides a simple method for evaluating sediment metal data and allows results of sediment chemical analyses to be used for a variety of environmental information needs including: (1) distinguishing natural versus enriched metal concentrations in estuarine sediments; (2) comparing metal concentrations within an estuary; (3) comparing results from different estuaries; (4) tracking the spatial influence of a known pollution source; (5) monitoring temporal trends in metal concentrations; (6) examining data

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for procedural or laboratory errors; and (7) as a screening tool to promote the cost-effective use of other tests (e.g., bioassay, elutriate). (Lantz-PTT)
W91-01898

MODELING OF WIND-INDUCED DESTRATIFICATION IN CHESAPEAKE BAY.
HydroQual, Inc., Mahwah, NJ.
A. F. Blumberg, and D. M. Goodrich.
Estuaries ESTUDO, Vol. 13, No. 3, p 236-249, September 1990. 12 fig, 5 tab, 31 ref. EPA Contract No. 68-03-3319.

Descriptors: *Chesapeake Bay, *Destratification, *Estuaries, *Mixing, *Model studies, *Wind-driven currents, Bays, Oxygen, Salinity, Tides, Turbulence, Vertical distribution.

It has been observed that storms in early fall can result in top to bottom mixing of the Chesapeake Bay. A three-dimensional, time dependent circulation model was used to examine this destratification process for September 1983, for which extensive current and hydrographic data are available. The model bay is forced at the surface by observed hourly winds, at the ocean boundary by observed hourly surface and bottom salinities and sea level fluctuations, and at the head by observed daily discharges for a 28-d period. A second-moment, turbulence-closure submodel, with no adjustments from previous applications to its requisite coefficients, was used to calculate the vertical turbulence mixing coefficients. Comparisons with data inside the model domain indicate relative errors of 7% to 14% for sea level, 7% to 35% for current, and 11% to 21% for salinity. The tidal portion of the spectrum is modeled better than the subtidal portion. The model is used to examine both the mechanisms of wind mixing and the temporal and spatial distribution of vertical mixing within the estuary. Wind-driven internal shear is shown to be a more effective mechanism of inducing destratification than turbulence generated at the surface. The model is also used to show that the vertical temperature inversion which occurs in the fall does not effect the timing of the destratification as much as its completeness. The distribution of mid-depth vertical mixing shows highly variable values in the mid-bay region, where wind induced mixing is dominant. This suggests that the source of oxygen to mid-bay bottom waters is similarly variable. Vertical turbulence mixing coefficients of .001 sq cm/s (background) to 1000 sq cm/s were needed to simulate the September period, indicating the need for time-variable mixing in models of dissolved and suspended estuarine constituents. (Author's abstract)
W91-01899

SHOT-SENSOR METHOD OF MEASURING CURRENTS IN SHALLOW ESTUARINE WATERS.
New Hampshire Univ., Durham. Jackson Estuarine Lab.
For primary bibliographic entry see Field 7B.
W91-01900

BAROTROPIC, SUBTIDAL EXCHANGE BETWEEN CALCASIEU LAKE AND THE GULF OF MEXICO.
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
For primary bibliographic entry see Field 2H.
W91-01901

SALINITY TRENDS IN LOUISIANA ESTUARIES.
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
W. J. Wiseman, E. M. Swenson, and J. Power.
Estuaries ESTUDO, Vol. 13, No. 3, p 265-271, September 1990. 5 fig, 3 tab, 13 ref. US Minerals Management Service Contract No. 14-12-0001-3052.

Descriptors: *Estuaries, *Louisiana, *Salinity, Analysis of variance, Bayou Lafourche, Mississippi River, Statistical analysis, Time series analysis.

Nonparametric tests for the presence of a trend in the time series of various salinity statistics were performed. Analysis of existing salinity time series from coastal Louisiana show that statistically significantly trends in mean salinity, salinity variance, and maximum salinity exist. These trends are of both signs, with no apparent large scale spatial pattern. Within individual estuaries, important trends have been identified; for example, increasing salinities within Bayou Lafourche. Linear estimates of the trend magnitudes suggest that the resultant changes in mean salinity, salinity variance, and maximum salinity have generally been small. The magnitudes of the predicted changes in mean salinity are generally small enough to be nondetrimental to the adjacent marsh lands. In a few locations, trends in the salinity regime are large and major changes in marsh vegetation have been observed. Natural variability in these systems, principally due to Mississippi River runoff and local climatology, are high and may hide weak trends. Nevertheless, extensive coastal degradation and land loss have been documented over time periods of the same order as the data records. If this were caused by a trend in the salinity regime, the present analysis should have identified the trend. (Lantz-PTT)
W91-01902

RELATIONSHIPS BETWEEN WETLAND FRAGMENTATION AND RECENT HYDROLOGIC CHANGES IN A DELTAIC COAST.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. E. Turner, and Y. S. Rao.
Estuaries ESTUDO, Vol. 13, No. 3, p 272-281, September 1990. 8 fig, 15 ref.

Descriptors: *Canals, *Hydrological regime, *Spoil banks, *Wetlands, Erosion, Estuaries, Gulf of Mexico, Ponds, Sediment transport.

Patterns in coastal wetland loss in the northern Gulf of Mexico were examined using aerial imagery from 1955-56 and 1978. Five qualitative types of wetland changes are evident: (1) spoil-bank parallel pond formation, (2) pond formation with apparent random distribution for the smallest ponds, but very clumped distribution for larger ponds, (3) semi-, or complete impoundments resulting in open water formation, (4) cutting off of stream channels upstream of where a spoil bank crosses a natural channel, and (5) erosion at the land water interface. Only ponds < 20 ha formed and disappeared in the interval, and it is clear that wetland breakup, not erosion at the pond-lake edge, is the dominant form of wetland to open water conversion. Canals and their spoil banks are spatially related to wetland-to-water conversion which is evident up to 2 km away from those man-made features. The indirect impacts of canals and spoil banks vary regionally, for example, with sediment compaction rates that increase with increasing sediment deposition. These results are consistent with the hypothesis that canals and spoil banks are a major factor driving wetland loss rates because they change wetland hydrology. (Author's abstract)
W91-01903

COMPARISON OF PHYTOPLANKTON ASSEMBLAGES AND ENVIRONMENTAL RELATIONSHIPS IN THREE ESTUARINE RIVERS OF THE LOWER CHESAPEAKE BAY.
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
H. G. Marshall, and R. W. Alden.
Estuaries ESTUDO, Vol. 13, No. 3, p 287-300, September 1990. 13 fig, 4 tab, 31 ref.

Descriptors: *Estuarine environment, *James River, *Phytoplankton, Algal blooms, Chesapeake Bay, Nitrogen, Phosphorus, Population dynamics, Rappahannock River, Seasonal variation, York River.

A 16-month data set of phytoplankton assemblages and environmental parameters were studied in the lower James, York (-Pamunkey), and Rappahonnock rivers using several exploratory statistical approaches. Based on species composition and river station relationships, three site groups were established and subsequently identified as predominantly tidal fresh, oligo-mesohaline, and mesohaline sites. Phytoplankton assemblages within these rivers were influenced and subsequently augmented by the onset of the spring freshet which was different in 1986 and 1987. Five temporal assemblages of phytoplankters were also identified and designed into seasonal groupings of spring 1986, summer-fall, summer-winter, fall-winter, and winter-spring 1987. Discriminant analysis (MANOVA) evaluations were made for water quality parameters to site and seasonal phytoplankton assemblages. Moving downstream along the oligohaline-mesohaline gradient, the nitrogen and phosphorous levels decreased and the phytoplankton composition was more similar at several corresponding site locations in the different rivers than at stations relatively close to each other in the same river. Within these data sets, approximately 58% of the explained variance was associated with site (spatial) effects, 30% with temporal effects, and 12% with site-temporal interactions. A transition from dominant bloom-producing freshwater diatoms to estuarine species occurs from the tidally influenced freshwater zone downstream. This change may be rapid as the decline of Skeletonema potamos, or gradual, as with Cyclotella striata and Cyclotella meneghiania. These are replaced downstream by Skeletonema costatum, Cyclotella caspis, and Leptocylindrus minimus as dominant species. (Author's abstract)
W91-01905

EFFECTS OF TRIBUTYLTIN WITHIN A THALASSIA SEAGRASS ECOSYSTEM.
Cornell Univ., Ithaca, NY. Ecosystems Research Center.
For primary bibliographic entry see Field 5C.
W91-01906

GROWTH OF SUBMERGED MACROPHYTES UNDER EXPERIMENTAL SALINITY AND LIGHT CONDITIONS.
University of Southwestern Louisiana, Lafayette. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-01907

RECRUITMENT FAILURE OF THE BAY SCALLOP, ARGOPECTEN IRRADIANS CONCENTRICUS, DURING THE FIRST RED TIDE, PTYCHODISCUS BREVIS, OUTBREAK RECORDED IN NORTH CAROLINA.
North Carolina Univ., Morehead City. Inst. of Marine Sciences.
For primary bibliographic entry see Field 5C.
W91-01908

COMPARISON OF THE DIETS OF GULF KILLIFISH, FUNDULUS GRANDIS BAIRD AND GIRARD, ENTERING AND LEAVING A MISSISSIPPI BRACKISH MARSH.
Louisiana Universities Marine Consortium, Chauvin.
L. P. Rozas, and M. W. LaSalle.
Estuaries ESTUDO, Vol. 13, No. 3, p 332-336, September 1990. 1 fig, 3 tab, 27 ref.

Descriptors: *Biological studies, *Fish diets, *Killifish, *Marshes, *Tidal marshes, Amphipods, Comparison studies, Crabs, Ecosystems, Estuaries, Estuarine environment, Fish food, Polychaetes, Tides.

An examination was conducted of the diets of Gulf Killifish, Fundulus grandis Baird and Girard, collected monthly from March through July 1988 with unbaited minnow traps during two sampling periods: (1) on flood tides before they reached the marsh surface, and (2) on ebb tides as they left the marsh. Thirty-five prey taxa, plant parts, and detritus were identified from the stomach contents of 110 Gulf Killifish (mean SL = 55 mm, range = 30-82 mm). Fiddler crabs, Uca longisignalis Salmon and Atsaides; amphipods, mostly Corophium louisianum Shoemaker; tanaidaceans, Hargeria rapax (Harger); and hydrobiids, Littoridinops palustris Thompson, were their most important prey. Killifish diets differed both quantitatively

and qualitatively relative to the habitat in which they were feeding. Fiddler crabs and polychaetes were consumed more frequently and in greater numbers in the intertidal zone, whereas more amphipods were eaten by killifish feeding in subtidal and low intertidal areas. Gulf Killifish consumed greater volume of food when they had access to the marsh surface than when they were confined to subtidal areas. (Author's abstract)
W91-01909

EFFECT OF TIDAL FLOODING ON MORTALITY OF JUVENILE MUSKRATS.
Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
Q. J. Kinler, R. H. Chabreck, N. W. Kinler, and R. G. Linscombe.
Estuaries ESTUDO, Vol. 13, No. 3, p 337-340, September 1990. 2 fig, 26 ref.

Descriptors: *Brackish water, *Ecological effects, *Marshes, *Mortality, *Muskrats, *Tidal floods, Population dynamics, Sea level, Seasonal variation, Water level.

An investigation was conducted in the brackish marsh in Louisiana by examining 50 muskrat lodges each month from July 1984 to June 1985 and tidal data over a 19 year period. Tide levels increased at a rate of 1.58 cm/yr during the 19-yr period prior to the study, and during the study, nest chambers in muskrat lodges were flooded on 43 d. Seventy-seven captured litters averaged 2.2 +/-0.3 young per litter. Older litters were less common than younger litters, but the number of young per litter did not differ among 5-d age classes, suggesting that mortality factors usually affected entire litters. The frequency of tidal flooding prior to the opening of lodges each month was associated negatively with the number of litters and number of young per litter. If marsh subsidence and sea level rise continue, tidal flooding will become more prevalent and litter mortality will likely increase. (Author's abstract)
W91-01910

FOOD HABITS OF TWO LARVAL FLIES (DOLICHOPODIDAE: DIPTERA) IN TWO GULF COAST OLIGOHALINE TIDAL MARSHES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. W. LaSalle, and T. D. Bishop.
Estuaries ESTUDO, Vol. 13, No. 3, p 341-348, September 1990. 2 fig, 3 tab, 42 ref.

Descriptors: *Ecosystems, *Flies, *Food habits, *Tidal marshes, *Wetlands, Energy, Estuarine environment, Food chains, Marshes, Nematodes, Oligochaetes, Polychaetes.

Food habits were analyzed from two species of dolichopodid fly larvae through monthly collections taken between June 1979 and May 1980. Larvae of Pelastonerurus abbreviatus Loew and Thinophilus frontalis Van Duzee, taken from a Juncus roemerianus Scheele dominated marsh, fed predominantly on oligochaetes and nematodes. Pelastoneurus abbreviatus, collected in a nearby Spartina cynosuroides (L.) Roth march, also fed on oligochaetes but consumed more polychaetes than nematodes. By being predators and prey in turn, these larvae serve in the transfer of energy between benthic, aquatic, and terrestrial components of the marsh system. (Author's abstract)
W91-01911

PHOSPHATE LIMITATION IN ESTUARINE AND COASTAL WATERS OF CHINA.
British Columbia Univ., Vancouver. Dept. of Botany.
P. J. Harrison, M. H. Hu, Y. P. Yang, and X. Lu.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 140, No. 1/2, p 79-87, July 31, 1990. 4 fig, 38 ref.

Descriptors: *China, *Limiting nutrients, *Nitrates, *Phosphorus, *Phytoplankton, *Primary productivity, Coastal areas.

Mesocosm experiments conducted off the southern coast of mainland China indicate that phytoplankton growth is limited by phosphorus, rather than nitrogen. In April, when natural seawater was enclosed in mesocosms, phosphorus always reached undetectable concentrations several days before inorganic nitrogen. This was not surprising since the initial N:P (by atoms) in the seawater at the start of the experiment was aproximately 80:1, indicating about a five-fold excess nitrogen over phosphorus. Bioassay experiments also indicated P-limited phytoplankton growth for seawater in Xiamen Bay. Several other estuaries along the coast of China have N:P ratios ranging from 30:1 to greater than 80:1. The large rivers of China have high nutrient loads with nitrogen in great excess over phosphorus (e.g., N:P up to 150:1). As a consequence of these large riverine inputs, vast areas along the coast of China are P-limited for primary production. (Author's abstract)
W91-01923

VARIATIONS IN STRUCTURE OF ESTUARINE FISH COMMUNITIES IN RELATION TO ABUNDANCE OF SUBMERSED VASCULAR PLANTS.
Maryland Dept. of Natural Resources, Annapolis.
L. Lubbers, W. R. Boynton, and W. M. Kemp.
Marine Ecology Progress Series MESEDT, Vol. 65, No. 1, p 1-14, July 19, 1990. 9 fig, 4 tab, 62 ref.
EPA's Chesapeake Bay Program grant R8059322010.

Descriptors: *Chesapeake Bay, *Estuaries, *Estuarine fisheries, Ecological distribution, Fish behavior, Fish diets, Fish populations, Macrophytes, Predation.

Fish communities and other ecological variables were sampled for 6 mo (May to October) in successive years (1979, 1980) at vegetated and non-vegetated areas in 2 distinctively different littoral zones (an open bay and a protected cove) of mid-salinity Chesapeake Bay. Fish abundance, biomass and species richness were higher in vegetated areas at both sites, and were significantly correlated with macrophyte biomass. Diel patterns of fish abundance varied, but highest catches generally occurred at dusk or at night. At one sampling site, fish assemblages were dominated by smaller individuals in the vegetated area, suggesting an attraction of juveniles to macrophyte beds for food or refuge from predation. Larger piscivorous fish, which were also caught in greater numbers in vegetated areas, may have been attracted there by higher densities of forage fish. At the cove site, the biomass of Paleomonetes sp. was comparable to that of the fish community towards the end of the plant growing season. Benthic infauna were also more abundant in vegetated areas at both sites, and stomach analyses indicated these organisms to be the dominant food resources for common fishes. Diets were generally non-selective in non-vegetated areas while highly selective for epiphytic fauna in macrophyte beds. Fish stomachs were also significantly fuller in vegetated areas, indicating generally greater feeding success. Fish production varied among major species but was higher overall at vegetated areas, following the seasonal patterns of primary production. Most of the differences in fish production between areas were attributable to higher instantaneous growth rates rather than higher biomass. It appears that the greater abundance and species richness of fish assemblages in vegetated areas of this region of the Chesapeake Bay resulted from the attractiveness of these habitats as rich sources of preferred foods. (Author's abstract)
W91-01926

SEASONAL AND TIDAL ABUNDANCE OF CRAB LARVAE IN A TROPICAL MANGROVE SYSTEM, GULF OF NICOYA, COSTA RICA.
Delaware Univ., Newark. Coll. of Marine Studies.
A. I. Dittel, and C. E. Epifanio.
Marine Ecology Progress Series MESEDT, Vol. 65, No. 1, p 25-34, July 19, 1990. 4 fig, 6 tab, 63 ref.
NSF grant INT-8613439 and Universidad de Costa Rica.

Descriptors: *Costa Rica, *Crabs, *Estuaries, *Gulf of Nicoya, *Mangrove swamps, *Tides, *Wetlands, Life cycles, Population dynamics, Seasonal variation, Tidal currents.

Crab larvae were collected from a platform moored in the mouth of a mangrove tidal creek in the Gulf of Nicoya on the Pacific coast of Costa Rica, Central America. Eight observation periods encompassed both spring and neap tides and covered all seasons of the year. During each observation period, samples were collected every 2 h over 5 consecutive tidal cycles. Samples were collected from a depth of 1 m with a gasoline-powered impellar pump; total volume of each sample was 10 to 12 cu meters cubed. The gross taxonomic composition of the observed larval assemblage was similar to that seen in temperate estuaries along the Atlantic coast of North America. Larvae of Uca spp., Grapsidae, Xanthidae and commensal crabs such as Pinnotheres spp. were the most common forms in excess of 1000 larvae per cu meters. In contrast to temperate estuaries, spawning occurred year-round, but individual taxa showed distinct seasonality. As in temperate estuaries, spawning in the tidal creek was also influenced by lunar cycles and larvae of several taxa showed tidally rhythmic changes in abundance. Zoea I of Uca spp., Grapsidae, Xanthidae, Pinnotheres spp. and Petrolisthes spp. were significantly more abundant during ebb tides suggesting that these larvae were spawned in the creek and exported to the open Gulf. Advanced zoea and megolopae appeared to take advantage of nocturnal flood tides to be recruited back into the estuary. Export of early stages did not occurr in all taxa. Abundance of early zoeal stages of Pinnixa spp. was not affected by tidal phase suggesting that early stages were not exported from the tidal creek. (Author's abstract)
W91-01927

NATURAL ABUNDANCE OF 15N IN PARTICULATE NITROGEN AND ZOOPLANKTON IN THE CHESAPEAKE BAY.
Harvard Univ., Cambridge, MA. Museum of Comparative Zoology.
J. P. Montoya, S. G. Horrigan, and J. J. McCarthy.
Marine Ecology Progress Series MESEDT, Vol. 65, No. 1, p 35-61, July 19, 1990. 7 fig, 13 tab, 36 ref. NSF grants OCE-82-14932 and OCE-86-14199.

Descriptors: *Chesapeake Bay, *Estuaries, *Estuarine environment, *Nitrogen, *Zooplankton, Inorganic nitrogen, Particulate nitrogen, Phytoplankton, Seasonal variation, Trophic level.

Samples of dissolved inorganic nitrogen (DIN), particulate nitrogen (PN), and several species of zooplankton were collected at a series of stations in the main channel of the Chesapeake Bay, during cruises in spring and fall 1984. The spatial and temporal variation in the natural abundance of N15 (delta N15) in each of these pools, in combination with measurements of the concentrations of DIN, PN, plant pigments, and the rates of biologically-mediated transformations of nitrogen, provide a number of insights into the dynamics of the nitrogen cycle in the Chesapeake Bay. The overall gradient of DIN concentrations along the axis of the Bay appears to be less important than local processes in determining the distribution of N15 in PN. The relationship between delta N15 of PN and delta N15 of dissolved pools indicated that phytoplankton uptake was the dominant process acting on DIN in Spring, but that microbially-mediated transformations of nitrogen dominated in the fall. During both seasons, delta N15 of particulate and dissolved pools suggested that phytoplankton consume both NO3(-) and NH4+ roughly in proportion to concentration. The delta N15 of the zooplankton species sampled generally increased with trophic level. The spatial variability of delta N15 of all 3 trophic levels (PN, copepods, and ctenophores) was greater in spring than in all, suggesting that phytoplankton and zooplankton have a greater direct influence on the estuarine nitrogen cycle during spring. A comparison of the 2 transects conducted on each cruise demonstrates that delta 015 nitrogen of the PN and A. tonsa, but not that of M. Leidyi, can change markedly on a time scale of roughly a week. Such changes clearly indicate that repeated sampling may be essential in studies of the natural abundance of N15 in dynamic planktonic systems such as that in the Chesapeake Bay. (Author's abstract)

W91-01928

PELAGIC METABOLISM IN EUTROPHIC WATERS DURING A LATE SUMMER PERIOD.
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
K. Sand-Jensen, L. M. Jensen, S. Marcher, and M. Hansen.
Marine Ecology Progress Series MESEDT, Vol. 65, No. 1, p 63-72, July 19, 1990. 2 fig, 5 tab, 49 ref.

Descriptors: *Bacteria, *Denmark, *Eutrophic fjords, *Fjords, *Phytoplankton, *Primary productivity, Biomass, Eutrophication, Metabolism, Organic matter, Respiration.

Phytoplankton and bacterial biomass were measured at weekly intervals during summer in water samples from 2 sites in the shallow, eutrophic Roskilde Fjord, Denmark. In addition O2-uptake on unfiltered water and size fractions < 100 micrometers and < 1 micrometers was measured. Phytoplankton gross production in the water column was 6.2 g O2/sq m/d at Stn 1 and was balanced by pelagic community respiration and sediment respiration. Phytoplankton gross respiration was temporarily exceeded by pelagic community respiration plus sediment respiration at Stn 2 where there is additional production by littoral plant communities. Phytoplankton and bacteria together accounted for 72 to 85% of community respiration (Rc) and zooplankton for the remainder. Phytoplankton respired a large proportion (ca 30%) of their gross production and were apparently mainly grazed by benthic suspension feeders. Phytoplankton dominated pelagic respiration (50% of Rc) at Stn 1, which has the most phytoplankton, while bacteria dominated (44% of Rc) at Stn 2. The relatively larger respiratory activity of bacteria at Stn 2 is ascribed to an additional supply of organic matter from littoral plant communities and frequent sediment suspension. The importance of bacteria in the pelagic food web was supported by other findings. Bacterial biomass approached phytoplankton carbon biomass at Stn 2 and bacterial net production and respiration were linearly related in the bacterial size-fraction (<1 micrometer) with a bacterial growth yield of 47%. It is argued that the conversion factors applied to calculate bacterial net production and the mean growth yield attained are reasonable values considering the other measurements of pelagic carbon pools and processes. (Author's abstract)
W91-01929

DIEL VARIATIONS IN PHOTOSYNTHETIC ACTIVITY OF SUMMER PHYTOPLANKTON IN LINDASPOLLENE, WESTERN NORWAY.
Norsk Inst. for Vannforskning, Oslo.
S. R. Erga, and H. R. Skjoldal.
Marine Ecology Progress Series MESEDT, Vol. 65, No. 1, p 73-85, July 19, 1990. 9 fig, 2 tab, 90 ref. Norwegian Marine Pollution Research and Monitoring Program.

Descriptors: *Diurnal variation, *Fjords, *Norway, *Photosynthesis, *Phytoplankton, Correlation analysis, Depth, Light, Lindaspollene, Nutrients, Primary productivity.

Diel patterns in photosynthesis of natural phytoplankton were studied during a 5 d period during midsummer in Lindaspollene, a land-locked fjord of western Norway. Samples were taken from depths of 0.5, 5, 10 and 21 m at 3 to 4 h intervals. The natural light:dark cycle was 19:5 h. The coccolithophorid Emiliania huxleyi and ultraplankton (<5 micrometer) flagellates were predominant in the upper 10 m, while diatoms and silicoflagellates were predominant at 21 m. No clear diel pattern was seen in the variations of chlorophyll a and cell numbers. The photosynthesis vs. light relationship (P-I) was studied at 0.5 and 10 m, and the parameters PBmax (specific production rate at optimal light intensity) alpha B (initial slope of the light saturation curve) and Ik (irradiance at which the prolongation of the initial and horizontal parts of the parts of the photosynthesis curve intersect) showed pronounced diel rhythms. Maximum and minimum values of alpha B and PBmax differed by a factor of 3 to 4 and occurred in the morning and evening periods, respectively. These parameters were linearly correlated at both 0.5 and 10 m, indicating a phased diel periodicity. Ik showed a clear diel variation at 0.5 m with minimum values at night, whereas no persistant diel rhythm could be seen at 10 m. PB max and Ik were correlated at 0.5 m but not at 10 m, while Ik and alpha B were weakly correlated at both 0.5 and 10 m. In vivo florescence per unit chlorophyll a showed a diel variation pattern that was the opposite to that of PBmax and alpha B. The results indicate that an endogenous rhythm is regulating the diel oscillations in photosynthesis. This endogenous mechanism is possibly entrained by environmental signals such as cycles in nutrient availability and light conditions. (Author's abstract)
W91-01930

INCORPORATION OF THYMIDINE, ADENINE AND LEUCINE INTO NATURAL BACTERIAL ASSEMBLAGES.
Vandkvalitetsinstitutet, Hoersholm (Denmark).
B. Riemann, R. T. Bell, and N. O. G. Jorgensen.
Marine Ecology Progress Series MESEDT, Vol. 65, No. 1, p 87-94, July 19, 1990. 2 fig, 3 tab, 51 ref. Carlsburg Foundation grant 87-0358/40 and Danish National Science Research Council grant 41-0003.

Descriptors: *Adenine, *Amino acids, *Bacterial physiology, *Deoxyribonucleic acid, *Leucine, *Primary production, *Thymidine, Culture techniques, Growth rates, Incorporation rates.

Incorporation of H3-thymidine and H3-adenine into DNA and H3-leucine into protein were measured in diluted batch cultures of natural asssemblages of coastal marine and freshwater bacteria. Incorporation rates of DNA and protein synthesis were compared with changes in bacterial DNA and carbon pools. Incorporation rates of all three substances peaked before maximum cell densities were reached. H3-leucine incorporation was somewhat higher than both H3-thymidine and H3-adenineincorporation during early exponential and stationary growth periods. The molar ratio of incorporated H-3-adenine and H3-thymidine was 1:1 in freshwater and 3:1 in seawater cultures, and the cellular DNA content ranged from 2 to 4 fg per cell, corresponding to an average of 5.5% of cell carbon. DNA contents predicted from incorporation rates of adenine were 66 to 86% and of thymidine 28 to 77% of the measured DNA content. Conversion factors to derive bacterial cell numbers were 0.85 to 1.75 times 10 to the 18th power cells per mol thymidine incorporated and 0.47 to 0.92 times 10 to the 18th power cells per mol adenine incorporated. Carbon production predicted from incorporation rates of H3-thymidine, H3-adenine or H3-leucine differed by at most 31% from measured carbon production, suggesting that all three methods were applicable to determine growth rates and carbon production in the batch cultures. (Author's abstract)
W91-01931

UNUSUAL MARINE ECOSYSTEM IN THE FLOODED CRATER OF USHISHER VOLCANO.
Akademiya Nauk SSSR, Vladivostok. Inst. Biologii Morya.
A. V. Zhirmunsky, and V. G. Tarasov.
Marine Ecology Progress Series MESEDT, Vol. 65, No. 1, p 95-102, July 19, 1990. 9 fig, 22 ref.

Descriptors: *Heavy metals, *Marine biology, *Sulfur compounds, *Volcanoes, Algae, Bacteria, Chemical properties, Macroinvertebrates, Photosynthesis, Physiology, Usishe volcano.

A marine ecosystem in Kraternaya Bight (Yankich Island, Kurile Islands) which has arisen and is functioning under the influence of gaso-hydrothermal vents of the Ushisher volcano was studied. The concentrations of reduced sulfur compounds and a number of metals in the vents are 2 to 3 orders of magnitude higher than in seawater around the island. Together with the photosynthesis of algae, chemosynthetic bacteria play an essential part in primary production. Extreme chemical conditions in the outlets of vents have left a mark on the composition of communities and in peculiarities of certain species. Organisms (some of the dominant species) which have colonized Kraternaya Bight have changed in morphology and adapted to extreme conditions. They have essentially changed some of their biochemical characteristics: they have a high content of the cytochrom P-450, 5-aminolevulinate synthetase and high rate of the level oxidizing in the microsomal system. Concentrations of some metals are so high that ecosystems of Kraternaya Bight can be considered as a model of sea territory with a high degree of industrial pollution. At the request of the Institute of Marine Biology, a biological preserve in Kraternya Bight has been established. (Fleishman-PTT)
W91-01932

MUD BALANCE FOR BELGIAN-DUTCH COASTAL WATERS BETWEEN 1969 AND 1986.
Rijkswaterstaat, Rijswijk (Netherlands). North Sea Directorate.
For primary bibliographic entry see Field 2J.
W91-01934

DENITRIFICATION AND NITROUS OXIDE IN THE NORTH SEA.
Plymouth Marine Lab. (England).
For primary bibliographic entry see Field 5B.
W91-01935

WINTER DISTRIBUTION OF NUTRIENTS IN THE SOUTHERN BIGHT OF THE NORTH SEA (1961-1978) AND IN ESTUARIES OF THE SCHELDT AND THE RHINE/MUESE.
Nederlands Inst. voor Onderzoek der Zee, Texel.
A. J. Van Bennekom, and F. J. Wetsteijn.
Netherlands Journal of Sea Research NJSRBA, Vol. 25, No. 1/2, p 75-87, May 1990. 14 fig, 2 tab, 36 ref.

Descriptors: *Nitrates, *North Sea, *Nutrient concentrations, *Phosphates, *Rhine/Meuse Estuary, *Scheldt Estuary, Phytoplankton, Seasonal distribution, Silica, Tracers, Wind-driven currents.

The winter distribution of nutrients in the eastern part of the Southern Bight is influenced by phytoplankton growth, always in February, sometimes in January. The Scheldt river has higher nutrient concentrations than the rivers Rhine and Seine. The waters of the Scheldt river plume are distinguished from those of the Seine and the Rhine/Meuse using disolved silica as a tracer. The extension of the Scheldt river plume was related to wind direction. The increase of inorganic nutrients from January 1961 to January 1978 in the northern part of the Southern Bight was related to the nutrient increase in the river Rhine. The increase in the Strait of Dover was related to discharges from the river Seine and the English coast. Only data outside the Scheldt river plume were selected for comparison. An increase of nutrient concentrations was measurable over the entire salinity range and was largest for phosphate (up to 3 times at low salinities), less for nitrate (about 1.5 times for all salinities) and hardly noticeable for silicic acid. Nitrate extrapolation to low salinity agreed with upstream river values, but phosphate extrapolation gave higher concentrations, probably due to discharges of phosphogypsum in estuaries. (Author's abstract)
W91-01936

PHYTOPLANKTON BIOMASS AND POTENTIAL NUTRIENT LIMITATION OF PHYTOPLANKTON DEVELOPMENT IN THE SOUTHEASTERN NORTH SEA IN SPRING 1985 AND 1986.
Biologische Anstalt Helgoland (Germany, F.R.)
E. Bauerfeind, W. Hickel, U. Niermann, and H. V. Westernhagen.
Netherlands Journal of Sea Research NJSRBA, Vol. 25, No. 1/2, p 131-142, May 1990. 3 fig, 1 tab, 53 ref.

Descriptors: *Coastal waters, *Diatoms, *Limiting nutrients, *North Sea, *Phytoplankton, Biomass, Carbon, Nitrogen, Phosphates, Silicates.

The vernal phytoplankton bloom was observed during cruises to the southeastern part of the North Sea in 1985 and 1986. Maximum phytoplankton biomass expressed as phytoplankton carbon was similar in both years. In 1985 the bloom was located in the less saline coastal water close to the North Frisian coast. Phytoplankton was dominated by Coscinodiscus concinnus and Thalassiosira nordenskioldü. In 1986, highest phytoplankton biomass was observed northwest of the island of Sylt, where Thalassiosira nordenskioldii was the dominant phytoplankton species. Within areas of high phytoplankton standing stock, concentrations of the inorganic dissolved nutrients phosphate and silicate had dropped to nearly undetectable concentrations, whereas both in 1985 and 1986 the water was still rich in organic nitrogen. This, as well as the high ratios of DIN:PO4 and DIN:Si(OH)4 (> 50) point to phosphate and silicate as potential limiting nutrients during the spring phytoplankton bloom. The ratios of total nitrogen (TN) to total phosphorous (TP) (> 30) indicate also that phosphorous might then be in short supply. Phosphate and silicate have to be considered as potentially limiting nutrients during the vernal plankton bloom in the coastal waters of the southeastern North Sea, with nitrogen being present in surplus at that time of year. However, in the more offshore areas nitrogen may be considered the potentially limiting element at the same time. (Author's abstract)
W91-01937

PRIMARY PRODUCTION AND NITROGEN ASSIMILATION IN THE NORTH SEA DURING JULY 1987.
Plymouth Marine Lab. (England).
N. J. P. Owens, E. M. S. Woodward, J. Aiken, I. E. Bellan, and A. P. Rees.
Netherlands Journal of Sea Research NJSRBA, Vol. 25, No. 1/2, p 143-154, May 1990. 7 fig, 30 ref.

Descriptors: *Coastal waters, *Denitrification, *Nitrogen, *North Sea, *Primary production, Ammonium, Carbon, Chlorophyll, Nutrient concentrations, Phytoplankton.

Surface water inorganic nutrient concentrations and concomitant rates of primary production (C-14) and nitrogen assimilation (N-15) were measured in the North Sea in July 1987. Primary production was investigated using size fractionation techniques. Three vertical profiles of primary production and nitrogen assimilation were also investigated. Much of the North Sea exhibed thermal stratification. Surface nutrient concentrations were low and chlorophyll concentrations typically <1 mg per meter cubed. More than 75% of the primary production was attributable to cells <5 micrometers in diameter. Ammonium assimilation accounted for most of the nitrogen assimilation. The water column was vertically well mixed in the coastal zones. Here, inorganic nitrogen concentrations were high with chlorophyll concentrations up to 10 per mg cubed, and organisms >5 micrometers in diameter accounted for most of the primary production. As in offshore regions, ammonium accounted for the major part of the nitrogen assimilated. A 115 km section obtained using an undulating oceanographic recorder showed that in certain regions of the North Sea physical features acted to increase the dependence of the phytoplankton on nitrate. (Author's abstract)
W91-01938

CHANGES IN SPATIAL DISTRIBUTION OF PRIMARY PRODUCTION, PHOTOSYNTHETIC PIGMENTS AND PHYTOPLANKTON SPECIES COMPOSITION DURING TWO SURVEYS IN THE GERMAN BIGHT.
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
F. Colijn, L. Villerius, M. Rademaker, K. D. Hammer, and K. Eberlein.
Netherlands Journal of Sea Research NJSRBA, Vol. 25, No. 1/2, p 155-164, May 1990. 11 fig, 2 tab, 33 ref.

Descriptors: *Chlorophyll, *North Sea, *Phytoplankton, *Pigments, *Primary production, Diatoms, Flagellates, German Bight, Nutrients, Spatial distribution, Species composition.

A grid of 61 stations was sampled twice in the German Bight. At all stations dissolved nutrients (Si, P, N), fluorescence, temperature and salinity were measured along the vertical at surface, 5 m, 10 m, and 10 m intervals to the bottom. At selected stations, photosynthetic rates were measured with C-14 method (both surveys) and pigment with a HPLC method (first survey). Phytoplankton species composition was dominated by small diatoms, mainly Leptocylindrus minimus, flagellates, both dinoflagellates and choanoflagellates and near shore blooms of Phaeocystis pouchetü. Primary production and chlorophyll-a showed a linear correlation (r=0.90, n=23). Primary production showed highest rates along the North and East Frisian islands, where phytoplankton was dominated by Phaeocystis and Leptocylindrus. These coastal stations were completely mixed whereas a large part already showed stratification due to salinity and temperature. Thermocline and pycnocline were at about 10 m depth. No differences in oxygen content of surface or bottom waters were observed. Silicate and phosphate concentrations were very low whereas nitrogen still showed very high concentrations. Low hypolimnetic oxygen concentrations are only possible when transport of primary produced organic matter is transported to stratified regions later in summer. Rapid growth of blooms was observed within a weeks period. More primary production measurements in the German Bight should be done to allow for budget calculations of oxygen consumption below the thermocline. (Author's abstract)
W91-01939

CHANGES IN SUBLITTORAL ZOOBENTHOS IN THE GERMAN BIGHT WITH REGARD TO EUTROPHICATION.
Alfred-Wegener-Inst. fuer Polar- und Meeresforschung, Bremerhaven (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W91-01940

CONCENTRATIONS OF ORGANOCHLORINE COMPOUNDS IN THE HERMIT CRAB PAGURUS BERNHARDUS FROM THE GERMAN BIGHT, DECEMBER 1988 - MAY 1989.
Hamburg Univ. (Germany, F.R.). Inst. fuer Biochemie und Lebensmittelschemie.
For primary bibliographic entry see Field 5B.
W91-01941

SUPPLY AND DEPOSITION OF SEDIMENT ALONG THE NORTH BANK OF HANGZHOU BAY, CHINA.
East China Normal Univ., Shanghai. Inst. of Estuarine and Coastal Research.
For primary bibliographic entry see Field 2J.
W91-01942

EFFECT OF HEAVY METALS ON BAY SCALLOPS, SURF CLAMS, AND BLUE MUSSELS IN ACUTE AND LONG-TERM EXPOSURES.
National Marine Fisheries Service, Milford, CT. Milford Lab.
For primary bibliographic entry see Field 5C.
W91-01973

SIMULATION MODEL OF WATER DEPTH IN MANGROVE BASIN FORESTS.
Collier Mosquito Control District, Naples, FL. S. A. Ritchie.
Journal of the American Mosquito Control Association JAMAET, Vol. 6, No. 2, p 213-222, June 1990. 6 fig, 1 tab, 10 ref.

Descriptors: *Computer models, *Hydrologic models, *Mangrove swamps, *Model studies, *Simulation, *Water depth, *Wetlands, Calibrations, Hydrologic cycle, Hydrologic data, Mosquitoes, Rainfall.

The ability to understand and predict short and long-term mosquito abundance is a key to effective control of Aedes taeniorhynchus (Wiedemann), the black salt marsh mosquito. To help satisfy these goals, a hydrological model simulating the water depth within mangrove basin forests was constructed and validated. Rainfall, water table, water depth and tide data collected from a red mangrove basin forest on Marco Island, FL, was used to estimate model parameters. These included the basin spillover height, evapotranspiration-infiltration rate and the functional relationship of water depth change to rainfall, tide and basin spillover. The model was constructed with LOTUS 123 and calibrated from staff gauge water depth records. The model proved accurate and adaptable. Water depths from the model and staff gauge were highly correlated (r = 0.98). Data from an adjacent black mangrove forest featuring complex wet-dry cycling were used to modify the model. After calibration, the model provided an accurate record of water depths at the site (r = 0.89). This model will provide water depths used in a model of Aedes taeniorhynchus population dynamics. (Author's abstract)
W91-01989

MASS-BALANCE OF METALS AND IDENTIFICATION OF THEIR SOURCES IN BOTH RIVER AND FALLOUT FLUXES NEAR GDANSK BAY, BALTIC SEA.
Akademia Medyczna, Gdansk (Poland). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5B.
W91-02007

RECENT TAXONOMIC DISCOVERIES CONCERNING THE MUSSEL MYTILUS: IMPLICATIONS FOR BIOMONITORING.
Memorial Univ. of Newfoundland, St. John's. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5A.
W91-02030

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

RECOVERY OF MINERAL SALTS AND POTABLE WATER FROM DESALTING PLANT EFFLUENTS BY EVAPORATION: PART I. EVALUATION OF THE PHYSICAL PROPERTIES OF HIGHLY CONCENTRATED BRINES.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Chemical Engineering.
H. K. Abdel-Aal, K. M. Ba-Lubaid, D. K. Al-Harbi, and A. A. Shaikh.
Separation Science and Technology SSTEDS, Vol. 25, No. 3, p 309-321, 1990. 7 fig, 2 tab, 10 ref.

Descriptors: *Brines, *Desalination wastes, *Drinking water, *Evaporation, *Reclaimed water, Flash evaporation, Industrial plants, Magnesium chloride, Sodium chloride, Solubility, Specific gravity.

The recovery of a salt (in particular, magnesium chloride) from rejected brines of desalination plants through the simulation of a modified Multistage Flash (MSF) evaporation system was studied. Such a proposal is attractive for countries highly dependent on water desalination. Saudi Arabia and other Arab Gulf states are good examples. A basic assumption underlying this study (both Part I and Part II) is that desalination effluents contain only the two most abundant salts in seawater: sodium and magnesium chlorides. An equilibrium relationship describing the solubility of sodium chloride in aqueous solutions of magnesium chloride is developed. This generalized correlation is based on the solubility data available in the literature. The correlation is valid for the temperature range 15-200 C and for a concentration of magnesium chloride up to 30 g/100 g saturated solution. Calculations of the specific gravity and viscosity of highly concen-

trated brines are presented and then compared with experimental data. It is concluded that the solubility correlation is valid for predicting the solubility of sodium chloride in aqueous magnesium chloride solution for the indicated temperature and concentration ranges. An average deviation of less than 8% was calculated, except for a few points which probably had inherent experimental errors. For these specific points, the deviation was extremely high. (Agostine-PTT)
W91-01757

CHARACTERIZATION OF DESALTING CONCENTRATES.
Rostek Services, Inc., Fort Myers, FL.
I. C. Watson.
Desalination DSLNAH, Vol. 78, No. 1, p 5-9, July 1990. 3 tab.

Descriptors: *Desalination wastes, *Membrane processes, *Reverse osmosis, *Waste characteristics, *Waste disposal, Chemical analysis, Desalination, Estimating, Florida, Heavy metals, Organic compounds.

With the recent rapid growth of desalting applications in Florida, the subject of desalting concentrate disposal has assumed a significant role. In order that the designer may realistically project expected concentrate characteristics, it is necessary to examine the various membrane processes involved. Typical compositions of concentrates produced from brackish water reverse osmosis, membrane softening and electrodialysis reversal methods are detailed. Use of the seawater reverse osmosis method may also be used in the future, due to its simple method of disposing concentrate by discharging it back into the sea. Desalting plant concentrate characteristics may be predicted with reasonable accuracy in the absence of actual test data. While software developed by the membrane manufacturers will predict the major ionic species, most of those components examined by the Florida Depart of Environmental Regulation will have to be derived in theory. Several rules of thumb are given for the estimation of heavy metals, organics, and hydrogen sulfide, and for calculating the concentration factor. (VerNooy-PTT)
W91-01976

HISTORIC DEVELOPMENT OF THE CONCENTRATE REGULATIONS.
Stone and Webster Engineering Corp., Fort Lauderdale, FL.
For primary bibliographic entry see Field 5G.
W91-01977

CURRENT REGULATORY CONCERNS RELATED TO THE DISPOSAL OF RO CONCENTRATES IN FLORIDA.
Florida State Dept. of Environmental Regulation, Tallahassee.
For primary bibliographic entry see Field 5G.
W91-01978

SURFACE WATER DISCHARGE OF REVERSE OSMOSIS CONCENTRATES.
Post, Buckley, Schuh and Jernigan, Inc., Orlando, FL.
For primary bibliographic entry see Field 5E.
W91-01979

DISPOSAL OF CONCENTRATE FROM BRACKISH WATER DESALTING PLANTS BY USE OF DEEP INJECTION WELLS.
For primary bibliographic entry see Field 5E.
W91-01980

IRRIGATION WITH MEMBRANE PLANT CONCENTRATE: FORT MYERS CASE STUDY.
Boyle Engineering Corp., Fort Myers, FL.
For primary bibliographic entry see Field 3C.
W91-01981

USE OF SOLAR PONDS IN THE DISPOSAL OF DESALTING CONCENTRATE.
California State Dept. of Water Resources, Fresno. Special Investigations Branch.
For primary bibliographic entry see Field 5E.
W91-01982

DISPOSAL OF CONCENTRATES FROM BRACKISH WATER DESALTING PLANTS BY MEANS OF EVAPORATION TECHNOLOGY.
Bechtel National, Inc., Washington, DC.
For primary bibliographic entry see Field 5E.
W91-01983

RECLAIMING REVERSE OSMOSIS BLOWDOWN WITH ELECTRODIALYSIS REVERSAL.
Ionics, Inc., Watertown, MA.
For primary bibliographic entry see Field 5D.
W91-01984

HIGH RECOVERY REVERSE OSMOSIS.
Stone and Webster Engineering Corp., Fort Lauderdale, FL.
B. M. Watson.
Desalination DSLNAH, Vol. 78, No. 1, p 91-97, July 1990. 5 fig.

Descriptors: *Brines, *Desalination, *Desalination wastes, *Feedwater treatment, *Reverse osmosis, *Scaling, *Waste disposal, Liming, Pilot plants, Wastewater disposal.

The costs of transmission and disposal of reverse osmosis (RO) plant concentrates per unit of water production are directly related to brine volumes, which affect size of pipe, stripping towers, sedimentation basins, outfalls and/or injection wells, and any repumping required en route. These costs may be markedly reduced by increasing product recovery. As a means to minimize or eliminate brine disposal problems, high recovery RO must be accompanied by pre or post-treatment to avoid scale precipitation, almost entirely by calcium sulfate. All such methods, such as pretreatment by lime-soda softening, post-treatment by lime/lime-soda softening, and pretreatment by desulfation will add to water cost. However, rigorous comparison must be made with the costs and constraints of brine disposal at recoveries low enough not to require these treatments. Such examination is invariably and totally site-specific. Prior to detailed design of any large RO facility, it is always prudent to invest in a pilot plant testing program, whereby membrane performance under varying recovery and flux may be evaluated on the raw feed to be used at full scale. Because of the even tighter design limits imposed at high recovery, pilot tests of combined membrane and treatment processes are absolutely essential. (Author's abstract)
W91-01985

3B. Water Yield Improvement

META-ANALYTIC REAPPRAISAL OF STATISTICAL RESULTS IN THE ENVIRONMENTAL SCIENCES: THE CASE OF A HYDROLOGICAL EFFECT OF CLOUD SEEDING.
Hebrew Univ. of Jerusalem (Israel). Inst. of Earth Sciences.
D. Sharon.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 5, p 390-395, 1990. 2 fig, 2 tab, 9 ref.

Descriptors: *Cloud seeding, *Data interpretation, *Hydrologic models, *Model studies, *Simulation analysis, *Statistical analysis, *Statistical methods, Experimental data, Israel, Meteorological data, Model testing, Streamflow forecasting.

A frequent problem in the statistical analysis of data in the environmental sciences is the synthesis of results obtained independently from various sets of data such as from different measuring points or from replicated experiments. Unlike their separate analysis, the sets' ultimate combined evaluation is often given in descriptive terms. The critical final stage of data synthesis is where meta-analysis is important. Meta-analysis offers a theoretical basis for combining outcomes from a number of independent data sets, or replicated experiments, into one integrated result. It also provides an integrated significance test. The meta-analysis approach was applied to a cloud seeding project in Israel to determine the hydrological effect on stream and spring flow. The effectiveness of this approach was illustrated by means of a series of mostly positive primary results, which, however, were lacking significance when subjected to separate t-tests. In the case of rainfall enhancement in Israel, the lack of significance in primary tests had previously been considered overriding, whereas the meta-analytic combination of results came out distinctly significant. (Fish-PTT)
W91-01470

PERSISTENCE OF SEEDING EFFECTS IN A WINTER OROGRAPHIC CLOUD SEEDED WITH SILVER IODIDE BURNED IN ACETONE.
Bureau of Reclamation, Auburn, CA.
T. Deshler, and D. W. Reynolds.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 6, p 477-488, 1990. 5 fig, 32 ref.

Descriptors: *Cloud liquid water, *Cloud seeding, *Meteorological data, *Orographic precipitation, *Silver iodide, Aircraft, Atmospheric circulation, Ice, Isotopic tracers.

A number of experiments have focused on determining the physical effects of cloud seeding. Measurements in a cloud chamber indicate that an AgI NH4I NH4CO4 mixture will produce detectable levels of ice crystals in clouds as warm as -6 C. Also the AgI is useful as a tracer since it can be measured with an ice nucleus counter. Seeding material was identified and tracked in a wintertime, fairly shallow, stratiform cloud over the central Sierra Nevada with the use of a research aircraft. The effects of aerial seeding with the silver iodide mixture were observed to persist for over 90 min after seeding and 100 km downwind of the seedline. The aircraft was able to locate and track the line source of AgI using an ice nucleus counter. High ice crystal concentrations due to seeding were not apparent until more than one hour after seeding. This may have been partially due to the high natural concentrations of ice, but post-mission analysis revealed that most sampling passes during the first hour following seeding were made below the AgI seeded volume. Ice nucleus measurements confirmed sampling of the seedline from 1-1.5 h after seeding, with associated increases in ice crystal concentrations. The effectiveness of the seeding material in the field was higher than laboratory measurements would suggest. (Fish-PTT)
W91-01473

NEW GENE SOURCES FOR DEVELOPMENT OF AGRONOMIC PLANTS WITH TOLERANCE TO DROUGHT AND OTHER ABIOTIC STRESSES.
New Mexico State Univ., Las Cruces. Dept. of Chemistry
G. D. Kuehn.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-140229/AS. Price codes: A04 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 247, November 1989. 60p, 15 fig, 7 tab, 106 ref. USGS Contract No. 14-08-0001-G1438-05. USGS State Project No. 1423618 and 1423698.

Descriptors: *Drought resistance, *Genetic engineering, *Plant physiology, *Plant-water relationships, *Proteins, Abiotic stresses, Alfalfa, Cotton, Plant stress, Thermophilic eubacteria, Uncommon polyamines.

This project was an investigation in plant biochemistry/molecular biology/molecular genetics directed toward saving water through the development of water-conserving plants. The central, specific objective was to determine whether the thermophilic eubacterium, Thermus thermophilus HB8, produced one specific enzyme protein responsible for the biosynthesis of a class of compounds newly

discovered in higher plants called uncommon polyamines. Uncommon polyamines may be protectants against abiotic stresses such as drought and heat. The rationale of the project was that if the central objective could be achieved, then the gene in T. thermophilus which produced the unique enzyme protein would be a valuable objective for cloning and transfer from the bacterium to plants using recombinant DNA methods. This transfer might confer improved tolerances in plants towards drought and heat stresses. The major conclusions of the project were the following: (1) Numerous criteria based on purification trials of the protein from T. thermophilus indicated that one unique protein is responsible for all uncommon polyamine biosyntheses; (2) The enzyme protein demonstrated extraordinary catalytic efficiency indicating that it would be an excellent candidate for isolation of its gene and its transfer to plants; (3) Unexpectedly, plants themselves were discovered to produce this enzyme protein and the uncommon polyamines in preselected drought-tolerant alfalfa and heat-tolerant cotton strains and; (4) Metabolic inhibitors were identified which could be exploited to develop cell selection protocols which may yield crop plants with improved drought tolerances. (USGS)
W91-01859

3C. Use Of Water Of Impaired Quality

EFFECT OF IRRIGATION WITH SEWAGE EFFLUENT ON DECOMPOSITION OF LITTER IN PINUS RADIATA FORESTS.
New Zealand Forest Service, Rotorua. Forest Research Inst.
T. G. Baker, W. J. Dyck, P. G. Barton, G. R. Oliver, and G. Nicholson.
Forest Ecology and Management FECMDW, Vol. 31, No. 4, p 205-214, April 1990. 2 fig, 4 tab, 21 ref.

Descriptors: *Detritus, *Organic matter, *Pine trees, *Wastewater disposal, *Wastewater irrigation, *Water pollution effects, Calcium, Forests, Hydrogen ion concentration, Magnesium, Phosphorus, Spray irrigation.

Two Pinus radiata D. Don forests (aged 18 and 25 years) were spray irrigated for 32 months with domestic sewage effluent from a secondary oxidation pond. Effluent was applied at rates of 25 and 50 mm/wk. Irrigation decreased litter organic matter by 43%-57% but there was no change in organic matter in the soil (0-50 mm). Annual loss constants determined from a litter bag study in one forest approached 1.0 in the irrigated plots, compared to 0.48 in the control. Irrigation increased the pH and the availability of P, Ca and Mg in the soil. Increased concentrations of N, P, Ca, and Mg in irrigated litterbags were closely correlated with increases in the rate of decomposition of the organic matter. The effect of irrigation on decomposition was due, in part, to the maintenance throughout the year of a more suitable environment in the litter for decomposers, particularly during dry summer periods. (Author's abstract)
W91-01067

DIFFERENTIAL RESPONSE OF WHEAT AND BARLEY GENOTYPES TO SUBSTRATE-INDUCED SALINITY UNDER NORTH INDIAN CONDITIONS.
Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India). Dept. of Agronomy.
A. P. Prabhakaran Nair, and N. C. Khulbe.
Experimental Agriculture EXAGAL, Vol. 26, No. 3, p 221-225, April 1990. 4 tab, 8 ref.

Descriptors: *Barley, *India, *Irrigation effects, Saline soils, *Salt stress, *Salt tolerance, *Wheat, Altitude, Climates, Crop yield, Genotypes, Irrigation, Plant reproduction, Salinity, Water use efficiency.

A crucial problem in low altitude agriculture is the shortage of adequate agricultural land. In India, about seven million hectares of salt-affected land adjacent to irrigation systems pose a potential threat to the quality of the irrigation water. Ten wheat and barley genotypes were tested for their response to soil salinity regimes varying from 0 to 16 mmhos/cm. Barley showed remarkable resistance to salt stress, linked to its capability to resist efflux of potassium ions from the plant system. Both crops showed substantial yield reductions at 12 mmhos/cm, but barley still outyielded wheat by over 50%. There were significant interactions between salinity levels and genotypes in wheat but not in barley. The wheat variety Sonalika showed poor salt tolerance. The implications of these findings in breeding salt-tolerant varieties are the possibility of reclaiming salt-affected land by seeking salt tolerant crops for use on these soils. This investigation shows that long term and sustainable approaches to combat salt affected lands in India require a switch from conventional breeding for yield strategies to those of selection for tolerance to salt stress. (Brunone-PTT)
W91-01113

EFFECTS OF SALINE WATER IRRIGATION ON GROWTH AND MINERAL DISTRIBUTION IN GUAR (CYAMOPSIS TETRAGONOLOBA (L.) TAUB).
Karachi Univ. (Pakistan). Dept. of Botany.
D. Khan, R. Ahmad, S. Ismail, and S. H. Zaheer.
Pakistan Journal of Botany PJBOB6, Vol. 21, No. 2, p 290-301, December 1989. 5 fig, 3 tab, 22 ref.

Descriptors: *Guar, *Plant growth, *Saline water irrigation, *Salt stress, Calcium, Potassium, Sodium.

Growth and mineral distribution of a local strain of guar (Cyamopsis tetragonoloba (L.) Taub) were investigated in relation to salinity. Growth in terms of height and dry matter of different plant parts decreased significantly under salinity. Threshold ECiw inducing 50% reduction in seed production was 5.76 dS/m). Net reproductive effort of the plants treated with 30% sea water was 10.85%, as compared to 27.32% in control. Salinity decreased the number of pods and seeds per plant, whereas, the number of seeds per pod were unaffected and averaged around 7-8 seeds. Distribution of seeds among pods was leptokurtic in all the cases but with salinity variance increased and distribution tended to be more negatively skewed. Absorption of Na+ and K+ increased with salinity, whereas K+ declined at high salinity. Absorption of these ions was almost equal at 20% sea water treatment. Ca++ absorption although declined with salinity, Mg++ behaved indifferently. Distribution patterns of ions showed that plant responded to salinity by excluding ions from reproductive parts specifically from the seeds. All cations were generally more allocated in leaves. (Author's abstract)
W91-01149

REMOVAL OF ORGANOHALOGENS AND ORGANOHALOGEN PRECURSORS IN RECLAIMED WASTEWATER--I.
California Univ., Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-01415

REMOVAL OF ORGANOHALOGENS AND ORGANOHALOGEN PRECURSORS IN RECLAIMED WASTEWATER--II.
California Univ., Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-01416

RECOVERY OF MINERAL SALTS AND POTABLE WATER FROM DESALTING PLANT EFFLUENTS BY EVAPORATION: PART I. EVALUATION OF THE PHYSICAL PROPERTIES OF HIGHLY CONCENTRATED BRINES.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 3A.
W91-01757

NEW GENE SOURCES FOR DEVELOPMENT OF AGRONOMIC PLANTS WITH TOLERANCE TO DROUGHT AND OTHER ABIOTIC STRESSES.
New Mexico State Univ., Las Cruces. Dept. of Chemistry
For primary bibliographic entry see Field 3B.
W91-01859

MICROALGAE PRODUCTION AND SHELLFISH FEEDING TRIALS AT THE ROSWELL TEST FACILITY.
New Mexico State Univ., Las Cruces. Southwest Technology Development Inst.
B. Goldstein.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-2223164/AS. Price codes: A05 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 249, March 1990. 68p, 29 fig, 5 tab, 21 ref. USGS Contract No. 14-08-0001-G1438. USGS State Project No. 1423695 and 1423659.

Descriptors: *Aquaculture, *New Mexico, *Shellfish farming, Algae, Algal growth rate, Algal productivity, Clams, Microalgae, Mollusks, Oysters, Saline water.

It has been demonstrated that several microalgae species, which are thought to be good food for feeders, will survive and grow in Roswell Test Facility (RTF) saline groundwater at pilot scale (50 cu m raceways). Under specific environmental and cultural conditions, several species of shellfish have demonstrated excellent survival and growth. However, the productivity and cultural stability of algae are greatly diminished during cold months of the year in Roswell (October to March). The potential for commercial production of bivalve mollusks in saline groundwater in southern New Mexico is great if a site can be found that has a source of geothermal water for heating purposes and a source of saline water that will support the growth of marine species. A concerted effort should be made to locate such sites, and to construct and operate a large pilot-scale facility at the site. Simultaneously, algae and shellfish should continue to be grown at pilot scale in Roswell to demonstrate the technical feasibility to the private sector and to optimize methods for growing marine organisms hundreds of miles from the nearest ocean. (USGS)
W91-01867

IRRIGATION WITH MEMBRANE PLANT CONCENTRATE: FORT MYERS CASE STUDY.
Boyle Engineering Corp., Fort Myers, FL.
E. Edwards, and P. Bowdoin.
Desalination DSLNAH, Vol. 78, No. 1, p 49-58, July 1990. 4 tab, 3 ref.

Descriptors: *Case studies, *Desalination wastes, *Irrigation water, *Land disposal, *Membrane processes, *Salinity, *Waste disposal, *Wastewater irrigation, *Water treatment wastes, Desalination, Dissolved solids, Drainage water, Florida, Golf courses, Reverse osmosis, Salt tolerance, Trace elements, Wastewater disposal, Water quality data.

Use of irrigation as the primary disposal method of membrane plant concentrate becomes more difficult as the salinity and total dissolved solids (TDS) of the feedwaters increase beyond the freshwater levels. Crop tolerances to specific ions become of greater concern. Blending with suitable irrigation water supplies is a means of decreasing the applied salinity and TDS concentrations. Guidelines for interpretation of water quality for irrigation are discussed, along with a list of recommended maximum trace element levels in irrigation waters. A case study was made of the Fort Myers membrane softening plant. Water quality data was obtained and analyzed for the feed and reject water (concentrate) from the pilot scale testing plant on June 22, 1988. One possible use for the waste concentrate is as a supplemental irrigation supply for the golf course located adjacent to the City's proposed water plant site. Excess concentrate not utilized for irrigation will be discharged off of the golf course site in accordance with the drainage plan of the course. Plans for use of concentrate from the pro-

posed Fort Myers membrane softening plant must encompass a wide variety of considerations including determination of the irrigation suitability of the concentrate without blending, a study of the potential impacts of introducing concentrate to the existing surface water, a study of the potential impact on groundwaters beyond projected zones of discharge, and a study of the potential impact from discharge of excess blended waters to the City's stormwater drainage system. The use of membrane softening concentrate as an irrigation supply appears feasible for the City of Fort Myers, based on generalized irrigation guidelines and applicable state water quality criteria. (VerNooy-PTT)
W91-01981

3D. Conservation In Domestic and Municipal Use

LEAKAGE CONTROL IN A UNIVERSALLY METERED DISTRIBUTION SYSTEM: PINETOWN WATER'S EXPERIENCE.
Pinetown Regional Water Services Corp., Natal (South Africa).
R. E. Mills.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 3, p 235-241, June 1990. 4 fig, 3 tab, 3 ref.

Descriptors: *Leakage, *South Africa, *Water distribution, *Water loss, *Water metering, Computers, Cost analysis, Hydraulic valves, Minimum flow, Monitoring, Sounding, Water districts, Water pressure.

As a result of water losses reaching a high point of 16% in 1973, combined with a relatively high and increasing retail tariff, the Pinetown Regional Water Services Corporation (Natal, South Africa) embarked upon a program to reduce losses to an acceptable level of about 10%. The program involved: (i) the establishment of district metering throughout the distribution system; (ii) the replacement of certain retail meters; and (iii) the metering of new fire connections (other than those serving sprinkler installations). Further steps were taken to improve the situation and included monitoring of minimum night flows, regular sounding of distribution mains and the establishment of a full-time waste detection gang. Also with improved control valves becoming available, more effective pressure control of the system was achieved. The Corporation's computer was called upon to determine monthly losses from each of the hundred or so districts, the life history, in graphical form, of retail meters under review and a record of expenditure on leakage control. The development of methods used in leakage control (costing less than half a cent per cubic meter of water purchased) and practical experience gained in reducing losses from 15% to less than 5% over a period of 14 years resulted in a reduction in leakage losses and a better working knowledge of the distribution system. (Author's abstract)
W91-01270

INFRASTRUCTURE--WEATHERING A BOOM-AND-BUST DEVELOPMENT CYCLE.
Austin Water and Wastewater Utility, TX.
For primary bibliographic entry see Field 6B.
W91-01555

URBAN CAPACITY SHARING: AN INNOVATIVE PROPERTY RIGHT FOR MATURING WATER ECONOMIES.
University of New England, Armidale (Australia). Centre for Water Policy Research.
For primary bibliographic entry see Field 6E.
W91-01632

3E. Conservation In Industry

INDUSTRIAL PRETREATMENT: COOPERATION--TO A POINT...
Metropolitan Waste Control Commission, St. Paul, MN.
For primary bibliographic entry see Field 5D.
W91-01565

3F. Conservation In Agriculture

EFFECT OF CONVENTIONAL VS. NO-TILLAGE ON PESTICIDE LEACHING TO SHALLOW GROUNDWATER.
Agricultural Research Service, Beltsville, MD.
For primary bibliographic entry see Field 5B.
W91-01014

NITRATE CONTAMINATION OF GROUNDWATER UNDER IRRIGATED COASTAL PLAIN SOILS.
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W91-01015

EFFECTS OF ACIDIC IRRIGATION ON SOIL MICROORGANISMS AT KEVO, NORTHERN FINLAND.
Turku Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-01109

DIFFERENTIAL RESPONSE OF WHEAT AND BARLEY GENOTYPES TO SUBSTRATE-INDUCED SALINITY UNDER NORTH INDIAN CONDITIONS.
Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India). Dept. of Agronomy.
For primary bibliographic entry see Field 3C.
W91-01113

EVAPOTRANSPIRATION, WATER USE EFFICIENCY, MOISTURE EXTRACTION PATTERN AND PLANT WATER RELATIONS OF RAPE (BRASSICA CAMPESTRIS) GENOTYPES IN RELATION TO ROOT DEVELOPMENT UNDER VARYING IRRIGATION SCHEDULES.
Haryana Agricultural Univ., Hissar (India).
For primary bibliographic entry see Field 2D.
W91-01114

PREDICTING WATER USE AND WATER APPLICATION EFFICIENCIES FOR DIFFERENT IRRIGATION DEPTHS IN WHEAT.
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
V. K. Gupta, and N. K. Narda.
International Journal of Tropical Agriculture IJTADD, Vol. 7, No. 1/2, p 34-40, March/June 1989. 3 tab, 10 ref.

Descriptors: *Irrigation efficiency, *Irrigation programs, *Model studies, *Water use efficiency, *Wheat, Evaporation, Irrigation requirements, Plant physiology, Plant water potential, Soil water, Transpiration, Water management.

Optimal irrigation scheduling requires precise estimates of soil moisture status in the soil profile. Since soil moisture exerts a direct influence on the plant's physiological process, the daily prediction of soil moisture availability in the crop root zone is needed. A model is presented which, when given the inputs of soil, plant, and climatic parameters, predicts water use and soil moisture content in the wheat root zone. The daily estimates of evapotranspiration were obtained and separated into evaporation and transpiration. The transpiration was extracted from the soil profile depending on the rooting densities available in different soil layers. Daily transpiration values were added up to arrive at optimal irrigation schedules. The predicted values were quite close to the values observed in the fields for a range of water management options. Simulation runs of the model revealed that an optimal use of 37.5 cm of water during the season gave reasonably good water application efficiency. (Brunone-PTT)
W91-01115

EFFECT OF SCHEDULING IRRIGATION AND PHOSPHORUS LEVELS ON YIELD OF PIGEONPEA IN GANG COMMAND AREA.
Rajasthan Coll. of Agriculture, Udaipur (India). Dept. of Agronomy.
M. Lal, and O. P. Gupta.
International Journal of Tropical Agriculture IJTADD, Vol. 7, No. 1/2, p 56-64, March/June 1989. 2 fig, 4 tab, 16 ref.

Descriptors: *Crop yield, *India, *Irrigation practices, *Legumes, *Phosphorus, Climates, Irrigation requirements, Plant growth, Plant nutrients, Plant water potential, Water stress, Water use efficiency.

Two years of field research showed that in pigeonpea, branching and flowering stages were critical for moisture stress. Application of water, through irrigation, at these two crop stages, gave average pulse yields of 22.03 q/ha and resulted in water use efficiency (WUE) of 5.55 kg/mm/ha. Irrigation applied at other crop stages gave significantly less pulse yield and WUE. Scheduling irrigation by climatological approach showed that cumulative pan evaporation (CPE) of 125 mm was equivalent to two irrigation periods, at branching and flowering stages, for pulse yield and WUE. But at this CPE, three to four applications of irrigation water had to be applied. More frequent irrigation did not increase pigeonpea yield. Pigeonpea responded significantly to the application of phosphorus (up to 60 kg orthophosphate/ha) with pulse yield increased of 2.84 q/ha and WUE by 9.9% over the control. (Author's abstract)
W91-01116

EFFECTS OF IRRIGATION METHODS ON GROWTH, YIELD AND CONSUMPTIVE USE OF WATER OF BANANA CV. NENDRAN GROWN IN CLAY LOAM SOILS.
Regional Agricultural Research Station, Kasaragod (India).
A. Rajagopalan, K. Sudhakara, R. Ravegndran Nair, and G. S. L. H. V. Prasada Rao.
International Journal of Tropical Agriculture IJTADD, Vol. 7, No. 1/2, p 111-117, March/June 1989. 1 fig, 5 tab, 6 ref.

Descriptors: *Banana, *Consumptive use, *Irrigation effects, *Irrigation practices, *Plant growth, Basin irrigation, Drip irrigation, India, Irrigation requirements, Plant physiology, Plant water potential, Soil types, Soil water, Subsurface irrigation.

Banana growers in the Kerala region of India cultivate the crop under rainfed conditions where soil moisture stress is severe during the bunch emergence stage. The conventional method of basin irrigation at different frequencies, drip irrigation and subsoil injection of water were studied on Nendran bananas grown in clay loam soils. Basin irrigation at 20 mm on alternate days was superior to drip irrigation and subsoil injection for growth and yield of bananas. For water use efficiency, 5 mm water, via subsoil injection, on alternate days and 2.5 mm water, via drip irrigation, on every day were the most efficient methods. Frequent basin irrigations with 40 L water favor the growth and yield of the Nendran banana. In areas where irrigation water is available in plenty and labor is cheap, irrigation every two days is recommended. In places where irrigation water is available, but labor charges are high, irrigation with 40 L water every five to six days is recommended. In places where both water and labor are scarce, drip irrigation should be practiced. (Brunone-PTT)
W91-01117

MIXING IN OVERLAND FLOW DURING RAINFALL.
Missouri Univ.-Columbia. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-01153

AGRICULTURE: A POSITIVE CONTRIBUTION TO WATER QUALITY.
Imperial Chemical Industries Ltd., Billingham (England).

For primary bibliographic entry see Field 5G.
W91-01249

EFFECT OF ROCK BUNDS AND TIED RIDGES ON SOIL WATER CONTENT AND SOIL PROPERTIES IN THE SUDAN SAVANNAH OF BURKINA FASO.
Semi-Arid Food Grain Research and Development Office, Ouagadougou (Burkina Faso).
N. R. Hulugalle, J. de Koning, and P. J. Matlon.
Tropical Agriculture TAGLA2, Vol. 67, No. 2, April 1990. 2 fig, 3 tab, 20 ref.

Descriptors: *Agricultural hydrology, *Cultivated ands, *Soil water, *West Africa, Agricultural unoff, Clays, Crop production, Cultivation, Organic matter, Particle size, Rock bunds, Sand, Silt, Sorghum, Tied ridges.

A trial was conducted during the growing seasons of 1985 and 1986 in the Sudan Savannah of Burkina Faso, West Africa, to evaluate the effect of ock bunds and tied ridges constructed by donkey-raction on soil water content and soil properties. Soil water content was measured by gravemetric ampling at 7 to 10-day intervals during the season. Soil sampled from 0-0.05 m depth at the termina-ion of the trial was analyzed for particle size istribution, organic matter content and soil water etention. Rock bunds increased soil water content n the surface 0.30 m immediately above a rock line y an average of 32% in both 1985 and 1986. Away from the rock lines, bunds had no effect whereas tied ridges increased soil water content. At 2 m below a rock line, soil water content was ncreased by an average of 23% in 1985 and 19% n 1986 and midway between two rocklines by an verage of 11% in 1985 and 18% in 1986. Both ock bunds and tied ridges improved water conser-ation in the short-term, with the tied ridges being ore efficient. Soil water retention and clay con-nt in the surface 0.05 m were, however, greater ith rock bunds and greatest when tied ridges and ock bunds were combined. Sand, silt and soil rganic matter were not affected by either rock unds or tied ridges. Sorghum grain yield was creased only by tied ridges, and was due primari-to increases in soil water content during flower-g. Yield was greatest, however, when tied ridges ere combined with rock bunds. It was concluded at tied ridges were more efficient than rock unds in increasing soil water content during the owing season. Rock bunds were, however, more fficient in reducing loss of clay particles in surface noff. (Author's abstract)
W91-01330

OMPUTERIZED SCHEDULING FOR IRRI-ATION MANAGEMENT AND PUMPING OP-RATIONS IN THE WATERCOURSE COM-AND.
ational Agricultural Research Centre, Islamabad akistan).
Ahmad, and D. F. Heermann.
gricultural Water Management AWMADF, Vol. , No. 1, p 1-13, May 1990. 1 fig, 3 tab, 13 ref.

escriptors: *Computerized irrigation scheduling, rrigation, *Irrigation efficiency, *Irrigation heduling, *Model studies, *Pakistan, Agricultur-hydrology, Demand irrigation, Farming, Fixed-tation irrigation, Simulation.

model to simulate the irrigation schedules of a tercourse command was developed to predict opping intensity, net farm return, farm water use, rcent water utilized, deep percolation at farm el, rainfall contribution, and extra tubewell ter pumped. Schedules for three selected farms a watercourse command in Sargodha, Pakistan re simulated with three fixed-rotation strategies d compared to a demand strategy. The fixed-ation strategies were also compared for evalua-n of the allowable depletion criteria. Evaluation simulation (1973-1982) showed that the three ed-rotation systems reduced the net farm return 28-43% from that of a demand strategy. The ed-rotation system also had 17-39% in water npage and energy consumed will be reached in ixed-rotation system. The change of the fixed-ation system to a demand system will signifi-cantly increase the net farm return in addition to improved water allocation to various farms on a watercourse command. The demand strategy will provide savings in energy due to scheduled pumping operations and effective utilization of canal water supplies. (Author's abstract)
W91-01404

ADOPTING WATER-CONSERVING IRRIGATION TECHNOLOGY: THE CASE OF SURGE IRRIGATION IN ARIZONA.
Idaho Univ., Moscow. Dept. of Agricultural Economics.
R. H. Coupal, and P. N. Wilson.
Agricultural Water Management AWMADF, Vol. 18, No. 1, p 15-28, May 1990. 3 tab, 24 ref, append.

Descriptors: *Arid lands, *Arizona, *Cost analysis, *Furrow irrigation, *Irrigation, *Irrigation efficiency, *Surge irrigation, Agricultural water, Deserts, Farming.

Surge-flow irrigation technology is a potential means for increasing irrigation efficiencies in desert agriculture. An economic analysis of the adoption decision for Arizona farmers reveals that an investment in surge irrigation is only economically viable when developing new agriculture lands or where gated pipe is already in use. Since the majority of the agricultural land in Arizona is furrow irrigated using ditches and syphon tubes, the potential for high adoption rates on existing farmland is rather limited. The analysis indicates that water costs, under conservative but realistic assumptions, would have to rise to $0.08/cubic m ($100/acre foot) before surge irrigation would be economically viable as a substitute for open ditch furrow irrigation. Further research is needed on potential labor savings and management efficiencies related to surge irrigation in order to measure potential profitability more accurately. (Author's abstract)
W91-01405

ESTIMATION OF MANNING'S ROUGHNESS COEFFICIENT FOR BASIN AND BORDER IRRIGATION.
Bangladesh Agricultural Research Inst., Joydebpur.
M. Harun-ur-Rashid.
Agricultural Water Management AWMADF, Vol. 18, No. 1, p 29-33, May 1990. 1 tab, 5 ref.

Descriptors: *Bangladesh, *Irrigation, *Mannings equation, *Roughness coefficient, *Surface irrigation, Agricultural hydrology, Data interpretation, Volume balance analysis, Water potentials.

Selection of a specific surface roughness value in a particular field situation in surface irrigation is not well established. Therefore a technique for determination of surface roughness values for basin and border irrigation from irrigation field data was developed. Volume balance analysis, a partial differential form of the continuity equation, and Manning's equation for open channel flow were used as governing equations. The forward difference approximation of the finite difference method was used as the solution technique. Flow resistance (Manning's n) is one of the important factors which govern the flow in irrigation basins and borders. Accuracy of results by the present technique depends on the accuracy of input data, particularly the surface water depth data. The accuracy of surface water depth data is again dependent on the levelness of the field and the efficiency, experience and visual judgment of the observer. If a good set of irrigation field data is available, a reasonable result can be obtained from the analysis of this technique. Field data collected from the central farm of Bangladesh Agricultural Research Institute at Joydebpur was used to test the technique. Roughness values derived by this technique were compared with those reported by several investigators. A reasonably good agreement was found between the predicted and reported roughness values. (Mertz-PTT)
W91-01406

CANOPY TEMPERATURE AS AN INDICATOR OF DIFFERENTIAL WATER USE AND YIELD PERFORMANCE AMONG WHEAT CULTIVARS.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
P. J. Pinter, G. Zipoli, R. J. Reginato, R. D. Jackson, and S. B. Idso.
Agricultural Water Management AWMADF, Vol. 18, No. 1, p 35-48, May 1990. 10 fig, 1 tab, 26 ref.

Descriptors: *Canopy, *Crop yield, *Plant growth, *Temperature effects, *Water potentials, *Wheat, Agricultural hydrology, Arid lands, Arizona, Farming, Irrigation, Soil water.

Field experiments were conducted at Phoenix, Arizona to investigate the usefulness of canopy temperatures in screening wheat genotypes for water use and yield characteristics. Six spring wheat (Triticum aestivum L.) cultivars were grown under well-watered conditions and two deficit irrigation regimes. Canopy temperatures were measured daily at 1045 hours, 1345 hours and 1545 hours using hand-held infrared thermometers. Leaf stomatal conductances were obtained between 1245 and 1400 hours. Seasonal water use was estimated via a soil water budget approach. There were small but consistent differences in canopy temperatures among cultivars in the well-watered treatments. Yecora, the warmest cultivar, had a mean midday canopy temperature of 25.1 C over the growth period from stem elongation until the hard dough stage of growth; Siete cerros, the coolest, was 23.3 C. Canopy temperatures values were lower earlier and later in the day but all cultivars maintained the same ranking relative to each other. Cultivars with higher midday canopy temperatures under well-watered conditions used less water and had lower stomatal conductances than those with cooler temperatures. Grain yields for all cultivars were similar under well-watered conditions but varied considerably under water stress. Cultivars that were warmest when well-watered maintained the highest relative yields when exposed to deficit irrigation regimes. Results indicate that routine canopy temperature comparisons between new cultivars and genotypes having well-known water use and yield characteristics will provide additional selection criteria for maximizing performance under water stress conditions. (Author's abstract)
W91-01407

WATER AND FERTILIZER INTERRELATIONS WITH IRRIGATED MAIZE.
Obafemi Awolowo Univ., Ile-Ife (Nigeria). Dept. of Agricultural Engineering.
H. O. Fapohunda, and M. M. Hossain.
Agricultural Water Management AWMADF, Vol. 18, No. 1, p 49-61, May 1990. 6 fig, 4 tab, 12 ref.

Descriptors: *Corn, *Crop yield, *Fertilization, *Irrigation, *Nigeria, *Sprinkler irrigation, Crop production, Maize, Soil water, Water potentials, Water requirements.

Maize yield interactions with water and fertilizer using a line source sprinkler system were examined. Field studies were conducted at the Teaching and Research Farm of the Obafemi Awolowo University, Ile-Ife, Nigeria between December, 1984 and February, 1986 on a silty loam soil classified as an Alfisol. The experiment was conducted twice for two seasons. Maize yields as related to water applied and fertilizer used were determined using a line source sprinkler system. The line source irrigation system used impact sprinklers at 6.1 m intervals along the lateral. The average discharge per sprinkler was 0.51 L/second with a wetting diameter of 30 m. Generally, maize yields increased with increasing water and fertilizer applications. The maximum grain yield of 6.15 ton/hectare was produced with 523 mm of water and 300 kg/hectare of NPK (15-15-15) fertilizer, while the highest dry matter yield of 17.84 ton/hectare occurred with 495 mm of water and 300 kg/hectare of NPK fertilizer. Maize yields were highly correlated with water and fertilizer. A highly significant water x fertilizer interaction (at 1% level) indicated high maize yields when fertilizer uptake is enhanced by high soil moisture level. Water productivity was increased by fertilizer application, but the relationship was not as definite with soil moisture. Produc-

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tion functions were generated to reliably predict maize yields. (Mertz-PTT)
W91-01408

DYNAMICS OF ROOT AND SHOOT GROWTH OF BARLEY UNDER VARIOUS LEVELS OF SALINITY AND WATER STRESS.
Agriculture and Water Resources Research Centre, Baghdad (Iraq). Dept. of Soil and Land Reclamation.
S. Al-Khafaf, A. Adnan, and N. M. Al-Asadi.
Agricultural Water Management AWMADF, Vol. 18, No. 1, p 63-75, May 1990. 9 fig, 4 tab, 22 ref.

Descriptors: *Barley, *Crop yield, *Evapotranspiration, *Irrigation, *Plant water potential, *Saline soils, *Water stress, Dry weight, Growth, Roots, Salinity, Soil water.

Response of barley to water stress at different growth stages at various levels of soil salinity was studied in cylindrical wooden containers (1.1 m long and 0.6 m in diameter). The treatments consisted of three salinity levels and two irrigation treatments; no water stress at any given growth stage, and plants exposed to water stress at either tillering, vegetative, flowering or seed formation stage and normally irrigated in the other stages. Comparison in above-ground dry weights indicated a significant variation between different treatments at each sampling date. The interaction between salinity and water stress was also significant. Maximum reduction in shoot dry weight was 70% under high salinity treatment when the plants were exposed to waste stress in the vegetative growth stage. The relative reductions in shoot dry weights due to salinity at the vegetative growth stage were 33% for medium salinity and 46% for high salinity, in comparison with low salinity treatment. Root dry weights significantly varied between different treatments. The highest reduction in root dry weights was recorded when the plants were exposed to water stress and/or salinity at the vegetative growth stage. Linear relations between evapotranspiration and above-ground dry weights, grain yields and root dry weights were obtained. Regardless of water stress or salinity levels, barley grain, above ground dry weights, and root dry weights were correlated with evapotranspiration. (Author's abstract)
W91-01409

SUSTAINABLE RATES OF SEWAGE SLUDGE FOR DRYLAND WINTER WHEAT PRODUCTION: I. SOIL NITROGEN AND HEAVY METALS.
Colorado State Univ., Fort Collins. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W91-01503

SUSTAINABLE RATES OF SEWAGE SLUDGE FOR DRYLAND WINTER WHEAT PRODUCTION: II. PRODUCTION AND INCOME.
Colorado State Univ., Fort Collins. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W91-01504

CHANGES IN WEST AFRICAN SAVANNA AGRICULTURE IN RESPONSE TO GROWING POPULATION AND CONTINUING LOW RAINFALL.
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
For primary bibliographic entry see Field 6D.
W91-01683

HEAT STRESS, PLANT-AVAILABLE SOIL MOISTURE, AND CORN YIELDS IN IOWA: A SHORT- AND LONG-TERM VIEW.
Iowa State Univ., Ames. Dept. of Agronomy.
R. E. Carlson.
Journal of Production Agriculture, Vol. 3, No. 3, p 293-297, July/September 1990. 6 fig, 2 tab, 19 ref.

Descriptors: *Available water, *Corn, *Crop yield, *Iowa, *Soil-water-plant relationships, *Thermal stress, History, Model studies, Regression analysis, Soil water, Stress, Temperature, Weather.

A study was conducted to identify weather factors that significantly affect corn production in Iowa from available long-term weather records. Regression analysis identified heat stress and plant available soil moisture as the two most important weather-related variables affecting corn yields in central Iowa. Heat stress was defined as the monthly or seasonal accumulation of the number of degrees each day when maximum temperatures exceeded 86 F (30 C). The regression model used included terms representing technology (time), heat stress in July and August, 1 July plant-available soil moisture in the top five feet of soil, and an interaction term between the last two variables. The model accounted for 90% of the variation in corn yield between 1954 and 1988. Time trends accounted for 62% of the yield variation, and weather factors for 28%. When July 1 plant available soil moisture was below normal (approximately 7 in), heat stress in July and August caused greater yield reductions than when plant available soil moisture was above normal. To compare the present climate with previous years, a seasonal heat stress variable was computed for 1900-1988. This revealed periods of both benign (1958-1975) and hostile (1900-1957) characteristics relative to expected and realized corn yields. Runs of stressful days each season showed similar patterns of season to season variability. The 1 July plant available moisture trends for central Iowa clearly show that the benign period mentioned was also one of adequate levels of crop growing season soil moisture. This work identifies two variables (heat stress and 1 July plant-available soil moisture) that, over a long period of time, reveal considerable interannual variability. The late 1950's, the 1960s, and the early 1970s were very favorable for corn production in central Iowa, as well as in other parts of the midwest. This data reveals this to be an unusual and benign time period when compared to other time periods of this century. The ups and downs of the 1908s may be closer to current expected weather. (Lantz-PTT)
W91-01703

USE OF LIME-STABILIZED DAIRY-PLANT WASTE FOR FORAGE PRODUCTION.
Missouri Univ.-Columbia. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W91-01704

CROPPING SYSTEM AND TILLAGE EFFECTS ON AVAILABLE SOIL WATER AND YIELD OF GRAIN SORGHUM AND WINTER WHEAT.
Southwest Kansas Research-Extension Center, Garden City.
C. A. Norwood, A. J. Schlegel, D. W. Morishita, and R. E. Gwin.
Journal of Production Agriculture, Vol. 3, No. 3, p 356-362, July/September 1990. 8 tab, 11 ref.

Descriptors: *Crop yield, *Soil-water-plant relationships, *Sorghum, *Tillage, *Wheat, Available water, Comparison studies, Garden City, Kansas, Productivity, Soil water, Tribune, Water conservation.

Wheat (Triticum aestivum L.), in the central or southern Great Plains, is grown in a 2 yr wheat-fallow (WF) cropping system or with grain sorghum (Sorghum bicolor (L.) Monech) in a 3 yr wheat-sorghum-fallow (WSF) system. Tillage during fallow causes loss of crop residue and soil water. Long-term studies were conducted at Garden City and Tribune, KS, to determine the effects of cropping system and reduced tillage on available soil water and yield of dryland winter wheat and grain sorghum. Conventional (CT), reduced (RT), minimum (MT), and nontillage (NT) systems were compared with CT in sorghum-fallow (SF), continuous sorghum (SS), and continuous wheat (WW). Reductions in tillage resulted in increased available soil water and yield. Reduced tillage resulted in increased WF yields at both locations, while WSF wheat yields were increased at Tribune. Sorghum yields were more consistently increased by reduced tillage at Tribune. Sorghum-fallow yields were higher than WSF sorghum yields at Tribune. Wheat-fallow yields usually did not differ from WSF yields at either location. Sorghum yields in WSF exceeded SS yields 67% of the time at Garden City. At Tribune WSF-RT yields exceeded SS yields 73% of the time, while WSF-CT yields were no better or less than SS yields 60% of the time. Continuous wheat yields were less than other wheat yields 98% of the time. In terms of soil water storage and yield, the WSF system is appropriate for both locations, and is more effective when combined with reduced tillage, particularly at Tribune. (Author's abstract)
W91-01705

STRENGTH OF SCLEROPHYLLOUS CELLS TO RESIST COLLAPSE DUE TO NEGATIVE TURGOR PRESSURE.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Plant Sciences.
For primary bibliographic entry see Field 2I.
W91-01800

DEVELOPMENT OF METHODOLOGY AND CRITERIA FOR IRRIGATION MANAGEMENT UNDER LIMITED WATER CONDITIONS.
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
R. J. Supalla, and D. L. Martin.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-222308/AS. Price codes: A04 in microfiche, A01 in paper copy. Final Report, April 20, 1990. 68p, 24 fig, 6 tab, append. USGS Contract no. 14-08-0001-G1141.

Descriptors: *Groundwater, *Irrigation scheduling, *Management planning, *Nebraska, *Optimum development plans, *Water conservation, Dynamic programming, Irrigation systems, Model studies, Regulations, Water allocation.

How to optimally manage irrigation systems under water limiting groundwater regulations is an increasingly common question in the Western United States. Methodologies for addressing this question were developed and applied to a Nebraska case study region. Dynamic programming was used to analyze both inter-seasonal planning decisions and intra-seasonal irrigation scheduling decisions. The optimum plan for Central Nebraska under ground water limitations was generally to produce continuous corn at less than full irrigation. For some water limiting conditions a permanent or short term disinvestment in irrigation systems was found to be profitable and small acreages of alternative crops emerged as appropriate in a few instances. Optimum intra-seasonal irrigation scheduling involved establishing a target marginal net return based on the planning model and then applying water to meet the target, with consideration of actual weather and the plant response in each growth stage. (USGS)
W91-01853

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

REVISED RUNOFF BLOCK OF SWMM.
Colorado Univ. at Denver. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4C.
W91-01190

SWMM-4.
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 4C.
W91-01191

REAL-TIME MULTIPURPOSE RESERVOIR OPERATION: A CASE STUDY.
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
S. Vedula, and S. Mohan.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 4, p 447-462, August 1990. 4 fig, 5 tab, 21 ref.

Descriptors: *India, *Multipurpose reservoirs, *Regression analysis, *Reservoir operation, *Water resources development, Case studies, Computer models, Developing countries, Hydroelectric power, Irrigation, Model testing, Simulation analysis, Streamflow, Streamflow forecasting, Water resources management.

Optimum development of water resources for irrigation and hydropower generation is a high priority consideration in the economic development of most developing countries, as food and energy continue to be among the most pressing needs. A real-time operational methodology was developed for a multipurpose reservoir operation for the generation of hydroelectric power irrigation water, which was applied to the Bhadra reservoir system in the state of Karnataka, India. The method consists of three phases of computer modeling. In the first phase, the optimal release policy for a given initial storage and inflow is determined using a stochastic dynamic programming model. Streamflow forecasting using an adaptive AutoRegressive Integrated Moving Average model constitutes the second phase. A real-time simulation model is developed in the third phase which uses the forecast inflows from the second phase and the operating policy from the first phase. A comparison of the optimal monthly real-time operation with the historical operation demonstrates the relevance, applicability and relative advantages of the proposed methodology. (Author's abstract)
W91-01464

SIMPLIFIED ANALYSIS OF SOIL WATER FLOW TO A MOLE DRAIN.
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W91-01476

DOWNSTREAM OF THE NOVOSIBIRSK HYDROELECTRIC STATION ON THE OB RIVER.
V. P. Bityukov.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 10, p 587-591, April 1990. 1 fig. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 10, p 25-28, October 1989.

Descriptors: *Channel erosion, *Dams, *Hydroelectric plants, *Hydrologic regime, *Metropolitan water management, *Soviet Union, *Water resources management, Channel improvement, Channel stability, Reservoirs, Water level fluctuations, Watershed management.

The construction of large hydroelectric developments on flatland rivers introduces large changes in their natural hydrologic regime. The 30-year period of operation of the Novosibirsk (Soviet Union) hydro development on the Ob River clearly confirms the indicated relation between fluvial processes in the river and operation of water-management objects of the city. The natural process of deep channel erosion diminished after damming the river and creation of the reservoir during the first decade of operation. In the second half of the 1960s, quarrying in the lower pool adjacent to the hydrostation began to have a substantial effect on the natural transformation process of the channel due to streamflow regulation and retention of sediments by the reservoir. During the period between 1966 and 1984 more than 40 million cu m of sand-gravel mixture was dredged from the river channel and floodplain, causing a decrease in water levels. A decrease in levels downstream led to a deficit of reservoir water resources in dry years. The priority of water users of Novosibirsk is partial restoration of the water levels in the stretch between the hydrostation and the city by constructing embankments damming nonnavigable branches and converting the channel into a single-branch channel. A radical solution for the problem of reliably providing water to consumes in the city is to reconstruct all intakes located downstream of the hydro development. (Fish-PTT)
W91-01544

EVALUATION OF DETENTION BASIN PERFORMANCE IN THE PIEDMONT REGION OF NORTH CAROLINA.
North Carolina Univ. at Charlotte. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-01824

FLOOD OF OCTOBER 1983 AND HISTORY OF FLOODING ALONG THE SAN FRANCISCO RIVER, CLIFTON, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-01849

4B. Groundwater Management

GROUNDWATER: A REVIEW OF THE 1989 LITERATURE.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 2F.
W91-01178

DEEP-WELL IN THE NORTH-HOLLAND DUNE AREA.
Waterworks of North-Holland, Bloemendaal (Netherlands).
E. Roosma, and A. Stakelbeek.
Ground Water GRWAAP, Vol. 28, No. 5, p 778-782, September/October 1990. 10 fig, 8 ref.

Descriptors: *Artificial recharge, *Deep wells, *Groundwater management, *Infiltration, *The Netherlands, *Water resources development, *Water resources management, *Water supply, Drinking water, Ecological effects, Potable water, Public policy, Water quality.

The government's policy concerning the management of the dunes in The Netherlands on behalf of the interests of nature and the environment is causing constraints for the waterworks of North-Holland located in the dunes at the North Sea coast. The existing artificial recharge systems consist mostly of ponds and open canals in which imported pretreated surface water is infiltrated to provide a reliable drinking water supply in the province of North-Holland. Because the quality of the water, infiltrated by canals has a negative influence on ecological values, extension of this system will not be possible. An alternative is deep-well infiltration; instead of infiltrating by canals, water will be infiltrated in semiconfined aquifers, so there will be less influence on existing ecological values. The Provincial Waterworks of North-Holland are constructing a pilot plant with a capacity of 5 million cubic meters/acre/year to investigate its reliability and its suitability for a development as natural as possible for this region. The history of artificial recharge is presented along with an overall look at the preliminary investigations, and an overview of the main issues for a definite engineering. (Author's abstract)
W91-01304

BIOFILM GROWTH AND THE RELATED CHANGES IN THE PHYSICAL PROPERTIES OF A POROUS MEDIUM. 1. EXPERIMENTAL INVESTIGATION.
Princeton Univ., NJ. Dept. of Computer Science.
For primary bibliographic entry see Field 2F.
W91-01531

BIOFILM GROWTH AND THE RELATED CHANGES IN THE PHYSICAL PROPERTIES OF A POROUS MEDIUM. 2. PERMEABILITY.
Princeton Univ., NJ. Dept. of Civil Engineering and Operations Research.
For primary bibliographic entry see Field 2F.
W91-01532

BIOFILM GROWTH AND THE RELATED CHANGES IN THE PHYSICAL PROPERTIES OF A POROUS MEDIUM. 3. DISPERSIVITY AND MODEL VERIFICATION.
Princeton Univ., NJ. Dept. of Civil Engineering and Operations Research.
For primary bibliographic entry see Field 2F.
W91-01533

OPTIMAL ARTIFICIAL RECHARGE IN INTERMITTENT MULTIBASIN SYSTEM.
K.N. Toossi Univ. of Technology, Tehran (Iran). Dept. of Civil Engineering.
K. Zomorodi.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 5, p 639-651, September/October 1990. 7 fig, 23 ref.

Descriptors: *Artificial recharge, *Flow equations, *Recharge basins, *Sedimentation, *Water resources management, Computer models, Constant flow, Flow rates, Infiltration rate, Suspended sediments.

Among the various factors that reduce the rate of recharge in an artificial recharge basin with time, the settling of the suspended sediments in the recharge water is usually the most important. An equation has been developed to represent the change of infiltration rate of a turbid water with time and with the concentration of suspended sediments. This equation was further generalized to consider the effect of the basin size on the recharge rate. Optimal scheduling of consecutive recharge and dry periods was determined to result in the maximum recharge rate in the long run. A computer model was developed to provide the optimal design of an intermittent multibasin recharge (IMBR) system. The model was run using a set of real field data, and the results show that when a constant flow rate is available during the recharge season, IMBR would be a more efficient system of artificial recharge than either continuous or intermittent recharge on a single basin. (Author's abstract)
W91-01554

RECONNAISSANCE-LEVEL ALTERNATIVE OPTIMAL GROUND-WATER USE STRATEGIES.
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 6D.
W91-01557

CALIFORNIAZATION OF ARIZONA WATER POLITICS.
For primary bibliographic entry see Field 6B.
W91-01631

PREDICTING WELL DRAWDOWN DURING PROLONGED PUMPING.
Westinghouse Environmental and Geotechnical Services, Cary, NC.
D. L. Goodrich.
Water Well Journal WWJOA9, Vol. 44, No. 8, p 32-33, August 1990. 2 fig.

Descriptors: *Groundwater movement, *Wells, Confined aquifers, Unconfined aquifers, *Aquifers, *Drawdown, *Pumping test, Water supply, Data interpretation.

An important consideration in groundwater management is whether prolonged pumping will result in dewatering of the aquifer. The first step in extrapolating the drawdown data beyond the end of a constant-rate pumping test is to plot the data from the test on semilogarithmic graph paper. The drawdown data from the test of an unconfined aquifer is usually corrected for locally diminished transmissivity and plotted above the field data. The trend of the actual artesian drawdown may be projected in a straight line to predict the drawdown after several months of continuous pumping.

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To simulate a maximum drawdown, the slope of the projected trend can be steepened to double that of the observed data. If the cone of depression is small in relation to the size of the aquifer, the drawdown will stabilize in less than 70 days in most situations. This procedure can be useful in predicting long-term drawdown when pumping a water supply well during periods of drought. (Miller-PTT)
W91-01682

MODELING ORGANIC CONTAMINANT SORPTION IMPACTS ON AQUIFER RESTORATION.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W91-01827

GROUND-WATER RESOURCES OF THE ARKANSAS RIVER BASIN IN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01835

WATER-RESOURCES DATA-NETWORK EVALUATION FOR MONTEREY COUNTY, CALIFORNIA, PHASE 3: NORTHERN SALINAS RIVER DRAINAGE BASIN.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W91-01836

ASSESSMENT OF HYDROLOGIC AND HYDROGEOLOGIC DATA AT CAMP LEJEUNE MARINE CORPS BASE, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01840

HYDROGEOLOGY OF AQUIFERS IN CRETACEOUS AND YOUNGER ROCKS IN THE VICINITY OF ONSLOW AND SOUTHERN JONES COUNTIES, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01841

WATER RESOURCES OF CODINGTON AND GRANT COUNTIES, SOUTH DAKOTA.
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01842

HYDROLOGY OF THE POWDER RIVER ALLUVIUM BETWEEN SUSSEX, WYOMING, AND MOORHEAD, MONTANA.
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01852

DEVELOPMENT OF METHODOLOGY AND CRITERIA FOR IRRIGATION MANAGEMENT UNDER LIMITED WATER CONDITIONS.
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3F.
W91-01853

4C. Effects On Water Of Man's Non-Water Activities

NUTRIENT EXPORT IN STORMFLOW FOLLOWING FOREST HARVESTING AND SITE-PREPARATION IN EAST TEXAS.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 5B.
W91-01009

ASSESSMENT OF CUMULATIVE IMPACTS TO WATER QUALITY IN A FORESTED WETLAND LANDSCAPE.
Clemson Univ., Georgetown, SC. Belle W. Baruch Forest Science Inst.
D. L. Childers, and J. G. Gosselink.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 455-464, July/September 1990. 5 fig, 3 tab, 38 ref.

Descriptors: *Ecological effects, *Environmental impact, *Forest ecosystems, *Forest watersheds, *Land use, *Water pollution effects, *Wetlands, Agriculture, Louisiana, Management planning, Nitrogen, Phosphorous, Streams, Suspended sediments, Tensas Basin, Turbidity, Water quality management, Water quality monitoring, Watershed management.

In a procedure for determining cumulative impacts in bottomland hardwood forests (BLHF), changes in landscape integrity over time were assessed using structural and functional ecosystem indices. Historical records of suspended sediment, N, P, and turbidity from three streams in the Tensas Basin, Louisiana were analyzed. Significant positive relationships between water levels in these streams and concentrations of total P, total Kjeldahl N, total suspended sediment and turbidity confirmed a loading phenomenon characteristic of watersheds in which much of the original forest cover has been cleared. Eighty-five percent of the original forest in the Tensas Basin has been converted to agricultural fields. N/P ratios in two of the rivers (6.4:1 and 10.2:1 molar ratios) were lower than expected in P-limited freshwater systems, where N/P ratios are generally >10-15. Most of the excess in P is probably related to the geochemical adsorption of P to sediment particles and selective loading of P during erosive storm events. As a result, the nutrient limiting aquatic primary productivity may be N in much of the Tensas Basin. Between 1978 and 1986, P levels exceeded 0.1 mg/L 96% of the time (P >0.1 mg/L signals eutrophy in lotic systems). Total suspended sediment concentration patterns were erratic and in excess of 80 mg/L over half of the time in two of the three streams studied (1966-1986). A goal oriented management plan for improved water quality in the Tensas Basin was devised based on this cumulative impact assessment. Improvement of the ecosystem can be achieved in a number of ways, including the reestablishment of natural hydrologic flow wherever possible, the use of agricultural practices that reduce runoff, the protection of existing forested corridors along streams, and the mitigative creation of new buffering zones. (Author's abstract)
W91-01017

EFFECTS OF CLEARFELLING A SITKA SPRUCE STAND ON THE WATER BALANCE OF A PEATY GLEY SOIL AT KERSHOPE FOREST, CUMBRIA.
Forestry Commission, Midlothian (Scotland). Northern Research Station.
A. R. Anderson, D. G. Pyatt, and J. P. Stannard.
Forestry, Vol. 63, No. 1, p 52-71, 1990. 3 fig, 9 tab, 26 ref, 1 append.

Descriptors: *Clear-cutting, *Forest watersheds, *Hydrologic budget, *Kershope Forest, *Soil water, *Spruce trees, Environmental effects, Evapotranspiration, Forestry, Land use, Precipitation, Rainfall-runoff relationships, Scotland.

From 1981-1985 the water balance of four 2 ha plots of a ploughed and drained Sitka spruce plantation was monitored. During 1983, three plots were clearfelled and a fourth was left standing as a control. A ground level rain gage over-collected during snow, but otherwise collected 3% more water than standard rain gages. Annual precipitation (1259-1688 mm) averaged 1439 mm. The forest canopy intercepted 38% and transpired 12% of gross precipitation. Fifty percent of gross precipitation was evaporated while 50% left the site as runoff. Throughfall and stemflow fractions of net precipitation were 0.87 and 0.13 respectively. After clearfelling, annual runoff increased to 68% of gross precipitation. After adjustment using the before and after comparison in the control plot, the decrease in annual evaporative loss resulting from clearfelling was 290 mm. (Author's abstract)
W91-01069

HUMUS FORM DEVELOPMENT AND HILLSLOPE RUNOFF, AND THE EFFECT OF FIRE AND MANAGEMENT, UNDER MEDITERRANEAN FOREST IN NE-SPAIN.
Amsterdam Univ. (Netherlands). Lab. for Physical Geography and Soil Science.
For primary bibliographic entry see Field 2G.
W91-01079

UNEXPECTED HYDROLOGIC PERTURBATION IN AN ABANDONED UNDERGROUND COAL MINE: RESPONSE TO SURFACE RECLAMATION.
Indiana Geological Survey, Bloomington.
D. Harper, G. A. Olyphant, and E. J. Hartke.
Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 3, p 179-187, May/June 1990. 5 fig, 2 tab, 12 ref.

Descriptors: *Coal mines, *Land reclamation, *Mine wastes, *Subsidence, Disturbance, Flooding, Geologic fractures, Potentiometric level.

A reclamation project at the abandoned Blackhawk Mine site near Terre Haute, Indiana, lasted about four months and involved the burial of coarse mine refuse in shallow (less than 9 m) pits excavated into loess and till in an area of about 16 ha. An abandoned flooded underground coal mine underlies the reclamation site at a depth of about 38 m; the total area underlain by the mine is about 10 sq km. The potentiometric levels associated with the mine indicate a significant (2.7 m) and prolonged perturbation of the deeper confined groundwater system; 14 months after completing reclamation, the levels began to rise linearly (at an average rate of 0.85 cm/day) for 11 months, then fell exponentially for 25 months, and are now stable. Prominent subsidence features exist near the reclamation site. Subsidence-related fractures were observed in cores from the site, and such fractures may have provided a connection between the shallower and deeper groundwater systems. (Author's abstract)
W91-01098

DIRECT IMPACTS OF OUTER CONTINENTAL SHELF ACTIVITIES ON WETLAND LOSS IN THE CENTRAL GULF OF MEXICO.
Louisiana State Univ., Baton Rouge. Center for Energy Studies.
For primary bibliographic entry see Field 2L.
W91-01099

PROCEEDINGS OF STORMWATER AND WATER QUALITY MODEL USERS GROUP MEETING.
For primary bibliographic entry see Field 5G.
W91-01188

USER DEFINED CONDUITS IN THE EXTRAN BLOCK OF SWMM.
Tulane Univ., New Orleans, LA.
M. L. Yasenchak, and T. J. McGhee.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988 Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 1-9, 4 fig, 2 ref.

Descriptors: *Computer models, *Conduits, *Network design, *Storm Water Management Model, *Storm water, *Urban hydrology, *Urban runoff, *Water supply development, Computer programs, EXTRAN, Finite difference methods, Flood routing, Floodwater, Hydraulic models, Louisiana, Mathematical studies, New Orleans, Pipelines, Pumping, Runoff, Simulation analysis.

The drainage system in the City of New Orleans is extremely complex, containing conduits ranging from small circular pipes to very large open canals with complicated cross-sectional geometries. Invert slopes are low (sometimes zero) and permit the branching of flow in the downstream direction as well as flow reversal during runoff events. Both large and small conduits are surcharged and the entire flow must be pumped since the city is surrounded by levees. This network has been simulated using EPA's Storm Water Management Model (SWMM). SWMM provides a variety of alternative routing techniques, ranging from a quasi-steady state storage routing procedure in RUNOFF, to a finite difference solution of the Saint Venant equations in EXTRAN. The solution technique employed in EXTRAN is most suitable for New Orleans, but this block permits use of only six standard conduit shapes which do not always correspond to those which exist in the system. Since the system is not satisfactorily simulated by TRANSPORT, EXTRAN has been modified to permit the use of any shape whatsoever, whether it can be mathematically defined or not. The revised version of EXTRAN will accept and run data sets prepared for the standard program with no changes whatsoever and has been use to assess the effects of approximating unusual sewer shapes by the standard sections of EXTRAN. To determine whether the modifications to EXTRAN were correct, a network of rectangular and circular conduits, was analyzed using the modified version without user-defined conduits. Next, it was reanalyzed by sequentially replacing the rectangular and circular conduits one by one with user-defined shapes, which were actually rectangles and circles. This replacement created large differences in calculated flows and depths became progressively larger. This hydraulic radius computational error was corrected, yielding a maximum difference between flows commonly 0.01 cu ft/sec (cfs) and averaged 0.04 cfs. The results were compared with those shapes obtained for hydraulically equivalent rectangular and circular shapes. It was found that as the channels approach full flow, the differences diminished and at full flow the differences were negligible. (See also W91-01188) (Lantz-PTT)
W91-01189

REVISED RUNOFF BLOCK OF SWMM.
Colorado Univ. at Denver. Dept. of Civil Engineering.
J. C. Y. Guo, and B. Urbonas.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 10-20, 4 fig, 6 tab, 5 ref.

Descriptors: *Conduits, *Model studies, *Storm Water Management Model, *Urban hydrology, *Urban runoff, *Water management, *Water quality, Computer models, Data interpretation, Erosion, Flood routing, Floods, Hydraulic models, Pipelines, Pipes, Runoff, Simulation analysis, Storm runoff, Storm water management, Water quality management.

The Storm Water Management Model (SWMM) model consists of hydraulic watershed simulation, water quality modeling, hydraulic routing, contamination prediction, and erosion estimation, as well as other features to function as a complete water quality and quantity model. Changes were made to the Runoff Block of SWMM in 1974 to include the option of an overflow section for pipes and channels, and routing capability to model storage reservoirs such as detention ponds. In March 1985, the revised version of the Runoff Block of SWMM was converted to a microcomputer version and named UDSWM2-PC which includes only the rainfall and runoff subroutines required for stormwater drainage modeling. The software was modified to be capable of reading and routing hydrographs previously generated by software which uses the synthetic unit graph convolution to predict storm hydrographs. In this study the UDSWM2-PC was further modified to include a pipe sizing capability which enables the software to compute the required pipe diameter for the given hydrographs. The new version, named UDSWM3-PC is capable of simulating flood propagations in a drainage system with or without existing pipes in the network. Results of this study indicate that the auto-pipe sizing greatly enhances the versatility of the UDSWM2-PC model. UDSWM3-PC can now be used for drainage basin analysis with or without existing storm sewers. The UDSWM2-PC model is inefficient with computer memory space. Approximately 90 arrays of 399 points are reserved for storing gutter and subbasin data. Only a portion of these arrays are utilized during computations depending on the total numbers of gutters and sub-basins in the drainage network. The remainder of the array space remains idle. The case study used only 4.5% of the reserved array space. (See also W91-01188) (Lantz-PTT)
W91-01190

SWMM-4.
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
W. G. Huber, and R. E. Dickinson.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 21-32, 3 fig, 9 ref.

Descriptors: *Management planning, *Rainfall-runoff relationships, *Storm Water Management Model, *Storm runoff, *Urban hydrology, *Urban runoff, *Water quality, Data interpretation, Model studies, Precipitation, Runoff, Storm water management, Water management, Water quality management.

Version 4 of the EPA Storm Water Management Model (SWMM) was released during September 1988. Improvements and changes include: full adaptation for microcomputer use, addition of natural channel geometry to the EXTRAN and Transport Blocks (using HEC-2 input formats), addition of subsurface quantity routing to the Runoff Block, ability to access recent National Weather Service precipitation and meteorological data and perform statistical analysis on these data, variable time steps in the Runoff Block, metrification of the Extran Block, and simplification of the input data. The model is available from the EPA Center for Exposure Assessment Modeling in Athens, Georgia. Version 4 of SWMM attempts to update and correct errors found in earlier versions, add new computational features, and make the program easier to run on a microcomputer without eliminating the option for use on main-frames. The conceptualization of the rainfall-runoff quality process remains the same, with attendant strengths and weaknesses. SWMM is expected to remain a familiar and improving tool for the analysis of urban hydrologic and similar problems for the foreseeable future. (See also W91-01188) (Lantz-PTT)
W91-01191

IMPROVEMENTS TO SURCHARGE CALCULATIONS IN EXTRAN.
Brown and Caldwell, Seattle, WA.
For primary bibliographic entry see Field 7C.
W91-01192

URBAN RUNOFF MODELING FOR ADMINISTRATIVE PURPOSES.
Wright Water Engineers, Inc., Denver, CO.
W. P. Ruzzo.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, COl. EPA Report No. EPA/600/9-89/001, January 1989. p 43-51.

Descriptors: *Flood plain management, *Hydrologic models, *Rainfall-runoff relationships, *Urban hydrology, *Urban runoff, Administration, Management planning, Model studies, Public policy, Runoff, Urbanization.

Computer modeling of urban runoff has advanced in the last decade, particularly with the advent of the personal computer. The modeling techniques for simulating watershed responses and real-time rainfall have increased the ability to more precisely predict the runoff peaks and hydrographs. This advance in modeling capabilities has benefited the overall understanding of the physical sciences. Input data as it relates to the actual end use of the model results has also advanced. In many cases the model results are used to develop a floodplain for regulatory purposes, or to develop hydrographs to design flood mitigation facilities. This aspect of modeling is more for administrative purposes and the decisions on the input data are not necessarily based on simulating the actual physical processes. Instead, decisions are made to facilitate the administration of the floodplain regulations or to provide a sound engineering basis for facilities which are designed for anticipated future development. Decisions were made during urban runoff modeling for several watersheds in the Denver area, are presented which required the model to account for anticipated future watershed conditions. The decisions are based on administrative considerations such as: (1) worst case scenarios, (2) limited jurisdictional control of development, (3) ability to accurately predict future conditions, and (4) local policies regarding stormwater management. The use of inadvertent detention that occurs upstream of road or railroad embankments, flood flows which become split from the main channel, projections of impervious land densities, and selection of watershed characteristics and routing patterns, are highlighted. (See also W91-01188) Lantz-PTT)
W91-01193

MODELING STUDIES FOR THE CITY OF AUSTIN STORMWATER MONITORING PROGRAMS.
Austin Environmental Protection Dept., TX.
G. C. Chang, J. H. Parrish, and C. Soeur.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 52-61, 7 tab, 13 ref.

Descriptors: *Austin, *Model studies, *Monitoring, *Storm water management, *Texas, *Urban hydrology, *Urban runoff, *Water quality, Computer models, Computer programs, Filtration, Land use, Management planning, Urban watersheds, Water quality management.

Statistical modeling studies are presented for the City of Austin's two stormwater quality monitoring programs. One program monitors creeks of various large multiple-land use urban watersheds. The other program monitors flow and water quality of small single-land use urban watersheds and control structures. The stormwater quality and rainfall runoff data generally follow log-normal probability distributions. Based on the assumptions of normality or log-transformed normality, the data were analyzed using SAS computer programs. Regression equations relating runoff and rainfall variables were successfully developed for each watershed. Total and incremental pollutant loads for storms were regressed on runoff variables and antecedent rainfall conditions. Validation of the regression equation was dependent on statistical tests and specific precision standards. The amount of impervious cover in a watershed was chosen to represent the degree of urbanization for the watershed; the pollutant load per storm was found to linearly increase with the increase of watershed impervious cover. The pollutant concentration depended on various factors, many of which also relate to the amount of impervious cover. For the large watersheds, the concentration of many of those parameters was found to increase with impervious cover. For small urban watersheds these relationships do not exist; the concentration was dependent on the land use and maintenance. Results from two filtration basins and one wet pond support the City of Austin's watershed ordinance which specifies impervious cover limitations, and requires sedimentation and/or filtration basins for controlling stormwater quality for developing areas. (See also W91-01188) (Lantz-PTT)
W91-01194

APPLICATION OF SWMM IN THE NEW ORLEANS AREA.
Tulane Univ., New Orleans, LA.
T. J. McGhee, and M. L. Yasenchak.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988,

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Denver, COl. EPA Report No. EPA/600/9-89/001, January 1989. p 62-72, 2 fig, 1 tab, 6 ref.

Descriptors: *Computer models, *Louisiana, *Model studies, *New Orleans, *Storm Water Management Model, *Storm runoff, *Urban hydrology, *Urban runoff, Flood plain management, Runoff, Storm water management.

A review of recent applications of SWMM in the New Orleans Metropolitan area is presented. The city and adjoining areas of Jefferson Parish are entirely enclosed by levees, have very little surface relief, and have drainage systems which are thoroughly interconnected and subject to reversals of flow. Rainfall amounts are heavy. The normal annual precipitation exceeds 60 inches and individual storms may produce totals of 10-12 inches in as many hours. In recent years extensive property damage resulting from flooding has been the impetus for studies intended to improve the capacity of systems which, in at least some cases, were built to dewater marsh and swamp land and are now used to drain developed urban areas. The standard SWMM blocks RUNOFF, TRANSPORT, and EXTRAN have all been used depending upon the particular circumstance. In addition, certain modifications have been made which make the model more useful in the New Orleans region. Among these are the use of 'Standard Streets' in a manner analogous to that employed in the Chicago Drainage Model, inclusion of user-defined conduits in EXTRAN, and improvement of the pumping calculations in EXTRAN to better simulate a system with multiple pumps and variable suction and discharge bay elevations. Simulation of storms in excess of the drainage system capacity illustrated the deficiencies by showing discharges at internal points. The inadequate sections were increased in dimension and other modifications were made in the modeled system unit it was capable of conveying the flow to the pump stations without flooding. (See also W91-01188) (Lantz-PTT)
W91-01195

USE OF SWMM/EXTRAN AND TR-20 TO DEVELOP REGIONAL STORMWATER DETENTION PLANS IN THE WASHINGTON, D.C. REGION.
Camp, Dresser and McKee, Inc., Annandale, VA.
B. W. Mack, T. S. George, and J. P. Hartigan.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 73-80, 1 fig, 1 tab, 3 ref.

Descriptors: *District of Columbia, *Storm Water Management Model, *Urban hydrology, *Urban runoff, Flood plain management, Management planning, Model studies, Runoff, Storm runoff, Storm water management, Urban watersheds, Water quality.

A regional approach to stormwater detention is the current trend for stormwater master plan development in the Washington metropolitan region. The development of criteria for locating and designing regional basins, and the modeling approaches used to maximize regional detention benefits on a watershed basis are addressed. Stormwater models were applied to develop a regional detention basin master plan for Fairfax County, Virginia, along with a preliminary stormwater management investigation for Montgomery County, Maryland. Following the selection of regional detention basin sites and the completion of conceptual designs the SWMM/EXTRAN model and the Soil Conservation Service TR-20 model were used to determine the water shed wide impacts of alternative detention systems. To assess regional benefits, various locational schemes were analyzed for both county plans. The Fairfax County plan included the design of maximum efficiency basins which utilize lower maximum release rates to compensate for areas not controlled by regional facilities. The regional detention basin network, recommended in the Montgomery County investigation, demonstrated the use of extended detention on top of a permanent pool for water quality benefits. In several cases, in addition to water quality benefits, this type of design reduced the post-development 2-year peak flows to levels less than pre-development conditions. The TR-20 model was used to evaluate the watershed wide impacts of this type of design. In addition, a PC graphics package was developed to illustrate the watershed interactions of the routed TR-20 hydrographs. (See also W91-01188) (Author's abstract)
W91-01196

APPLICATION OF QUAL II TO EXPLORE WASTELOAD ALLOCATION ALTERNATIVES.
Rhode Island Dept. of Environmental Management, Providence.
For primary bibliographic entry see Field 5G.
W91-01197

MULTI-MODEL MICRO-COMPUTER BASED WET DETENTION BASIN DESIGN METHODOLOGY.
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
S. L. Harrell.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 119-125, 3 fig, 6 ref, append.

Descriptors: *Computer programs, *Design standards, *Detention reservoirs, *Storm water management, *Urban hydrology, *Urban runoff, Flood control, Management planning, Runoff, Sedimentation, Spillways, Storm runoff, Water management.

A regulatory driven technical guidance manual, including a compendium of model series, is being synthesized from widely available manuals and models to assist developers in planning stormwater control mechanisms, and to aid municipal officials in reviewing these plans. Design of wet detention basins, usually consists of determining in four steps: (1) the minimum surface area of the permanent pool, (2) the storage volume that will detain a specified runoff, (3) principal spillway size and additional storage volume for flood control and sediment accumulation, and (4) the dam and emergency spillway design parameters. Tables of the required surface area for a given drainage area, impervious, and watershed characteristics are used for the first step. The remaining steps are completed using a LOTUS 123 spreadsheet model. (See also W91-01188) (Lantz-PTT)
W91-01200

MODELING AND FIELD EVALUATIONS OF URBAN WET DETENTION PONDS.
North Carolina Univ. at Charlotte. Dept. of Civil Engineering.
J. S. Wu.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 129-141, 1 fig, 8 tab, 17 ref.

Descriptors: *Detention reservoirs, *Field tests, *Model studies, *Urban hydrology, *Urban runoff, *Water quality, Management planning, North Carolina, Runoff, Water management, Water quality management.

An extensive stormwater sampling program was conducted on three existing urban wet detention ponds in the Piedmont region of North Carolina, and an EPA model was examined and verified for its usefulness in analyzing the water-quality improvement performance of urban wet detention ponds. By analyzing the pollutant removal data collected from eleven runoff events, a performance relationship was observed, permitting the incorporation of water quality improvement requirements into the proper sizing of wet detention ponds. To achieve a minimum level of urban runoff pollution control, the surface area ratio of detention ponds must be greater than 0.5%. Approximately 1% to 2% of the watershed area is needed for developing detention ponds to control 70% or more of the sediment load. (See also W91-01188) (Lantz-PTT)
W91-01201

HYDROLOGIC DATA AUTOMATION USING AUTOCAD.
Kiowa Engineering Corp., Denver, CO
For primary bibliographic entry see Field 7C.
W91-01202

DISTRIBUTED RAINFALL-RUNOFF MODELING BASED ON DIGITAL MAP DATABASE.
Colorado Univ. at Denver. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W91-01203

PC-SYNOP, A RAINFALL ANALYSIS TOOL.
Woodward-Clyde Consultants, Oakland, CA.
For primary bibliographic entry see Field 7C.
W91-01204

COMPUTER AIDED PLANNING OF DRAINAGEWAY IMPROVEMENTS MADE EASY WITH LOTUS 1-2-3.
Greenhorne and O'Mara, Inc., Aurora, CO.
For primary bibliographic entry see Field 7C.
W91-01205

HYETOGRAPH COMPOSITING EFFECTS ON URBAN RUNOFF MODELLING.
Kiowa Engineering Corp., Denver, CO.
For primary bibliographic entry see Field 7C.
W91-01206

GULF COAST FLOOD ROUTING.
Wright Water Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 2E.
W91-01210

FORESTS AND THE TEMPERATURE OF UPLAND STREAMS IN WALES: A MODELLING EXPLORATION OF THE BIOLOGICAL EFFECTS.
University Coll., Cardiff (Wales). School of Pure and Applied Biology.
For primary bibliographic entry see Field 2E.
W91-01343

CULTURAL EUTROPHICATION OF WEST POINT LAKE--A 10-YEAR STUDY.
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 5C.
W91-01354

EFFECT OF HYDROPOWER PEAKING FLOW FLUCTUATIONS ON COMMUNITY STRUCTURE AND FEEDING GUILDS OF INVERTEBRATES COLONIZING ARTIFICIAL SUBSTRATES IN A LARGE IMPOUNDED RIVER.
Minnesota Univ., St. Paul. Dept. of Forest Resources.
N. H. Troelstrup, and G. L. Hergenrader.
Hydrobiologia HYDRB8, Vol. 199, No. 3, p 217-228, July 31, 1990. 2 fig, 4 tab, 41 ref.

Descriptors: *Aquatic insects, *Dam effects, *Hydroelectric power, *Limnology, *Macroinvertebrates, *Missouri River, *Nebraska, *Reservoir releases, *Species diversity, *Stream discharge, *Stream ecology, Abundance, Artificial substrates, Caddisflies, Depth, Diurnal variation, Food habits, Impoundments, Mayflies, Midges, Monitoring, Oligochaetes, Unsteady flow.

Artificial substrates were used to monitor the invertebrate communities below a power peaking impoundment and a flow re-regulating impoundment on the Missouri River in Northeastern Nebraska. Invertebrate communities on shallow samplers subjected to exposure from diel fluctuations in flow averaged 3 taxa per sampler and 91 organisms per square meter. In the absence of diel fluctuations, number of taxa per sampler increased to 12 and mean densities increased to 743 per square meter. Fluctuating discharges had no significant effect on numbers of taxa or densities o

continually submerged artificial substrates. However, greater numbers of taxa and total densities were observed on deep (107 cm) versus shallow (30 cm) samplers below both impoundments. Polycentropodidae (Trichoptera), Chironomidae (Diptera) and Oligochaeta were observed to tolerate diel fluctuations and exposure below Fort Randall Dam while Hydropsychidae (Trichoptera) and Heptageniidae (Ephemeroptera) were extremely intolerant. Collector-gathers and predator-engulfers were the predominant functional groups colonizing samplers below both impoundments. Higher numbers of collector-gathers, collector-filterers, and scrapers were observed from samplers in the absence of diel flow fluctuations. These findings corroborate results from a number of other investigations, separated in space and time. Examined collectively, these studies provide the framework for understanding power peaking as a stress to benthic stream communities. (Author's abstract)
W91-01357

BUFFERING CAPACITY OF COAL MINE SPOILS AND FLY ASH AS A FACTOR IN THE PROTECTION OF THE AQUATIC ENVIRONMENT.
Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.
For primary bibliographic entry see Field 5G.
W91-01455

ENVIRONMENTAL IMPACTS OF DEVELOPMENT ON WETLANDS IN ARID AND SEMI-ARID LANDS.
University Coll., London (England). Dept. of Geography.
For primary bibliographic entry see Field 6G.
W91-01462

CHANGES IN STREAM MORPHOLOGY AND STORM TRANSPORT OF SESTON FOLLOWING WATERSHED DISTURBANCE.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 2J.
W91-01505

PROBLEMS IN DETERMINING THE RETURN OF A WATERSHED TO PRETREATMENT CONDITIONS: TECHNIQUES APPLIED TO A STUDY AT CASPAR CREEK, CALIFORNIA.
Forest Service, Arcadia, CA.
R. B. Thomas.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2079-2087, September 1990. 7 fig, 6 tab, 14 ref.

Descriptors: *Flood peak, *Forest watersheds, *Land use, *Logging, *Rainfall-runoff relationships, *Road construction, *Storm runoff, *Suspended sediments, Land management, Streamflow, Watershed management.

Using a previously treated basin as a control in subsequent paired watershed studies requires the control to be stable. Basin stability can be assessed in many ways, some of which were investigated for the South Fork of Caspar Creek in northern California. This basin is recovering from logging and road building in the early 1970s. Three storm-based discharge characteristics (peak discharge, quick flow, and total storm flow), daily flows, and concentration of suspended sediment were studied to see if the South Fork can be used as a control in a second experiment. Mean sediment concentration in three discharge classes and regression parameters for the other data were tested to estimate remaining treatment effects relative to the North Fork. Patterns of change were similar for most data, with rises in response followed by returns toward pretreatment conditions. The storm and sediment data showed few significant differences, but tests on daily flows indicated that differences still exist. The overall evidence suggests that the South Fork has returned to near pretreatment conditions. Better sediment data are needed for studies of the effects of land management. (Author's abstract)
W91-01523

BACTERIAL PRODUCTION AND RESPIRATION IN THE LAKES OF DIFFERENT TYPES.
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
For primary bibliographic entry see Field 2H.
W91-01611

RESPONSE OF COASTAL ZONE MANAGEMENT PROGRAMS TO SEA LEVEL RISE IN THE UNITED STATES.
Washington Univ., Seattle. Inst. for Marine Studies.
For primary bibliographic entry see Field 6B.
W91-01619

VEGETATION DYNAMICS IN IMPOUNDED MARSHES ALONG THE INDIAN RIVER LAGOON, FLORIDA, USA.
Florida Medical Entomology Lab., Vero Beach.
J. R. Rey, R. A. Crossman, and T. R. Kain.
Environmental Management EMNGDC, Vol. 14, No. 3, p 397-409, March/April 1990. 7 fig, 5 tab, 28 ref. Office of Coastal Zone Management-NOAA Grants CM-47, CM-73, and CM-93.

Descriptors: *Florida, *Mangrove swamps, *Marsh management, *Marsh plants, *Salt marshes, *Vegetation establishment, *Water resources development, *Wetlands, Batis, Glasswort, Halophytes, Reservoirs, Succession, Vegetation regrowth, Water control, Water management.

Data are presented on the vegetation dynamics of two impounded marshes along the Indian River Lagoon, in east-central Florida. Vegetation in one of the marshes (IRC 12) was totally eliminated by overflooding and by hypersaline conditions (salinities over 100 ppt) that developed there in 1979 after the culvert connecting the marsh with the lagoon was closed. Over 20% recovery of the herbaceous halophytes Salicornia virginica, S. bigelovii, and Batis maritima was observed at that site after the culvert was reopened in 1982, but total cover in the marsh remains well below the original 75%. No recovery of mangroves was observed at this site. The second site (SLC 24), while remaining isolated from the lagoon during much of the study, did not suffer the complete elimination of vegetation experienced at the first site. At this location, mangroves increased in cover and frequency with a concomitant decrease in herbaceous halophytes. Considerable damage to the vegetation was evident at IRC 12 when the impoundment was closed and flooded for mosquito control in 1986. Although the damage was temporary, its occurrence emphasizes the need for planning and constant monitoring and adjustment of management details as conditions within particular marshes change. Storms and hurricanes may be important in promoting a replacement of black mangroves by red mangroves in closed impoundments because the former cannot tolerate pneumatophore submergence for long periods of time. (Author's abstract)
W91-01636

HYDRAULIC SHOCK LOADINGS OF WASTEWATER TREATMENT SYSTEM TO URBAN RAINFALL-RUNOFF (EFFETS CHOCS HYDRAULIQUES DES EAUX USEES DE RUISSELLEMAENT PLUVIAL URBAIN SUR UN SYSTEME DE TRAITEMENT DES EAUX).
Institut National de la Recherche Scientifique, Rimouski (Quebec).
For primary bibliographic entry see Field 5D.
W91-01638

CHANGES IN WEST AFRICAN SAVANNA AGRICULTURE IN RESPONSE TO GROWING POPULATION AND CONTINUING LOW RAINFALL.
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
For primary bibliographic entry see Field 6D.
W91-01683

PEAK-FLOW CHARACTERISTICS OF SMALL URBAN DRAINAGE ALONG THE WASATCH FRONT, UTAH.
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. L. Lindskov, and K. R. Thompson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4095, 1989. 38p, 17 fig, 7 tab, 13 ref.

Descriptors: *Model studies, *Peak flow, *Rainfall-runoff relationships, *Storm runoff, *Urban hydrology, *Urban runoff, *Utah, Peak discharge, Urban drainage, Urban watersheds, Wasatch Front.

Designers and planners for local, State, and Federal agencies need up-to-date methods for determining peak-flow characteristics for urban drainages along the Wasatch Front, Utah. This report summarizes methods used to develop equations that estimate peak-flows for small urban drainages along the Wasatch Front. Mathematical equations were developed that estimate peak flows for recurrence intervals of 2, 5, 10, 25, 50 and 100 years, for small urban drainages. Data entry to the equations requires measurements of basin slope, size and percent impervious area. Rainfall and runoff data collected from eight urban drainages along the Wasatch Front from 1984-86, were used to calibrate a rainfall-runoff model called DR3M-II. Rainfall data collected from 1948-83 at the National Weather Service Salt Lake City Airport station provided additional long-term data to the calibrated models. Log Pearson fits made to the peak flow data were used to estimate the recurrence interval peaks for each basin. Paired stations on Little Cottonwood Creek near Salt Lake City were used to help determine the effects of intervening urban drainage on peaks of larger streams. In general, peaks on larger streams caused by snowmelt and peaks caused by rainfall (where urban areas may have a significant effect) did not occur simultaneously. (USGS)
W91-01834

RELATIONSHIPS BETWEEN WETLAND FRAGMENTATION AND RECENT HYDROLOGIC CHANGES IN A DELTAIC COAST.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2L.
W91-01903

HEAVY METAL ACCUMULATION AND TRANSPORT THROUGH DETENTION PONDS RECEIVING HIGHWAY RUNOFF.
University of Central Florida, Orlando. Dept. of Civil Engineering and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W91-01995

4D. Watershed Protection

SEDIMENT-SOURCE DATA FOR FOUR BASINS TRIBUTARY TO LAKE TAHOE, CALIFORNIA AND NEVADA, AUGUST 1983-JUNE 1988.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W91-01847

SUSPENDED SEDIMENT AND BED LOAD PROBLEMS OF THE UPPER RHINE.
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
E. Golz.
Catena, Vol. 17, No. 2, p 127-140, April 1990. 8 fig, 2 tab, 20 ref.

Descriptors: *Bed load, *Dam effects, *Erosion, *Erosion control, *Regulated flow, *Rhine River, *Sediment control, *Sedimentation, *Suspended sediments, Gravel, Mine wastes, Particle size, Rivers, Sand, Wastewater.

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The regulation of the southern Upper Rhine by dams down to Iffezheim has considerably changed the sediment balance of the stream. In the impounded sections fine-grained sediments are deposited, narrowing the cross section and impeding high-water discharge. The high illite content of the suspended material indicates that a considerable part of the settling sediment is derived from Alsatian potassium mining wastewaters. In the freely flowing Rhine downstream of Iffezheim, erosion occurs. Although the degradation of the riverbed downstream of the Iffezheim dam is prevented successfully by artificial addition of gravel, this has no positive influence on the erosion taking place farther north. This becomes apparent both in the petrographic composition of the bed load material as well as in its particle size distribution. Medium-grained to coarse gravel with high carbonate rock content is deposited upstream of Speyer. Downstream of Speyer, sand and fine gravel rich in crystalline components are taken up from the river bottom. This situation might be improved by appropriate addition of sand and fine gravel downstream of Iffezheim. (Author's abstract)
W91-01871

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

APPLICATION OF A HOLLOW-FIBER, TANGENTIAL-FLOW DEVICE FOR SAMPLING SUSPENDED BACTERIA AND PARTICLES FROM NATURAL WATERS.

Geological Survey, Menlo Park, CA.
J. S. Kuwabara, and R. W. Harvey.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 625-629, July/September 1990. 1 fig, 3 tab, 25 ref.

Descriptors: *Dewatering, *Filtration, *Instrumentation, *Membrane filters, *Pollutant identification, *Samplers, *Water sampling, Analytical techniques, Bacterial analysis, Hollow-fiber filters, Suspended particles, Tangential flow, Water analysis.

Increasing interest in suspended particles that control transport, partitioning, and bioavailability of a variety of contaminants in natural waters has necessitated the development of efficient dewatering/particle-concentration devices. The design and application of a hollow-fiber tangential-flow filtration device for concentration of bacteria and suspended particles from large volumes of surface water and groundwater samples (i.e., hundreds of liters) was described. The device is composed of a filtration module, containing two all polypropylene, hollow-fiber tangential-flow filtration cartridges (0.2 microm pore size), and a pump module. Filtrate flux rates (4-8 L/min) are equal to or faster than those of other devices that are based on continuous flow centrifugation and plate and frame filtration. Particle recovery efficiencies for inorganic particles (approximately 90%) were similar to other dewatering devices, but microbial cell recoveries (30-90%) were greatly improved by this technique relative to other currently available methods. Although requirements for operation and maintenance of the device are minimal, its size, as with other dewatering devices, limits its applicability at remote sites. Nevertheless, it has proven useful for sample collection in studies involving microbial transport and analysis of particle-associated trace inorganic solutes. (Author's abstract)
W91-01031

VARIABILITY OF DIATOM CONCENTRATIONS AND ACCUMULATION RATES IN SEDIMENTS OF A SMALL LAKE BASIN.

University Coll., London (England). Palaeoecology Research Unit.
For primary bibliographic entry see Field 2H.
W91-01049

STUDIES ON THE ABILITY OF WATER HYACINTH (EICHHORNIA CRASSIPES) TO BIOCONCENTRATE AND BIOMONITOR AQUATIC MERCURY.

Berhampur Univ. (India). Dept. of Botany.
M. Lenka, K. K. Panda, and B. B. Panda.
Environmental Pollution ENPOEK, Vol. 66, No. 1, p 89-99, 1990. 4 fig, 3 tab, 15 ref.

Descriptors: *Aquatic plants, *Bioindicators, *Biological magnification, *Mercury, *Monitoring, *Water hyacinth, Bioaccumulation, Genotoxicity, Plant growth, Spectrophotometers, Water pollution control.

Water hyacinth (Eichhornia crassipes,) plants were employed to assess bioconcentration and genotoxicity of aquatic mercury. Plants were exposed to water contaminated with mercuric chloride (MC) or phenyl mercuric acetate (PMA) at 0.001 to 1.0 mg/L or mercury contaminated effluent from a chloralkali plant for various periods of 4 to 96 hours. Root samples taken after 4, 8, 12, 24, 48, 72, and 96 hours of exposure were analyzed for bioconcentration of mercury spectrophotometrically, and the root meristems were fixed in aceto-ethanol for cytological analysis to determine the frequencies of cells with micronuclei (MNC). Ethyl methane sulfonate and tap water served as positive and negative controls, respectively. The results indicated that bioconcentration of mercury in root tissue was both time-dependent and concentration-dependent, providing evidence that water hyacinth is a good absorbent of aquatic mercury. The frequency of root meristematic cells with MNC followed a concentration-response. The findings indicate the potential of water hyacinth plants for in situ monitoring and for mitigation of aquatic mercury pollution. (Author's abstract)
W91-01112

HEAVY METAL CONCENTRATION IN TELESCOPIUM FROM DARWIN HARBOUR, N.T., AUSTRALIA.

Northern Territory Univ., Darwin (Australia). School of Chemistry.
N. Peerzada, C. Eastbrook, and M. Guinea.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 6, p 307-308, June 1990. 1 fig, 1 tab, 9 ref.

Descriptors: *Bioaccumulation, *Bioindicators, *Darwin Harbour, *Gastropods, *Pollutant identification, *Telescopium, *Water pollution sources, Atomic absorption spectrometry, Australia, Cadmium, Copper, Elizabeth River, Frances Bay, Path of pollutants, Race Course Creek, Rapid Creek, Trace metals, Wastewater pollution, Zinc.

Some gastropods have the clear potential to act as indicators of trace metals. Telescopium which is widely eaten by the aborigines is a sedentary filter feeder and likely to show the accumulation of heavy metal in Darwin Harbour. Samples of telescopium were collected from 11 sites around Darwin Harbour; at least, 15-20 specimens were collected from each site. The samples were digested and analyzed by flame atomic absorption spectrophotometry with a Varian AA1475. No background correction was used. The level of lead found ranged from undetectable to 8.99 microgm/g. High levels of lead were found in samples from Rapid Creek and Frances Bay. The highest levels were at Rapid Creek which received some treated sewage and storm runoff. Frances Bay received some Macerated sewage. No lead was detected elsewhere. High concentrations of Cd, 20.6 microgm/g, Zn, 1199.47 microgm/g, and Cu 72.05 microgm/g, were found at Race Course Creek, which receives sewage. The highest Cd levels were at Elizabeth River near boat ramps, landfills and sewage outlets. The concentration of Zn in samples from Rapid Creek ranged from 19.70 to 53.69 microgm/g. Oysters from the same area had Zn concentrations of 661.0 microgm/g indicating that telescopium is not a good accumulator of zinc compared to oysters. The concentration of Cu in the telescopium, 72.05 microgm/g, was double the concentration found in the oysters found in these creeks, 30 to 39 microgm/g. The concentration of Pb, Zn, Cu, Mn, Co, and Ni were generally below the recommended limit with the exception of Pb. (King-PTT)
W91-01164

NONPRIORITY ANALYSIS OF THE WASTEWATER STREAMS OF FOUR DYE MANUFACTURING FACILITIES.

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Food Science.
L. H. Alaimo, T. G. Hartman, R. T. Rosen, L. J. McGgeorge, and R. W. Meyer.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 5, p 665-669, July/August 1990. 2 tab, 33 ref.

Descriptors: *Analytical methods, *Dye industry wastes, *Industrial wastes, *Pollutant identification, *Priority pollutants, *Wastewater analysis, Chloroaniline, Chlorotoluene, Dichloroaniline, Dioctyl phthalate, Gas chromatography, Mass spectrometry, High performance liquid chromatography, Mass spectrometry, Methylbenzenesulfonamide, Organic compounds, Toxicity, Trinitrophenol, Triphenyl.

The wastestreams of four dye manufacturing facilities were analyzed for the presence of dyes, dye precursors and intermediates using a battery of mass spectrometric techniques. Wastewater samples were extracted and concentrated using liquid/liquid extraction and XAD-2 resin adsorption methodology. Priority pollution analysis was conducted using EPA Method 625. Extracts were also analyzed using direct on-column injection capillary gas chromatography/mass spectrometry and desorption ionization techniques including thermospray high performance liquid chromatography/mass spectrometry and fast atom bombardment mass spectrometry. Elemental formulas for unknown compounds present at levels above 100 ppb were derived from accurate mass measurements using high-resolution mass spectrometry. The combined analytical data identified 313 compounds in the various wastewater streams. Partial structural characterization was obtained for an additional 94 compounds. A total of 107 unknown compounds were also detected. Only nine priority pollutants were detected using standard EPA methodology. The identified compounds were searched for genotoxic potential using the Gene-Tox database and 32 of them were identified as having genotoxic properties. The most concentrated of these were: chlorotoluene, 149 ug/l; dioctyl phthalate, 104 ug/l; triphenyl, 99 ug/l; dichloroaniline, 77 ug/l; chloroaniline, 59 ug/l; methylbenzenesulfonamide, 51 ug/l; and trinitrophenol, 46 ug/l. (Author's abstract)
W91-01172

RECOVERY OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE FROM WATER SAMPLES ON XAD RESINS AND THE EFFECT OF CHLORINE ON ITS MUTAGENICITY.

Health Effects Research Lab., Research Triangle Park, NC. Genetic Toxicology Div.
K. M. Schenck, J. R. Meier, H. P. Ringhand, and F. C. Kopfler.
Environmental Science and Technology ESTHAG, Vol. 24, No. 6, p 863-867, June 1990. 4 fig, 2 tab, 18 ref.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Chlorine, *Drinking water, *Mutagens, *Pollutant identification, *Public health, *Water pollution effects, Adsorption, Bacterial physiology, Humic substances, Laboratory methods, Residual chlorine.

The potent bacterial mutagen 3 chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) has been found to significantly contribute to the mutagenic activity in chlorinated drinking water. Reliable assessment of the possible effects of MX on human health requires an accurate measurement of the MX levels present in drinking water samples. This study indicates that optimal recovery from aqueous solution is obtained by adsorption of MX at acidic pH on XAD-8 Amberlite resin. In addition, in the presence of chlorine, the concentration of MX decreases at a rate that increases with increasing chlorine concentration. The data suggest that the MX level present in tap water is dependent not only on the amount of MX produced by the chlorination of humic substances, but also on the rate of

MX degradation by residual chlorine. (D'Agostino-PTT)
W91-01181

ECOLOGICAL MONITORING: THE NEED FOR A STANDARD.
Wimpol Ltd., Swindon (England).
For primary bibliographic entry see Field 5G.
W91-01216

MULTI-ELEMENT ANALYSIS OF NATURAL WATER USING INDUCTIVELY COUPLED PLASMA-SOURCE MASS SPECTROMETRY (ICP-MS).
Surrey Univ., Guildford (England). Dept. of Chemistry.
N. I. Ward.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 197-204, 3 fig, 1 tab, 23 ref.

Descriptors: *Mass spectrometry, *Pollutant identification, *Trace elements, Aluminum, Atomic absorption spectrophotometry, Drinking water, Groundwater, Surface water, United Kingdom.

Inductively coupled plasma-source mass spectrometry (ICP-MS) offers exceptional ultra-trace multi-element sensitivity which is vital for measuring the concentrations which normally exist at microgram/milliliter or microgram/L in natural waters. ICP-MS provides simple spectra of isotopic elemental data covering a linear dynamic range of six orders of magnitude, with typical detection limits (3 sigma) for the majority of elements lying between 0.01 and 0.1 microgram/L. ICP-MS also offers the ability to measure isotope ratios enabling isotope dilution studies or the use of stable isotope tracers. Comparison is made with other established analytical methods (neutron activation analysis, atomic absorption spectrometry, ICP-OES, SS-MS, etc.) for the throughput/cost per determination analysis of natural waters. The preliminary assessment of the elemental composition of various British water samples collected from reservoirs (before filtration), after separation (filtration/treatment), and from consumer's tap-flow sites covering various rural and urban locations of thirteen water authority catchment areas revealed a wide variation in elemental content, especially Al as assessed by ICP-MS. (See also W91-01211) (Author's abstract)
W91-01219

NECESSITY OF BIOASSAYS IN WATER QUALITY MONITORING.
Institut fuer Wasserforschung G.m.b.H. Dortmund, Schwerte (Germany, F.R.).
C. Schmidt.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 245-254, 9 fig, 5 tab, 12 ref.

Descriptors: *Bioassay, *Monitoring, *Pollutant identification, *Toxicity, *Water pollution effects, Algae, Bioindicators, Fluorescence, Rhine River, Water quality.

A water quality management program requires continuous supervision of surface water and groundwater. The complexity of natural systems makes it difficult to determine the toxic potential of a substance in situ. Short-term changes of water quality cannot be detected by discontinuous sampling. Many chemicals cause biological reactions at very low concentrations and toxic substances almost always appear in a mixture. The biological effects of such a mixture cannot be determined by chemical analysis since water quality parameters like hardness, oxygen or pH influence the toxic effects. Consequently, it is the knowledge of toxic substances, water quality data, organisms and their reactions, which allows an estimate of toxicological potential. Depending on the specific problems, additional to the tests on the degradability of substances or tests on long-term effects, alarm-tests with a very short reaction time are required for water quality monitoring. These bioassays should use organisms from different trophic levels (i.e., bacteria, algae, zooplankton, higher plants and fishes). Bioassays for water quality monitoring purposes should be sensitive to a wide spectrum of substances and insensitive to matrix effects. They must show a respone within minutes, have a high degree of automation and no time-consuming servicing; they must additionally have low construction and working costs. An algae fluorescence bioassay was used to measure nitrite, nitrate, phosphate, and ammonia in the River Ruhr. An automated version of this algae fluorescence test is being used to monitor surface water quality along the Rhine River. (See also W91-01211) (Author's abstract)
W91-01225

PHOTOGRAPHIC SCREENING PROCEDURE FOR TRIAZINE HERBICIDES IN WATER USING AN ENHANCED LUMINESCENT IMMUNOASSAY.
Surrey Univ., Guildford (England). Dept. of Biochemistry.
A. Hardcastle, W. Aherne, and G. Thorpe.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 293-296, 1 fig, 2 tab, 3 ref.

Descriptors: *Herbicides, *Immunoassay, *Photography, *Triazines, *Water analysis, Atrazine, Laboratory methods, Pollutant identification, Quantitative analysis, Simazine.

The detection and quantitation of triazine herbicides in large numbers of water samples at the maximum allowable concentration of 100 nanograms/L poses a problem to the water analyst. The feasibility of using an enhanced luminescent immunoassay, with a photographic endpoint, for screening samples was assessed. Antisera to atrazine and simazine were raised in sheep and purified for the best immunological activity. Flexible round-bottomed microtiter plates were coated for at least 12 hr at 4 C with 200 microliters of purified antiserum diluted in barbitone buffer. Plates can be stored for several weeks before use. The concentration of coating antiserum and Horseradish Peroxidase (HRPO) label were optimized for the required assay incubation time. A Dynatec Microlite camera luminometer was used to record the light intensity produced in each well onto high-speed film (Polaroid 612). Visual estimates of atrazine concentration compared well with quantitative assay results. Large numbers of samples can be analyzed quickly using simple equipment. It is suggested that with further evaluation and validation, the procedure may represent an ideal method for screening samples for the presence of triazine. (See also W91-01211) (Geiger-PTT)
W91-01230

TOXICITY OF WATER EXTRACTS OF HAZARDOUS WASTE.
Wyzsza Szkola Inzynierska, Zielona Gora (Poland).
For primary bibliographic entry see Field 5C.
W91-01231

SHORE-BASED MICROBIOLOGICAL SAMPLING OF RECREATIONAL/BATHING WATERS: POSSIBLE PROBLEMS AND SOLUTIONS.
Clyde River Purification Board, East Kilbride (Scotland).
D. P. Milne.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 331-336, 3 fig, 2 tab, 10 ref.

Descriptors: *Bioindicators, *Coliforms, *Mathematical models, *Sampling, *Swimming, *Water analysis, *Water quality, *Water quality standards, Advection, Estuaries, Model studies, Tidal effects, Water quality control, Wind velocity.

Tidal state, wind velocity, and density structure can influence the near-shore levels of bacterial indicators by altering the distribution of discharged effluent. Field data from the Firth of Clyde, Scotland illustrate that the careful choosing of the sampling time can make a difference of up to two orders of magnitude in the fecal coliform level and, therefore, dictate whether recreational waters comply or not with the European Community Bathing Waters Directive. The Clyde River Purification Board and the University of Strathclyde's Department of Applied Physics have formed a research group to develop a mathematical microbiological model which may be applied to coastal waters. The model is based on the continuity equation which relates the advective and diffusive fluxes to fecal coliform input and inactivation. The model should prove to be an invaluable management tool in predicting whether an area is likely to comply, over a bathing season, and in planning the necessary developments required to make non-complying waters meet the Directive's standards. (See also W91-01211) (Geiger-PTT)
W91-01234

BIOFILMS: DETECTION, IMPLICATIONS AND SOLUTIONS.
Centre for Applied Microbiology Research, Salisbury (England).
For primary bibliographic entry see Field 5F.
W91-01239

BETA-GLUCURONIDASE AS A RAPID COLORIMETRIC ASSAY FOR E. COLI IN WATER AND SEWAGE SAMPLES.
Surrey Univ., Guildford (England). Dept. of Microbiology.
M. R. Adams, and S. M. Grubb.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 391-395, 4 fig, 3 ref.

Descriptors: *Analytical techniques, *Bacterial analysis, *Colorimetry, *Enzymes, *Escherichia coli, *Pollutant identification, *Water analysis, Bioassay, Coliforms, Fluorometry, Quantitative analysis, Shigella.

Production of the enzyme beta-glucuronidase by bacteria is largely confined to Escherichia coli and, to a lesser extent, its close relatives in the genus Shigella. Approximately 95% of E. coli strains demonstrate this activity and its has been employed as a diagnostic feature in the identification and enumeration of the organism. In these tests, enzyme activity is invariably scored as present or absent based upon the production of color or fluorescence from an appropriate synthetic substrate. An alternative approach uses a quantitative assessment of color development as a means of directly enumerating the organism. Lake water and raw sewage were used to compare the present test with two reference methods in a competitive situation involving an unknown mixture of environmental organisms including E. coli. The lake water sample was concentrated to achieve detection in one day (detection time 6.55 hr). Both neat and diluted sewage were used. The undiluted sewage sample appeared to produce an inherent background color that interfered with the assessment of the detection time. The diluted sample was found more suitable for use with this method (detection time 6.4 hr). This method of quantitative assessment of the activity of the enzyme beta-glucuronidase as a means of directly enumerating E. coli showed promise as a rapid technique suitable for automation. (See also W91-01211) (Geiger-PTT)
W91-01242

ROTAVIRUS AS A VIRAL INDICATOR IN SHELLFISH.
Surrey Univ., Guildford (England). Dept. of Microbiology.
M. R. Adams, and D. A. Lloyd.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-

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20 April, 1989. Pergamon Press, New York. 1989. p 397-404, 13 ref.

Descriptors: *Analytical techniques, *Bioindicators, *Pollutant identification, *Rotaviruses, *Shellfish, *Viruses, Antibiotics, Bacteria, Enzymes, Heavy metals, Humic acids, Immunoassay, Separation techniques, Toxicity.

An immunoperoxidase procedure has enabled rotavirus to be assayed in under 24 hr in samples of shellfish. Primary antibody tagging uses hyperimmune bovine anti-rotavirus serum while secondary antibody tagging uses rabbit anti-bovine serum conjugated with horseradish peroxidase. An elution-precipitation procedure or an alternative extraction procedure was used to concentrate the sample. Toxic components which interfere with virus uptake and cell metabolism such as heavy metals, humic acids and unspecified high molecular weight compounds must be removed by sewage flocculants, diphenylthiocarbazone (chelating agent), or Sephadex beads. In addition, dilution of the final extracts reduces toxicity to animal cells, and reduction in time of exposure reduces cytotoxic effects while allowing viral adsorption to take place. To assay viruses in animal cells grown in a nutrient-rich environment, bacteria must be removed by antibiotics, solvent extraction, or filter sterilization. Using the present methods, rotaviruses may prove to be a successful indicator organism for the presence of less culturable viruses in polluted waters. (See also W91-01211) (Geiger-PTT)
W91-01243

COMPARISON OF MEASURED INSTREAM BIOLOGICAL RESPONSES WITH RESPONSES PREDICTED USING THE CERIODAPHNIA DUBIA CHRONIC TOXICITY TEST.
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5C.
W91-01261

EFFECT OF SEDIMENT SPATIAL VARIANCE AND COLLECTION METHOD ON CLADOCERAN TOXICITY AND INDIGENOUS MICROBIAL ACTIVITY DETERMINATIONS.
Wright State Univ., Dayton, OH. Dept. of Biological Sciences.
B. L. Stemmer, G. A. Burton, and G. Sasson-Brickson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 1035-1044, August 1990. 4 fig, 2 tab, 36 ref.

Descriptors: *Creosote, *Daphnia, *Path of pollutants, *Pollutant identification, *Quality control, *River sediments, *Sampling, *Sediment contamination, *Toxicity, *Toxicology, Analysis of variance, Bioassay, Enzymes, Mortality, Particle size, Sediment sampler, Spatial variation, Survival, Waterfleas.

Quantitative assessments of sediment quality frequently are based on data derived from sediments collected by grab sampling. Often only one sediment or one composited sediment is collected at a sample site, thereby preventing any determination of spatial variance. The significance of spatial variance and collection method on cladoceran toxicity and indigenous microbial activities was determined at a creosote contaminated site in the Little Scioto River in Marion County, Ohio. Replicate sediments were collected on two occasions from a horizontal sample grid (110 sq m and 1.4 sq m) using an Ekman Dredge and hand core. Sediment particle size fractions did not vary significantly between replicate grab samples. Survival of Daphnia magna and Ceriodaphnia dubia in 48 hour solid phase exposures varied, however, from 1 to 100% horizontally and vertically at the test site. Percent survival and beta-glucosidase activity decreased in sediment sections below a 4 to 5 cm depth. Dredged sediments produced less toxicity to the daphnids than did core collected samples. The coefficient of variance was high (> 40%) for both survival and hydrolase activities (alkaline phosphatase, beta-galactosidase and beta-glucosidase) between horizontal sediment replicates collected by either dredge or core. Subsample variance, however, was small (< 20%). These results highlight the important role that sediment heterogeneity and collection method have on sediment quality assessments. (Author's abstract)
W91-01262

YOLK RETINOIDS (VITAMIN A) IN EGGS OF THE HERRING GULL AND CORRELATIONS WITH POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS.
Ottawa Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-01264

TOXICITY OF FLUORANTHENE IN SEDIMENT TO MARINE AMPHIPODS: A TEST OF THE EQUILIBRIUM PARTITIONING APPROACH TO SEDIMENT QUALITY CRITERIA.
Environmental Research Lab.-Narragansett, Newport, OR. Mark O. Hatfield Marine Science Center.
For primary bibliographic entry see Field 5C.
W91-01265

SIMULTANEOUS DUAL COLUMN, DUAL-DETECTOR GAS CHROMATOGRAPHIC DETERMINATION OF CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS IN ENVIRONMENTAL SAMPLES.
Battelle Ocean Sciences, Duxbury, MA.
G. S. Durell, and T. C. Sauer.
Analytical Chemistry ANCHAM, Vol. 62, No. 17, p 1867-1871, September 1990. 2 fig, 4 tab, 15 ref.

Descriptors: *Chemical analysis, *Chlorinated hydrocarbons, *Gas chromatography, *Measuring instruments, *Pesticides, *Pollutant identification, *Polychlorinated biphenyls, *Water analysis, Data acquisition, Performance evaluation.

The lack of confirmation of identified analytes in environmental gas chromatography (GC) that uses the traditional one-column, one detector systems (e.g., GC-electron capture detection with a nonpolar column) often raises questions as to the validity of the data. To avoid misidentification of chlorinated pesticides and polychlorinated biphenyls (PCB), simultaneous dual-column, dual-detector GC analysis was conducted. Within one GC instrument, injected sample extracts were split in two and each portion passed through a capillary column of different polarity. A traditional nonpolar column, DB-5, was connected to an electron capture detector for initial identification of analytes; a more polar column DB-17, was used with the halogen specific electrolytic conductivity detector for confirmation analysis. GC column retention characteristics were determined for a large set of environmentally important pesticides and PCB congeners for the DB-5 and DB-17 analytical columns. The dual-column, dual-detector system was then evaluated on a large number of environmental samples of different matrix types. Results indicated that a substantial number of analytes, especially pesticides, may be incorrectly identified in environmental samples with one-column, one-detector systems. Use of a simultaneous dual-column, dual-detector system, substantially decreases the risk of false positive identifications without significantly increasing the cost at time of analysis. (Author's abstract)
W91-01281

EFFECTS OF SALINITY, TEMPERATURE, AND CADMIUM ON CADMIUM-BINDING PROTEIN IN THE GRASS SHRIMP, PALAEMONETES PUGIO.
Texas Univ. Health Science Center at Houston. School of Public Health.
For primary bibliographic entry see Field 5B.
W91-01309

LONG-TERM TOXICITY TEST COMPRISING REPRODUCTION AND GROWTH OF ZEBRAFISH WITH 4-CHLOROANILINE.
Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W91-01318

INCORPORATION OF A SUBACUTE TEST WITH ZEBRA FISH INTO A HIERARCHICAL SYSTEM FOR EVALUATING THE EFFECT OF TOXICANTS IN THE AQUATIC ENVIRONMENT.
Swedish Environmental Research Inst., Stockholm.
For primary bibliographic entry see Field 5C.
W91-01327

ADVANCES IN ESTIMATING BACTERIAL BIOMASS AND GROWTH IN AQUATIC SYSTEMS.
Vandkvalitetsinstitutet, Hoersholm (Denmark).
B. Riemann, and R. T. Bell.
Archiv fuer Hydrobiologie AHYBA4, Vol. 118, No. 4, p 385-402, June 1990. 6 fig, 70 ref. Danish EPA (NPO 4.6), Danish Nat. Sci. Res. Council (J.No. 11-5573) and the Swedish Nat. Sci. Res. Council (B-Bu 9170-300).

Descriptors: *Aquatic bacteria, *Bacterial analysis, *Bacterial growth, *Biomass, *Limnology, *Water analysis, Calibrations, Estimating, Growth rates, Nucleic acids, Testing procedures.

A review of the methods designed to measure growth rates of natural bacterial assemblages is presented. In addition, problems in sizing bacteria and determining bacterial carbon biomass are considered. A large number of techniques are now available to determine growth rates of natural bacterial assemblages. 3H-thymidine incorporation and 3H-adenine incorporation into DNA and 3H-leucine incorporation into protein are currently in use in many laboratories. When properly calibrated these methods can give reasonable estimates of bacterial growth rates. The leucine and thymidine methods together will give the best assessment of bacterial growth rates and information on their physiological status. Adenine incorporation requires size fractionation of environmental samples if used to measure only bacterial growth. When adenine is used together with thymidine, an index of both algal and bacterial DNA synthesis can be obtained. The use of the frequency of dividing cells (FDC) procedure often overestimates bacterial carbon production compared to results obtained from other techniques. It was found that many of the methods are complementary when compared over proper time scales, but continued calibrations and validations of the methods are still needed when environmental samples are examined for growth of bacteria. (Author's abstract)
W91-01334

MOST DILUTE LAKE IN THE WORLD.
E and S Environmental Chemistry, Inc., Corvallis, OR.
For primary bibliographic entry see Field 2H.
W91-01348

ACCUMULATION OF SCANDIUM IN THE SHOOTS OF AQUATIC BRYOPHYTES IN ACID WATER.
National Inst. for Environmental Studies, Ibaraki (Japan).
For primary bibliographic entry see Field 2H.
W91-01355

PHARMACOKINETIC MODELING IN AQUATIC ANIMALS. I. MODELS AND CONCEPTS.
Dow Chemical Co., Midland, MI. Environmental Toxicology and Chemistry Research Lab.
M. G. Barron, G. R. Stehly, and W. L. Hayton.
Aquatic Toxicology AQTODG, Vol. 17, No. 3, p 187-211, September 1990. 3 fig, 2 tab, 70 ref.

Descriptors: *Bioindicators, *Data interpretation, *Literature review, *Model studies, *Pharmaco-

kinetics, *Toxicology, *Water pollution effects, Mathematical models, Mathematical studies.

While clinical and toxicological applications of pharmacokinetics have continued to evolve both conceptually and experimentally, pharmacokinetic modeling in aquatic animals has not progressed accordingly. Several methods and concepts are presented this literature review of pharmacokinetic modeling in aquatic animals using multicompartmental, clearance-based, non-compartmental and physiologically-based pharmacokinetic models. These models should be considered as alternatives to traditional approaches, which assume that the animal acts as a single homogeneous compartment based on apparent monoexponential elimination. Multicompartmental models are a necessary increase in complexity when elimination is biphasic, or when there is a widely different distribution between high perfusion and low perfusion tissues. Alternatives to traditional rate constant based models are clearance-based compartmental models, which have parameters that may be interpreted in terms of the controlling physiological and biochemical processes. Non-compartmental methods characterize uptake, distribution, elimination, and persistence without making assumptions about the underlying model topology. The development of physiologically based models is highly desirable because they allow extrapolation to other species, body sizes and environmental conditions. (Author's abstract)
W91-01361

FISH HEALTH AND ENVIRONMENTAL HEALTH.
National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.
For primary bibliographic entry see Field 5C.
W91-01376

AUTOTROPHIC AND HETEROTROPHIC ATP POOLS IN MICROBIAL COMMUNITIES: SUGGESTIONS FOR SEPARATION AND FOR BACTERIAL GROWTH RATE EVALUATION.
Parma Univ. (Italy). Ist. di Ecologia.
R. Antonietti.
Ergebnisse der Limnologie ERLIA6, Vol. 34, p 75-80, 1990. 6 fig, 11 ref.

Descriptors: *Adenosine triphosphate, *Aquatic bacteria, *Bacterial physiology, *Microbiological studies, *Separation techniques, *Toxicity, *Water pollution effects, *Water quality monitoring, Algae, Analytical methods, Bacterial analysis, Bioassay, Biomass, Inhibitors, Mathematical models.

The measurement of adenosine triphosphate (ATP) was utilized as a speedy, sensitive, precise and accurate indicator of bacterial biomass changes. Some substances (sodium and potassium hydroxides, potassium cyanide, hydrogen peroxide and sodium azide) were found to decrease bacterial ATP pools within a few seconds. The effects were not observed for Chlorococcus sp., Selenastrum sp. and Scenedesmus sp. If this behavior is confirmed in all algae, then it will be possible to define the bacterial/algal ATP ratio. The bacterial growth rate could then be evaluated using ATP as a biomass index in a simple mathematical model. It is probable that the physiological response to toxic substances depends not so much on the trophic level of microorganisms as on multiple factors such as the biochemical and physiological structure of the microbial community and the complexity of cell/detritus aggregates. Further study of the effects of toxic substances on a wider spectrum of microorganisms, especially Cyanobacteria, is recommended. (MacKeen-PTT)
W91-01595

ECOLOGICAL ASPECTS OF ENZYME REGULATION IN AQUATIC BACTERIA.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
For primary bibliographic entry see Field 2H.
W91-01596

ANALYSIS OF 228RA AND 226RA IN PUBLIC WATER SUPPLIES BY A GAMMA-RAY SPECTROMETER.
Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
B. Kahn, R. Rosson, and J. Cantrell.
Health Physics HLTPAO, Vol. 59, No. 1, p 125-131, July 1990. 2 fig, 5 tab, 20 ref. EPA Grant CR-813-630-01.

Descriptors: *Data interpretation, *Pollutant identification, *Radon radioisotopes, *Spectrometry, *Water analysis, *Water supply, Detection limits, Public waters, Radioactivity, Water quality standards.

Methods for measuring 228Ra were reviewed to select a brief and simple screening procedure under the National Interim Primary Drinking Water Regulations for public water supplies. A two-step method was considered to concentrate Ra by evaporation or co-precipitation and to count it with a gas ionization detector, a liquid-scintillation detector, or a Ge detector with multichannel analyzer. Gross beta particle counting appears to be feasible for screening to meet the 0.04 Bq/L detection limit. The same sample volume can be utilized to measure radiation with commonly available equipment in reasonable time. The required sample volumes were estimated on the basis of known counting efficiencies and background count rates. Gamma-ray spectral analysis is the recommended option, however, because 226Ra and 228Ra can be determined directly and simultaneously. Several aspects of the method were examined to assure that the concentration procedure is nearly quantitative and that the detection limit can be reached with a 3.8 L sample in a 6000 s counting period. The method was tested with Ra tracer solutions and EPA intercomparison samples over the range of 0.04 to 1 Bq/L. It was found appropriate for 228Ra and 226Ra analyses. (Author's abstract)
W91-01667

INDUCTION OF ALKOXYRESORUFIN METABOLISM: A POTENTIAL INDICATOR OF ENVIRONMENTAL CONTAMINATION.
Barcelona Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W91-01685

CHARACTERIZATION OF GENOTOXIC COMPONENTS IN SEDIMENTS BY MASS SPECTROMETRIC TECHNIQUES COMBINED WITH SALMONELLA/MICROSOME TEST.
Barcelona Univ. (Spain). Dept. of Microbiology.
M. Grifoll, A. M. Solanas, and J. M. Bayona.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 2, p 175-184, March/April 1990. 4 fig, 3 tab, 31 ref.

Descriptors: *Bioassay, *Genotoxicity, *Mass spectrometry, *Pollutant identification, *Polycyclic aromatic hydrocarbons, *Sediment contamination, *Toxicology, Anhydrides, Aromatic compounds, Azaarenes, Barcelona, Biological studies, Chemical analysis, Gas chromatography, Ketones, River sediments, Salmonella/microsome test, Spain.

The application of Salmonella/microsomal mammalian tests to column chromatography fractions isolated from river and marine sediments collected in the vicinity of Barcelona city, Spain, demonstrated a positive response (TA98+S9 mix) among the polar fractions. Chemical analysis by high resolution gas chromatography coupled to negative ion chemical ionization mass spectrometry (HRGC-NICI MS) provided sensitivity and selectivity to detect several mutagenic chemical classes. Among them, nitrated PAHs, azaarenes, aromatic amines, anhydrides, and ketones were identified. A total of 116 compounds were tentatively identified, 22 for the first time, of which 16 possessed mutagenic activity. However, a lack of correlation between chemical composition and fraction mutagenicity in the medium polarity fractions, especially in the river sediment, was evidenced. The occurrence of multiple interactions between components in spiked organic extracts is demonstrated. (Author's abstract)
W91-01686

USE OF THE MUSSEL WATCH AND MOLECULAR MARKER CONCEPTS IN STUDIES OF HYDROCARBONS IN A TROPICAL BAY (TODOS OS SANTOS, BAHIA, BRAZIL).
Centro de Investigacion y Desarrollo, Barcelona (Spain). Dept. of Environmental Chemistry.
C. Porte, D. Barcelo, T. M. Tavares, V. C. Rocha, and J. Albaiges.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 2, p 263-274, March/April 1990. 7 fig, 3 tab, 51 ref.

Descriptors: *Bioaccumulation, *Bioindicators, *Brazil, *Hydrocarbons, *Mussels, *Path of pollutants, *Pollutant identification, *Todos os Santos Bay, *Tropical regions, *Water quality, Alkylbenzene, Bays, Monitoring.

Data on aliphatic and aromatic hydrocarbons in different species of edible bivalves collected from the Todos os Santos Bay (Bahia, Brazil) are reported on for the first time along the Southwest Atlantic coast. The species and collection sites were selected for the identification of suitable regional sentinels and for the assessment of different coastal pollutant sources. To this end, the molecular marker concept was applied. A new series of biogenic 20C, 25C, and 30C highly branched isoprenoid alkenes were present in clean samples. Long-chain alkylbenzenes and specific distributions of isoprenoids, steranes, and hopanes reflected local industrial activities. Petrogenic alkanes and aromatic hydrocarbons, ranged between 0.1-42 micrograms/L wet wt and 0.1-9.1 micrograms eq chrysene/g wet wt, respectively, the higher levels being found in the neighborhood of an oil refinery and a plant oil industrial plant. Anomalocardia brasiliana, the dominant and most frequent bivalve of the Brazilian coast, was found to be an adequate bioindicator because it accumulates organic pollutants with reasonable sensitivity. (Author's abstract)
W91-01690

GC-MS IDENTIFICATION OF GASEOUS VOLATILES IN WASTEWATER.
National Univ. of Singapore. Dept. of Civil Engineering.
L. C. C. Koe, and N. C. Tan.
Environmental Monitoring and Assessment EMASDH, Vol. 15, No. 1, p 13-24, July 1990. 4 fig, 5 tab, 8 ref.

Descriptors: *Chemical analysis, *Gas chromatography, *Mass spectrometry, *Pollutant identification, *Volatile organic compounds, *Wastewater, *Water analysis, Aeration, Air stripping, Chlorinated hydrocarbons, Hydrocarbons, Organic acids, Phenols, Sulfides.

Gaseous volatiles from wastewater samples taken from a local sewage treatment plant were air stripped and trapped onto Tenax GC. These volatiles were then thermally desorbed and subsequently analyzed using gas chromatograph coupled to a mass spectrometer (GC-MS). The results show that saturated aliphatic and aromatic hydrocarbons were the most dominant compounds found in the sewage gaseous volatiles. Other compounds found were chlorinated hydrocarbons, organic acids, sulfides and phenols. A wide variety of gaseous volatiles were found in the raw wastewater, the primary clarifier effluent, the pre-aeration wastewater and the sludge samples. A comparison of the gas chromatograms for the pre and post-aeration wastewater shows that many odorous gaseous volatiles were removed during the aeration process in the treatment plant. (Author's abstract)
W91-01696

RELATIONSHIP BETWEEN WATER QUALITY AND CADDISFLY ASSEMBLAGE STRUCTURE IN FAST-RUNNING RIVERS. THE RIVER CADAGUA BASIN.
Universidad del Pais Vasco, Bilbao (Spain). Lab. de Ecologia.
A. Basaguren, and E. Orive.
Environmental Monitoring and Assessment

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EMASDH, Vol. 15, No. 1, p 35-48, July 1990. 4 fig, 5 tab, 31 ref.

Descriptors: *Bioindicators, *Cadagua River, *Caddisflies, *Ecosystems, *Spain, *Species diversity, *Water pollution effects, *Water quality, Headwaters, Oxygen, Species composition.

Water quality effects were studied in of the River Cadagua basin in Spain, using trichopteran taxa as indicators. Differences between headwater reaches and lower parts of the main river and its principal tributaries are chiefly based on the downstream substitution of the species of the genus Rhyacophila by species of the genus Hydropsyche. The first station of the Cadagua River is separated from other headwater sites by the presence of a trichopteran assemblage composed of Rhyacophila tristis, Lype reducta and Tinodes assimilis. Sympatric species of the genera Rhyacophila and Hydropsyche coexist at several places, although appear alone at other sites, and show differential preferences for the highest or the lowest sites. Thus, Hydropsyche pellucidula coexisted with Hydropsyche siltalai in the middle section of the rivers, but the former was distributed further downstream than the latter which occupied higher reaches. Among sites, differences in trichopteran assemblage structure are a result of both natural and anthropogenic changes in the physicochemical features of the watercourse. Therefore, trichopteran diversity and coexistence of sympatric species increase downstream with increasing nutrient values (whether the oxygen content of the water is near the saturation level). However, Trichoptera disappear from sites with low oxygen content. Conductivity values do not seem to affect the trichopteran distribution in natural waters, as values higher than 700 microS/cm were found at the head water of the main river which contained an assemblage characteristic of these sites. (Author's abstract)
W91-01697

TRIAZINE HERBICIDE FATE IN A NO-TILLAGE CORN (ZEA MAYS L.)-CROWNVETCH (CORONILLA VARIA L.) 'LIVING MULCH' SYSTEM.
Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W91-01709

EXCHANGEABLE IMMOBILIZED ENZYME REACTOR FOR ENZYME INHIBITION TESTS IN FLOW-INJECTION ANALYSIS USING A MAGNETIC DEVICE. DETERMINATION OF PESTICIDES IN DRINKING WATER.
Gesellschaft fuer Biotechnologische Forschung m.b.H., Brunswick (Germany, F.R.). Dept. of Enzyme Technology.
R. Kindervater, W. Kunnecke, and R. D. Schmid.
Analytica Chimica Acta ACACAM, Vol. 234, No. 1, p 113-117, July 1990. 5 fig, 17 ref.

Descriptors: *Analytical methods, *Drinking water, *Enzymes, *Flow-injection analysis, *Pesticides, *Pollutant identification, *Water analysis, Acetylcholinesterase, Carbofuran, Enzyme inhibition testing, Malaoxon, Water quality management.

A flow-injection system for rapid automated enzyme inhibition testing was developed using magnetic particles as the enzyme support. Exchange of inactivated enzyme immobilized on magnetic particles was performed with magnetic devices which could be electrically switched off to release all bound material. The flow resistance of the reactor was excellent. Inhibition of immobilized acetylcholinesterase (ACHE) was used to determine pesticides in drinking water. Concentrations of 0.5 microgram/L of the pesticides carbofuran and malaoxon were detected. A complete cycle of analysis, including calibration, took 20 min. The sensitivity of this assay is excellent and covers the demands for European drinking water analysis, although the detection limit has not yet been optimized. However, as the contamination of drinking water is expressed as the amount of pesticide and not as the toxicity against ACHE, the proposed method is a good alternative to non-biological standard methods such as gas chromatography and liquid chromatography. (Agostine-PTT)
W91-01710

ON-LINE CONTINUOUS-FLOW EXTRACTION SYSTEM IN LIQUID CHROMATOGRAPHY WITH ULTRAVIOLET AND MASS SPECTROMETRIC DETECTION FOR THE DETERMINATION OF SELECTED ORGANIC POLLUTANTS.
Universidad Politecnica de Cataluna, Barcelona (Spain). Dept. of Chemical Engineering.
A. Farran, J. L. Cortina, J. De Pablo, and D. Barcelo.
Analytica Chimica Acta ACACAM, Vol. 234, No. 1, p 119-126, July 1990. 6 fig, 1 tab, 23 ref.

Descriptors: *Analytical methods, *Chemical analysis, *Liquid chromatography, *Mass spectrometry, *Organic pollutants, *Pesticides, *Pollutant identification, *Spectrometry, *Water analysis, Organophosphorus compounds, Surface water.

An on-line extraction system with completely continuous-flow analysis prior to the liquid chromatographic (LC) column was used for the determination of the organophosphorus pesticides tetrachlorvinphos and parathion-methyl and their degradation products 2,4,5-trichlorophenol and 4-nitrophenol, respectively, and the chlorinated phenoxy acids 2,4-D, 2,4,5-T and silvex in water samples. The extent of extraction varied from 100% for chlorinated phenoxy acids to 60% for organophosphorus pesticides and 2,4,5-trichlorophenol. The extraction of 4-nitrophenol was less than 10% under these conditions. By employing positive-ion mode thermospray LC-mass spectrometry, the characterization of tetrachlorvinphos was feasible, indicating (M + NH4)(+) as the base peak and a second peak with 20% relative intensity corresponding to (M + H)(+). When the negative-ion mode was used, the chlorinated phenoxy acids and 2,4,5-trichlorophenol exhibited (M + HCOO)(-) as the base peak and a second peak with 30% relative intensity corresponding to (M-H)(-). Enrichment factors of almost one order of magnitude have been achieved for model compounds in water samples. These enrichment factors using liquid-liquid extraction are lower than those obtained with on-line precolumn systems using solid adsorbents, but there are less memory effects. This system allows the ultraviolet detection and mass spectometer characterization of low-nanogram levels of pesticide residues in river water samples. (Author's abstract)
W91-01711

DETECTION OF ORGANIC TOXIC POLLUTANTS IN WATER AND WASTE-WATER BY LIQUID CHROMATOGRAPHY AND IN VITRO CYTOTOXICITY TESTS.
Instituto Nacional de Investigaciones Agrarias, Madrid (Spain). Centro de Investigacion y Tecnologia.
J. V. Tarazona, A. Castano, and B. Gallego.
Analytica Chimica Acta ACACAM, Vol. 234, No. 1, p 193-197, July 1990. 6 fig, 12 ref.

Descriptors: *Bioassay, *Cytology, *Liquid chromatography, *Organic pollutants, *Pollutant identification, *Surface water, *Toxicology, *Wastewater, Analytical methods, Effluents, Fish, Industrial wastes, Trout.

A group of toxicity tests on RTG-2 cell line (a fibroblastic line derived from rainbow trout) was standardized in order to enhance reproducibility and sensitivity. Liquid chromatographic (LC) separation of organic chemicals from industrial effluents and polluted waters and in vitro toxicity tests on RTG-2 as a biological detector of toxicity in the eluted peaks were conducted. Effluents and polluted waters were concentrated, if required, using Sep-Pak C-18 cartridges, and analyzed by reversed-phase LC using a 30-cm C-18 column with an acetonitrile gradient from 10 to 100% in water in 60 min at a flow-rate of 1 mL/min and UV detection at 254 and 280 nm. The cytotoxicity test was adapted to use 20-microliter fractions of acetonitrile-water mixtures, allowing toxicity detection every 12 s with eight replicates per sample (or every 5 s with four replicates). The LC-cytotoxicity test combination allowed the detection in the effluents of those compounds for which short-term aquatic toxicity could be expected. Cytotoxicity to fish cell lines was found to be fairly well correlated with in vivo toxicity tests on fish, showing the capability of this method. The correlation between in vivo and in vitro methods has also been demonstreaed in mammalian cells, and therefore this method is usefull not only in aquatic toxicology but also, by choosing a representative cell line, in environmental, clinical or forensic toxicology. (Author's abstract)
W91-01712

AUTOMATED METHOD FOR THE DETERMINATION OF BORON IN WATER BY FLOW-INJECTION ANALYSIS WITH IN-LINE PRECONCENTRATION AND SPECTROPHOTOMETRIC DETECTION.
National Water Research Inst., Burlington (Ontario). Research and Applications Branch.
I. Sekerka, and J. F. Lechner.
Analytica Chimica Acta ACACAM, Vol. 234, No. 1, p 199-206, July 1990. 6 fig, 5 tab, 33 ref.

Descriptors: *Analytical methods, *Boron, *Chemical analysis, *Pollutant identification, *Spectrophotometry, *Water analysis, Emission spectrometry, Ion exchange, Monitoring, Natural waters.

A sensitive, automated method for the determination of boron in water samples is described, involving flow injection with on-line ion-exchange preconcentration and spectrophotometric detection of the azomethine-H-boron complex. The method is applicable to various water samples and is free from interferences, even in colored samples. Detection limits of 5 microgram/L at 20 samples/h and 1 microgram/L at 10 samples/h with relative standard deviations of < 10% at 1-10 microgram/L and < 5% at 10-200 microgram/L levels of boron were achieved. The recoveries for spiked natural water samples ranged from 96 to 101%. The method compares favorably with inductively coupled plasma atomic emission spectrometry. (Author's abstract)
W91-01713

LIQUID CHROMATOGRAPHIC METHOD WITH FLUORESCENCE DETECTION FOR THE DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN ENVIRONMENTAL SAMPLES.
Laboratorio Municipal de Barcelona (Spain). Seccion Quimica y Bromatologia.
M. D. Nunez, and F. Centrich.
Analytica Chimica Acta ACACAM, Vol. 234, No. 1, p 269-273, July 1990. 6 fig, 3 tab, 11 ref.

Descriptors: *Chemical analysis, *Fluorescence, *Hydrocarbons, *Liquid chromatography, *Pollutant identification, *Polycyclic aromatic hydrocarbons, *Water analysis, Analytical methods, Extraction techniques.

A method using liquid chromatography (LC) with fluorimetric detection for the determination of polynuclear aromatic hydrocarbons (PAHs) in water samples and air filters is presented. The study focused on fluoranthene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene and benzo(ghi)perylene. The behavior of these compounds was studied using two columns with the same stationary phase(C-18), but different supports, Hypersil-ODS and Spherisorb ODS-2. Better resolution was obtained with Spherisorb ODS-2. Samples were extracted with light petroleum-diethyl ether (85 + 15) and the extracts were concentrated before analysis. Reversed-phase liquid chromatography with fluorescence detection was applied to separate and determine the PAHs. Recoveries of individual PAHs from spiked water samples were 0.16-0.27 ng/mL. Detection limits in the picogram range were obtained for each compound based on recoveries of 79-96% from the water matrix. (Agostine-PTT)
W91-01714

EXAMINATION OF THE RANGE OF COPPER COMPLEXING LIGANDS IN NATURAL WATERS USING A COMBINATION OF CATHODIC STRIPPING VOLTAMMETRY AND COMPUTER SIMULATION.
Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 5B.
W91-01715

SPECIATION OF MERCURY COMPOUNDS IN WASTE WATER BY MICROCOLUMN LIQUID CHROMATOGRAPHY USING A PRECONCENTRATION COLUMN WITH COLD-VAPOR ATOMIC ABSORPTION SPECTROMETRIC DETECTION.
Nagoya Univ. (Japan). Dept. of Applied Chemistry.
E. Munaf, H. Haraguchi, D. Ishii, T. Takeuchi, and M. Goto.
Analytica Chimica Acta ACACAM, Vol. 235, No. 2, p 399-404, August 15, 1990. 6 fig, 1 tab, 26 ref.

Descriptors: *Atomic absorption spectrophotometry, *Chemical analysis, *Heavy metals, *Liquid chromatography, *Mercury, *Pollutant identification, *Speciation, *Wastewater analysis, Analytical methods, Mercury compounds, Wastewater.

A microcolumn liquid chromatographic method with cold-vapor atomic absorption spectrometric detection was developed for the speciation of mercury compounds in wastewater. The sample solution containing mercury at the 4-ng level was injected into a preconcentration column (27 mm x 0.51 mm i.d.) packed with Develosil-ODS (30 micrometer) and eluted with cysteine-acetic acid through a separation column (125 mm x 0.5 mm i.d.) packed with STR-ods-H 95 micrometer). After oxidation, tin (II) chloride in sodium hydroxide solution was used to reduce mercury compounds to mercury. The generated mercury vapor was swept from a gas-liquid separator by argon into the detector cell and monitored at 253.7 nm. Mercury (II) chloride, methylmercury chloride and ethylmercury chloride, were well resolved and the determination was completed in less than 16 min. The method was successfully applied to the speciation of mercury compounds in wastewater. (Author's abstract)
W91-01716

FATE OF CATIONIC SURFACTANTS IN THE MARINE ENVIRONMENT: I. BIOCONCENTRATION OF LONG-CHAIN ALKYLNITRILES AND TRIALKYLAMINES.
Centro de Investigacion y Desarrollo, Barcelona (Spain). Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 5B.
W91-01723

ANALYSIS OF TARGET AND NONTARGET POLLUTANTS IN AQUEOUS LEACHATES FROM THE HAZARDOUS WASTE SITE IN STRINGFELLOW, CALIFORNIA, VIA ION CHROMATOGRAPHY-PARTICLE BEAM AND INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY.
California Dept. of Health Services, Berkeley. Hazardous Materials Lab. Section.
M. A. Brown, I. S. Kim, R. Roehl, F. I. Sasinos, and R. D. Stephens.
Chemosphere CMSHAF, Vol. 19, No. 12, p 1921-1927, 1989. 2 fig, 16 ref.

Descriptors: *Analytical methods, *California, Chemical analysis, *Hazardous wastes, *Leachates, *Mass spectrometry, *Pollutant identification, *Water analysis, Chlorine, Halogens, Ion exchange chromatography, Organic pollutants, Phosphorus, Sulfur.

Liquid chromatography particle beam mass spectrometry (PB/MS) is a powerful tool for the analysis of target pollutants but complementary methods are required for nontarget compounds. Preliminary data are presented on an anion exchange chromatography PB/MS based method for the detection of the target compound 4-chlorobenzene sulfonic acid (a contaminant found in hazardous waste leachates) and also for nontarget pollutants in aqueous leachate samples from the Stringfellow hazardous waste site in California. Anion exchange chromatography coupled to inductively coupled plasma mass spectrometry yields qualitative and quantitative elemental analysis showing the presence or absence of key heteroatoms in organic pollutants including chlorine, other halogens, phosphorus and sulfur. (Author's abstract)
W91-01728

POLYNUCLEAR AROMATIC HYDROCARBON (PAH) CONTENT OF ARCHIVED SEWAGE SLUDGES.
Lancaster Univ. (England). Inst. of Environmental and Biological Sciences.
S. R. Wild, S. P. McGrath, and K. C. Jones.
Chemosphere CMSHAF, Vol. 20, No. 6, p 703-716, 1990. 3 fig, 5 tab, 29 ref.

Descriptors: *Path of pollutants, *Polycyclic aromatic hydrocarbons, *Sludge analysis, *Sludge utilization, *Waste disposal, *Wastewater, Agriculture, Hydrocarbons, Land disposal, Sludge.

Twenty-nine anaerobically digested, lagoon dried sewage sludges were analyzed for polynuclear aromatic hydrocarbons (PAHs). These sludges had been applied to the plots of a long term agricultural experiment from 1942 to 1961. The exact dates of sludge production and treatment are unknown, although they are likely to be 1-5 years prior to sludge application dates. The sludges had a mean Sum-PAH (defined ad the sum of the compounds measured) concentration of 50 mg/kg, with a range of 18-125 mg/kg. The most abundant compound was benzo(ghi)perylene with a mean concentration of 10 mg/kg. A trend is apparent in the Sum-PAH content through time, increasing until 1948 to over 125 mg/kg, then decreasing to 29 mg/kg by 1961. These changes are tentatively attributed to changes in air quality and smoke emissions. The PAH content of contemporary sludges is also reviewed. There is little evidence to suggest that the PAH abundance in the London area has changed significantly from the 1960's to the present day. (Author's abstract)
W91-01737

ISOLATION AND CHARACTERIZATION OF HEPATOTOXIC MICROCYSTIN HOMOLOGS FROM THE FILAMENTOUS FRESHWATER CYANOBACTERIUM NOSTOC SP. STRAIN 152.
Helsinki Univ. (Finland). Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W91-01761

FAILURE OF A DIAGNOSTIC MONOCLONAL IMMUNOFLUORESCENT REAGENT TO DETECT LEGIONELLA PNEUMOPHILA IN ENVIRONMENTAL SAMPLES.
Veterans Administration Medical Center, Pittsburgh, PA. Special Pathogens Section.
R. M. Vickers, J. E. Stout, and V. L. Yu.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 9, p 2912-2914, September 1990. 1 tab, 10 ref.

Descriptors: *Fluorescence, *Hospitals, *Immunoassay, *Legionella, *Pathogenic bacteria, *Pollutant identification, Human pathogens, Potable water, Water distribution.

Three commercial diagnostic fluorescein-labeled antibodies, one monoclonal and two polyclonal, were compared to evaluate their abilities to detect Legionella pneumophila in environmental samples collected from 4 hospitals, one nursing home, and one industrial plant. The samples were taken from 9 hot and cold storage tank waters, three swabs from two showers and 1 faucet. The monoclonal conjugate failed to detect L. pneumophila in the 12 environmental samples studied by direct immunofluorescence. In contrast, the two polyclonal conjugates detected L. pneumophila in all 12 samples by both direct and indirect immunofluorescence. However, isolates recovered by culture from the 12 samples demonstrated equal immunofluorescence with all three conjugates. The reason for the failure of the monoclonal antibody to detect L. pneumophila in the environmental samples remains unknown. Laboratories considering the use of the monoclonal conjugate to screen environmental samples for L. pneumophila should be aware of this finding. (Author's abstract)
W91-01764

IMPROVED DETECTION OF ACID MINE WATER STRESSED COLIFORM BACTERIA ON MEDIA CONTAINING CATALASE AND SODIUM PYRUVATE.
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
J. P. Calabrese, and G. K. Bissonnette.
Canadian Journal of Microbiology CJMIAZ, Vol. 36, No. 8, p 544-550, August 1990. 2 fig, 4 tab, 37 ref.

Descriptors: *Acid mine drainage, *Coliforms, *Culture media, *Escherichia coli, *Pollutant identification, *Water pollution effects, Bioindicators, Culturing techniques, Enzymes, Heterotrophic bacteria, Membrane filters.

Pure culture suspensions of two strains of exponential and stationary phase Escherichia coli exhibited significant reductions in catalase activity following exposure to acid mine water (AMW). The exogenous addition of catalase (500-2000 U) or sodium pyruvate (0.05-5%) to a nonselective recovery medium resulted in enhanced detection (12-to 465-fold) of AMW-stressed E. coli as compared with recovery on the medium lacking these supplements, whereas addition of 3,3'-thiodipropionic acid failed to improve recovery. Additional in vitro experiments utilizing selective M-FC, mT7, and M-Endo media containing 1000 U catalase or 1.0% pyruvate similarly resulted in improved detection of AMW-stressed cells, with the exception of M-Endo containing pyruvate. Appropriately modified media were then used to analyze an AMW-impacted stream by the membrane filtration technique. Addition of catalase, pyruvate, or a combination of both significantly improved recovery of fecal and total coliforms without promoting growth of noncoliforms. Supplementation of plate count agar with pyruvate and/or catalase enhanced detection of total heterotrophs. These findings suggest that addition of catalase or pyruvate to standard recovery media may improve detection of coliform and total heterotrophic bacteria in AMW-impacted waters. (Author's abstract)
W91-01770

INDICATORS OF CHEMICAL POLLUTION FROM SEPTIC SYSTEMS.
Geraghty and Miller, Inc., Raleigh, NC.
B. J. Alhajjar, G. Chesters, and J. M. Harkin.
Ground Water GRWAAP, Vol. 28, No. 4, p 559-568, July/August 1990. 5 fig, 2 tab, 49 ref.

Descriptors: *Chlorides, *Conductivity, *Detergents, *Fluorescence, *Groundwater pollution, *Hydrogen ion concentration, *Pollutant identification, *Septic tanks, *Septic wastewater, *Water pollution sources, Effluents, Nitrates, Statistical methods, Water chemistry.

The median-polish statistical method was used to test and quantify chloride, electrical conductivity, pH and fluorescence of laundry detergent optical brighteners as indicators of groundwater pollution from septic systems. The septic systems were located in coarse-textured soils over a high water table close to discharge areas in south-central Wisconsin. Parameters were measured monthly for two years in septic tank effluent samples and in water samples collected downgradient from 17 septic systems and from upgradient background samples. The median-polish technique was excellent for comparing hydrochemical data: chloride was a conservative tracer and the most suitable indicator of contaminant plumes, electrical conductivity was semiconservative and electrical conductivity and pH were only acceptable; and fluorescence was unacceptable. Fluorescence as an optical brightener in septic tank effluents ranged between 0.14 and 0.98 mg/L with an average value of 0.40 +/-0.16 mg/L. In groundwater downgra-

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dient from the septic systems, fluorescence levels were within the background levels. Natural substances such as humic and fulvic acids were probably the sources of fluorescence in groundwater, not optical brighteners, because optical brighteners did not pass through septic systems drainfields. Fluorescence of naturally occurring compounds in groundwater was between < 0.01 and 260 microg/L with a mean of < or = 51 +/-14 microg/L expressed as optical brightener. Nitrification in the soil below the drainfields caused groundwater pH values to decrease within a few meters of the drainfields. (Author's abstract)
W91-01785

DETERMINATION OF TRACE QUANTITIES OF ORGANOTIN COMPOUNDS IN COASTAL WATERS OF GREECE BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY.
Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
K. Fytianos, and V. Samanidou.
Science of the Total Environment STENDL, Vol. 92, p 265-268, March 1990. 1 tab, 12 ref.

Descriptors: *Analytical techniques, *Atomic absorption spectrophotometry, *Coastal waters, *Greece, *Marinas, *Organotin compounds, *Spectral analysis, *Tributyltin, *Water pollution, *Water pollution sources, Boats, Coastal environment, Coasts, Recreation facilities, Seasonal variation.

In recent years the growing use of antifouling paints containing organotin compounds of high toxicity has increased the possibility of pollution in areas of high pleasure-craft activity. The active biocides in these paints are bis(tributyltin) oxide (TBTO) and tributyltin chloride (TBTCL). Where the density of boats is greatest and exchange with open water is least, water concentrations have consistently exceeded those known to be toxic to a variety of marine organisms. Samples of surface seawater from marinas in Greece were examined for the presence of tributyltin compounds. Samples were collected at 3-month intervals over a 1-year period from 1987-1988. Trace concentrations of tributyltin in seawater were determined by graphite furnace atomic adsorption spectrometry using preconcentration by extraction into toluene. Seasonal trends in contamination coincided with boat usage patterns and peaked during summer months. Concentrations of TBT in seawater dropped significantly with increasing distance from the marinas; TBT was below detection limit (<5 ng/L) in the middle of Themaikos Gulf and in areas used for swimming. In Thessaloniki Harbor, the concentrations ranged between 25 and 115 ng/L and was clearly related to the high density of moorings and routes of major shipping traffic. The concentrations of organotin compounds in the examined areas were compared with those reported in the literature and are found to be similar to levels in slightly polluted areas. (Author's abstract)
W91-01823

EVALUATION OF DETENTION BASIN PERFORMANCE IN THE PIEDMONT REGION OF NORTH CAROLINA.
North Carolina Univ. at Charlotte. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-01824

TENTATIVE IDENTIFICATION OF ORGANIC COMPOUNDS AT THE WESTSIDE WASTEWATER TREATMENT PLANT (HIGH POINT, NC) AND IMPLICATIONS FOR AQUATIC TOXICITY.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5D.
W91-01826

SAMPLING STRATEGIES FOR PARAMETER ESTIMATION IN GROUNDWATER QUALITY MANAGEMENT: THEORY AND FIELD VALIDATION.
California Univ., Los Angeles. Dept. of Civil Engineering.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-222258/AS. Price codes: A03 in paper copy, A01 in microfiche. Report UCLA-ENG-90-20, Feb 1990. 76p, 13 fig, 10 tab, 32 ref. USGS Contract No. 14-08-0001-G1499.

Descriptors: *Experimental design, *Field tests, *Groundwater pollution, *Optimization, *Sampling, Algorithms, Groundwater management, Mathematical models, Parameter estimation, Planning, Tracers.

The report is divided into two parts. In part I, an optimal design algorithm is developed to facilitate the planning and the optimal configuration and scheduling of a groundwater tracer test whose data are to be used to estimate model parameters. A maximal information criterion is used to select among competing designs. A zero-one integer heuristic is used to solve a simplified example for experiment configurations under a given experimental duration. The design considers the installation cost which is a function of location and depth of the observation well, as well as the samples themselves. The resulting designs are intuitively reasonable. It was found that a dramatic increase in information can be obtained with an experimental budget increase in a heterogeneous example case. Part II of the report describes a two-well field test conducted to estimate the retardation of organic contaminants during transport in groundwater at the Borden site, Ontario, Canada. One inorganic tracer and four organic solutes were injected for a period of 48 hours and their migration towards the extraction well monitored by 3 multi-level and 1 partially penetrating monitoring wells. The results of this forced gradient field test are analyzed and compared with the results from a previous natural gradient experiment and associated laboratory studies of the aquifer media. (USGS)
W91-01866

ACID PRECIPITATION: BIOLOGICAL MONITORING OF STREAMS AND LAKES.
Bergen Univ. (Norway). Zoological Museum.
A. Fjellheim, and G. G. Raddum.
Science of the Total Environment STENDL, Vol. 96, No. 1/2, p 57-66, July 1990. 3 fig, 1 tab, 29 ref.

Descriptors: *Acid rain effects, *Invertebrates, *Monitoring, *Norway, *Water pollution effects, Acid streams, Benthic fauna, Buffer capacity, Fishkill, Model studies, Precipitation, Salmon.

The activities and results from the Norwegian invertebrate acidification monitoring program are summarized. The program was started in 1981 and includes five watersheds. A key tool in the invertebrate monitoring program is a model which calculates an acidification index based on acid-sensitive invertebrates. The model is presented together with the acidification tolerances limits for different invertebrates. The results show that the degree of damage due to acificiation differed over time and between watersheds. Generally, the watersheds in the southernmost parts of Norway were most acidified. In watersheds on the west coast, maximum acidification was measured in 1983 to 1984. This was correlated with episodic kills of young Atlantic salmon. During recent years, acidification has decreased in most rivers with the exception of those found in the southernmost regions. The rivers are, however, still vulnerable to acidification due to poor buffer capacity. (Author's abstract)
W91-01890

OCCURRENCE OF HEAVY METALS IN WATER, PHYTOPLANKTON, AND ZOOPLANKTON OF A MESOTROPHIC LAKE IN EASTERN POLAND.
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
For primary bibliographic entry see Field 5B.
W91-01891

POLYCLONAL AND MONOCLONAL ENZYME IMMUNOASSAYS FOR PICLORAM DETECTION IN WATER, SOIL, PLANTS, AND URINE.
Guelph Univ. (Ontario). Dept. of Environmental Biology.
R. J. A. Deschamps, J. C. Hall, and M. R. McDermott.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 38, No. 9, p 1881-1886, September 1990. 1 fig, 7 tab, 17 ref.

Descriptors: *Bioassay, *Herbicides, *Immunoassay, *Pesticides, *Picloram, *Pollutant identification, Biological studies, Clopyralid, Fluroxpyr, Soil contamination, Triclopyr, Urine, Water pollution.

Two indirect enzyme immunoassays for picloram detection were compared in terms of sensitivity, accuracy and precision. The assay, using a rabbit antipicloram serum, had a linear working range from 5000 ng/mL with a mean 50I value of 140 ng/mL and a lower detection limit of 5ng/mL. The assay, using a monoclonal antibody obtained from a mouse hybridoma cell line, yielded a linear working range from 1 to 200 ng/mL with a mean 50I value of 10 ng/mL and a lower detection limit of 1 ng/mL. Neither assay showed appreciable cross-reactivity with the structurally related pyridine herbicides clopyralid, fluroxypyr, and triclopyr or with the phenoxyacetic acid herbicide 2,4-D. From the analysis of fortified river water, soil extracts, plant extracts, and urine, the monoclonal antibody based assay was shown to be more sensitive, more accurate and more precise than the polyclonal antiserum based assay. Only the monoclonal assay was suitable for quantitative determination of picloram. (Author's abstract)
W91-01912

BROAD-RANGE METHODS FOR DETERMINATION OF POLLUTANTS IN WASTEWATER.
Environmental Protection Agency, Washington, DC. Industrial Technology Div.
W. A . Tellard.
Journal of Chromatographic Science JCHSBZ, Vol. 28, No. 9, p 453-459, September 1990. 10 tab, 7 ref.

Descriptors: *Chemical analysis, *Laboratory methods, *Organic compounds, *Pollutant identification, *Wastewater analysis, *Water analysis, Atomic absorption spectrometry, Chlorinated hydrocarbons, Dioxins, Gas chromatography, Mass spectrometry, Metals.

The EPA is required by the Federal Water Pollution Control Act (FWPCA) and the Clean Water Act (CWA), and amendments thereto, to control or eliminate discharges of pollutants into waterways in the US, its territories and possessions. In controlling these discharges, the EPA's Industrial Technology Division (ITD) within the EPA's Office of Water Regulations and Standards (OWRS) has been given the responsibility of establishing effluent limits for any substance that may have an adverse effect on human health or the environment. The ITD determines the concentrations of pollutants at industrial plants in order to assess the performance of various water and waste treatment technologies. To determine the concentration of pollutants, ITD uses broad range analytical methods so that the largest number of pollutants can be measured at the lowest cost. At the same time, ITD must produce the most precise and accurate data possible so that the regulations most closely reflect the true value of the pollutants in wastewater. This paper gives technical details of Method nos.: 1620, which surveys 69 elements using inductively coupled plasma spectrometry (ICP), graphite furnace atomic absorption spectrometry (GFAA), and cold vapor atomic absorption (CVAA); 1613, which measures the tetra-, through octa-, chlorinated dibenzo-p-dioxins (CDDs) and chlorinated dibenzofurans (CDFs) using high resolution gas chromatography/mass spectrometry (HRGC-HRMS); Method 1618, which measures herbicides, PCBs, and organochlorine and organophosphorus pesticides using GC; and Method 1624, which determines purgeable or-

ganic compounds by calibrated isotope dilution or internal standard GC/MS. (Lantz-PTT)
W91-01914

DETERMINATION OF VOLATILE ORGANICS IN DRINKING WATER WITH USEPA METHOD 524.2 AND THE ION TRAP DETECTOR.
Environmental Monitoring Systems Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W91-01915

SUPERCRITICAL FLUID EXTRACTION AND ITS APPLICATION TO ENVIRONMENTAL ANALYSIS.
Mid-Pacific Environmental Lab., Mountain View, CA.
V. L. Avila, N. S. Dodhiwala, and W. F. Beckert.
Journal of Chromatographic Science JCHSBZ, Vol. 28, No. 9, p 468-476, September 1990. 5 fig, 8 tab, 16 ref.

Descriptors: *Chemical analysis, *Chlorinated hydrocarbons, *Organophosphorus pesticides, *Pesticides, *Pollutant identification, *Supercritical gases, *Water analysis, Aromatic hydrocarbons, Comparison studies, Laboratory methods.

Sand, spiked with 41 organochlorine pesticides and 47 organophosphorous pesticides, was extracted with supercritical carbon dioxide at various pressures and temperatures, and the recoveries were determined. Two standard reference materials certified for polynuclear aromatic hydrocarbons were extracted under supercritical conditions, and the data compared with the certified values which have been determined by conventional extraction techniques. There is a large discrepancy between the resulting data and the certified values. To explain the discrepancy, a preliminary optimization study was conducted in which the influences on recoveries of seven variables were investigated. The study allowed for the estimation of the main effects of the seven variables; however, the authors could not test the statistical significance of any of these effects. Results from the preliminary method optimization experiments indicate that under the conditions used, recovery is most effected by extraction time and extraction pressure, followed by moisture content of the material and sample size. The approximate costs associated with setting up and using a supercritical fluid extraction system in an analytical laboratory are presented and are compared with those for Soxhlet extraction. (Author's abstract)
W91-01916

RAPID METHOD FOR THE SIMULTANEOUS ANALYSIS OF CHLORPYRIFOS, ISOFENPHOS, CARBARYL, IPRODIONE, AND TRIADIMEFON IN GROUNDWATER BY SOLID-PHASE EXTRACTION.
Massachusetts Pesticide Analysis Lab., Amherst.
J. W. Brooks, D. Tessier, D. Soderstrom, J. Hankins, and J. M. Clark.
Journal of Chromatographic Science JCHSBZ, Vol. 28, No. 9, p 487-489, September 1990. 3 fig, 2 tab, 7 ref.

Descriptors: *Carbaryl, *Chlorpyrifos, *Groundwater pollution, *Iprodiene, *Isofenphos, *Laboratory methods, *Pesticides, *Pollutant identification, *Triadimefon, Chemical analysis, Detection limits, Gas chromatography, Water analysis.

A method for the simultaneous analysis of pesticides in groundwater involves the extraction of the pesticides onto 18C columns and then elution with methylene chloride. After solvent exchange to hexane, the extracts are analyzed by gas chromatography using nitrogen-phosphorous detection. Recoveries average higher than 90% with a detection limit of 1 ppb for carbaryl, iprodione, and triadimefon, and 0.1 ppb for chlorpyrifos and isofenphos. (Author's abstract)
W91-01917

REVERSED-PHASE LIQUID CHROMATOGRAPHIC COLUMN SWITCHING FOR THE TRACE-LEVEL DETERMINATION OF POLAR COMPOUNDS. APPLICATION TO CHLOROALLYL ALCOHOL IN GROUND WATER.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Organic-Analytical Chemistry.
E. A. Hogendoorn, A. P. J. M. De Jong, P. Van Zoonen, and U. A. T. Brinkman.
Journal of Chromatography JOCRAM, Vol. 511, p 243-256, July 1990. 6 fig, 3 tab, 24 ref.

Descriptors: *Chemical analysis, *Chromatography, *Groundwater pollution, *Laboratory methods, *Liquid chromatography, *Pollutant identification, *Water analysis, Chloroacrylic acid, Dichloropropene, Mass spectrometry, Trace levels, Ultraviolet radiation.

Reversed-phase liquid chromatographic (LC) column switching employing two 18C columns was used for the trace level determination of the polar compound chloroallyl (CAAL), a key metabolite of the soil sterilant dichloropropene, in groundwater. The selectivity of the LC procedure is crucial as CAAL does not possess a chromophoric group and must be detected by UV absorbance at 205 nm. It was shown that the selectivity can be enhanced considerably by the use of a column-switching technique. A completely automated procedure was developed for the determination of CAAL with a limit of detection (LOD) of 1 ppb (signal to noise ratio = 3). Recoveries at the 20 ppb level were 103% for cis-CAAL (relative standard deviation (R.S.D.) = 3.4%) and 102% for trans-CAAL (R.S.D. = 2.5%). Response was linear over more than two decades. The sample throughput is high, as the total time required for the analysis is less than 10 min. If necessary, LODs can be lowered to 0.1 ppb by means of a liquid/liquid extraction combined with a concentration step, resulting in recoveries of 88% (R.S.D. = 4.1%) at a level of 2 ppb. Confirmation of CAAL and a second metabolite of dichloropropene, chloroacrylic acid (CAAC), was performed by gas chromatography-negative ionization chemical mass spectrometry (GC-NCI-MS), using derivation procedures to convert CAAL and CAAC into their pentafluorobenzoyl derivatives, respectively. (Author's abstract)
W91-01918

TRACE DETERMINATION OF LOWER VOLATILE FATTY ACIDS IN SEDIMENTS BY GAS CHROMATOGRAPHY WITH CHEMICALLY BONDED FFAP COLUMNS.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
C. A. Hordijk, I. Burgers, G. J. M. Phylipsen, and T. E. Cappenberg.
Journal of Chromatography JOCRAM, Vol. 511, p 317-323, July 1990. 3 fig, 3 tab, 18 ref.

Descriptors: *Chemical analysis, *Chromatography, *Fatty acids, *Gas chromatography, *Laboratory methods, *Pollutant identification, *Sediment analysis, *Volatile acids, Formic acid, Freshwater, Trace levels.

A capillary gas-liquid chromatography method was developed for the quantification of free lower volatile fatty acids (LVFA) in freshwater sediments. The method is based on the application of water-resistant FFAP (free fatty acid phase) columns and splitless injection. An important feature is the ability to determine LVFA directly at picomole levels in 1-3 microL of water without sample extraction, clean-up or derivatization. Continuous saturation of the carrier gas with formic acid in superfluous, making this method compatible with mass selective detection. The ability to study LVFA metabolism using stable isotope tracers is presented. The method allows for the measurement of well defined concentration profiles (4-70 microM) in sediment pore waters and is a good alternative to existing techniques for determining trace amounts of LVFA in very small volumes of organic-rich matrices. (Author's abstract)
W91-01919

NOAA'S STATUS AND TRENDS MUSSEL WATCH PROGRAM: CHLORINATED PESTICIDES AND PCBS IN OYSTERS (CRASSOSTREA VIRGINICA) AND SEDIMENTS FROM THE GULF OF MEXICO.
Texas A and M Univ., College Station. Dept. of Oceanography.
J. L. Sericano, E. L. Atlas, T. L. Wade, and J. M. Brooks.
Marine Environmental Research MERSDW, Vol. 29, No. 3, p 161-203, 1990. 14 fig, 6 tab, 52 ref. National Oceanic and Atmospheric Administration contract 50-DGNC-5-00262.

Descriptors: *Bioindicators, *Chlorinated hydrocarbons, *Gulf of Mexico, *Mollusks, *Mussels, *Oysters, *Pesticides, *Sediment contamination, Bioaccumulation, DDD, DDT, Distribution patterns, PCB, Polychlorinated biphenyls.

Chlorinated pesticides and PCB's were analyzed in more than 590 oyster and sediment samples collected during 1986 and 1987, the first 2 years of the NOAA's Status and Trends Mussel Watch Program established to monitor the current status and temporal trends of these contaminants in the Gulf of Mexico. Chlorinated hydrocarbons in oysters and sediments presented similar distribution patterns; however, their concentrations in oysters were several times higher than the concentration detected in the surrounding sediments. Alpha-chlordane, trans-nonachlor and dieldrin were the most abundant non-DDT pesticides in both types of sample. The major fraction of DDT related compounds measured in oysters and sediment was DDD. Based on average PCB concentrations, penta-, hexa-, and tetrachlorobiphenyls were preferentially accumulated by oysters as compared to the average sediment composition. Although this study was designed to avoid known point-sources of contaminant inputs, the measured concentrations were, in general, within the range of concentrations previously reported for the Gulf of Mexico. After the first 2 years of this program, the geographical distribution of chlorinated hydrocarbons in oyters and sediments is well defined. In contrast, the temporal trends at the different sites are not clear. Continued sampling will allow the identification of long-term trends in concentrations of chlorinated hydrocarbons in the Gulf of Mexico. (Author's abstract)
W91-01933

GAS CHROMATOGRAPHY IN ENVIRONMENTAL ANALYSIS: AIMS AND CHALLENGES.
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.). Aktiengesellschaft labor fuer Umweltanalytik und Okologie.
H. J. Neu.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 337, No. 6, p 583-588, July 1990. 9 ref.

Descriptors: *Chromatography, *Gas chromatography, *Pollutant identification, *Sensitivity analysis, *Water analysis, Automation, Mass spectrometry, Organic compounds, Phenols, Qualitative analysis, Quantitative analysis, Trace levels, Wastewater analysis.

Gas chromatography (GC) is currently still the most frequently used technique for determining trace organic compounds in environmental samples. Though GC is already a very highly developed technique, there is still a need for further improvements with respect to the reliability of qualitative and quantitative data and to the overall efficiency of the analysis procedure. Future development should concentrate on all aspects of automation in order to reduce manual work. This refers to automation of pre-chromatographic sample treatment steps such as enrichment, clean-up and derivatization procedures. The derivatization of phenols in water can be considerably simplified by using the reaction of many phenols with pentafluorobenzoylchloride that can be performed directly in alkaline aqueous solution. Using the reagent in a hexane solution, derivatization and extraction of the derivatives can be performed in a single step procedure. Then the organic phase is separated, the excess reagent is destroyed, the extract is dried and subjected to GC-analysis. The

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detection of phenols in wastewater at the picogram level can be performed by a simplification of the above procedure. Derivatization procedures for the determination of hydrophilic compounds in water can also simplify GC analysis. In addition, the sensitivity of GC analysis can be improved by refinements in mass spectrophotometric detector sensitivity. (Geiger-PTT)
W91-01954

TRACE GAS ANALYSIS USING THERMOANALYTICAL METHODS.
Gesamthochschule Wuppertal (Germany, F.R.). Fachbereich 9 - Analytische Chemie.
H. Hartkamp, J. Rottmann, and M. Schmitz.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 337, No. 7, p 729-736, August 1990. 7 fig, 23 tab, 13 ref.

Descriptors: *Analytical methods, *Calorimetry, *Pollutant identification, *Trace levels, Chemical reactions, Chlorinated hydrocarbons, Metal complexes, Qualitative analysis, Quantitative analysis, Sampling, Soil gases, Thermal properties, Water pollution.

There is an increasing demand for trace gas analytical information, especially in the fields of environmental protection, due to emissions from soil and water pollution. Most trace analytical procedures are costly, time-consuming and require highly qualified personnel to perform them. This difficulty can be overcome by the development of simple one-step procedures based on low price ready-for-use sampling units which can be processed with a minimum of manpower input while providing information of the required reliability. The measurement of caloric effects associated with the decomposition of the products resulting during the sampling step from a gas-solid reaction between the traces to be analyzed and suitable solid state reagents may provide such needed technology to overcome previous difficulties in trace analysis. Starting from properly prepared text gas mixtures, the gas-solid reactions of numerous amines, alcohols, aldehydes, ketones, hydrocarbons, and halogenated hydrocarbons with several metal complexes and with reagents capable of forming clathrates have been investigated by means of thermoanalytical methods, mainly by means of differential scanning calorimetry. Results show that in many cases the very simple thermoanalytical evaluation enables both qualitative identification and quantification of the gas traces under concern with satisfying selectivity. These reactions may serve as a promising basis for further development of fast, simple and reliable trace gas analyses using thermoanalytical methods. (Author's abstract)
W91-01955

GC-FTIRS: APPLICATIONS IN ORGANIC TRACE ANALYSIS.
Johannes Kepler Univ., Linz (Austria). Dept. of Analytical Chemistry.
H. Malissa, T. Kreindl, and K. Winsauer.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 337, No. 7, p 843-847, August 1990. 1 fig, 36 ref.

Descriptors: *Analytical methods, *Chemical analysis, *Chromatography, *Gas chromatography, *Organic pollutants, *Pollutant identification, *Trace levels, *Water analysis, Atrazine, Herbicides, Spectrophotometry.

The gas chromatography-infrared spectrophotometry (GC-FTIRS) coupling used as a measuring instrument in trace analytical procedures can be fully effective only if the maximum possible sensitivity is provided simultaneously with undistorted chromatographic and spectrometric representation of the eluted compounds. Great efforts have been made in recent years to design improved interfacing and measurement principles. GC capillary separation with flow-through gas cells (light-pipes), matrix isolation and cryodeposition techniques are discussed and compared in terms of sensitivity. The lightpipes achieves a sensitivity of between 1 and 10 nanograms for strong IR-absorbers, although 400 picograms have been attained in a precisely balanced system. For weak IR-absorbers, the quantity required may raise up to 100 nanograms. In the eluate trapping techniques, identifiable spectrum from 25 picograms has been obtained with the matrix isolation system for the model substance isobutyl methacrylate. The minimum identification concentration of a herbicide in groundwater and drinking water is approximately 1 ppb using an analytical procedure with solid state enrichment, large sample injection and GC-FTIRS with the light-pipe technique. (Geiger-PTT)
W91-01956

DETERMINATION OF ORTHO-AND PYROPHOSPHATES IN WATERS BY EXTRACTION CHROMATOGRAPHY AND FLOW-INJECTION ANALYSIS.
Akademiya Nauk SSSR, Moscow. Inst. Geokhimii i Analiticheskoi Khimii.
B. Y. Spivakov, T. A. Maryutina, L. K. Shpigun, V. M. Shkinev, and Y. A. Zolotov.
Talanta TLNTA2, Vol. 37, No. 9, p 889-894, September 1990. 7 fig, 3 tab, 13 ref.

Descriptors: *Chromatography, *Orthophosphates, *Phosphates, *Pollutant identification, *Water analysis, Anions, Cations, Chemical analysis, Separation techniques, Spectrophotometry, Wastewater analysis.

Extraction-chromatographic separation of ortho- and pyrophosphate anions on an inert support modified with an organotin extractant was studied and used for their subsequent determination in a flow-injection analysis (FIA) system. The proposed FIA manifold included an extraction-chromatographic mini-column, on which the phosphate anions were separated and preconcentrated, and a post-column spectrophotometric detector. For the determination of orthophosphate, the absorbance of the reduced 12-molybdophosphoric acid was monitored at 660 nanometers. The sum of ortho- and pyrophosphate was determined after preliminary hydrolysis of pyrophosphate to orthophosphate in neutral solution at 50 C by use of inorganic pyrophosphatase. For a sample volume of 6 ml, the calibration graph was linear within a range of 5.0-100.0 nanograms/ml P. The limit of detection was 0.3 nanograms/ml P. The recovery of the ions to be determined was not less than 96%, the relative error was not worse than 4%. When the proposed method was used for the analysis of river water samples, the deviations between the amounts of phosphate ions found and added were within experimental error. Close agreement was also noted for results achieved with the present method and those obtained by the solvent extraction-spectrophotometric method. The FIA procedure developed can also be applied to the analysis of anions and cations in wastewaters. (Geiger-PTT)
W91-01962

EFFECTS OF SAMPLE PREPARATION ON MEASURED CONCENTRATIONS OF EIGHT ELEMENTS IN EDIBLE TISSUES OF FISH FROM STREAMS CONTAMINATED BY LEAD MINING.
National Fisheries Contaminant Research Center, Columbus, OH. Field Research Station.
C. J. Schmitt, and S. E. Finger.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 2, p 185-207, March 1987. 6 fig, 7 tab, 65 ref. Fish and Wildlife Service and Army Corps of Engineers Interagency Agreement DACW 43-80-A-0109.

Descriptors: *Analytical techniques, *Bioaccumulation, *Biological samples, *Fish, *Heavy metals, *Lead, *Pollutant identification, *Sample preparation, *Tissue analysis, *Water pollution effects, Animal tissues, Bass, Catfish, Correlation analysis, Mine wastes, Missouri, Path of pollutants, Stream pollution.

The influence of sample preparation on measured concentrations of eight elements in the edible tissues of fish from two rivers in southeastern Missouri contaminated by mining and related activities was investigated. Concentrations of lead (Pb), cadmium (Cd), copper (Cu), zinc (Zn), iron (Fe), manganese (Mn), barium (Ba), and calcium (Ca) were measured in two skinless, boneless samples of axial muscle from individual fish prepared in a clean room. One sample (normally processed) was removed from each fish with a knife in a manner typically used by investigators to process fish for elemental analysis and presumably representative of methods employed by anglers when preparing fish for home consumption. A second sample (clean-processed) was then prepared from each normally-processed sample by cutting away all surface material with acid-cleaned instruments under ultraclean conditions. The samples were analyzed by atomic absorption spectrophotometry. Only Pb regularly exceeded current guidelines for elemental contaminants in food. Concentrations were high in black redhorse from contaminated sites, regardless of preparation method; for the other fishes, Pb levels depended upon preparation technique. Except for Mn and Ca, concentrations of all elements measured were significantly lower in clean than in normally precessed tissue samples. Concentrations of Pb, Ca, Mn and Ba in individual fish were closely correlated regardless of sample size, while correlations between Zn, Fe, and Cd occurred only in normally-processed samples (suggesting that these correlations resulted from high concentrations on the surfaces of some samples). Reported concentrations of certain elements should be regarded only as estimates and regardless of the care exercised during the collection, preparation, and analysis of samples, results should be interpreted with the awareness that contamination from external sources may have occurred. (Author's abstract)
W91-01968

MUTAGENS, TOXICANTS, AND OTHER CONSTITUENTS IN SMALL CITY SLUDGES IN NEW YORK STATE.
Pennsylvania State Univ., University Park. Pesticide Research Lab.
R. O. Mumma, K. A. Rashid, D. C. Raupach, B. S. Shane, and J. M. Scarlet-Kranz.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 5, p 657-663, September 1988. 1 fig, 3 tab, 18 ref.

Descriptors: *Chemical analysis, *Hazardous materials, *Municipal wastes, *Mutagens, *New York, *Pollutant identification, *Sludge analysis, *Toxicology, Land disposal, Polychlorinated biphenyls, Radiochemical analysis, Sampling, Surveys.

An analytical survey was conducted of sewage sludges from 15 small cites in New York State for mutagens, 44 elements, polychlorinated biphenyls (PCBs) and radioactivity. Using the Ames salmonella assay, low levels of mutagenicity were detected in several of the samples. PCBs were very high in only one sample, from the Elmira sewage plant (48.4 ppm). A number of toxic elements (i.e., arsenic, boron, barium, cadmium, chromium, copper, mercury, nickel, lead, antimony, and zinc) were found at elevated concentrations in specific sludges, but it is not possible to relate these to specific industrial sources with certainty. The concentrations of specific toxicants in five city sludges were above presently suggested federal guidelines for their suitability for land application. Gamma emission was comparatively low in all samples at 1.6 to 326 cpm per gram above background. Possible sources of specific constituents in sludge are discussed. The concentrations of various constituents in sludges may vary greatly, up or down, with time of sampling, therefore, continuous analytical monitoring for toxicants in sludges is necessary to calculate an average composition for a given period of time if federal guidelines are to be effectively followed. (Author's abstract)
W91-01974

RISK ASSESSMENT OF DRINKING WATER IN A RESERVOIR CONTAMINATED BY PAHS ORIGINATED FROM ROAD TRAFFIC.
Ehime Prefecture Inst. of Public Health, Matsuyama (Japan).
For primary bibliographic entry see Field 5C.
W91-01991

SUBSTANCE LOAD IN RAINWATER RUNOFF FROM DIFFERENT STREETS IN HAMBURG.
Hamburg Univ. (Germany, F.R.). Inst. fuer Anorganische und Angewandte Chemie.
For primary bibliographic entry see Field 5B.
W91-01993

POLLUTION OF STREET RUN-OFF BY TRAFFIC AND LOCAL CONDITIONS.
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-01994

APPLICATIONS OF MAGNETIC MEASUREMENTS TO SEDIMENT TRACING IN URBAN HIGHWAY ENVIRONMENTS.
Middlesex Polytechnic, Enfield (England). Urban Pollution Research Center.
P. R. Beckwith, J. B. Ellis, and D. M. Revitt.
The Science of the Total Environment STENDL, Vol. 93, p 449-463, April 1990. 3 fig, 4 tab, 29 ref.

Descriptors: *Highway effects, *Magnetic studies, *Particulate matter, *Sediment transport, *Storm runoff, *Urban areas, *Urban runoff, Catchment basins, Data acquisition, Hydrology, Sediments.

Mineral magnetic techniques are used to follow the transport and sequencing of surface sediments through a separate stormwater system within a small, well-defined urban catchment. The contributions of these sediments to subsurface deposits and stormwater particulates have been assessed by consideration of magnetic parameter values, by comparison of graphical representations and by derivation of discriminatory equations. A realistic balance is achieved by consideration of each of these. For example, the discrimination procedure predicts that in-pipe deposits collected from below the confluence of the road and roof drainage systems are predominantly categorized as highway associated sediments whereas direct comparison of the appropriate magnetic parameters suggests contributions from both highways and roof areas depending on specific flow characteristics and source sediment loadings. Substantial proportions of the total magnetic mineral loading can occur in the initial stages of the storm events, with as much as 80% of the overall IRM sub 300mT (Isothermal Remanent Magnetization induced by generating a uniform field of 300 mT) loading being discharged in the first 20 minutes, and therefore, these early stages can be important in determining the dominant sediment sources for the overall event. Stormwater quality is shown to be strongly influenced by contributions from atmospheric particulates and the scouring of in-pipe deposits with the latter being dependent upon the dominant sources of stormwater sediment at the end of the preceding storm. (Stoehr-PTT)
W91-01997

INFLUENCE OF COMPLEXING AGENTS AND SURFACTANTS ON METAL SPECIATION ANALYSIS IN ROAD RUNOFF.
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Sanitary Engineering.
L. M. P. Morrison, and T. M. Florence.
The Science of the Total Environment STENDL, Vol. 93, p 481-488, April 1990. 4 tab, 13 ref.

Descriptors: *Chemical analysis, *Heavy metals, *Highway effects, *Pollutant identification, *Sample preservation, *Sampling, *Surfactants, *Urban runoff, *Voltammetry, *Water analysis, Acidity, Cadmium, Copper, Ion exchange, Speciation, Zinc.

A combination of medium exchange and sample acidification techniques are used to calculate the individual effects of complexing agents and surfactants on the deposition and stripping steps in anodic stripping voltammetry (ASV) for copper, lead and cadmium from road and urban runoff. A simple acidification procedure is presented for determining the toxic fraction. ASV is used for the determination of copper in the presence of fulvic and humic acids and Triton X-100, for cadmium and lead in the presence of Triton X-100, and for lead and urban runoff samples. The major effects of both complexing agents and Triton X-100 are on the deposition step. In phosphate buffer pH 7.0., lead is deposited as lead (II), but is stripped as lead (IV), giving enhanced stripping peaks at pH 7.0, but not at pH 1.9. Triton X-100 caused a considerable decrease in the deposition of all three metals, and surfactants were the major cause of low differential pulse ASV (DPASV) labilities in the water samples. Despite these large effects on ASV metal speciation, 5 mg/L of Triton X-100 in the presence or absence of copper had no effect on the growth rate of Chlorella pyrenoidosa at pH 7.0. This result has important implications for the use of DPASV lability in estimating the 'toxic fraction' of a metal. Since surfactants in road runoff are the dominant factor in the decrease of ASV lability, but do not decrease metal toxicity toward aquatic test organisms, then ASV will seriously underestimate the toxic fraction. This study has demonstrated several potential problems in the application of ASV lability measurements to the estimation of the toxic fraction of a metal in road runoff samples. The use of membrane-coated electrodes or direct current with peak integration, rather than either differential pulse-, or square wave-ASV, will eliminate the effect of the stripping step on ASV lability, but surfactants will still influence deposition. The measurement required for toxicity studies, i.e., the effect of complexing agents on deposition, can be readily obtained by DPASV using two successive ASV-labile determinations in the same sample aliquot with a simple acidification procedure. (Stoehr-PTT)
W91-01999

APPLICATION OF MULTIVARIATE ANALYSIS FOR CHARACTERIZATION OF ORGANIC COMPOUNDS FROM URBAN RUNOFF.
Universidad Politecnica de Madrid (Spain). Escuela Tecnica Superior de Ingenieros de Caminos.
M. T. Bomboi, A. Fernandez, F. Marino, and E. Hontoria.
The Science of the Total Environment STENDL, Vol. 93, p 523-536, April 1990. 3 fig, 2 tab, 23 ref.

Descriptors: *Aliphatic hydrocarbons, *Fatty acids, *Hydrocarbons, *Multivariate analysis, *Organic compounds, *Pollutant identification, *Spain, *Urban runoff, Madrid, Mathematical analysis, Pollutants.

A one year study for determining the concentrations of aromatic and aliphatic hydrocarbons and fatty acids in urban runoff has been established in Madrid. Seasonal traffic and area variations were studied to calculate enrichment factors after which apportionment techniques were used. Hierarchical cluster analysis was used to identify urban runoff in homogenous classes. Squared euclidean distance was used as a measure to calculate the similarity between samples and the mean distance was employed as the fusion strategy to obtain the dendogram. Factor analysis was developed to determine sources of urban runoff pollutants. The Varimax rotation technique was chosen to resolve organic compound origins and obtain their profiles and contributions to the receptor site. The results show that pyrolytic, petrogenic and natural sources are the main components of hydrocarbons and fatty acids in urban runoff. (Author's abstract)
W91-02004

RECENT TAXONOMIC DISCOVERIES CONCERNING THE MUSSEL MYTILUS: IMPLICATIONS FOR BIOMONITORING.
Memorial Univ. of Newfoundland, St. John's. Dept. of Earth Sciences.
P. B. Lobel, S. P. Belkhode, S. E. Jackson, and H. P. Longerich.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 508-512, July/August 1990. 3 tab, 14 ref.

Descriptors: *Bioassay, *Bioindicators, *Marine pollution, *Mollusks, *Mussels, *Taxonomy, Growth rates, Mass spectrometry, Metabolism, Speciation.

The mussel Mytilus has been widely used as a bioindicator of marine pollution. Because of its wide distribution around the world, it has been possible to establish a global 'mussel watch' to monitor pollutants in the marine environment. Recent taxonomic discoveries based on studies of allozyme variation, however, have shown that Mytilus edulis is actually a complex consisting of three separate evolutionary lineages which deserve the ranks of separate species: the Atlantic Mytilus edulis, Mytilus galloprovincialis, and Mytilus trossulus. Many mussels previously classified as Mytilus edulis can be reclassified as either Mytilus galloprovincialis or Mytilus trossulus. In the present study, specimens of Mytilus edulis and Mytilus trossulus were collected from the same habitat and analyzed for the concentrations of 25 elements by inductively coupled plasma mass spectrometry. Mytilus trossulus had higher element concentrations than Mytilus edulis. Differences between the element concentrations of the two species were related to differences in growth rather than to any direct differences between the element metabolism of the species. Such differences could be corrected by standardizing the mussels to a fixed width/height ratio. In order to avoid errors in future monitoring programs, taxonomic variables should be considered. (Author's abstract)
W91-02030

EXPRESSION OF RESULTS FROM GROWTH INHIBITION TOXICITY TESTS WITH ALGAE.
Vandkvalitetsinstitutet, Hoersholm (Denmark).
For primary bibliographic entry see Field 5C.
W91-02031

MULTIRESIDUE METHOD BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY-BASED FRACTIONATION AND GAS CHROMATOGRAPHIC DETERMINATION OF TRACE LEVELS OF PESTICIDES IN AIR AND WATER.
California Univ., Davis. Dept. of Environmental Toxicology.
J. N. Seiber, D. E. Glofelty, A. D. Lucas, M. M. McChesney, and J. C. Sagebiel.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 583-592, July/August 1990. 5 fig, 5 tab, 25 ref. NIEHS Grant No. ES04699.

Descriptors: *Air pollution, *Analytical methods, *Chromatography, *Gas chromatography, *High performance liquid chromatography, *Path of pollutants, *Pesticides, *Pollutant identification, *Water pollution, Carbamate pesticides, Organophosphorus pesticides, Silica gel fractionation, Solutes.

A multiresidue analytical method, accommodating chemicals over a broad range of polarities, is outlined for pesticides, transformation products, and related toxicants based upon high performance liquid chromatographic fractionation of extracted residue on a Partisil silica gel normal phase column followed by selective-detector gas chromatographic determination of components in each fraction. The HPLC mobile phase gradient (hexane to methyl t-butyl ether) gave good chromatographic efficiency, resolution, reproducibility and recovery for 61 test compounds, and allowed for collection in four fractions spanning polarities from low polarity organochlorine compounds (fraction 1) to polar N-methylcarbamates and organophosphorus oxons (fraction 4). The multiresidue method was developed for use with air samples collected on XAD-4 and related trapping agents, and water samples extracted with methylene chloride. Detection limits estimated from spiking experiments were generally 0.3 to 1 ng/c m for high volume air samples, and 0.01 to 0.1 microg/L for one liter water samples. The combination of silica gel HPLC fractionation with element selective GC determination appears to offer several advantages when combined in a multiresidue method. The HPLC fractionation gives clean separation on the basis of solute polarity, and fraction cuts may be tailored to meet the needs of a given analytical problem. This technique can analyze pesticides and related compounds in air and water samples. (Brunone-PTT)
W91-02038

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5B. Sources Of Pollution

METAL CONTENT OF FUNGAL SPOROCARPS FROM URBAN, RURAL, AND SLUDGE-TREATED SITES.
Pacific Northwest Forest and Range Experiment Station, Wenatchee, WA. Forestry Sciences Lab.
D. Zabowski, R. J. Zasoski, W. Littke, and J. Ammirati.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 372-377, July/September 1990. 1 fig, 4 tab, 24 ref.

Descriptors: *Fungi, *Path of pollutants, *Sludge, *Soil contamination, *Trace metals, *Washington, Cadmium, Copper, Food chains, Forests, Iron, Manganese, Nickel, Rural areas, Urban areas, Zinc.

Fungal sporocarps can influence metal cycling by the uptake of trace metals, which are then readily available for consumption and incorporation into higher food chain levels. This study was conducted to determine if increased sporocarp metal (Cd, Cu, Fe, Mn, Ni, Zn) concentrations occurred relative to substrate metal availability in rural, urban, and sludge-treated sites in western Washington state. Fungal fruiting bodies were collected from rural forests, from urban forests receiving point-source metal pollution and from forests that had been treated with municipal sewage sludge. Metal concentrations in fungal sporocarps were found to be significantly higher on sewage sludge-treated sites when all species were considered. Smelter pollution and serpentinite soil, however, were also found to elevate some metals to levels similar to those found at sludge-amended areas. Overall, individual species appear to be the most important factor for predicting metal uptake from impacted soils and possible inclusion into food chains. (Author's abstract)
W91-01005

AQUEOUS BEHAVIOR OF CHROMIUM IN COAL FLY ASH.
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
D. Rai, and R. W. Szelmeczka.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 378-382, July/September 1990. 5 fig, 3 tab, 14 ref. Electric Power Research Institute, Inc. Contract RP2485-08.

Descriptors: *Chromium, *Coal wastes, *Path of pollutants, Chemical analysis, Chemical reactions, Chromium compounds, Coal fly ash, Hydrogen ion concentration, Interstitial water.

Although the average Cr content in coal fly ash is fairly small, a total of approximately 17,000 mg of Cr contained in fly ash is disposed of on the land surface in the U.S. annually. Because Cr, especially Cr(VI), is hazardous even in small quantities, it is important to determine or predict pore-water Cr concentrations. Studies were conducted to determine the dominant reactions controlling aqueous Cr concentrations in four coal fly ashes. The fly ashes were adjusted to a range of pH values between 2 and 10. Cr was found to be present in these aqueous and solid phases as Cr(III). Because of the amorphous character of the important Cr(1lI) compounds ((Fe,Cr)(OH)3 and Cr(OH)3) and because of the very low total Cr content of the fly ashes (<0.025%), it was not possible to identify directly the Cr-containing compounds. However, an indirect technique for identifying Cr compounds, comparison of observed activities with those in equilibrium with known solid phases, and with those obtained after spiking the coal ash suspensions with Cr(1lI), suggested that Cr concentrations are controlled by (Fe,Cr)(OH)3(am) at low pH and by (Fe,Cr)(OH)3(am) and/or Cr(OH)3(am) at pH values greater than about 5. (Author's abstract)
W91-01006

TEMPORAL SOLUBILITY TRENDS OF ALUMINUM AND IRON LEACHED FROM COAL SPOILS AND CONTAMINATED SOIL MATERIALS.
Kentucky Agricultural Experiment Station, Lexington. Dept. of Agronomy.
A. D. Karathanasis, Y. L. Thompson, and V. P. Evangelou.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 389-395, July/September 1990. 10 fig, 1 tab, 25 ref.

Descriptors: *Acid mine drainage, *Aluminum, *Coal spoil, *Iron, *Path of pollutants, Kentucky, Leaching, Sediment contamination, Soil columns, Soil contamination, Solubility, Watersheds.

Column leaching experiments were conducted over a period of 5 months on selected spoil, soil, and sediment samples collected from acid mine watersheds with low buffering capacity in Kentucky. Evaluation of effluent compositions over time suggested that at different stages of leaching these samples may release different levels of Al and Fe. These levels appeared to be controlled by the solubility of characteristic sequences of basic Al-sulfate, Al-hydroxide, and alumino-silicate minerals, or Fe-sulfate and Fe-hydroxide minerals, which are sample specific. Jurbanite-jurbanite, jurbanite-alunite, and jurbanite-alunite-microcrystalline gibbsite appeared to be the dominant mineral species controlling the solubility of Al. Similarly, the jarosite-amorphous Fe(OH)3 and amorphous Fe(OH)3-geothite sequences appeared to control the solubility of Fe. Alternating water saturation and desaturation cycles appeared to cause more drastic changes in the above relationships than different flow rates simulating rain events of different intensity. The findings suggest that understanding temporal relationships among the sequence of mineral phases controlling Al and Fe solubility is essential for realistic modeling of Al and Fe release into aquifers. (Author's abstract)
W91-01007

VIRUS TRANSPORT AND SURVIVAL IN SATURATED AND UNSATURATED FLOW THROUGH SOIL COLUMNS.
Arizona Univ., Tucson. Dept. of Soil and Water Science.
D. K. Powelson, J. R. Simpson, and C. P. Gerba.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 396-401, July/September 1990. 4 fig, 4 tab, 36 ref. USEPA CR-81147.

Descriptors: *Groundwater pollution, *Path of pollutants, *Viruses, *Water pollution, Saturated flow, Soil adsorption, Soil columns, Survival, Unsaturated flow.

Water with entrained disease-causing virus entering soil normally passes through water saturated and unsaturated regions before reaching the groundwater. The effects of saturated and unsaturated flow on the survival and transport of a virus, MS-2 bacteriophage, were compared. The viruses were added to well water and applied to soil columns 0.052 m in diameter and 1.05 m long. The soil material was Vint loamy fine sand (a sandy, mixed, hyperthermic Typic Torrifluvent) mixed with recent alluvium. Samples of the soil water were taken daily at 0.20, 0.40, and 0.80 m depths through stainless steel samplers and at 1.05 m from the percolate leaving the column. For saturated flow the virus concentrations reached the influent concentration in less than two pore volumes (PV). For unsaturated flow the concentrations remained at levels much lower than the influent, ranging from 27% of inflow at 0.20 m (18 PV) to 5% at 1.05 m (3.3 PV). At the end of the experiments soil samples from each depth were assayed to determine virus adsorption to the soil. The average distribution coefficient of the unsaturated columns, 0.27, indicates very little adsorption. The number balance showed that only 39% of the unsaturated flow virus were accounted for. It appears that under unsaturated flow conditions enhanced inactivation of this virus occurs. (Author's abstract)
W91-01008

NUTRIENT EXPORT IN STORMFLOW FOLLOWING FOREST HARVESTING AND SITE-PREPARATION IN EAST TEXAS.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
W. H. Blackburn, and J. C. Wood.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 402-408, July/September 1990. 4 fig, 4 tab, 31 ref.

Descriptors: *Clear-cutting, *Forest management, *Nutrient transport, *Water pollution sources, Agricultural practices, Field tests, Small watersheds, Storm runoff, Texas, Water quality, Water quality monitoring.

In December 1979 nine small (2.57 to 2.79 ha) watersheds in East Texas were instrumented to determine the effects on stormflow water quality of: (1) clearcutting, shearing, windrowing, and burning; (2) clearcutting, roller chopping, and burning; and (3) undisturbed control. Nutrient losses and concentrations, pH, electrical conductivity, and turbidity were not significantly different for all pre-treated watersheds. The first year following harvesting and site preparation, most nutrient losses and concentrations were greater from the sheared and cropped watersheds than from the undisturbed watersheds. Most nutrient losses and concentrations during the second and third post-treatment years were not significantly different from the chopped and undisturbed watersheds, but continued to be significantly greater from the sheared watersheds than from chopped or undisturbed watersheds. During the fifth post-treatment year all nutrient levels except for K(+) losses were not significantly different for all treatments. Although nutrient losses from all treatments were small, shearing and windrowing had the greatest impact on nutrient export. Roller chopping as applied in this study had a minimal impact on stormflow nutrient losses and should not degrade water quality. (Author's abstract)
W91-01009

BATCH LEACHING STUDIES OF RUNDLE OIL SHALE.
Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Coal Technology.
D. R. Jones.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 408-413, July/September 1990. 3 fig, 4 tab, 16 ref.

Descriptors: *Arsenic, *Australia, *Oil shale, *Oil wastes, *Path of pollutants, *Trace metals, Batch tests, Hydrogen ion concentration, Kerosene Creek, Leachates, Rundle prospect, Solid wastes, Telegraph Creek.

Disposal of overburden, waste shale, and retorted shale may pose a significant environmental problem in the commercial exploitation of the oil shale in the Rundle prospect near Gladstone, Australia. The leaching of Fe, Mn, Al, Zn, Cd, Pb, Ni, Cu, As, and Se from samples of raw and retorted Kerosene Creek seam oil shale and Telegraph Creek seam claystone from the Rundle oil shale deposit was studied over the pH range 2 to 9.5. Low pH values were used to simulate the effects of possible acidification that might occur by oxidation of pyrite contained in the solids. The variation in leachate composition with pH highlighted the shortcomings of any batch test that seeks to categorize the behavior of a waste material solely on the basis of extraction at a single pH value. In this context, the results provided by the Resource Conservation and Recovery Act (RCRA) toxicity and American Society for Testing and Materials (ASTM) leach tests were compared. The RCRA test would not have identified As as being a potential problem in leachate from the retorted shale, because, at pH 5, this element (in the form of arsenate) is strongly absorbed by the shale matrix. The natural pH of a slurry of this waste is, however, greater than 9. Under these conditions, As is the trace element present in the highest concentrations in the leachate. (Author's abstract)
W91-01010

DISSOLVED AND SUSPENDED SOLIDS TRANSPORT FROM COASTAL PLAIN WATERSHEDS.
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.

R. K. Hubbard, J. M. Sheridan, and L. R. Marti.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 413-420, July/September 1990. 5 fig, 1 tab, 30 ref.

Descriptors: *Dissolved solids, *Georgia, *Path of pollutants, *Sediment transport, *Suspended solids, *Water pollution sources, *Water quality, Base flow, Coastal plains, Sediment concentration, Sediment load, Small watersheds, Surface runoff.

Excessive amounts of dissolved or suspended solids in surface runoff or base flow may degrade the quality of streams, lakes, or other water bodies. Loads of dissolved or suspended solids in streamflow reflect the quality of water entering via surface runoff or base flow. This study was conducted to determine the concentrations and loads of dissolved and suspended solids in Coastal Plain streamflow; to examine relationships between concentrations. loads, and flow rate; and to determine overall streamflow water quality for these parameters. Dissolved solids and suspended sediment concentrations were determined on weekly or high flow storm event streamflow samples collected at gaging stations on three subwatersheds (B, 334.3 sq km; F, 114.9 sq km; and k, 16.7 sq km) of the Little River Watersheds located near Tifton, Georgia. Dissolved solids concentrations ranged from 19 to 59 mg/L, and generally decreased as per unit area instantaneous discharge rate increased. Suspended sediment concentrations ranged from 1 to 137 mg/L, and generally increased as per unit area discharge rate increased. Regression analyses showed strong correlation between log transforms of both dissolved solids load and suspended sediment load versus total monthly runoff (correlation coefficients of 0.97 and 0.79, respectively). Mean suspended sediment concentrations during high flow events were greater than means from the overall data set, while mean concentrations of dissolved solids were reduced relative to the overall data set. The results showed that dissolved solids are the major component of total solids in Coastal Plain streamflow. The mean dissolved and suspended sediment concentrations during the study were 67, 9, and 51 mg/L; and 14, 17, and 14 mg/L for watersheds B, F, and K, respectively. Overall, it was demonstrated that, as measured on these watersheds, Coastal Plain streamflow is of good quality in terms of both dissolved and suspended solids. This good quality may reflect land use practices designed to prevent soil erosion, but primarily reflects the Coastal Plain landform shape, which causes sediments eroded from the uplands to be deposited in the riparian zone before they can enter the streamflow. (Author's abstract)
W91-01011

FLUENCE OF WATER CHEMISTRY ON SPENDED SOLIDS IN COAL MINE SEDIENTATION PONDS.
ntucky Agricultural Experiment Station, Lexton. Dept. of Agronomy.
r primary bibliographic entry see Field 5D.
91-01013

FECT OF CONVENTIONAL VS. NO-TILLE ON PESTICIDE LEACHING TO SHALW GROUNDWATER.
ricultural Research Service, Beltsville, MD.
R. Isensee, R. G. Nash, and C. S. Helling.
rnal of Environmental Quality JEVQAA, Vol. No. 3, p 434-440, July/September 1990. 6 fig, 1 23 ref.

criptors: *Agricultural practices, *Groundwatollution, *Maryland, *No-till cultivation, *Path pollutants, *Pesticides, Beltsville, Confined undwater, Leaching, Monitoring wells, Rainfall act, Tillage, Unconfined groundwater.

eld site was established at Beltsville, Maryland, 986 to assess the effect of conventional and nocultural practices on the movement of pesti- s into shallow groundwater. Groundwater ples taken from unconfined (<1.5 m deep) and fined (>3 m deep) monitoring wells in 1986- were analyzed for atrazine, deethylatrazine, hlor, cyanazine, and carbofuran. Atrazine was d in groundwater all year, while cyanazine, alachlor, and carbofuran were present only for a short period (<3 mo) after pesticide application. Fairly constant background levels of <0.5 microg/L atrazine were found under fields treated before 1986, while levels under continuously treated fields were <2.0 microg/L for 22 of 25 samplings. Pesticide residues in unconfined groundwater were usually higher (ca. 2 to 4 fold) than in confined groundwater. Rainfall timing relative to pesticide application was critically important to pesticide leaching. A prolonged rain immediately after the 1988 application resulted in peak atrazine and cyanazine levels ca. 200 microg/L in unconfined and 30 to 40 microg/L in confined groundwater, which resulted in short term levels 2 to 50 fold greater under no-till than conventional till plots. The results suggest that preferential transport occurred. (Author's abstract)
W91-01014

NITRATE CONTAMINATION OF GROUNDWATER UNDER IRRIGATED COASTAL PLAIN SOILS.
Maryland Univ., College Park. Dept. of Agronomy.
R. R. Weil, R. A. Weismiller, and R. S. Turner.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 441-448, July/September 1990. 3 fig, 7 tab, 12 ref.

Descriptors: *Groundwater pollution, *Nitrates, *Nonpoint pollution sources, *Path of pollutants, *Water pollution sources, Agricultural runoff, Coastal plains, Denitrification, Fertilizers, Forests, Irrigation effects, Leaching, Manure, Maryland, Monitoring wells, Seasonal variation.

To develop best management practices (BMP) for agricultural land to protect groundwater, data is needed on the leaching of N from irrigated coastal plain soils treated with poultry manure. This study was conducted to determine the vertical and seasonal patterns of nitrate leaching under such soils. Four commercially farmed corn (Zea mays L.) fields were studied, two receiving only fertilizer N (240-360 kg N/ha over a two year period) and two with a continuing history of poultry manure applications (25-29 Mg/ha over 2 yr). In each field, a transect of four monitoring wells was installed 4 to 8 m deep (1 m below the seasonally low water table). Three additional wells were installed in forestland adjacent to three of the fields. Groundwater and soils (to 1.5 m depth) were periodically sampled for analysis of nitrate N. Under the unmanured field, groundwater nitrate N concentrations averaged 15.1 mg/L during August through November 1986, while the corresponding figure for the manured fields was not significantly different at 18.3 mg/L. Two months after spreading manure in November and December, as much as 104 mg/L nitrate N was measured in the groundwater under the manured fields. From December 1986 through September 1987 the groundwater under the manured fields had significantly higher nitrate N concentrations than did that under the unmanured fields (43.7 vs. 18.1 mg/L, respectively). Only for one well site with a buried A horizon did high Cl to nitrate N ratios and low nitrate N concentrations indicate rapid denitrification. The forestland groundwater always contained <1 mg/L nitrate N, and high Cl to nitrate N ratios, suggesting that nitrate in the cropland groundwater was lost after entering the forested areas, and that forests may therefore protect waterways from subsurface N contamination. (Author's abstract)
W91-01015

NITRATE LEACHING FROM SYSTEMATICALLY TILED POTATO FIELDS IN NEW BRUNSWICK, CANADA.
Agriculture Canada, Fredericton (New Brunswick). Research Station.
P. Milburn, J. E. Richards, C. Gartley, T. Pollock, and H. O'Neill.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 448-454, July/September 1990. 2 fig, 5 tab, 34 ref.

Descriptors: *Agricultural runoff, *Crops, *Drainage, *Nitrates, *Nonpoint pollution sources, *Path of pollutants, *Water pollution sources, Canada, Fertilizers, Leaching, Mineralization, New Brunswick, Nitrogen, Potatoes, Seasonal variation, Water quality.

Flow volumes and nitrate N concentrations of drain discharge from five systematically tiled, commercial potato (Solanum tuberosum L.) fields were measured from April to December, 1987 and 1988 to assess the potential for nitrate N leaching associated with current production practices. The sites, located in New Brunswick, Canada, ranged from 3 to 10 ha and varied in fertilizer application rate, cropping practices, rainfall, and duration of data collection (the last due to site access difficulties in the spring). Three of the five sites were representative of intense potato rotations, whereas the remaining two were representative of land conversions into potato production from more passive, low input production systems. Ten site-years of data were collected. Drain outflow volumes averaged 75 and 115 mm per unit area in 1987 and 1988, respectively. Considerable drain flow occurred during snowmelt each year before data collection began. Measured nitrate N concentrations ranged from 1 to 65 mg/L and there were substantial variations within flow events. The flow weighted average annual nitrate concentrations of the drainage effluent were greater than or equal to 10 mg/L for potato site-years, regardless of whether the sites were established potato rotation fields or not. The flow weighted nitrate concentrations of the established potato rotation sites also remained >10 mg/L for the first non-potato year following a potato year. The flow weighted nitrate concentration of one potato rotation site was more than double that of the other two sites. Incubation studies showed that the soil at this site had considerably more potential to mineralize N than the other two sites. Total nitrate N leaching for the potato site-years for the measured April to December periods ranged from 5 to 33 kg N/ha. More work, under controlled conditions, is required to determine both dormant and growing season nitrate N leaching associated with various potato production systems. (Author's abstract)
W91-01016

ASSESSMENT OF CUMULATIVE IMPACTS TO WATER QUALITY IN A FORESTED WETLAND LANDSCAPE.
Clemson Univ., Georgetown, SC. Belle W. Baruch Forest Science Inst.
For primary bibliographic entry see Field 4C.
W91-01017

LEACHING OF RADIONUCLIDES FROM DECAYING BLUEBERRY LEAVES: RELATIVE RATE INDEPENDENT OF CONCENTRATION.
Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
S. C. Sheppard, and W. G. Evenden.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 464-469, July/September 1990. 1 fig, 2 tab, 24 ref.

Descriptors: *Food chains, *Leaching, *Path of pollutants, *Radioisotopes, *Sediment transport, Cesium radioisotopes, Decomposition, Iodine radioisotopes, Leaves, Mathematical models, Radiochemical analysis, Selenium radioisotopes, Uranium radioisotopes, Vegetation effects.

Leaching of radionuclides from decaying vegetation has not been extensively investigated, especially for radionuclides other than Cs-137. Leaves of blueberry (Vaccinium angustifolium x V. corymbosum) were obtained that contained over 25-fold ranges in Se, Cs, and I concentrations, as well as a small quantity of leaves containing detectable U. All were contaminated by way of root uptake. Leaching took place for a period of 1 yr in the laboratory using leach water from forest litter. Monthly measurements were made of the radionuclide contents and decaying leaf dry weights. The data conformed to an exponential decay model with two first-order components. In no case did the relative loss rates vary systematically with the initial tissue radionuclide concentrations. Loss rates decreased in the order Cs>I>U>dry wt>Se. Because of the low leaching rate of Se

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relative to the loss of dry weight, decaying litter may actually accumulate elements such as Se. Accumulation of radionuclides in litter could have important implications for lateral transport, recycling, and direct incorporation into edible mushrooms. (Author's abstract)
W91-01018

AEROBIC AND ANAEROBIC DEGRADATION OF ALACHLOR IN SAMPLES FROM A SURFACE-TO GROUNDWATER PROFILE.
Agricultural Research Service, Stoneville, MS. Southern Weed Science Lab.
J. V. Pothuluri, T. B. Moorman, D. C. Obenhuber, and R. D. Wauchope.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 525-530, July/September 1990. 2 fig, 4 tab, 26 ref.

Descriptors: *Alachlor, *Biodegradation, *Fate of pollutants, *Georgia, *Herbicides, *Soil contamination, Aerobic conditions, Anaerobic conditions, Aquifer testing, Microbial degradation, Plains, Vadose zone.

Estimates of pesticide degradation rates in subsoils are needed to improve models predicting pesticide movement to groundwater. Biodegradation rates of the herbicide alachlor (2-chloro-(2,6-diethylphenyl)-N-(methyoxymethyl)acetamide) in surface soil, vadose zone, and aquifer samples collected from a single site near Plains, Georgia were determined in the laboratory under aerobic and anaerobic conditions. Degradation was described by first-order kinetics during 126 d of incubation. Under aerobic conditions the halflife of alachlor in the surface soil (23 d) was less than in the vadose zone (73-285 d) and aquifer samples (320-324 d). Alachlor in anaerobic samples degraded less rapidly in the surface (0 to 0.6 m) and the next deepest (0.6 to 2.4 m) subsoil than under aerobic conditions (halflife of 100 and 144 d, respectively). Degradation in anaerobic aquifer samples was very slow (halflife of 337 to 553 d). Addition of organic nutrients enhanced aerobic degradation in subsurface soils and one aquifer sample, indicating that nutrient availability limits biodegradation. Total aerobic microbial populations ranged from 6.6 x 10(3) to 2.5 x 10(6) cells per gram of soil in the subsoils and aquifer samples, but were not correlated with aerobic or anaerobic degradation rates. The lower degradation rates in vadose zone and aquifer materials may be due to less microbial activity or the absence of alachlor degraders. (Author's abstract)
W91-01019

METOLACHLOR TRANSPORT IN SURFACE RUNOFF.
Trent Univ., Peterborough (Ontario). Dept. of Geography.
J. M. Buttle.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 531-538, July/September 1990. 7 fig, 5 tab, 23 ref.

Descriptors: *Agricultural runoff, *Herbicides, *Metolachlor, *Ontario, *Path of pollutants, *Water pollution, Adsorption, Agricultural practices, Canada, Sediment contamination, Soil contamination, Surface runoff, Transport.

In 1987 metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl) -N-(2-methoxy-1-methylethyl) acetamide) was applied to a 5.5 ha corn field in southern Ontario, Canada, in two separate areas: as a preemergence surface spray with cross-contour plowing and as a pre-plant incorporated treatment with contour plowing. The application rate for both treatments was 2.64 kg a.i./ha. Metolachlor concentrations in soils and in the dissolved and absorbed phases in runoff from natural rainstorms were monitored throughout the growing season. Persistence in soils decreased exponentially after application although there was evidence of temporary accumulation of metolachlor in footslope areas. Dissolved concentrations in runoff decreased with time while temporal trends in adsorbed concentrations reflected changes in metolachlor persistence in soils. Average ratios of adsorbed to dissolved herbicide concentrations ranged from 7 to 57, and were dependent upon hydrological and pedologic conditions within the treatments. Sediment carried between 9 to 58% of the total metolachlor yield from runoff plots during individual storms, and 20 to 46% of the total yield over the monitoring period. Herbicide incorporation and contour plowing led to significant reductions in dissolved and adsorbed concentrations, and in total metolachlor loss in runoff, relative to application as a preemergence spray with cross-contour plowing. Incorporation was associated with an increase in the relative importance of sediment in metolachlor transport. Variations in herbicide losses and the relative importance of transport vectors within a given treatment were linked to local hydrological processes. (Author's abstract)
W91-01020

ASSESSMENT OF MANAGEMENT PRACTICES FOR REDUCING PESTICIDE RUNOFF FROM SLOPING CROPLAND IN ILLINOIS.
Illinois Natural History Survey, Champaign.
For primary bibliographic entry see Field 5G.
W91-01021

ATRAZINE AND BROMIDE MOVEMENT THROUGH A SILT LOAM SOIL.
Agricultural Research Service, Beltsville, MD. Environmental Chemistry Lab.
J. L. Starr, and D. E. Glotfelty.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 552-558, July/September 1990. 7 fig, 2 tab, 16 ref.

Descriptors: *Agricultural chemicals, *Agricultural practices, *Atrazine, *Bromides, *Leaching, *Path of pollutants, *Pesticides, Cultivation, Groundwater pollution, Soil cores, Soil types, Tillage.

The movement of agrochemicals through soil to groundwater is affected by soil properties, soil management, timing of leaching events, and kinetics of the transformation processes. This study was conducted to determine the pattern(s) of movement of Br and atrazine (2-chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine) through a field soil as affected by plow-till and conservation-till corn (Zea mays L.) under severe leaching conditions. The soil surface inside double-ring infiltrometers was sprayed with chemicals. One week later 10 cm of solution was applied under ponded flow conditions, and soil cores removed the next day for chemical analysis. The distribution patterns of Br and atrazine with soil depth were quite similar, with the largest proportion of the chemicals observed in the surface horizon, yet all cores showed some movement of chemicals to the deepest sampling depth (90 cm). However, on average <50% of the applied water, Br, and atrazine could be found. Two quite different processes seem to be involved in the movement of these chemicals through this soil: one-dimensional movement through the soil matrix and rapid downward movement through macropores which bypassed most of the soil matrix. The data suggest that the leaching losses of agrochemicals during the typical leaching season in eastern regions of the U.S. (fall to spring), may not be greatly affected by tillage. (Author's abstract)
W91-01022

SORPTION OF NAPROPAMIDE ON CLAY AND SOIL IN THE PRESENCE OF DISSOLVED ORGANIC MATTER.
National Taiwan Univ., Taipei. Dept. of Agricultural Chemistry.
D.-Y. Lee, W. J. Farmer, and Y. Aochi.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 567-573, July/September 1990. 3 fig, 5 tab, 14 ref.

Descriptors: *Napropamide, *Organic matter, *Path of pollutants, *Pesticides, *Soil contamination, *Sorption, Clays, Dissolved solids, Isotherms, Nonionic pesticides, Sediments, Soil types.

Dissolved organic matter (DOM) can affect the distribution of solutes between solution and sorbed phases and the availability and environmental fate of the solutes. Batch sorption isotherm techniques were used to evaluate solute-solute and solute-sorbent interactions that control the effects of DOM on the sorption of a nonionic, moderately polar organic solute by solid sorbents. The sorption of napropamide (2-(alpha-naphthoxy-N,N-diethyl propionamide) by Na-, Cu-, and Al-montmorillonite decreased when dissolved humic acid derived from peat was present in the slurry. For Na-montmorillonite, the effect of DOM on sorption was reduced when a dialysis membrane prevented the contact between the DOM and the clay. This suggests that competition for sorption sites on the clay between DOM and the pesticide contributed to decreased napropamide sorption. The extent of the DOM effect was also dependent on the concentration and the source of DOM added. In contrast to the montmorillonite system, the effect of DOM on napropamide sorption by soil was observed only when the dialysis membrane was present or when the dissolution of native organic matter from the sorbate surface itself was enhanced by increasing the pH of the slurry system. These results demonstrate that the effect of DOM on the sorption of nonionic pesticides by soils and sediments can be a function of the association of DOM with pesticides in the solution phase, interactive forces of both DOM and the pesticide with the sorbent surface, and the nature of the sorbent surface. (Author's abstract)
W91-01023

BEHAVIOR OF TOLUENE ADDED TO SLUDGE-AMENDED SOILS.
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
Y. Jin, and G. A. O'Connor.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 573-579, July/September 1990. 5 fig, 3 tab, 22 ref. USEPA Cooperative Agreement CR-812687-02.

Descriptors: *Fate of pollutants, *Organic compounds, *Path of pollutants, *Sludge utilization, *Soil contamination, *Toluene, Adsorption, Organic carbon, Sludge, Sludge-treated soils, Soil types, Volatilization, Waste disposal.

Toluene is a priority pollutant that can be introduced to soils in a variety of wastes, including some municipal sludges. Laboratory experiments were conducted to study the behavior of toluene in two soils in the presence and absence of municipal sludge. Sludge additions increased toluene adsorption in two soils because of increased organic C content. The source of organic C (soil or sludge) and soil clay content also influenced toluene adsorption. Toluene adsorption-desorption was reversible in one soil, but slightly hysteretic in the other soil. An air-flow incubation system was used to evaluate toluene volatilization and degradation. The primary fate of surface-applied toluene in both soils was volatilization. Toluene volatilization rates were independent of sludge treatments. Toluene degradation was negligible in all treatments because of rapid volatilization losses. Despite increased toluene adsorption in the presence of sludge and reduced volatilization in saturated soils, gaseous transfer dominated all soils and treatments so that no toluene remained after 10 d. (Author's abstract)
W91-01024

EFFECT OF MUNICIPAL SEWAGE SLUDGE APPLICATION ON GROWTH OF TWO REVEGETATION SHRUB SPECIES IN COPPER MINE SPOILS.
Brigham Young Univ., Provo, UT. Dept. of Agronomy and Horticulture.
B. R. Sabey, R. L. Pendleton, and B. L. Webb.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 580-586, July/September 1990. 7 tab, 46 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Path of pollutants, *Plant growth, *Sludge, *Sludge utilization, *Waste disposal, Copper mine spoils, Grasses, Growth rates, Land reclamation, Nutrients, Shrubs, Soil management.

Municipal sludge has been used for many years to improve chemical, physical, and biological properties of agricultural soils. One-year old transplants of fourwing saltbush (Atriplex canescens (Pursh) Nutt.) and mountain big sagebrush (Artemisia tridentata ssp. vaseyana (Rybd.) Beetle) were grown for 9 mo in large greenhouse pots containing copper mine spoil material amended with one of three rates of municipal sewage sludge. Sludge was thoroughly mixed with the soils in some pots and concentrated around the root plug in others. Additionally, some pots were seeded with western wheatgrass (Agropyron smithii Rydb.) to determine whether the presence of grasses would affect shrub response to sludge addition in low pH copper mine spoils. Growth of fourwing saltbush was enhanced from 38-fold to over 300-fold by the addition of sewage sludge. Growth of big sagebrush was increased over six-fold. This was likely the result of increased N, P, and K availability although improved biological and physical properties of the spoil-sludge mix may also have been factors. The addition of western wheatgrass to pots containing fourwing saltbush caused a decrease in shrub growth, undoubtedly due to competition for nutrients and other plant growth factors. At the conclusion of the study, shrub leaves contained high levels of Cd and Pb, reflecting the high Cd and Pb content of the growth medium. Zn, Cu, Mn, and Fe levels were also largely higher than are typical for plant tissue. Shrubs grown in pots in which sludge additions were concentrated around the root plug accumulated more heavy metal than did mixed treatments. Grass tissue did not accumulate excessively high quantities of heavy metals, with the exception of Cu. (Author's abstract)
W91-01025

ADSORPTION, DEGRADATION, AND PLANT AVAILABILITY OF 2,4-DINITROPHENOL IN SLUDGE-AMENDED CALCAREOUS SOILS.
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
G. A. O'Connor, R. J. Lujan, and Y. Jin.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 587-593, July/September 1990. 2 fig, 4 tab, 14 ref. U.S. EPA Cooperative Agreement CR-812687-02.

Descriptors: *Biodegradation, *Dinitrophenol, *Fate of pollutants, *Organic compounds, *Path of pollutants, *Sludge, *Sludge utilization, *Soil contamination, Adsorption, Calcareous soils, Degradation, Groundwater pollution, Leaching, Plant uptake, Soil treatment.

2,4-Dinitrophenol (DNP) is a moderately weak acid that is expected to be highly labile (leachable and plant available) in high-pH soils. The adsorption and degradation behavior of DNP in two sludge-amended, calcareous soils was determined and used to explain DNP uptake by plants grown in the soils in the greenhouse. The DNP adsorption was minor in both soils and was only slightly affected by sludge. The DNP degradation was rapid in both soils and was unaffected by sludge. Thus, despite limited soil adsorption, plant uptake of DNP was minor in all crops and plant parts owing to rapid soil DNP degradation. Even if a municipal sludge highly contaminated with DNP was identified (an unlikely occurrence), concerns over possible plant contamination should not limit sludge application to calcareous soils at agronomic rates. Rapid degradation will minimize opportunities for plant uptake of DNP from contaminated soils or leaching of DNP to groundwater, given careful water management. (Author's abstract)
W91-01026

PLANT UPTAKE OF PENTACHLOROPHENOL FROM SLUDGE-AMENDED SOILS.
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
G. A. Bellin, and G. A. O'Connor.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 598-602, July/September 1990. 1 fig, 1 tab, 21 ref. U.S. EPA Cooperative Agreement CR-812687-02.

Descriptors: *Bioaccumulation, *Fate of pollutants, *Organic compounds, *Path of pollutants, *Pentachlorophenol, *Plant uptake, *Sludge, *Sludge utilization, *Soil contamination, Alkaline soils, Crops, Degradation, Food chains, Radioisotopes, Soil treatment.

A greenhouse study was conducted to determine the effects of sludge on plant uptake of (C-14)-pentachlorophenol (PCP). Plants included tall fescue (Festuca arundinacea Schreb.), lettuce (Latuca sativa L.), carrot (Daucua carota L.), and chile pepper (Capsicum annum L.). Minimal intact PCP was detected in the fescue and lettuce by gas chromatography/mass spectrometry (GC/MS) analysis. No intact PCP was detected in carrot tissue extracts. Chile pepper was not analyzed for intact PCP because methylene chloride extracts contained minimal C-14. The GC/MS analysis of soil extracts at harvest suggested a half-life of PCP of about 10 d, independent of sludge rate or PCP loading rate. Rapid degradation of PCP in the soil apparently limited PCP availability to the plant. Bioconcentration factors (dry plant wt/initial soil PCP concentration) based on intact PCP were <0.01 for all crops, suggesting little PCP uptake. Thus, food chain crop PCP uptake in these alkaline soils should not limit land application of sludge. (Author's abstract)
W91-01027

SORPTION AND DEGRADATION OF PENTACHLOROPHENOL IN SLUDGE-AMENDED SOILS.
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
C. A. Bellin, G. A. O'Connor, and Y. Jin.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 603-608, July/September 1990. 4 fig, 1 tab, 22 ref. U.S. EPA Cooperative Agreement CR-812687-02.

Descriptors: *Biodegradation, *Fate of pollutants, *Organic compounds, *Path of pollutants, *Pentachlorophenol, *Sludge, *Sludge utilization, *Soil contamination, Acidic soils, Alkaline soils, Degradation, Leaching, Radioisotopes, Soil treatment, Sorption.

Sorption and degradation of pentachlorophenol (PCP) by two alkaline and one acid soil was studied in the presence and absence of sewage sludge. The PCP concentrations used (0.1-10 mg/kg) included PCP rates expected with land application of normal municipal sewage sludges. Sorption/desorption isotherms, derived using batch equilibrium techniques, were described by the Freundlich equation. The PCP sorption increased with increasing sludge additions. Desorption in the alkaline soils was completely reversible and no irreversible residues were formed. Leaching of PCP would be most likely in the unamended alkaline soils. Degradation of PCP at low (0.75 mg/kg) initial concentration was rapid (half-life of 10-15 d) in alkaline soils, but much slower (half-life of approximately 38 d) in the acid soils. Sludge additions to the soils did not substantially affect PCP degradation. More rapid degradation of PCP in alkaline vs. acid soils was attributed to less sorption and more favorable conditions for microbial activity. Rapid degradation in the alkaline soil, and greater sorption in the acid soil, reduce the chance of PCP leaching. However, longer PCP residence times in the acid soil increase the possibility for plant uptake. (Author's abstract)
W91-01028

NITRIFICATION IN SLUDGE-AMENDED MICHIGAN FOREST SOILS.
Michigan State Univ., East Lansing. Dept. of Forestry.
For primary bibliographic entry see Field 5E.
W91-01029

PRECIPITATION NUTRIENT INPUTS IN SEMIARID ENVIRONMENTS.
Agricultural Research Service, Tucson, AZ. Aridland Watershed Management Research Unit.
For primary bibliographic entry see Field 2B.
W91-01030

OUTBREAK OF PONTIAC FEVER DUE TO LEGIONELLA ANISA.
Santa Clara County Health Dept., San Jose, CA.
For primary bibliographic entry see Field 5C.
W91-01032

IDENTIFYING FLOW PATHS IN MODELS OF SURFACE WATER ACIDIFICATION.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. B. Beck, F. M. Kleissen, and H. S. Wheater.
Reviews of Geophysics RVGPB4, Vol. 28, No. 2, p 207-230, May 1990. 18 fig, 1 tab, 36 ref.

Descriptors: *Acid rain effects, *Acidic water, *Acidification, *Flow models, *Model studies, *Path of pollutants, *Surface water, Coefficients, Flow pattern, Glasgow, Mathematical models, On-site data collections, Scotland, Surface flow, Tracers, Uncertainty.

A clear identification of the movement of water through soils is of central importance to the characterization of surface water acidification. The problem of how a uniquely best set of values for the coefficients of simple models can be estimated from field observations, in particular, tracer observations was explored. Two external observation couples, precipitation/flow and concentrations of a conservative tracer, have been used in the conceptual modeling of the acidification of surface waters. A method for the analysis of model identifiability includes: (1) the postulation of a set of experimental field conditions with their associated assumptions of observation accuracy; (2) the postulation of a model and its associated uncertainties; and (3) the exploration of the identifiability of the model's constituent parameters (hypotheses). A (U.K.) Royal Society's Surface Water Acidification Programme field site situated 40 km north of Glasgow was the subject of an analysis of model uncertainty. For a one-store model, with no observations of the tracer, the proportionality constant, k(a), was relatively well identified when first events occurred after dry periods while the accuracy of the estimate progressively declined during wet periods. When observations of the tracer were included, k(a) was much better identified. For a two-store nonlinear model, tracer observations improved the identifiability of parameters, and the relative identifiability of the model parameters was analyzed. The skill in predicting future behavior in flow paths in a catchment will lie in locating the ambiguity in the model and making predictive statements that are minimally sensitive to it. (MacKeen-PTT)
W91-01033

ESTIMATION OF AMMONIFICATION AND AMMONIUM ASSIMILATION IN SURFICIAL COASTAL AND ESTUARINE SEDIMENTS.
Tokyo Univ. (Japan). Ocean Research Inst.
For primary bibliographic entry see Field 2L.
W91-01035

MICROBIAL BIOMASS IN THE COASTAL PLUME OF CHESAPEAKE BAY: PHYTOPLANKTON-BACTERIOPLANKTON RELATIONSHIPS.
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 2L.
W91-01036

PERIODIC BACTERIVORE ACTIVITY BALANCES BACTERIAL GROWTH IN THE MARINE ENVIRONMENT.
Umea Univ. (Sweden). Dept. of Microbiology.
For primary bibliographic entry see Field 2L.
W91-01037

BIOGEOCHEMISTRY OF CARBON IN THE AMAZON RIVER.
Washington Univ., Seattle. School of Oceanography.
J. E. Richey, J. I. Hedges, A. H. Devol, P. D. Quay, and R. Victoria.

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Limnology and Oceanography LIOCAH, Vol. 35, No. 2, p 352-371, March 1990. 9 fig, 3 tab, 54 ref. NSF Grants DEB 81-07522 and BSR 83-16359.

Descriptors: *Amazon River, *Biochemistry, *Biogeochemistry, *Carbon cycle, *Dissolved organic carbon, *Geochemistry, *Nutrients, *Organic carbon, *Suspended sediments, Carbon dioxide, Chemical properties, Dissolved oxygen, Dissolved solids, Solute transport.

Depth-integrated, discharge-weighted water samples were collected over 1,800 km of the Amazon River on eight cruises at different stages of the hydrograph, 1982-1984. Fine (FPOC, < 63 microns) and coarse (CPOC, > 63 microns) particulate organic carbon as weight percentage of suspended sediment varied between 0.9-1.5% for FPOC and 0.5-3.4% for CPOC. Concentrations of FPOC ranged from 5 mg/liter upriver to 2 mg/liter downriver in the mainstem and from 6 mg/liter in the Rio Madeira to < 1 in the Rio Negro. CPOC had similar distribution patterns, but with concentrations 15-30% those of FPOC. Dissolved organic carbon (DOC) averaged 4-6 mg/liter in the mainstem and up to 12 mg/liter in the Rio Negro. Upriver dissolved inorganic carbon (DIC) concentrations of about 1,200 micromolar were diluted by tributaries and floodplain drainage to 600 micromolar at the most downriver site. Evasion of CO2, invasion of O2, and in situ oxidation were of comparable magnitude, 3-8 micromoles/square meter/s. The average export of total organic carbon (TOC) was 36.1 terragrams/yr (8.5 g/square meter/yr), of which 62% was DOC, 34% was FPOC, and 4% was CPOC. TOC inputs were insufficient to support in situ oxidation by a factor of at least two. A relatively small, rapidly cycling pool of labile organic matter may coexist with a much larger pool of more refractory material. (Author's abstract)
W91-01039

RAPID AMMONIUM CYCLING AND CONCENTRATION-DEPENDENT PARTITIONING OF AMMONIUM AND PHOSPHATE: IMPLICATIONS FOR CARBON TRANSFER IN PLANKTONIC COMMUNITIES.
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
For primary bibliographic entry see Field 2H.
W91-01043

DISTRIBUTION OF LABILE DISSOLVED ORGANIC CARBON IN LAKE MICHIGAN.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W91-01044

PLASMA CHLOROFORM CONCENTRATIONS IN SWIMMERS USING INDOOR SWIMMING POOLS.
Modena Univ. (Italy). Ist. di Igiene.
G. Aggazzotti, G. Fantuzzi, P. L. Tartoni, and G. Predieri.
Archives of Environmental Health AEHLAU, Vol. 45, No. 3, p 175-179, 1 fig, 2 tab, 15 ref, May/June 1990.

Descriptors: *Chlorination, *Chloroform, *Public health, *Swimming pools, *Water treatment, Biochemistry, Gas chromatography, Italy, Modena, Recreation, Statistical analysis.

The chloroform content of swimmers and visitors who were exposed to chloroform (CHCl3) at three indoor swimming pools in Modena, Italy were evaluated. Chloroform was measured in plasma samples of 127 subjects present at the pools and in 40 nonexposed subjects. The analyses were performed by head-space gas chromatography. Chloroform was present in all samples collected from the 127 subjects who attended the pools (median = 7.5 nmol/L; range = 0.8-25.1 nmol/L. Swimmers who trained for competitions showed a significantly higher mean value of plasma CHCl3 than nonagonistic swimmers and visitors. Plasma CHCl3 levels were significantly correlated with: (1) CHCl3 concentrations in water and in environmental air; (2) the number of swimmers in the pools, and; (3) the time spent swimming. Covariance analysis showed that plasma CHCl3 levels also depended on the intensity of the sport activity (total explained variance = 67.4%). (Author's abstract)
W91-01053

INVESTIGATION OF THE METAL-ALGAE BINDING SITE WITH 113-CD NUCLEAR MAGNETIC RESONANCE.
Texas Univ. at Austin. Dept. of Chemistry.
V. Majidi, D. A. Laude, and J. A. Holcombe.
Environmental Science and Technology ESTHAG, Vol. 24, No. 9, p 1309-1312, September 1990. 4 fig, 15 ref.

Descriptors: *Algae, *Bioaccumulation, *Cadmium, *Fate of pollutants, *Heavy metals, *Nuclear magnetic resonance, *Path of pollutants, Biochemistry, Cadmium radioisotopes, Cobalt, Copper, Hydrogen ion concentration, Iron, Sodium.

Metal-algae interactions in a unialgal culture (Stichococcus bacillaris) were examined with 113-Cd nuclear magnetic resonance (NMR) spectroscopy. In addition to a peak which was attributed to cadmium in solution, a second broad resonance was assigned to cadmium binding with the algal cell wall. Studies of competitive uptake with other metals permit an affinity ranking assigned as Cu, Fe, > Cd, Co, and Na. pH studies indicate that although the presence of protons in the solution does not chemically alter the nature of the binding sites, the excess protons will directly replace the bound Cd. An NMR chemical shift of -10 to -18 ppm for the bound cadmium indicates the functional group responsible for metal uptake is most likely a carboxylic group. The chemical shift of the resonance also suggests the carboxyl groups involved in metal adsorption may possess larger chain lengths and perhaps multiple carboxyl groups per chain. (Author's abstract)
W91-01060

VARIATIONS IN SUSPENDED SEDIMENT AND ASSOCIATED TRACE ELEMENT CONCENTRATIONS IN SELECTED RIVERINE CROSS SECTIONS.
Geological Survey, Doraville, GA.
For primary bibliographic entry see Field 2J.
W91-01061

CADMIUM CONCENTRATIONS OF CRUSTACEAN ZOOPLANKTON OF ACIDIFIED AND NONACIDIFIED CANADIAN SHIELD LAKES.
Guelph Univ. (Ontario). Dept. of Zoology.
N. D. Yan, G. L. Mackie, and P. J. Dillon.
Environmental Science and Technology ESTHAG, Vol. 24, No. 9, p 1367-1372, September 1990. 2 fig, 3 tab, 41 ref.

Descriptors: *Acid rain effects, *Acidic lakes, *Bioaccumulation, *Cadmium, *Limnology, *Precambrian Shield Lakes, *Zooplankton, Canada, Crustaceans, Fate of pollutants, Lakes, Ontario, Organic carbon, Path of pollutants, Phosphorus, Plastic Lake, Seasonal variation, Temporal variation.

The cadmium in Epilimnetic zooplankton collected from 33 nonacidified, south central Ontario lakes, most of which were remote from local point sources of Cd emissions, ranged in concentration from 0.16 to 29.8 micro grams/gram of dry weight. Levels were positively correlated with aqueous Cd concentrations and negatively correlated with lake water Ca, organic carbon, and total phosphorous concentrations. A stepwise regression model developed for these lakes overestimated Cd concentrations in zooplankton from acidic (pH <5), clear water lakes, presumably because the acidity of these lakes depressed Cd uptake. Cd levels varied by 5 fold over the ice-free season in plastic lake, an acidifying lake in south central Ontario. While Cd levels were not correlated with zooplankton composition in the lake survey, temporal variations in Cd levels in Plastic Lake were attributed, in part, to seasonal and annual changes in zooplankton community structure in the lake. (Author's abstract)
W91-01062

MERCURY SPECIATION IN SURFACE FRESHWATER SYSTEMS IN CALIFORNIA AND OTHER AREAS.
California Univ., Santa Cruz. Inst. of Marine Sciences.
For primary bibliographic entry see Field 2K.
W91-01063

OCCURRENCE, DISTRIBUTIONS, AND TRANSPORT OF HERBICIDES AND THEIR DEGRADATION PRODUCTS IN THE LOWER MISSISSIPPI RIVER AND ITS TRIBUTARIES.
Geological Survey, Denver, CO.
W. E. Pereira, and C. E. Rostad.
Environmental Science and Technology ESTHAG, Vol. 24, No. 9, p 1400-1406, September 1990. 5 fig, 3 tab, 16 ref.

Descriptors: *Herbicides, *Mississippi River, *Path of pollutants, Agricultural runoff, Alachlor, Atrazine, Chemical analysis, Chlorinated hydrocarbons, Chloroacetanalide, Cyanazine, Gulf of Mexico, Metolachlor, Pollution load, Simazine, Triazines.

The Mississippi River and its tributaries drain extensive agricultural regions of the mid-continental US where large amounts of herbicides are applied as weed control agents on crops such as corn and soybeans. Studies being conducted by the US Geological Survey (USGS) along the lower Mississippi River and its major tributaries, representing a 1930-km river reach, have confirmed that several triazine and chloroacetanalide herbicides and their degradation products are present in this riverine system. These herbicides include atrazine, and its degradation products, desethl-, and desisopropylatrazine; cyanazine; simazine; metolachlor; and alachlor and its degradation products, 2-chloro-2',6'-diethylacetanalide, and 2-hydroxy-2',6'-diethylacetanilide. Loads of these compounds were determined at 17 different sampling stations under various seasonal and hydrologic conditions, during five sampling trips from July 1987 to June 1989. Stream loads of herbicides were relatively small during the drought of 1987 and 1988. Stream loads were much greater during the relatively wet year of 1989. Trace levels of atrazine, cyanazine, and metolachlor also were associated with suspended sediments. Distribution coefficients of these compounds varied considerably between sites and were much larger than values reported in the literature. The annual transport of atrazine into the Gulf of Mexico was estimated to be less than 2% of the amount of atrazine applied each year in the mid-west. (Author's abstract)
W91-01064

ENVIRONMENTAL FACTORS AFFECTING THE PRODUCTION OF PEPTIDE TOXINS IN FLOATING SCUMS OF THE CYANOBACTERIUM MICROCYSTIS AERUGINOSA IN A HYPERTROPHIC AFRICAN RESERVOIR.
Council for Scientific and Industrial Research, Pretoria (South Africa). Div. of Water Technology.
For primary bibliographic entry see Field 2H.
W91-01065

POLYCYCLIC AROMATIC HYDROCARBON EMISSIONS FROM THE COMBUSTION OF CRUDE OIL ON WATER.
National Inst. of Standards and Technology (NEL), Gaithersburg, MD.
B. A. Benner, N. P. Bryner, S. A. Wise, G. W. Mulholland, and R. C. Lao.
Environmental and Planning B. Planning & Design, Vol. 17, No. 1, p 1418-1427, 1990. 6 fig, 1 tab, 25 ref.

Descriptors: *Cleanup operations, *Environmental effects, *Incineration, *Oil pollution, *Polycyclic aromatic hydrocarbons, *Water pollution sources, *Water pollution treatment, Air pollution, Chemical analysis, In situ treatment, Organic carbon

An investigation was conducted concerning some of the factors necessary to assess the environmental impact of an in situ burn: the fraction of an oil layer that can be burned, the quantity of smoke, and the concentrations of 18 polycyclic aromatic hydrocarbons (PAHs) in the smoke, crude oil, and burn residue. Alberta Sweet crude in 2-, 3-, 5, 10, and 30-mm layers on water was burned and smoke samples were collected at elevated and ambient temperatures and analyzed by two independent laboratories. While burning the crude oil produced less total PAHs than were in the original crude oil, the concentrations of PAHs with five or more rings were 10 to 20 times greater in the smoke than in the oil. The organic carbon fraction of the smoke was in the range of 14-21%. As the fuel layer thickness was increased from 2 to 10mm, the smoke yield increased from 0.035 to 0.080 g of smoke/g of fuel, and the percentage of oil residue decreased from 46 to 17%. By consuming much of the oil spill and reducing the amount of PAHs in the water, and by dispersing the combustion products over a larger area, in situ burning can migrate the local environmental impact of an oil spill. There appears to be a range of conditions, such as in Arctic ice fields, where in situ burning might be the most viable cleanup method. (Author's abstract)
W91-01066

CHEMICAL AND PHYSICAL SPECIATION OF TRACE METALS IN FINE GRAINED OVERBANK FLOOD SEDIMENTS IN THE TYNE BASIN, NORTH-EAST ENGLAND.
Newcastle upon Tyne Univ. (England). Dept. of Geography.
M. G. Macklin, and R. B. Dowsett.
Catena, Vol. 16, No. 4/5, p 135-151, August/October 1989. 8 fig, 1 tab, 24 ref.

Descriptors: *Chemical speciation, *England, *Flood plain sediments, *Heavy metals, *Path of pollutants, *Sedimentation, *Speciation, *Trace metals, Contamination, Metal complexes, Tyne Basin, Water pollution.

Deposition of fine sediment contaminated by heavy metals on floodplains in the Tyne Basin, north-east England, during a major flood in August 1986 provided an unusual opportunity to investigate the physical and chemical speciation of metals in overbank fines. Selective extractions and heavy-liquid analyses were used to assess the chemical forms of sediment-associated metal and the relationship between grain size, density and metal concentration and to identify sources of metalliferous material. Generally the highest concentrations of trace metals were found in the 500-250 microm size range and in the heavier density fractions (> 3.3 g/ml), though more than 60% of metals reported to the lightest (< 3.3 g/ml) density product. THe principal source of metals appeared to be reworked alluvium contaminated by historic mining activity. Metals concentrations in flood sediment decrease downstream from former mining areas at varying rates depending on the physical properties and chemical phase of individual metals. With the exception of copper (dominated by lithogenic fraction), metals are primarily associated with iron/manganese oxides (lead, zinc) and to a lesser extent with carbonates (cadmium, zinc), organic matter (zinc, copper) and an operationally defined exchangeable cadmium component. In the upper and middle parts of the Tyne basin physical processes of downstream sediment metal content reduction were found to predominate, while in the lower reaches of the Tyne sediment, metal transport appears to be governed by chemical sorption-desorption processes associated with iron/manganese oxides and organic material. Before employing sediment-density based dispersal models to predict downstream metal concentrations, grain size and density fractions must be ascertained for the majority of sediment-associated metals, and their chemical form as revealed by selective extraction techniques. (Brunone-PTT)
W91-01082

HYDROGEOLOGY AND HISTORICAL ASSESSMENT OF A CLASSIC SEQUENTIAL-AND USE LANDFILL SITE, ILLINOIS, USA.
Northern Illinois Univ., De Kalb. Dept. of Geology.
For primary bibliographic entry see Field 5F.
W91-01097

HEAVY METAL DISTRIBUTION IN SEDIMENTS OF KRISHNA RIVER BASIN, INDIA.
McGill Univ., Montreal (Quebec). Dept. of Geological Science.
R. Ramesh, V. Subranian, and R. Van Grieken.
Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 3, p 207-216, May/June 1990. 5 fig, 6 tab, 30 ref.

Descriptors: *Heavy metals, *India, *Krishna River, *Path of pollutants, *Suspended sediments, Topography, Trace metals, Water pollution, X-ray fluorescence.

Suspended and bed sediments collected from the entire region of the Krishna River and its major tributaries were analyzed for heavy metals (vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc, and lead) by the thin-film energy dispersive x-ray fluorescence technique. There is considerable variation in the concentration of elements proceeding downstream, which may be due to the variation in the subbasin geology and various degrees of human impact. Suspended particles have high concentrations of heavy metals throughout the basin bed sediments. The heavy metals are highest in coarse size fractions (10 to 90 microm) throughout the Krishna River except for the Bhima tributary where finer fractions (2 microm) dominate. Transition elements correlate very well with each other. There is a striking similarity between the bed sediments of Krishna River and the average for Indian rivers. When the annual heavy metal flux carried by the Krishna River was estimated, and viewed in relation to the other major riverine transport, the Krishna appears to be a minor contributor of heavy metals to the Bay of Bengal. (Author's abstract)
W91-01100

ENFORCEMENT OF FEDERAL UNDERGROUND STORAGE TANK REGULATIONS.
North Carolina Univ. at Wilmington. Dept. of Philosophy.
For primary bibliographic entry see Field 5G.
W91-01103

INTERACTION BETWEEN COMPONENTS OF ELECTROPLATING INDUSTRY WASTES, INFLUENCE OF THE RECEIVING WATER ON THE TOXICITY OF THE EFFLUENT.
Institut National de la Sante et de la Recherche Medicale, Villeneuve d'Ascq (France). Microbe Ecotoxicology Unit 146.
For primary bibliographic entry see Field 5C.
W91-01106

PHOSPHORUS IN WATERS FROM SEWAGE SLUDGE AMENDED LYSIMETERS.
Illinois Univ., Urbana. Dept. of Agronomy.
T. D. Hinesly, and R. L. Jones.
Environmental Pollution ENPOEK, Vol. 65, No. 4, p 293-309, 1990. 6 tab, 17 ref.

Descriptors: *Lysimeters, *Path of pollutants, *Phosphorus, *Sludge utilization, *Soil amendments, *Soil-water-plant relationships, Aluminum, Corn, Eutrophication, Fertilizers, Iron, Runoff, Tile drainage.

In surface waters, phosphorus (P) concentrations exceeding 0.05 mg/L may cause eutrophic conditions. Total P concentrations were measured in runoff and tile drainage waters from land receiving either inorganic fertilizer or anaerobically digested sewage sludge during two years of sample collections from instrumented, large-scale lysimeters planted to corn (Zea mays). During the three years prior to monitoring P concentrations, six of the lysimeter plots had been amended with anaerobically digested sewage sludge which supplied 5033 kg P per ha. Additional sludge applications supplied 1058 and 1989 kg P per ha during the first and second years of monitoring operations. Another six lysimeters were annually treated with fertilizer which included P applications amounting to 112 kg per ha. For years 1 and 2, annual losses from lysimeters treated with sewage sludge were 4.27 and 0.35 kg P per ha in runoff and 0.91 and 0.51 kg P per ha in drainage waters. Parallel annual losses of P from lysimeters treated with superphosphate were 2.15 and 0.17 kg P per ha in runoff and 0.53 and 0.35 kg P per ha in tile drainage waters. Sludge applications did not significantly change absolute soil contents of organic P, but did decrease the percent of total P present in organic forms. Sludge and soil contained 21% and 36% of their total P contents in organic forms. In sludge and soil about 85% and 64% of their respective total inorganic P contents were associated with the Al and Fe fractions. Sludge applications significantly increased soil contents of P in the saloid aluminum, iron and reductant soluble P fractions, but contents of calcium-bound P were not changed. Total P contents of the soil below a depth of 30 cm were not affected by sludge incorporated to a depth of about 15 cm by plowing. (Author's abstract)
W91-01107

GREEN OYSTERS CAUSED BY COPPER POLLUTION ON THE TAIWAN COAST.
National Taiwan Univ., Taipei. Inst. of Oceanography.
For primary bibliographic entry see Field 5C.
W91-01108

BIOACCUMULATION AND TOXICITY OF ZINC IN THE GREEN ALGA, CLADOPHORA GLOMERATA.
Polytechnic of Central London (England). Applied Ecology Research Group.
For primary bibliographic entry see Field 5C.
W91-01111

DENITRIFICATION IN NITRATE-RICH STREAMS: DIURNAL AND SEASONAL VARIATION RELATED TO BENTHIC OXYGEN METABOLISM.
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
For primary bibliographic entry see Field 2H.
W91-01142

COMPARISON OF THE ACIDIFICATION EFFICIENCIES OF NITRIC AND SULFURIC ACIDS BY TWO WHOLE-LAKE ADDITION EXPERIMENTS.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. W. M. Rudd, C. A. Kelly, D. W. Schindler, and M. A. Turner.
Limnology and Oceanography LIOCAH, Vol. 35, No. 3, p 663-679, May 1990. 7 fig, 4 tab, 58 ref. Dept. of Fisheries and Oceans, Govt. of Canada and NSERC Grants A2671 and OGPGP 010.

Descriptors: *Acid rain, *Acid rain effects, *Denitrification, *Lake acidification, *Limnology, *Nitric acid, *Sulfuric acid, Algal uptake, Sediment-water interfaces.

The acidification efficiencies of nitric and sulfuric acids were compared for 5 yr by separate experimental additions of the acids to the partitioned north and south basins of Lake 302. In the epilimnion, nitric acid was 70% as efficient as sulfuric acid in reducing alkalinity. On a whole-lake basis, acidification by nitric acid was about half as efficient as by sulfuric acid. In-lake processes removed 70 and 57% of the added nitric and sulfuric acids. Before acidification, algal uptake and sediment sulfate uptake were of about equal importance in terms of in-lake sulfate removal. Nitrate was primarily removed by algal uptake and sedimentation. After acidification, algal uptake of nitrate and sulfate did not change, but rates of uptake in the sediments by bacterial processes increased and dominated in-lake removal. Nitric acid acidified the north basin because the acid additions exceeded the capacity of all biological removal processes. Algal uptake and sedimentation of nitrogen could

not increase in proportion to increases in nitrate because of P limitation. Sediment-denitrification rates increased tremendously (about 40-fold) but only removed a portion of the incoming nitrate because denitrification was limited by the rate of transport to the sediment-water interface. (Author's abstract)
W91-01143

MIXING IN OVERLAND FLOW DURING RAINFALL.
Missouri Univ.-Columbia. Dept. of Civil Engineering.
R. L. Peyton, and T. G. Sanders.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 4, p 764-784, July/August 1990. 11 fig, 1 tab, 27 ref.

Descriptors: *Mathematical models, *Mixing, *Model studies, *Nonpoint pollution sources, *Overland flow, *Path of pollutants, *Rainfall-runoff relationships, *Water pollution sources, Convection, Data interpretation, Rainfall, Reynolds number, Turbulent flow.

Vertical mixing coefficients in overland flow is estimated with rainfall using laboratory data and a mathematical model of shear-flow convection, rainfall dilution and vertical mixing. The laboratory data consist of concentration-time measurements downstream from an injection of a conservative dye. The dye was injected into overland flow (during rainfall) over a smooth impervious surface with constant slope and without sediment. The flow is in the laminar Reynolds number range. Results of the mathematical model were compared to the concentration-time measurements to calibrate values of the vertical mixing coefficient. The calibrated values of the vertical mixing coefficient are most highly correlated to the slope and a Reynolds number related to rainfall intensity. An analysis of the calibrated vertical mixing coefficient values using equations for eddy turbulence did not prove satisfactory. (Author's abstract)
W91-01153

MERCURY CONTENT OF SWORDFISH, XIPHIAS GLADIUS, IN RELATION TO LENGTH, WEIGHT, AGE, AND SEX.
Universidade dos Acores, Horta (Portugal). Dept. de Oceanografia e Pescas.
L. R. Monteiro, and H. D. Lopes.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 6, p 293-296, June 1990. 4 fig, 3 tab, 28 ref.

Descriptors: *Bioaccumulation, *Bioindicators, *Mercury, *Swordfish, Heavy metals, Marine pollution, Water quality.

Levels of total mercury were determined in the white muscle tissue of swordfish, Xiphias gladius L., caught in the Azores, ranging in weight from 0.06 to 4.91 microgm/g. Mercury concentrations were studied in relation to length, weight, age and sex and significant sex-based differences were found. The rate of mercury accumulation in males is significantly faster than in females, and for medium-large sized fish, mean mercury levels were higher in males. The mean mercury level in males was 1.3 microgm Hg/g and 0.93 microgm Hg/g for females. Possible explanations involve the consideration of specific mechanisms of mercury elimination in females due to a different chemistry of gonad and gamete affecting the affinity of mercury and loss of residues in the sex products. Or, to a simple difference in the total amount of sperm and ova shed. Swordfish were shown to have a concentration factor of 300 compared to plankton. (King-PTT)
W91-01160

TISSUE DISTRIBUTION OF HEAVY METALS IN SMALL CETACEANS FROM THE SOUTHWESTERN ATLANTIC OCEAN.
Instituto Nacional de Investigacion y Desarrollo Pesquero, Mar del Plata (Argentina).
J. E. Marcovecchio, V. J. Moreno, R. O. Bastida, M. S. Gerpe, and D. H. Rodriguez.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 6, p 299-304, June 1990. 2 fig, 4 tab, 32 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Marine mammals, *Marine pollution, *Path of pollutants, Bioindicators, Bottlenose dolphins, Cetaceans, Copper, Ecosystems, Fate of pollutants, Mammals, Mercury, Pollutant identification, Tissue analysis, Whales, Zinc.

Tissue distribution of heavy metals, total mercury, cadmium, zinc, and copper, in specimens of Bottlenose Dolphin (Tursiops gephyreus), Franciscana Dolphin (Pontoporia blainvillei), and Pigmy Sperm Whale (Kogia breviceps) stranded on SW Atlantic beaches were studied by atomic absorption spectrophotometry. The liver was the most important site for the accumulation of Hg, Zn, and Cu in the specimens studied while the kidney was most important for Cd accumulation. Mercury contamination in Tursiop gephyreus increased with age, and therefore, correlated with its ichyophagus habits. The Franciscana had lower mercury levels than the bottlenose because of their younger ages and a diet which is heavier in squid and crustaceans. Also, mercury levels were higher in the muscle tissues of Franciscana than in their livers. The Franciscana can stay in very saline waters and their ability to maintain a salt balance may help to detoxify their livers. Maximum mercury concentrations in the pigmy sperm whales was 11.74 ppm, well below the level found in the Bottlenose Dolphin. The sperm whales were adults so this lower Hg level was probably the result of their diet of squid. The highest Cd, Zn and Cu levels were found in the kidneys of all three species. (King-PTT)
W91-01162

MERCURY NEAR A CAUSTIC SODA PLANT AT KARWAR, INDIA.
Central Marine Fisheries Research Inst., Cochin (India).
P. K. Krishnakumar, and V. K. Pillai.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 6, p 304-307, June 1990. 2 fig, 2 tab, 13 ref.

Descriptors: *India, *Karwar, *Marine pollution, *Mercury, *Path of pollutants, Arabian Sea, Atomic absorption spectrophotometry, Bioaccumulation, Chlorine, Heavy metals, Mackerel, Marine sediments, Pollutant identification, Sodium hydroxide, Water pollution sources, Water quality.

Every year 180 tons of mercury are added to the Indian environment, of which 160 tons comes from 38 caustic soda plants including 23 units which electrolyze sea water. A caustic soda plant has been in operation south of Karwar, India since 1975. This plant discharges into the Binage Bay, known for its mackerel fishery. In February 1989, samples of surface water and bottom water were taken from four stations near the discharge point of the caustic soda plant. Surface sediment samples were collected from 10 stations from September 1987 to May 1988. Samples of mussels, oyster and seaweed were taken from 12 stations along the Karwar coast from September 1987 to February 1989. Fish, prawn, crab, and squid samples were taken from commercial landings in Karwar. Mercury was determined by cold vapor atomic absorption spectrophotometry. The mercury concentration in the vicinity of the discharge was 0.91 microgm/g to 2.62 microgr/g compared to the 0.061 microgm/g average concentration in the Arabian Sea. Levels were higher for surface water than bottom water. Mercury levels were highest in oysters and second highest in mussels, seaweed, and in order of declining concentration mackerel, prawn, crab, squid, and sardine. (King-PTT)
W91-01163

HEAVY METAL CONCENTRATION IN TELESCOPIUM FROM DARWIN HARBOUR, N.T., AUSTRALIA.
Northern Territory Univ., Darwin (Australia). School of Chemistry.
For primary bibliographic entry see Field 5A.
W91-01164

ESTIMATING THE EFFECTS OF DISPERSED ORGANIC POLYMERS ON THE SORPTION OF CONTAMINANTS BY NATURAL SOLIDS. 2. SORPTION IN THE PRESENCE OF HUMIC AND OTHER NATURAL MACROMOLECULES.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
Y. P. Chin, W. J. Weber, and B. J. Eadle.
Environmental Science and Technology ESTHAG, Vol. 24, No. 6, p 837-842, June 1990. 11 fig, 1 tab, 21 ref. Michigan Sea Grant Project R/TS-29 under NOAA Sea Grant NA86AA-O-SG043 and NSF Project ECE-8503903.

Descriptors: *Humic substances, *Organic pollutants, *Path of pollutants, *Sorption, Lake sediments, Model studies, Natural waters, Polymers, Synergistic effects.

Complex and dynamic interactions are known to occur between organic micropollutants, solid phases, and dispersed polymer subphases present in natural waters. In this study, a triphase distribution model was used in conjuction with experimental analyses to characterize the effects of humic polymers dispersed in an aqueous phase on the sorption of hydrophobic organic compounds from that phase by natural solids. The results indicate that the sorption of moderately hydrophobic compounds by lacustrine sediments is relatively unaffected by the presence of humic polymers, whereas the sorption of highly insoluble organic contaminants by the same sorbents is sensitive to small amounts of background organic polymers. These data support the reports of others regarding the extent of the impact of organic subphases on the fate and transport of pollutants in natural aquatic systems. (D'Agostino-PTT)
W91-01180

GEOCHRONOLOGY FOR POLYCYCLIC AROMATIC HYDROCARBON CONTAMINATION IN SEDIMENTS OF THE SAGUENAY FJORD.
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
J. N. Smith, and E. M. Levy.
Environmental Science and Technology ESTHAG, Vol. 24, No. 6, p 874-879, June 1990. 7 fig, 20 ref.

Descriptors: *Aluminum, *Path of pollutants, *Polycyclic aromatic hydrocarbons, *Sediment contamination, *Sediment distribution, Carcinogens, Estuarine sediments, Fluvial sediments, Quebec, Scavenging.

Of the wide range of environmental organic contaminants, polycyclic hydrocarbons (PAHs) are of particular concern due to their potential or proven carcinogenicity. After entering the environment, mainly by the combustion of organic materials, they are widely disseminated by fluvial and aeolian pathways and eventually accumulate in soils and sediments. Combined atmospheric/fluvial transport and deposition data indicate that the PAH concentrations and sediment fluxes of the Saguenay Fjord, Quebec, are directly accounted for by concurrent developments in the region's aluminum industry. In addition, the linear relationship observed between PAH and organic matter concentrations suggests that scavenging from the water column may be the dominant mechanism for PAH deposition. (D'Agostino-PTT)
W91-01183

CONTAMINATION OF BAVARIAN LAKES AFTER THE CHERNOBYL REACTOR ACCIDENT: A TWO-COMPARTMENT MODEL ANALYSIS.
Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
W. Sanger, and K. Hubel.
Health Physics HLTPAO, Vol. 58, No. 5, p 649-653, May 1990. 4 fig, 2 tab, 6 ref. Research project St.Sch.1.071, German Federal Ministry of the Environment.

Descriptors: *Chernobyl, *Mathematical models, *Nuclear accidents, *Nuclear reactors, *Path of pollutants, *Radioecology, Gamma radiation, Lakes, Surface water, Contamination.

Almost immediately following the reactor incident in Chernobyl in 1986, the short-lived radionuclides 103Ru, 131I, and 132Te, along with the longer-lived nuclides 134Cs and 137Cs were washed out by rainfall into the South Bavarian lakes. Shortly after, the Bavarian Agency for Water Research assessed the contamination by spectral measurement of the gamma radiation in unfiltered lake water surface samples. For all lakes and radionuclides examined, decomposition analysis using a mathematical two-compartment model indicated that the activity concentration changed from a rapid decrease, from initially high values, to an approximately 10 times slower decrease in a time-dependent manner. These data demonstrate a time-dependent dispersion of contaminating radionuclides in surface waters. (D'Agostino-PTT)
W91-01185

ASSOCIATION OF SHOWER USE WITH LEGIONNAIRES' DISEASE.
Center for Infectious Diseases, Atlanta, GA. Div. of Bacterial Diseases.
R. F. Breiman, B. S. Fields, G. N. Sanden, L. Volmer, and A. Meier.
JAMA: Journal of the American Medical Association JAMAAP, Vol. 263, No. 21, p 2924-2926, June 1990. 3 tab, 25 ref.

Descriptors: *Aerosols, *Amebas, *Bathing, *Human diseases, *Legionella, Bacterial analysis, Epidemiology, Potable water, Water analysis.

Prevention of Legionnaires' Disease (LD) has so far been limited due to a lack of understanding of the ecology of the causative agent, Legionella pneumophila. In a lengthy outbreak of nosocomial LD at a South Dakota hospital both the epidemiologic and laboratory data implicated the aerosolized shower water as the vehicle for disease transmission. In addition, the presence of amoebae at the implicated potable water sites correlated directly with the presence of the epidemic strain of Legionella pneuophilia. The combined evidence suggests that the amoebae serve as resevoirs and provide the bacteria with an intracellular environment for multiplication. Recognition of this interrelationship between amoebae and L. pneumophilia may lead to new disinfection methods and subsequent disease prevention. (D'Agostino-PTT)
W91-01186

MODELING STUDIES FOR THE CITY OF AUSTIN STORMWATER MONITORING PROGRAMS.
Austin Environmental Protection Dept., TX.
For primary bibliographic entry see Field 4C.
W91-01194

FREQUENCY ANALYSIS OF TRACE LEVEL WATER QUALITY DATA WITH A TIME VARYING CENSORING LEVEL.
Merrick and Co., Denver, CO.
S. R. Durrans.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 92-101, 1 fig, 7 ref.

Descriptors: *Frequency analysis, *Statistical analysis, *Trace levels, *Urban hydrology, *Urban runoff, *Water quality, Data interpretation, Pollutant identification, Regression analysis, Statistical methods.

Databases representing measurements of trace level contaminant concentrations are often censored by a constraint on the range over which measurements can be made. Technology is such that there is often a detection limit below which contaminant concentrations can not be measured and as a result, databases can be proliferated with entries such as 'undectable' or 'less than detection limit'. A number of recent studies have addressed the frequency analysis of censored data sets but have all been limited to the special case where the detection limit is constant over time. Statistical methods such as regression techniques and the method of maximum likelihood are intended to be applied to the lognormal distribution, but may also be applied to the normal distribution. The implications of the comparison between these two methods appears to be significant. The regression approach, because of its relative simplicity, is probably the most frequently applied of the two estimation techniques. This method has previously been shown to be comparable to the maximum likelihood technique and its use has thus been justified. A qualitifaction must now be imposed on the statement of comparability however. Previous studies have all addressed the special case of a time invariant censoring level rather than the more general situation presented here. While the regression technique might perform well in the special case, it fails in the general case since not even all of the non-censored data values can be utilized. The method of maximum likelihood, on the other hand, makes use of all observed data, including that which is censored, and thus serves to maximize the benefit that is afforded by a reduced censoring level. (See also W91-01188) (Lantz-PTT)
W91-01198

USE OF A COMPARTMENTAL MODEL TO DEVELOP RULES FOR THE INTERPRETATION OF WATER QUALITY DATA.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
J. P. Lumbers, and S. J. Wishart.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 147-158, 8 fig, 19 ref.

Descriptors: *Ammonia, *Data interpretation, *Expert systems, *Fish physiology, *Mathematical models, *Model studies, *Path of pollutants, *Toxicity, Fisheries, Performance evaluation, Water pollution prevention, Water quality.

A mathematical model was used to investigate the toxicity of fluctuating ammonia concentrations to freshwater fish. The effects of varying ammonia concentrations over time were integrated in a compartmental model designed to simulate the uptake and depuration of ammonia and its transport within the organism to a critical site. Adjustment of parameter values to allow for acclimation and other modifying factors was examined. The performance of the model was compared with published LC50-exposure curves and experimental evidence of the response of fish to varying ammonia concentrations. An immediate difficulty in the use of the compartmental model was a lack of direct observations of ammonia concentration in blood plasma and intracellular fluid which may be used to estimate the values of the rate constants incorporated in the model. Results are presented for the simulated response to synthetic time-series of ammonia in the environment. These results may be used for the control of fluctuating pollutant concentrations in response to water quality standards. The model may be used to derive permissible magnitude-duration-frequency combinations for pollution events. The compartment model could be used within an expert system during each interpretation or outside the expert system to derive rules to be written into the knowledge base. (See also W91-01211) (Geiger-PTT)
W91-01214

CYANOBACTERIAL TOXINS IN EUROPEAN WATERS: OCCURRENCE, PROPERTIES, PROBLEMS AND REQUIREMENTS.
Dundee Univ. (Scotland). Dept. of Biological Sciences.
G. A. Codd, W. P. Brooks, L. A. Lawton, and K. A. Beattie.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 211-220, 4 tab, 54 ref.

Descriptors: *Algal blooms, *Cyanophyta, *Eutrophication, *Path of pollutants, *Phosphorus removal, *Toxins, Aquatic bacteria, Europe, Monitoring, Pollutant identification, Water quality standards.

The cyanobacteria (blue-green algae) which commonly occur as massive growths in nutrient-enriched European freshwaters typically belong to groups which can produce toxins. Toxic cyanobacteria have long been recognized as causative agents of animal, bird and fish kills and evidence exists for their adverse effects on human health. Cyanobacterial toxins also have adverse effects on zooplankton and can be accumulated by shellfish. Toxic cyanobacterial blooms have been recorded from at least 16 European countries and their toxins have been detected in over 50% of the samples collected (>200) in Europe. Toxin-forming genera include Microcystis, Anabaena, Anabaenopsis, Aphanizomenon, Oscillatoria, Nodularia, Gloeotrichia, Coelosphaerium, Gomphosphaeria, Lyngbya, Schizothrix, Cylindrospermopsis, and Nostoc. The toxins include hepatotoxic cyclic 7-and 5-amino acid peptides, neurotoxic alkaloids, phenolics, lipopolysaccharides and others as yet uncharacterized. Cyanobacterial toxin detection and quantification has relied upon mouse bioassays until recently although chromatographic-, cytotoxicity-, and immunoassays are now available. Cyanobacterial toxin production has been successfully regulated by reducing phosphorus inputs to water sources. Monitoring of bacterial scums for cyanobacterial toxins should be done in a timely manner as scums may appear and disappear quite rapidly. Water columns should also be sampled due to the ability of cyanobacteria to stratify in a water source. The widespread occurrence of toxic cyanobacteria in eutrophic European freshwaters and the hazard which they pose to human health indicate the need for guidelines for freshwater containing these toxins and standards if such sources are for drinking. (See also W91-01211) (Author's abstract)
W91-01221

CONTAMINATION OF POTABLE WATER BY CORROSION OF TIN-LEAD SOLDERED JOINTS.
Surrey Univ., Guildford (England). Dept. of Materials Science and Engineering.
R. Walker, and R. J. Oliphant.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 221-228, 1 fig, 6 tab, 17 ref.

Descriptors: *Corrosion, *Lead, *Potable water, *Public health, *Tin, *Water conveyance, *Water pollution effects, Chlorides, Drinking water, England, Hydrogen ion concentration, Pipes, Silicates, Sulfates, Water pollution prevention, Zinc.

A survey of houses in Great Britain in 1977 found that 9% of homes had a lead content in domestic water in excess of 0.1 mg/L and 20% over 0.05 mg/L in the first draw sample of water remaining in pipes overnight. This compares unfavorably with the report of the Commission of European Communities which in 1980 gave a level of lead of 0.05 mg/L for a sample of running water as the maximum admissible concentration with the rider that where samples either frequently or to an appreciable extent exceed 0.1 mg/L, suitable measures must be taken to reduce the exposure to lead on the part of the consumer. This concentration of lead in water can arise from the corrosion of tin-lead solders in copper water pipes. A galvanic corrosion cell was designed and used to quantitatively assess the effects of various water quality parameters on corrosion rates of the solder. The main features stimulating corrosion were found to be low pH (high acidity) and high concentration of chloride. Fortunately the presence of sulfate, silicate and zinc were shown to inhibit corrosion; the zinc originated from the zinc chlorides used as an active ingredient in the flux used in soldering. Carbonate hardness and orthophosphate had no effect on the corrosion rate. Only by limiting the area of solder exposed in the bore of the tube could a significant long-term problem be avoided. The only sure way to avoid contamination is to specify lead-free solders. (See also W91-01211) (Author's abstract)
W91-01222

LIBRARY U. OF I. URBANA-CHAMPAIGN

CONSTRAINTS ON THE USE OF MODELS TO PREDICT THE MOVEMENT OF PESTICIDES TO GROUNDWATER.
R. J. Hance, and J. A. Guth.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 229-237, 33 ref.

Descriptors: *Error analysis, *Groundwater pollution, *Mathematical models, *Nonpoint pollution sources, *Path of pollutants, *Pesticides, *Water pollution sources, Adsorption, Herbicides, Pesticide kinetics, Prediction, Sampling.

Movement of a pesticide from soil to groundwater is affected by the properties of the chemical, the way in which it is used, the hydraulic properties of the soil and the hydrogeology of the region. These factors interact so they must all be considered if a realistic prediction is to be obtained. Currently available models for predicting groundwater contamination by pesticides involve simplifications of many, if not all, of the processes which are involved and often ignore some factors altogether. This is partly because of the complexity of the systems and partly because of a lack of appropriate data. Variability in the reported properties of pesticides, together with problems in measuring low concentrations and in sampling, make it difficult to validate models in the field so they are of limited value for predicting pesticide behavior. (See also W91-01211) (Author's abstract)
W91-01223

WELL-WATER METHAEMOGLOBINAEMIA: THE BACTERIAL FACTOR.
Norsk Hydro, Porsgrunn. Research Centre.
For primary bibliographic entry see Field 5C.
W91-01224

VIROLOGICAL QUALITY OF BATHING WATERS IN ENGLAND.
Severn-Trent Labs., Coventry (England).
R. Morris, and I. Cox.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 337-343, 3 fig, 3 tab, 18 ref.

Descriptors: *England, *Enteroviruses, *Swimming, *Water quality, *Water quality standards, Bacteria, Beaches, Coliforms, Pollutant identification, Recreation, Viruses, Water analysis, Water quality control.

The European Community (EC) bathing water directive includes a recommendation that waters at EC-designated bathing areas should be examined for the presence of enteroviruses whenever there are grounds for suspecting a deterioration in quality. In the United Kingdom this has been interpreted as being a response to the failure of bathing waters to satisfy the bacteriological requirements of the directive. The current U.K. practice is to examine two samples for enteroviruses in the recognized bathing season (May to September) when the water has failed bacteriologically in the previous year. In addition, the U.K. interpretation of the directive applies only to marine waters and, at this time, does not include any inland waters. In an examination of the virological data made available by many of the U.K. water authorities, the bodies currently responsible for bathing water quality, 48% of locations tested for the presence of enteroviruses in 1988 satisfied the requirements of the directive. However, of those failing to meet the enterovirus standard, 41% failed on only one sampling occasion while the remainder (11%) failed on at least two occasions. The highest level of enterovirus contamination detected was 206 plaque-forming units in a 10 liter sample. (See also W91-01211) (Author's abstract)
W91-01235

INCIDENCE OF ENTEROVIRUSES AROUND THE WELSH COAST: A THREE YEAR INTENSIVE SURVEY.
Welsh Water Authority, Bridgend.
H. Merrett, C. Pattinson, C. Stackhouse, and S. Cameron.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 345-351, 2 fig, 2 tab, 23 ref.

Descriptors: *Bioindicators, *Coliforms, *Enteroviruses, *Viruses, *Wales, *Water quality, *Water quality standards, Beaches, Monitoring, Pollutant identification, Public health, Recreation, Swimming, Water analysis, Water pollution sources, Water quality control.

The incidence of enteroviruses in 48 bathing waters around the Welsh coast was assessed during the period 1986-1988 as part of the routine compliance monitoring programme for European Community bathing waters. Out of a total of 623 samples taken, 168 (27%) were positive for enteroviruses and the number of virus particles in the samples ranged from 1-23 plaque-forming units/10 L water. Generally, the incidence of viruses in bathing waters adjacent to areas of high population density was higher than that in bathing waters far removed from these areas. However, viruses were also isolated from waters with no significant sewage input and where contamination by sewage material as estimated by the Escherichia coli/total coliform count was minimal. There was no correlation between the presence of enteroviruses and the presence of coliform organisms. Forty-six percent of samples which complied with mandatory E. coli/coliform standards did not comply with the enterovirus standard. (See also W91-01211) (Author's abstract)
W91-01236

MICROBIOLOGICAL QUALITY OF AN INLAND SURFACE WATER USED FOR RECREATIONAL PURPOSES.
Severn-Trent Labs., Coventry (England).
R. Morris.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 353-356, 2 tab, 11 ref.

Descriptors: *Coliforms, *Surface water, *Swimming, *Viruses, *Water pollution effects, *Water quality, *Water quality standards, Bacteria, Microbiological studies, Monitoring, Pollutant identification, Public health, Recreation, Rivers, Water quality control.

During 1987 an inland surface water was monitored to determine its microbiological quality. The water is extensively used for recreational purposes with users frequently experiencing total immersion. The findings are evaluated against the European Community directive for bathing water quality, the only standard against which the health risk associated with a recreational water can be assessed at the present time. The water failed to meet the mandatory standard set for total coliforms (<10,000 per 100 ml) on all but one occasion of 23 samplings. Similarly, the standard of <2,000 fecal coliforms/100 ml was satisfied on three occasions while the guideline value of <100 fecal streptococci/100 ml was met by eight samples. Virologically, the water failed to meet the standard of nil detectable viruses in a 10 liters sample on 20 of 24 occasions. The users of the water regularly complain of gastroenteritis and it is obvious from the microbiological data that it is inadvisable to use the surface water for recreational purposes. This is particularly important where total immersion can be a feature of the recreational activity. (See also W91-01211) (Author's abstract)
W91-01237

FATE OF GENETICALLY ENGINEERED MICROORGANISMS IN FRESHWATER.
Freshwater Biological Association, Ambleside (England).
R. W. Pickup, J. R. Saunders, J. A. W. Morgan, C. Winstanley, and J. G. Jones.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 375-380, 3 fig, 1 tab, 12 ref.

Descriptors: *Enterobacter, *Fate of pollutants, *Genetic engineering, *Genetic pollution, *Pseudomonas, Amino acids, Bioindicators, DNA, Escherichia coli, Serratia, Water pollution effects.

The survival of several members of the genera Pseudomonas and Enterobacteriaceae was monitored in sterile freshwater microcosms. The test organisms were able to survive and maintain a concentration of 1,000-100,000 cells/ml over periods exceeding 60 days. However, their ability to retain the plasmid associated phenotype (xylE) showed both intergeneric and intrageneric differences. Only the auxotrophic test organisms in the absence of vital amino acids declined rapidly once released into the microcosms and became undetectable after 30 days. These results indicate that, while it may be possible to predict the survival of the bacterial host in sterile freshwater, the fate of its recombinant DNA is less predictable. (See also W91-01211) (Author's abstract)
W91-01240

AGRICULTURE: A POSITIVE CONTRIBUTION TO WATER QUALITY.
Imperial Chemical Industries Ltd., Billingham (England).
For primary bibliographic entry see Field 5G.
W91-01249

EFFECTS AND BEHAVIOUR OF POLLUTANTS DURING ARTIFICIAL GROUNDWATER RECHARGE.
Institut fuer Wasserforschung G.m.b.H., Dortmund (Germany, F.R.).
N. Zullei-Seibert, and U. Schoettler.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 475-486, 12 fig, 3 tab, 14 ref.

Descriptors: *Artificial recharge, *Germany, *Groundwater pollution, *Groundwater recharge, *Path of pollutants, *Underground waste disposal, *Water pollution sources, Adsorption, Aromatic compounds, Biodegradation, Disinfectants, Filtration, Heavy metals, Infiltration, Organic carbon, Organic pollutants, Pesticides, Water pollution treatment.

Groundwater as a main source for drinking water supply is affected by industrial, agricultural, and domestic pollution. Risk analyses based on detailed knowledge of the various processes related to infiltration and underground passage are necessary for the protection of drinking water supplies. Experiences during drinking water purification of the waterworks of Dortmund, Germany show that each variation in the concentration of groundwater pollutants is caused by remote complex processes which are dependent on the specific substances involved, the local conditions of the subsoil, and the amount and duration of the pollution. The efficiency of infiltration and underground passage must be estimated with regard to high concentration of pollutants (caused by accidents) as well as to low concentrations over a long time (caused by agriculture or sewage discharge). The infiltrated water with its different components is subject to chemical, physical and biological processes such as filtration, flocculation, adsorption, and degradation. Polychlorinated biphenyls are easily adsorbed to particulate organic matter or accumulated by algae. Heavy metals show a high affinity for appropriate organic or inorganic adsorption structures, and possible remobilization with algal die down in the filter. Reactions within the recharge areas and their effects on the concentrations of pollutants can be described by black-box models. Additional information may be obtained by systematic classification of behavior patterns depending on substance specific properties. The substituted phenols may be easily degraded due to their

molecular structure. (See also W91-01211) (Geiger-PTT)
W91-01251

HYDROLYSIS OF CHLOROSTILBENE OXIDE: II. MODELING OF HYDROLYSIS IN AQUIFER SAMPLES AND IN SEDIMENT-WATER SYSTEMS.
Environmental Protection Agency, Athens, GA. Southeast Environmental Research Lab.
M. E. S. Metwally, and N. L. Wolfe.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 963-973, August 1990. 5 fig, 5 tab, 22 ref.

Descriptors: *Biodegradation, *Chlorostilbene oxide, *Fate of pollutants, *Groundwater pollution, *Hydrolysis, *Model studies, *Polycyclic aromatic hydrocarbons, *Toxicology, Aquifers, Hydrogen ion concentration, Kinetics, Sediment chemistry, Sorption.

Epoxides are a class of compounds that are formed as intermediates in the biological transformation of polycyclic aromatic compounds. The disappearance kinetics of 4-chlorostilbene oxide (CSO) were determined in aquifer samples and in sediment-water systems to derive kinetic expressions that describe heterogeneous effects. Disappearance rate constants were determined in heterolytic systems and compared with those obtained in distilled water to delineate the effect of solids on the kinetics of hydrolysis. In both neutral and acid hydrolysis studies, the sorption-desorption rates of CSO were faster than the hydrolysis rates in either the aqueous or sediment-sorbed phases. Both dissolved and sorbed CSO hydrolyzed at either neutral or acidic pHs. Above pH 5, where neutral hydrolysis dominates, the hydrolysis rate constant of CSO in sterile sediment-water systems was the same as in distilled water. This suggests that sorption neither retards nor promotes the natural hydrolysis pathway. At pHs below 5, where acid hydrolysis dominated, the pseudo-first-order hydrolysis rate constant was lower for the sorbed fraction than the rate constant in distilled water at the same pH. This indicates that the hydrolysis rate constant in the sorbed phase is slower than that in the bulk aqueous phase. Kinetics of hydrolysis were studied in raw sediment samples and samples sterilized by heat or with formalin to distinguish between abiotic and biotic hydrolysis processes. Above pH 5, the hydrolysis rate constants were larger in nonsterile systems when compared with the rate constants in the sterile systems, suggesting that both biotic and abiotic pathways contribute to the disappearance of CSO. Below pH 5, the hydrolysis rate constants were, within experimental error, the same in the sterile and nonsterile systems. In aquifer samples, the average disappearance rate constant of CSO was 0.000085 (+ or -0.000011)/min, which is about the same as the rate constant in distilled water. These results suggest that there is no heterolytic enhancement of the neutral hydrolysis rate constant by the aquifer materials. (Author's abstract)
W91-01256

EFFECT OF BODY SIZE ON THE UPTAKE AND BIOCONCENTRATION OF DI-2-ETHYLHEXYL PHTHALATE IN RAINBOW TROUT.
Washington State Univ., Pullman. Coll. of Pharmacy.
D. D. Tarr, M. G. Barron, and W. L. Hayton.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 989-995, August 1990. 7 fig, 1 tab, 29 ref. NIH Grant ES 01995 and EPA Grant R812818.

Descriptors: *Animal metabolism, *Bioaccumulation, *Biological magnification, *Fish, *Fish physiology, *Path of pollutants, *Phthalates, *Toxicology, *Trout, Bioassay, Growth stages, Kinetics, Model studies.

Di-2-ethylhexyl phthalate (DEHP) is widely used as a plasticizer in the production of polyvinyl chloride. Three groups of rainbow trout (Salmo gairdneri) having average body weights of 2.9, 61 and 440 g were exposed at 12 C by the water to di-2-ethylhexyl phthalate. The kinetics of uptake and bioconcentration were characterized in each group using a compartmental model. Most of the model parameters, when expressed per unit body weight, were similar in the three sizes of fish. The two major exceptions were the uptake rate parameter, a measure of the capacity of the gill to extract DEHP from water and the apparent size (volume of distribution) of the large DEHP storage compartment, which is a measure of the capacity of the fish to accumulate DEHP. The values of these parameters declined as body weight increased; they followed the allometric equation with body weight exponents of 0.44 and 0.77, respectively. The body weight-associated changes in the pharmacokinetic parameters caused the bioconcentration factor to decline as body weight increased from 51.5 to 1.6. (Author's abstract)
W91-01257

EQUILIBRIUM PARTITIONING AND BIOACCUMULATION OF SEDIMENT-ASSOCIATED CONTAMINANTS BY INFAUNAL ORGANISMS.
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
J. L. Lake, N. I. Rubinstein, H. Lee, C. A. Lake, and J. Heltshe.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 1095-1106, August 1990. 2 fig, 9 tab, 24 ref.

Descriptors: *Aroclors, *Bioaccumulation, *Mollusks, *Path of pollutants, *Polychaetes, *Sediment contamination, *Toxicology, Equilibrium, Mathematical models, Model studies, Organic carbon, Polychlorinated biphenyls, Population exposure, Sediment analysis, Tissue analysis.

The utility and limits of applicability of a simple equilibrium partitioning model for predicting the maximum concentration of neutral organic compounds which can be accumulated by infaunal organisms exposed to a contaminated sediment were examined. Accumulation factors (AFs) for PCBs, the lipid normalized PCB concentration in organisms divided by the organic carbon normalized PCB concentration in sediments, were measured for PCBs in infaunal mollusks and polychaetes at field sites with a range of sediment Aroclor (A-1254) and total organic carbon (TOC) concentrations. The average AFs for A-1254 were found to be higher (average = 4.94; range 3.76 to 7.27) at sites with lower contaminant concentrations (15.0 to 48.3 ng A-1254/g dry sediment) than at more contaminated sites (328-9200 ng/g), where AFs were lower (average = 2.62; range 1.14 to 5.04). AF data grouped on the basis of sediment A-1254 and TOC concentration differed statistically between, but not within each group. Significant differences in mean AFs were found between some species and were lower than that found for bioaccumulation factors on a wet weight basis, indicating the utility of lipid and organic carbon normalization. (Author's abstract)
W91-01267

POLLUTION ASPECTS OF STORM-SEWAGE OVERFLOWS.
Sheffield City Polytechnic (England).
D. J. Balmforth.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 3, p 219-226, June 1990. 8 fig, 1 tab, 12 ref.

Descriptors: *Combined sewer overflows, *Sewer systems, *Storm wastewater, *Storm-overflow sewers, *Urban hydrology, *Wastewater pollution, *Water pollution sources, Field tests, Model testing, Overflow, Path of pollutants, Pollutants, Stilling basins, Storm runoff, Storm sewers, Stream pollution, United Kingdom.

Storm-sewage overflows are one of the principal sources of urban river pollution in the United Kingdom. Various possible pollutants, such as carbon compounds, faecal matter, toxic pollutants, nutrients, bacterial pollutants such as E. coli bacteria, and their effect on the receiving stream are outlined. Features of individual overflow structures which are likely to lead to unsatisfactory performance are also detailed. These include any overflow that has dry-weather evidence of pollution; causes reduction in river classification; discharges to a watercourse which is used for amenity purposes; provides insufficient relief to the sewerage system downstream; suffers from siltation and/or blockage; is structurally unsound; or has difficult or unsafe access. Since the rationalization and rehabilitation of storm-sewage overflows should only be considered as part of a more general drainage area study, a strategy for rationalization is presented which identifies objectives for effective design and operation. It discusses, in particular, how chambers may be proportioned to give effective separation of visible pollutants. By combining field data with the results of model tests, a comparison of the performance of the main recommended types of overflow structure was made. Maintenance and safety measures include: proper venting; correct throttle design; prevention of solids accumulation on the floor; and safe adequate access points. (Author's abstract)
W91-01268

CHLORINATED SOLVENTS IN UK AQUIFERS.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
M. O. Rivett, D. N. Lerner, and J. W. Lloyd.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 3, p 242-250, June 1990. 5 fig, 4 tab, 45 ref.

Descriptors: *Chlorinated hydrocarbons, *England, *Groundwater pollution, *Path of pollutants, *Solvents, *Water pollution sources, Aquifer characteristics, Groundwater data, Monitoring, Water quality.

Background data on chlorinated solvents and all published data on chlorinated solvents in United Kingdom groundwater was reviewed. New data from an aquifer-wide survey of the organic water quality of the Birmingham aquifer (carried out by the University of Birmingham and the Water Research Centre (WRC)) show that contamination by chlorinated solvents is extensive and is greater than that observed in previously published United Kingdom studies. Trichloroethylene contamination is particularly apparent in the Birmingham aquifer, with 40% of the boreholes sampled containing waters above the new UK limit for this contaminant. Fortunately the Birmingham aquifer is not used for public supply. Land use and hydrogeological factors are shown to influence the contamination observed in particular boreholes. The difficulties associated with locating contaminated zones in aquifers, due to the immiscible flow of chlorinated solvents make it difficult to locate the actual source and hence to remove it. Development in the understanding of how solvents move in the subsurface, better field methods to observe aquifer contamination, and computer models to predict with greater accuracy the movement of solvents are all required to observe and remediate aquifer contamination by chlorinated solvents. (Author's abstract)
W91-01271

APPRAISAL OF THE POTENTIAL HEALTH IMPACTS OF SEWAGE DISPOSAL TO UK COASTAL WATERS.
Saint David's Univ. Coll., Lampeter (Wales). Centre for Research into Environment and Health.
F. Jones, D. Kay, R. Stanwell-Smith, and M. Wyer.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 3, p 295-303, June 1990. 1 tab, 69 ref.

Descriptors: *Coastal waters, *Hazard assessment, *Marine pollution, *Population exposure, *Public health, *Risk assessment, *United Kingdom, *Wastewater pollution, *Water pollution sources, *Water quality standards, Disinfection, Epidemiology, Wastewater disposal.

The discharge of sewage to the unique United Kingdom (UK) coastal environment has been a traditional and cost-effective means of treatment for many decades. This disposal option is increasingly questioned by professionals with public-health responsibilities as well as by environmental

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pressure groups. There are limited firm data on the epidemiological significance of existing disposal practices: the established prospective methods, developed by north American workers in this area, have not provided a scientifically-robust, epidemiological, research protocol. This leaves a scientific vacuum for those with operational and policy responsibilities in this important and sensitive area of water resource management. Primary treatment of effluents is essential at all discharges to coastal waters. However, this will not guarantee compliance with European Community (EC) Directive standards and does not ensure the absence of epidemiological risk. Complementary treatment options, such as ultraviolet and ozone disinfection should be evaluated. (Author's abstract)
W91-01278

INTERACTION OF CARBON TETRACHLORIDE WITH BETA-NAPHTHOFLAVONE-MEDIATED CYTOCHROME P450 INDUCTION IN WINTER FLOUNDER (PSEUDOPLEURONECTES AMERICANUS).
Louisiana State Univ., Baton Rouge. School of Veterinary Medicine.
For primary bibliographic entry see Field 5C.
W91-01279

INDUCTION OF PEROXISOME PROLIFERATION IN RAINBOW TROUT EXPOSED TO CIPROFIBRATE.
Massachusetts Univ., Amherst. School of Public Health.
For primary bibliographic entry see Field 5C.
W91-01280

ACID DEPOSITION IN CENTRAL JAPAN.
Iowa Univ., Iowa City. Dept. of Chemical and Biochemical Engineering.
Y. S. Chang, B. S. Ravishanker, G. R. Carmichael, H. Kurita, and H. Ueda.
Atmospheric Environment ATENBP, Vol. 24A, No. 8, p 2035-2049, August 1990. 10 fig, 3 tab, 17 ref. EPRI Contract RP 1630-49.

Descriptors: *Acid rain, *Japan, *Path of pollutants, *Water pollution sources, Air pollution, Model studies, Nitrates, Nitrites, Simulation analysis, Sulfates.

Previous studies on the long-range transport of pollutants in central Japan have focused on the production and transport of photochemical oxidants. Highly polluted air is found in the central mountainous areas late in the afternoon on clear summer days, resulting from the transport of pollutants from the Tokyo Metropolitan area. The impact of this long-range transport (LRT) on acid deposition at these inland regions is evaluated by simulating a series of hypothetical storms under LRT conditions using the STEM II model. Nitrate and SO4 concentrations in the rainwater in excess of 100 micromolar are predicted, indicating that the total wet deposition of NO3 exceeds that of SO4 by a factor of 2. The wet deposition during evening storms is nearly 100% higher than that during afternoon storms. Simulations with 50% reductions in NOx and SOx emissions decrease the wet deposition of NO3 and SO4 by 40% and 15%. (Author's abstract)
W91-01283

TRENDS OF AIR QUALITY AND ATMOSPHERIC DEPOSITION IN TOKYO.
Tokyo Metropolitan Research Inst. for Environmental Protection (Japan).
T. Komeiji, K. Aoki, I. Koyama, and T. Okita.
Atmospheric Environment ATENBP, Vol. 24A, No. 8, p 2099-2103, August 1990. 12 fig, 1 tab, 6 ref.

Descriptors: *Acid rain, *Air pollution, *Japan, *Path of pollutants, *Tokyo, *Water pollution sources, Nitrates, Nitrogen compounds, Sulfates, Sulfur dioxide.

In the late 1960s and early 1970s the levels of SO2 and SO4 airborne particulate matter and its elemental compositions were high in Tokyo. However, in the 1970s their levels rapidly declined because of emission controls and fuel and material switching. Although the usage of heavy oil of high sulfur content temporarily increases SO2 concentration, the introduction of desulfurization processes for heavy oil reduced the SO2 concentration drastically. Concurrently, SO4(2-) concentrations in rain water also rapidly declined. On the other hand, despite significant emission control of NOx, from stationary and mobile sources, NOx and consequent NO3(-) levels in air and precipitation have not reduced. This is due to the increased number of automobiles, particularly of diesel powered trucks. Recently, this decline has slowed down. The number of days in which Mt. Fuji is visible from Tokyo have increased in coincidence with the decrease of particulate matter concentrations. A decrease in the deposition of SO4 and other species also reflects the decline of air pollution. However, the atmospheric concentration and deposition of oxides of nitrogen have not decreased because of the increase in the number of automobiles. It is also recognized that the alteration of structures in the city changes air quality. (Lantz-PTT)
W91-01284

ANALYSIS OF RADM GAS CONCENTRATION PREDICTIONS USING OSCAR AND NEROS MONITORING DATA.
State Univ. of New York at Albany. Atmospheric Sciences Research Center.
P. Middleton, and J. S. Chang.
Atmospheric Environment ATENBP, Vol. 24A, No. 8, p 2113-2125, August 1990. 2 fig, 3 tab, 30 ref. EPA Contract 68D80016.

Descriptors: *Acid rain, *Data interpretation, *Model studies, *Path of pollutants, *Regional Acid Deposition Model, Data acquisition, Nitrogen compounds, Northeast Regional Oxidant Study, Oxidation and Scavenging Characteristics, Ozone, Sulfur dioxide.

The ability of the Regional Acid Deposition Model (RADM) to produce realistic atmospheric trace gas concentration patterns for a variety of atmospheric conditions is explored by comparing model results with surface monitoring data. Two frontal storm system episodes, monitored in 1981 as part of the Oxidation and Scavenging Characteristics of April Rains (OSCAR) experiment, and one relatively dry high pressure-system case from the 1979 Northeast Regional Oxidant Study (NEROS) were studied. The temporal and spatial variations of SO2, O3 and N species monitored at selected locations throughout the US and Canada were compared to the corresponding RADM grid-average predictions. Spatial distributions of SO2 and O3 daytime (10a-4p) and night-time (10p-4a) RADM concentration averages were compared to the observational averages to confirm that the model and data concentration patterns agreed over the domain. Predictions and observations showed similar patterns of high and low concentrations throughout the region for all three of the events for the daytime comparisons; the lower night-time agreement improved when night-time stability adjustments were applied to the model predictions. Summarizing over all of the individual grid-point, day-total comparisons for all three events, it was found that, for O3, all of the pairs were in agreement to better than a factor of two, and 50% of them were in agreement to a factor of 1.1 or better. For SO2, 88% of the pairs were in agreement to better than a factor of two and 25% of the pairs were in agreement to a factor of 1.1 or better. Predicted N species concentrations in the 1-4 and 5-7 ppm ranges for two OSCAR cases were comparable to the levels measured at a rural Indiana site during the OSCAR 1 and the OSCAR 4 events. Predictions of NEROS NO in the 3-11 ppb range were comparable with the concentrations measured at a rural Pennsylvania site for a summer 1986 case meteorologically similar to the 1979 NEROS I event. In general, higher agreement is associated with well mixed conditions in areas where local characteristics of the observational site more closely resemble the grid-average characteristics. (Lantz-PTT)
W91-01285

ACID RAIN MODEL DEVELOPMENT CONSIDERING ALTITUDINAL PRECIPITATION RATE.
Korea Advanced Inst. of Science and Technology, Seoul (Republic of Korea). Dept. of Civil Engineering.
J. K. Koo, S. O. Ko, and M. S. Hong.
Atmospheric Environment ATENBP, Vol. 24A, No. 8, p 2133-2139, August 1990. 8 fig, 3 tab, 15 ref.

Descriptors: *Acid rain, *Mathematical models, *Model studies, *Path of pollutants, Aerosols, Air pollution, Cloud physics, Physicochemical properties, Simulation analysis.

A one dimensional Eulerian model is developed to investigate the effect of physico-chemical parameters on the acidification processes of raindrops. The model is structured to treat the complex cloud's microphysical processes in a highly parameterized fashion. For a 1 h rain event simulation, gas depletion ratios range from 35 to 60% for HNO3, 40 to 70% for NH3, and 25 to 30% for SO2. Also, a formula is proposed to predict the rain acidity on the ground using known values of gaseous SO2 concentration, the height of the rain growth zone, and precipitation rate. The model can be extended to incorporate the cloud microphysical processes in a more sophisticated manner and, in the future, be extended to include aerosol capturing mechanisms. (Lantz-PTT)
W91-01286

SEMI-EMPIRICAL APPROACH TO ESTIMATE VERTICAL TRANSPORT BY NONPRECIPITATING CONVECTIVE CLOUDS ON A REGIONAL SCALE.
Research Triangle Inst., Research Triangle Park, NC.
F. M. Vukovich, and J. K. S. Ching.
Atmospheric Environment ATENBP, Vol. 24A, No. 8, p 2153-2168, August 1990. 13 fig, 1 tab, 29 ref. EPA Contract 68-02-4059.

Descriptors: *Acid rain, *Cloud physics, *Convective clouds, *Mathematical analysis, *Path of pollutants, *Vertical transport, Clouds, Cumulus clouds, Dewpoint, Fluctuations, Sensitivity analysis, Temperature.

A semi-empirical approach was used to estimate the vertical flux of mass of water and pollutants between the boundary layer and the cloud layer in an ensemble of nonprecipitating cumulus clouds. This CUVENT model determines the existence of the cloud ensemble, estimates the cloud amount at cloud base, and establishes the vertical distribution of the convective cloud amount attributed to a cloud population, having a continuous spectrum of cloud depth, using standard meteorological data. The mass flux is then estimated for the ensemble or for a processor cloud, a single cloud which on the average can be used to represent the ensemble using a modified version of the cloud model. Sensitivity analysis of CUVENT examined the behavior of the model as the vertical distribution of temperature and dewpoint changed from one atmospheric state to another. For the initial study, the temperature profile was held constant, and the dew profile varied. In a moist dewpoint profile, there was a small dewpoint depression, on the average, above the top of the boundary layer. In another case, a relatively dry dewpoint profile was used. In all cases, the cloud amount at cloud base was set equal to 1.0. Having cloud amounts < 1.0 will effect the quantitative results more than the qualitative results. In the next analysis, the dewpoint profile was held constant, but the temperature profile above cloud base and in the cloud layer varied. In the first case, the temperature decreased with height through the cloud layer. In the second case, an isothermal layer existed in the cloud layer. In the case where the temperature decreased with height through the cloud layer, the cloud thickness is approximately 1500 m and the maximum vertical velocity is near cloud base and is 53 cm/sec. (Lantz-PTT)
W91-01287

CHEMISTRY OF DEWS AND FROSTS IN INDIANAPOLIS, INDIANA.
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
J. R. Foster, R. A. Pribush, and B. H. Carter.
Atmospheric Environment ATENBP, Vol. 24A, No. 8, p 2229-2236, August 1990. 3 fig, 4 tab, 32 ref. Air Force Office of Scientific Research Grant AFOSR-85-0223.

Descriptors: *Acid rain, *Chemical analysis, *Dew, *Frost, *Indianapolis, *Path of pollutants, Acidification, Air pollution, Calcium, Carbon dioxide, Hydrogen ion concentration, Magnesium, Nitrogen dioxide, Pollutant identification, Potassium, Sodium, Sulfur dioxide.

Dews and frosts forming on chemically Teflon surfaces were sampled for pH and ion concentrations during a 13 month period in urban Indianapolis, Indiana. It was predicted that dews forming in this polluted atmosphere would be acidic due to absorption of SO2, NO2 and CO2, but that frost pH would be neutral due to the lack of gas absorption. However, measured pH ranged from 6.0 to 7.2, and dew and frost pH were not significantly different. Anion and cation concentrations did not differ between dews and frosts, implying similar mechanisms and rates for scavenging of atmospheric chemicals. Sulfite and nitrite were present in many samples, indicating SO2 and NO2 absorption by both dews and frosts. The presence of ions (K, Ca, Mg, Na) lacking gaseous sources suggested that sedimentation of aerosols, primarily carbonates and salts, from surrounding agricultural lands occurred into dews and frosts as they formed. Carbonate deposition may have been responsible for near-neutral dew and frost pH. Dews sampled from sugar maple leaves were depleted of ammonium and enriched in other ions, but did not differ substantially in pH, compared to dews simultaneously sampled from Teflon. Temporal (overnight) sampling of dews on Teflon showed that dew chemistry changed substantially during the course of the night. (Author's abstract)
W91-01288

HAILSTONES AS CLOUD WATER COMPOSITION PROBES: AN INITIAL ASSESSMENT.
Washington State Univ., Pullman. Lab. for Atmospheric Research.
For primary bibliographic entry see Field 2K.
W91-01289

ACID RAIN AND PHOTOCHEMICAL OXIDANTS CONTROL POLICIES IN THE EUROPEAN COMMUNITY: A DECISION ANALYSIS FRAMEWORK.
Environmental Resources Ltd., London (England).
For primary bibliographic entry see Field 5G.
W91-01290

DEVICE FOR IN SITU DETERMINATION OF GEOCHEMICAL TRANSPORT PARAMETERS. 1. RETARDATION.
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
R. W. Gillham, M. J. L. Robin, and C. J. Ptacek.
Ground Water GRWAAP, Vol. 28, No. 5, p 666-672, September/October 1990. 4 fig, 1 tab, 12 ref.

Descriptors: *Data acquisition, *Geochemistry, *Groundwater pollution, *In situ tests, *Path of pollutants, *Tracers, Aquifers, Augers, Measuring instruments, Organic compounds, Strontium.

The retardation factor for dissolved chemicals in groundwater is an important parameter in predicting the rate of migration of contaminants and in the design of remediation schemes for contaminated aquifers. Conventional methods for evaluating retardation factors include laboratory batch and column tests, and in the case of nonpolar organic contaminants, correlations with the organic carbon content of the aquifer material. In these procedures it is difficult to insure the geochemical integrity of the sediment material and the solutions used in the tests, leading to uncertainties concerning the applicability of the results. Alternatively, large-scale tracer tests can be conducted; however, because of the time and cost requirements, these procedures have generally been limited to research applications. A description is provided of an in situ column procedure for measuring retardation factors. This column is installed in advance of the cutting head of hollow-stem augers, minimizing the geochemical disturbance of the sediment. The sediment within the column is exposed only to natural ground water from the immediate vicinity of the test device. By maintaining geochemical integrity, the method has considerable advantages over laboratory procedures, while being substantially less costly than conventional field tracer tests. Two tests were conducted with the device in which retardation factors for strontium and for five halogenated organic compounds were found to be in good agreement with results obtained by conventional methods. (Author's abstract)
W91-01293

LOGNORMAL DISTRIBUTION OF RADON CONCENTRATION IN GROUND WATER.
Ecole Polytechnique, Montreal (Quebec).
L. Zikovsky, and B. Chah.
Ground Water GRWAAP, Vol. 28, No. 5, p 673-676, September/October 1990. 1 fig, 1 tab, 17 ref.

Descriptors: *Data interpretation, *Distribution, *Groundwater pollution, *Path of pollutants, *Radon, Mathematical studies, Statistical analysis, Statistical methods, Uranium.

Data on the concentration of radon in groundwater were compiled from the literature. From this compilation the means, medians, modes, standard deviations, coefficients of skewness and histograms have been calculated. The histograms were compared with the normal and lognormal distribution functions using chi-square test values for goodness of fit. Based on this, the concentrations were found to be lognormally distributed in all cases studied but one. The measured medians and modes were compared with their theoretical counterparts assuming either normality or lognormality; lognormality was found once more. The comparisons of chi-square test values, the differences between the measured medians and means or geometrical means, and the differences between measured modes and means or geometrical modes show that the concentration of radon in groundwater is lognormally distributed. In such cases, reporting only arithmetic means may create a false impression about exposure levels due to radon. A median or mode as a measure of central tendency would be more appropriate. The lognormality appears to be a consequence of heterogeneous distribution of uranium in soils and rocks. (Lantz-PTT)
W91-01294

USE OF TREE-RING CHEMISTRY TO DOCUMENT HISTORICAL GROUND-WATER CONTAMINATION EVENTS.
Geological Survey, Columbia, SC. Water Resources Div.
D. A. Vroblesky, and T. M. Yanosky.
Ground Water GRWAAP, Vol. 28, No. 5, p 677-684, September/October 1990. 9 fig, 27 ref.

Descriptors: *Chemical analysis, *Data acquisition, *Dendrochronology, *Groundwater pollution, *History, *Path of pollutants, *Tree rings, Chlorides, Chlorine, Groundwater movement, Iron, Landfills, Yellow poplar.

The annual growth rings of tulip trees (Liriodendron tulipifera L.) appear to preserve a chemical record of groundwater contamination at a landfill in Maryland. Zones of elevated iron and chlorine concentrations in growth rings from trees immediately downgradient from the landfill are closely correlated temporally with activities in the landfill expected to generate iron and chloride contamination in groundwater. Successively later iron peaks in trees increasingly distant from the landfill along the general direction of groundwater flow imply movement of iron contaminated groundwater away from the landfill. The historical velocity of iron movement (2 to 9m/yr) and chloride movement (at least 40 m/yr) in groundwater at the site was estimated from element concentration trends of trees at successive distances from the landfill. The tree ring derived chloride transport velocity approximates the known groundwater velocity (30-80 m/yr). A minimum horizontal hydraulic conductivity (0.01 to 0.02 cm/s) calculated from chloride velocity agrees well with values derived from aquifer tests (about 0.07 cm/s) and from groundwater modeling results (0.009 to 0.04 cm/s). (Author's abstract)
W91-01295

INFILTRATION OF IMMISCIBLE CONTAMINANTS IN THE UNSATURATED ZONE.
Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
D. D. Reible, T. H. Illangasekare, D. V. Doshi, and M. E. Malhiet.
Ground Water GRWAAP, Vol. 28, No. 5, p 685-692, September/October 1990. 6 fig, 1 tab, 15 ref.

Descriptors: *Aeration zone, *Immiscibility, *Infiltration, *Model studies, *Path of pollutants, *Soil water, *Unsaturated zone, Groundwater pollution, Permeability, Vadose zone.

The presence of a nonaqueous liquid phase in the subsurface often controls the rate and magnitude of groundwater contamination. In addition, remediation efforts that do not directly address the nonaqueous phase material are unlikely to provide cost-effective or timely solutions to groundwater contamination risk. Practical modeling tools that describe the fate and transport of a separate contaminant phase are described. Simple sharp front models that parameterize the capillary pressure and relative permeability relationships into effective coefficients can describe the main features of the unsaturated zone infiltration behavior of nonaqueous phase liquids. Experiments have indicated that infiltration of an immiscible organic phase into an initially residually water saturated vadose zone can be predicted using only the spill volume and area, the intrinsic permeability of the medium, the residual and irreducible residual of the infiltrating liquid in the medium, and the capillary rise height of the infiltrating liquid in the medium. The ultimate depth of infiltration can be estimated from only the initial volume and area of the spill and the residual chemical saturation in the soil. This simple modeling approach should be applicable to vadose zone infiltration of any nonaqueous phase that does not disrupt the properties of the soil medium. Volatile chemical infiltration also can be described, but the model is only applicable until vaporization results in a significant loss of mass. In practice, the approach is limited to essentially homogeneous, sandy soils in that fingering in and around heterogeneities, chemical-media interactions (such as electrical interactions with clays) are not considered, and sharply defined capillary pressure versus saturation behavior is assumed. (Lantz-PTT)
W91-01296

FIELD EVALUATION OF IN-SITU BIODEGRADATION OF CHLORINATED ETHENES: PART 2, RESULTS OF BIOSTIMULATION AND BIOTRANSFORMATION EXPERIMENTS.
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-01299

PH AND REDOX BUFFERING MECHANISMS IN A GLACIAL DRIFT AQUIFER CONTAMINATED BY LANDFILL LEACHATE.
Western Michigan Univ., Kalamazoo. Center for Water Research.
A. E. Kehew, and R. N. Passero.
Ground Water GRWAAP, Vol. 28, No. 5, p 728-737, September/October 1990. 9 fig, 4 tab, 21 ref.

Descriptors: *Fate of pollutants, *Geochemistry, *Glacial aquifers, *Groundwater pollution, *Hydrogen ion concentration, *Landfills, *Oxidation-reduction potential, *Path of pollutants, *Water pollution sources, Anions, Bicarbonates, Calcium, Chemical interactions, Chemical precipitation, Chemical reactions, Iron, Magnesium, Siderite, Solubility, Sulfides.

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The KL Landfill in Kalamazoo County, Michigan was closed in June 1979 because of groundwater contamination. Study of water analyses from a monitoring well network has provided insight into a variety of pH and redox buffering reactions within the contaminated plume. The reactions involved in pH and redox buffering are important in controlling the concentrations of many major and minor chemical species in the KL Landfill contaminant plume. Acid leachate causes carbonate material dissolution which, in turn, buffers the pH in the glacial drift aquifer at or near neutral background levels. Increases in calcium, magnesium, and bicarbonate concentrations result from these buffering reactions, thereby increasing the saturation indices of carbonate minerals in groundwater. Supersaturation of carbonate minerals persists possibly because precipitation is retarded kinetically and/or inhibited by complexation of cations with organic ligands in solution or blockage of nucleation sites on mineral surfaces. Determination of saturation indices based on uncorrected titration alkalinities may overestimate carbonate mineral saturation levels because the resulting bicarbonate concentrations erroneously include organic acid anions. Redox reactions in the contaminant plume include oxidation of dissolved organic compounds coupled with reduction of oxidized compounds in dissolved or solid phases. Specific reactions include the reduction of iron and manganese contained in oxyhydroxide solid phases. Dissolved iron concentrations as high as 50 mg/L are attributed to this reaction. Siderite precipitation provides a possible solubility control for iron concentrations in the plume when the saturation index reaches a value of approximately 2.0. It is also possible that dissolved iron persists above saturation levels with respect to carbonate and sulfide phases because of complexation with organic acid ligands. Sulfide mineral precipitation may maintain sulfide concentrations in the plume at very low levels. (Lantz-PTT)
W91-01300

TRIAZINE AND CHLOROACETAMIDE HERBICIDES IN SYDENHAM RIVER WATER AND MUNICIPAL DRINKING WATER, DRESDEN, ONTARIO, CANADA, 1981-1987.
Ontario Ministry of Agriculture and Food, Guelph. Agricultural Lab. Services Branch.
R. Frank, B. S. Clegg, C. Sherman, and N. D. Chapman.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 319-324, May/June 1990. 1 fig, 4 tab, 14 ref.

Descriptors: *Atrazine, *Canada, *Drinking water, *Herbicides, *Triazines, *Water pollution sources, *Water treatment, Alachlor, Charcoal, Chlorination, Cyanazine, Metolachlor, Metribuzin, Ontario, Pollutant identification, Water pollution.

Herbicide residues were measured in the Sydenham River to determine if these residues were still present in subsequent drinking-water supplies following chlorination. Samples of raw river water from the Sydenham River, Ontario were collected 30 to 50 times per year between 1981 and 1987 along with paired samples of drinking water from the town of Dresden, Ontario, Canada. Atrazine and its metabolite, diethyl atrazine, were found in 89 to 100% of the raw water over the seven year period. Alachlor was found only in 1982, 1984 and 1985 when 2 to 17% of raw waters were contaminated. Cancellation of the registration to use alachlor at the end of 1985 resulted in no residues being found in 1986 and 1987. Cyanazine was found in 3 to 29% (1982-87), metolachlor in 19-27% (1984-87) and metribuzin in 2-7% (1982-86) of raw river water. Comparison of those residues in raw water with those in drinking water revealed that chlorination of river water had no effect in reducing herbicide concentrations. During 1985 the addition of up to 50 mg/L of powdered charcoal to raw water reduced residues to near to below detection limits for s-triazine and chloracetamide herbicides. However, in 1986, with a reduced rate of 20 mg/L of charcoal herbicide residues were only slightly reduced and in 1987 with only 5 mg/L no reductions occurred. (Author's abstract)
W91-01306

PHOTOCHEMISTRY OF HALOGENATED BENZINE DERIVATIVES. XI. EFFECTS OF SODIUM CHLORIDE ON THE AQUATIC PHOTODEGRADATION OF BROMOXYNIL (3,5-DIBROMO-4-HYDROXYBENZONITRILE) HERBICIDE.
Manitoba Univ., Winnipeg. Dept. of Soil Science.
J. Kochany, G. G. Choudhry, and G. R. B. Webster.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 325-331, May/June 1990. 5 fig, 1 tab, 21 ref.

Descriptors: *Benzenes, *Fate of pollutants, *Halogenated pesticides, *Herbicides, *Path of pollutants, *Photodegradation, *Photolysis, *Sodium chloride, Bromoxynil, Photochemistry, Water chemistry, Water pollution.

Aqueous solution phase photochemistry of the herbicide bromoxynil (3,5-dibromo-4-hydroxybenzonitrile) in the presence of various concentrations of sodium chloride was extensively investigated with ultraviolet radiation near 313 nm. In the presence of 0.0005 to 0.025 moles NaCl, the quantum yields for the phototransformation of the herbicide bromoxynil amounted to 0.045 +/-0.005 to 0.017 +/-0.007 vs. 0.052 +/-0.004 in the absence of sodium chloride. These quantum yield data for the photolysis of the herbicide bromoxynil followed the Stern-Volmer equation. The photolysis of the 0.0000078 molar aqueous solution of the herbicide bromoxynil in the presence of sodium chloride gave rise to the formation of 3-bromo-4-hydroxybenzonitril, 3-bromo-5-chloro-4-hydroxybenzonitril, 3-chloro-4-hydroxybenzonitril, and 4-hydroxybenzonitril. The products 3-bromo-5-chloro-4-hydroxybenzonitril and 3-chloro-4-hydroxybenzonitril were formed via the photoincorporation of chloride ions into bromoxynil and into the primary photoproduct 3-bromo-4-hydroxybenzonitril. In the case of this photoreaction, the percentages of maximum concentrations of the following photoproducts were obtained after exposures to UV light: 3-bromo-5-chloro-4-hydroxybenzonitril at 10.5 minutes; 3-bromo-4-hydroxybenzonitril at 20.0 minutes; 3-chloro-4-hydroxybenzonitril at 30.0 minutes; and 4-hydroxybenzonitril at 44.0 minutes. 90% disappearance of the starting material was with 44-minute photolysis. The formation of 4-hydroxybenzonitril decreased with the rise in concentration of NaCl. When a mixture of aqueous solutions of 3.0 ml bromoxynil plus 0.5 ml NaCl was exposed to UV light for up to 3 hours, the photoproduct 4-hydroxybenzonitril could not be observed; however, other products, namely, phenols 3-bromo-4-hydroxybenzonitril, 3-bromo-5-chloro-4-hydroxybenzonitril, and 3-chloro-4-hydroxybenzonitril were produced. (Mertz-PTT)
W91-01307

EFFECTS OF SALINITY, TEMPERATURE, AND CADMIUM ON CADMIUM-BINDING PROTEIN IN THE GRASS SHRIMP, PALAEMONETES PUGIO.
Texas Univ. Health Science Center at Houston. School of Public Health.
C. L. Howard, and C. S. Hacker.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 341-347, May/June 1990. 4 fig, 2 tab, 31 ref.

Descriptors: *Bioaccumulation, *Bioassay, *Bioindicators, *Cadmium, *Crustaceans, *Heavy metals, *Path of pollutants, *Salinity, *Shrimp, *Temperature effects, *Toxicology, Grass shrimp, Synergistic effects, Toxicity, Water pollution, Water temperature.

The combined effects of salinity, temperature, and cadmium on the accumulation of cadmium-binding protein were studied in the grass shrimp, Palaemonetes pugio. In 96-hour bioassays, shrimp were exposed either to zero or to one of three concentrations of cadmium (0.50, 1.00, and 1.60 mg/L), under three different salinities (15, 25, and 35 parts per thousand) at two different temperatures (20 and 30 C). Cadmium-binding protein concentrations were quantified in survivors from the 24 exposure groups. Salinity and temperature did not affect survivorship unless the shrimp were also exposed to cadmium. P.pugio produced a 10,000-dalton metallothionein-like cadmium-binding protein when exposed to at least 0.1 mg Cd(2+)/L for 96 hours. Accumulation of cadmium-binding protein was elevated when either the level of cadmium or temperature was increased or salinity was decreased. Grass shrimp surviving the salinity-temperature-cadmium conditions associated with highest mortality exhibited the highest levels of cadmium-binding protein. Thus, cadmium-binding protein accumulation is not only related to cadmium exposure, but can be synergistically affected by environmental factors as well. When the biota are stressed to the point of synthesizing measurable levels of metal-binding proteins a toxic or potentially toxic condition exists. Therefore, cadmium-binding protein accumulation can be used to assess the effects of cadmium stress on a biological level. (Mertz-PTT)
W91-01309

INFLUENCE OF CADMIUM AND ZINC ON CADMIUM TURNOVER IN THE ZEBRAFISH, BRACHYDANIO RERIO.
Uppsala Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-01310

SELENIUM ACCUMULATION AND ELIMINATION IN MALLARDS.
Patuxent Wildlife Research Center, Laurel, MD.
G. H. Heinz, G. W. Pendleton, A. J. Krynitsky, and L. G. Gold.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 374-379, May/June 1990. 3 fig, 2 tab, 18 ref. San Joaquin Valley Drainage Program Intra-agency Agreement No. 6-AA-20-04170.

Descriptors: *Bioaccumulation, *Ducks, *Selenium, *Toxicology, *Water pollution effects, Chronic toxicity, Mallards, Mortality, Tissues, Toxicity, Water pollution.

Selenium accumulation and loss were measured in adult mallards (Anas platyrhynchos) fed selenomethionine during two experiments. In Experiment 1, both sexes were fed a diet containing 10 parts per million selenium for 6 weeks, followed by 6 weeks on untreated feed. Concentrations of selenium were predicted to reach 95% of equilibrium faster in liver (7.8 days) than in muscle (81 days). The loss of selenium from liver and muscle of females showed half-times of 18.7 for liver and 30.1 days for muscle. Males reached similar levels of selenium in liver and breast muscle as females and declined to similar levels once selenium treatment ended. In Experiment 2, females were fed increasing levels of selenium until some died. Survivors were switched to an untreated diet and selenium was measured in blood, liver, and breast muscle over 64 days. Half-times for loss of selenium from blood was 9.8 days and muscle was 23.9 days. Selenium initially decreased in liver by one-half in 3.3 days, with subsequent half times of 3.9, 6.0, and 45.1 days. (Mertz-PTT)
W91-01314

PREDICTING BIOACCUMULATION POTENTIAL: A TEST OF A FUGACITY-BASED MODEL.
Environmental Research Lab.-Narragansett, Newport, OR. Mark O. Hatfield Marine Science Center.
S. P. Ferraro, H. Lee, R. J. Ozretich, and D. T. Specht.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 386-394, May/June 1990. 2 fig, 7 tab, 44 ref.

Descriptors: *Bioaccumulation, *Clams, *Fate of pollutants, *Fugacity, *Model studies, *Oregon, *Organic pollutants, *Path of pollutants, *Water pollution, Accumulation factor model, Mollusks.

Clams (Macoma nasuta) from an unpolluted site in Yaquina Bay, Oregon were exposed in the laboratory for 28 days to 6 field-contaminated sediments which varied widely in concentration of 10 organic pollutants. Mean accumulation factors (accumu

lation factors = concentration in tissue/lipid, %/100 divided by concentration in sediment per total organic carbon, %/100) of 8 neutral organic compounds (DDE(p,p'), 2,2',3,5'6-pentachlorobiphenyl, 2,3',4,4',5-penta-chlorobiphenyl, Aroclor 1254, pyrene, chrysene, benzo(a)pyrene, benzo(b,(k))fluoranthene) were homogeneous across treatments. Statistically significant differences were detected between some treatment accumulation factors for DDD(p,p') and benz(a)anthracene, and between some chemicals within treatments. Accumulation factors were less than 2 and less variable in highly polluted, organically enriched sediments (total organic carbon >/ = 3.69 +/-0.044%), but sometimes exceeded 2 in clams exposed to surficial (0-2 cm deep) sediments with low pollutant concentration and low organic carbon content (</= 0.86 +/-0.037%). These results suggest that the accumulation factor model may provide reasonable estimates of bioaccumulation potential of hydrophobic neutral organic compounds in organically enriched, polluted sediments. (Author's abstract)
W91-01316

ACID PRECIPITATION AND FOOD QUALITY: INHIBITION OF GROWTH AND SURVIVAL IN BLACK DUCKS AND MALLARDS BY DIETARY ALUMINUM, CALCIUM, AND PHOSPHORUS.
Patuxent Wildlife Research Center, Laurel, MD.
For primary bibliographic entry see Field 5C.
W91-01320

EFFECT OF PH ON THE ACCUMULATION KINETICS OF PENTACHLOROPHENOL IN GOLDFISH.
Washington State Univ., Pullman. Coll. of Pharmacy.
G. R. Stehly, and W. L. Hayton.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 464-470, May/June 1990. 4 fig, 3 tab, 26 ref. National Institutes of Health, United States Public Health Service grant ES 01995 and U.S. EPA grant R812818.

Descriptors: *Acid rain effects, *Bioaccumulation, *Chlorinated hydrocarbons, *Fish physiology, *Hydrogen ion concentration, *Path of pollutants, *Pentachlorophenol, *Toxicity, *Water pollution effects, Carassius, Goldfish, Kinetics, Metabolism.

The kinetics of accumulation of pentachlorophenol at various pH values were investigated to explore how pH-dependent accumulation might influence pentachlorophenol toxicity. Goldfish (Carassius auratus) were exposed to 5 microgram pentachlorophenol/L in a static system buffered with 7.5 micromoles bicine or N,N-bis(2-hydroxyethyl)-2-aminoethane sulfonic acid at pH 7.0, 8.0, or 9.0. The amount of pentachlorophenol in the fish, concentration of pentachlorophenol in water, and the total amount of metabolites in the system were measured after exposure of fish from 1 to 96 hours. Equations for these variables based on a two compartment pharmacokinetic model were fitted simultaneously to the data using the model NONLIN, which uses an iterative nonlinear least squares technique. Uptake clearance, metabolic clearance, and apparent volume of distribution of pentachlorophenol decreased as pH increased. The decrease in pentachlorophenol accumulation with increased pH was not due solely to a pH-induced decrease in uptake. In addition, the distribution of pentachlorophenol within the fish was altered by changes in the external pH. The pH-associated changes in distribution may have altered access of pentachlorophenol to sites of metabolism, thereby altering the metabolic clearance. The pH-related changes in the pharmacokinetics of pentachlorophenol resulted in a decrease in its bioconcentration factor with an increase in pH and account both for the decreased capacity of the fish to accumulate pentachlorophenol and for its reduced LC50. (Author's abstract)
W91-01321

POLYCHLORINATED BIPHENYLS IN HOUSATONIC RIVER SEDIMENTS IN MASSACHUSETTS AND CONNECTICUT, USA: DETERMINATION, DISTRIBUTION, AND TRANSPORT.
Connecticut Agricultural Experiment Station, New Haven.
C. R. Frink, B. L. Sawhney, K. P. Kupl, and C. G. Fredette.
Environmental Auditor ENVAE8, Vol. 1, No. 2, p 79-130, 1990. 12 fig, 36 tab, 33 ref, 3 append.

Descriptors: *Massachusetts, *Path of pollutants, *Polychlorinated biphenyls, *River sediments, *Sediment contamination, Connecticut, Lake sediments, Lakes, Pollution load, Rivers, Water pollution.

Polychlorinated biphenyls (PCBs) have accumulated in the Housatonic River wherever sediments have accumulated. The concentration of PCBs in these sediments increased gradually with increasing distance upstream and then increased sharply in Woods Pond, the first impoundment below Pittsfield, Massachusetts. The distribution of PCBs within impoundments was found to be controlled by the distribution of fine-grained sediment. Calculations of the mass of PCBs in the river sediment indicate that, of the estimated total of 22,200 pounds, about 60% is in Massachusetts and nearly all of this amount is in sediment in Woods Pond. The remaining 40% of the total is in sediment in Connecticut: about 29% is in Lake Lillinonah, 10% is in Lade Zoar, and small amounts are at other locations. An anaylsis of these estimates indicates that errors should be within +/-50%. Transport of PCBs by suspended sediment down the river into Connecticut is estimated to be at the rate of 250 to 500 pounds per year. The results suggest that removal or containment of sediment in Woods Pond would help to alleviate further transport of PCBs into Connecticut. (Author's abstract)
W91-01328

EPILIMNETIC CARBON FLUX AND TURNOVER OF DIFFERENT PARTICLE SIZE CLASSES IN OLIGO-MESOTROPHIC LAKE LUCERNE, SWITZERLAND.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland). Inst. of Aquatic Sciences.
J. Bloesch, and U. Uehlinger.
Archiv fuer Hydrobiologie AHYBA4, Vol. 118, No. 4, p 403-419, June 1990. 6 fig, 4 tab, 44 ref.

Descriptors: *Carbon cycle, *Epilimnion, *Eutrophication, *Lake Lucerne, *Limnology, *Mesotrophic lakes, *Oligotrophic lakes, *Particulate matter, *Switzerland, *Water pollution effects, Excretion, Food habits, Lake turnover, Organic carbon, Particle size, Primary production, Respiration, Seasonal variation.

The carbon turnover in five different particle size classes (>/= 200 microm, 30-200 microm, 12-30 microm, 3-12 microm, </= 3 microm) was investigated in Lake Lucerne during 1984-1985. The smaller size fractions (</= 12 microm) were dominant in sestonic particulate organic carbon (POC) and primary production during summer stratification, whereas larger particles (>/= 30 microm) were abundant during winter turnover. Settling POC consisted mainly of large particles throughout the season. This pattern demonstrates the existence of biological particle transformation through zooplankton grazing (fecal pellet production), possibly supported by other biological and/or physico-chemical processes. Specific net increase rates of POC did not show much seasonal variation while scattering around zero. This is indicative of significant specific loss rates immediately compensating high production rates. POC sedimentation rates amounted to 12-39% of total loss in the larger size classes, and ca 20% of the primary production (193 g C ass/sq m/y) settled out of the epilimnion. Particulate C loss through washout did not significantly affect epilimnetic C turnover. Respiration was the dominant loss rate (68-79% of total loss in the size classes </= 12 microm). Grazing usually was not of great importance, except for the period in May/June when Daphnia grazed on abundant nannoplankton. Excretion was less than 7% of total loss in all size classes and did not contribute much to C turnover. It was concluded that epilimnetic C regeneration (including respiration, grazing, and excretion) amounted to ca 80% of the primary production, which is in the same range as P regeneration. (Author's abstract)
W91-01335

COMPARISON OF HISTORICAL AND RECENT DATA ON HYDROCHEMISTRY AND PHYTOPLANKTON IN THE RIJNLAND AREA (THE NETHERLANDS).
Hoogheemraadschap van Rijnland, Leiden (Netherlands).
S. P. Klapwijk.
Hydrobiologia HYDRB8, Vol. 199, No. 2, p 87-100, July 24, 1990. 5 fig, 6 tab, 32 ref.

Descriptors: *Acid rain effects, *Canals, *Eutrophic lakes, *Eutrophication, *Phytoplankton, *The Netherlands, *Water chemistry, *Water pollution effects, Algal blooms, Biological oxygen demand, Chlorophyll a, Limiting nutrients, Nitrogen, Orthophosphates, Phosphorus, Transparency.

In two canals and two lakes in the western part of the Netherlands a comparison was made between data on water chemistry and phytoplankton from 1941/1942 and recent data. Orthophosphate, and to some extent inorganic nitrogen have increased greatly, particularly in the Gouwe canal where Rhine water enters the area. The inorganic N/P mass ratio decreased in the last 45 years, indicating that the limiting nutrient has changed from phosphate in 1941 to nitrogen in 1987. The average seston volume, measured by filtering 100 L water through a plankton net (50 microm), has doubled. Blooms of the blue-green alga Microcystis aeruginosa occurred both historically and recently. The disappearance or reduction of several plankton species indicates the community has become impoverished in the last decennia. There has been no change in the saprobic index. Chlorophyll-a and transparency for 1941 were estimated based on correlations between chlorophyll-a and biological oxygen demand (BOD) and between transparency and seston volume using the 1987 data. The average chlorophyll-a concentration in the lakes has doubled or tripled in the last 45 years and the mean transparency in the Gouwe canal declined from 75 to 50 cm. Submerged higher plants at some sites have disappeared in the last decode. Using these results, ecological objectives for combatting eutrophication in canals and lakes and possibly the river Rhine can be developed. (Author's abstract)
W91-01352

SEASONAL CHANGES IN THE DISSOLVED FREE AMINO ACID AND DOC CONCENTRATIONS IN A HYPERTROPHIC AFRICAN RESERVOIR AND ITS INFLOWING RIVERS.
Council for Scientific and Industrial Research, Pretoria (South Africa). Div. of Water Technology.
For primary bibliographic entry see Field 2H.
W91-01356

DISTRIBUTION OF SHORT CHAIN CARBOXYLIC ACIDS IN EUTROPHIC DRAINAGE CHANNELS.
Sussex Univ., Brighton (England). School of Biological Sciences.
P. W. G. Doldorph, and J. D. Thomas.
Hydrobiologia HYDRB8, Vol. 199, No. 3, p 243-260, July 31, 1990. 12 fig, 4 tab, 62 ref.

Descriptors: *Carboxylic acids, *Dissolved organic matter, *Drainage canals, *England, *Eutrophication, Acetates, Butanoate, Dissolved oxygen, Diurnal variation, Hypolimnion, Propanoate, Seasonal variation, Sediments, Stratification.

Although it is generally accepted that dissolved organic matter (DOM) plays a central role in the metabolism of freshwater systems, little is known about its chemical composition. Therefore, the short chain carboxylic acids which are one component of DOM were investigated. The concentration of the C2-C5 carboxylic acids in the water column and sediment of shallow, eutrophic, drainage channels (Lewes Brooks, UK) were measured by gas chromatography. The concentrations of

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these acids were negatively correlated with dissolved oxygen. The highest concentrations of acetate (up to 200 microM), propanoate (up to 38 microM) and butanoate (up to 1.2 microM) were measured during the summer in the water above the sediment, which became hypoxic during this period. Both acetate and propanoate concentrations declined at night. High concentrations of the acids were also recorded in reedbeds, which were also hypoxic. Only acetate was detected in the sediment pore water (up to 168 microM). Its concentration declined during the autumn and winter and with increasing depth within the sediment. The short chain carboxylic acid pool which accumulates in the hypolimnion and sediment of the drainage channels constitutes a potential source of energy for bacteria, algae, and invertebrates, particularly during periods of mixing of the water column following prolonged stratification that may occur during autumnal turnover of lakes. (White-Reimer-PTT)
W91-01359

IMPLICATIONS OF AQUATIC ANIMAL HEALTH FOR HUMAN HEALTH.
Harvard Medical School, Boston, MA. Dept. of Pathology.
For primary bibliographic entry see Field 5C.
W91-01375

RELATIONS BETWEEN ACID RAIN AND VESICULAR-ARBUSCULAR MYCORRHIZA.
Utrecht Rijksuniversiteit (Netherlands). Dept. of Plant Ecology.
For primary bibliographic entry see Field 5C.
W91-01410

DRY DEPOSITION OF SULFUR: A 23-YEAR RECORD FOR THE HUBBARD BROOK FOREST ECOSYSTEM.
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
G. E. Likens, F. H. Bormann, L. O. Hedin, C. T. Driscoll, and J. S. Eaton.
Tellus TELLAL, Vol. 42B, No. 4, p 319-329, September 1990. 5 fig, 49 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Dry deposition, *New Hampshire, *Sulfur, Experimental basins, Forest watersheds, Hubbard Brook, Mass-balance method, Precipitation, Regression analysis, Streams, Sulfur dioxide.

Dry deposition of S was estimated for watershed-ecosystems of the Hubbard Brook Experimental Forest, New Hampshire, from 1964-65 through 1986-87. Two approaches, a regression analysis of bulk precipitation inputs and stream outputs and a mass-balance method, gave similar average values for Watershed 6 (430 equivalents SO4(2-)/hectare/year for regression analysis and 410 equivalents SO4(2-)/hectare/year for the mass-balance over the 23-year period). Dry deposition contributed about 37% of total S deposition, varying from 12% in 1964-65 to 61% in 1983-1984. Long-term data from replicated watershed-ecosystems showed that temporal variability in estimates of dry deposition was considerably greater than spatial (between watersheds) variability. Therefore, when using the mass-balance method for estimating dry deposition, short-term estimates of S dry deposition may be influenced by hydrology and must be interpreted with caution. No long-term, linear trend in dry deposition of SO4(2-) was observed during the last 23 years, despite a 40% reduction in wet deposition of SO4(2-) and a similar decrease in emissions of SO2 in the northeastern U.S. These differences in deposition trends may be due to differences in source areas for wet and dry deposition and have policy implications relative to regulation of anthropogenic emissions. (Mertz-PTT)
W91-01411

MATHEMATICAL MODEL OF BACTERIAL CONTAMINATION OF THE MORLAIX ESTUARY (FRANCE).
IFREMER, Paris (France).
J. C. Salomon, and M. Pommepuy.
Water Research WATRAG, Vol. 24, No. 8, p 983-994, August 1990. 10 fig, 13 ref.

Descriptors: *Bacteria, *Escherichia coli, *Estuaries, *France, *Model studies, *Morlaix Estuary, Salinity, *Path of pollutants, *Water pollution, Bacterial transport, Coliforms, Contamination, Mathematical studies, Shellfish, Water quality.

The sanitary problem of the Morlaix estuary (France) motivated the development of a physical/bacteriological mathematical model. The physical part of the model is based on well-known physical laws and, for testing and tuning purposes, only a few salinity measurements were necessary. Using a modeling procedure, knowledge concerning bacterial transport and disappearance can be attained that provides useful management information for minimizing fecal pollution in shellfishing areas such as Morlaix Bay. A set of two numerical models was built to simulate currents, water fluxes, transit times, trajectories, dispersion and bacterial decay. The models were tuned and fed by survival trials carried out in the field with Escherichia coli strains. Die-off rates ranged from 2 hours to 1 week. Model results compared well with in situ measurements and showed that, in all circumstances, physical dilution processes are much more efficient than mortality in this estuary. The last simulations provided suggestions for improving water quality in the study area. This modeling exercise is also of interest because the numerical code written for Morlaix estuary may be easily transformed for use in other coastal areas. The model is thus a general management tool useful in high hydrodynamic areas. (Mertz-PTT)
W91-01419

SPECIES-RELATED VARIATIONS OF SILVER BIOACCUMULATION AND TOXICITY TO THREE MARINE BIVALVES (VARIATIONS INTER-SPECIFIQUES DE LA BIOACCUMULATION ET DE LA TOXICITE DE L'ARGENT A L'EGARD DE TROIS MOLLUSQUES BIVALVES MARINS).
Nantes Univ. (France). Lab. de Ecotoxicologie de Milieux Aquatiques.
C. Metayer, C. Amiard-Triquet, and J. P. Baud.
Water Research WATRAG, Vol. 24, No. 8, p 995-1001, August 1990. 2 fig, 6 tab, 24 ref. English summary.

Descriptors: *Bioaccumulation, *Mollusks, *Path of pollutants, *Silver, *Toxicity, Crassostrea, Food chains, Heavy metals, Mussels, Mytilus, Oysters, Scallops, Water pollution.

Previous data about silver in marine molluscs have shown a high variability of both accumulation and toxicity of this metal. A potential relationship between these factors was examined. In a preliminary experiment, three species of bivalves (Crassostrea gigas, Mytilus galloprovincialis, Chlamys varia) were exposed to silver concentrations varying from 1 to 1000 microgram Ag/L in order to determine parameters of lethal toxicity. Then, specimens of the same species were exposed to sublethal levels of silver through food, water or both food and water. In this main experiment, the level of silver was identical (20 microgram Ag/L) in the culture medium of algae used as food and in the rearing medium of bivalves. Since the nominal levels of silver in water decreased during the experiment, seawater and contaminant were renewed every day. The species-related variations of mean lethal time revealed that the most resistant species was the oyster and the lesser one was the scallop. The patterns of bioaccumulation in soft tissues were different in oysters--in which the maximal concentration was reached within 2 weeks--and in mussels--in which this maximum was not reached after 4 weeks. Exposure to silver via food induced a significant uptake of this metal in soft tissues of bivalves, but it was low compared to uptake from seawater and to the contamination from the double method of exposure. The species-related behavior of silver may be interpreted from the point of view of ecotoxicological consequences. Species such as the oyster, with a low susceptibility and high ability to concentrate silver, could have an important role as the vector of contamination in food webs. Species such as the scallop, able to concentrate high levels of silver and very susceptible, could be eliminated from polluted ecosystems, but their role in trophic transfer will be eliminated. Species such as the mussel, which accumulate only low quantities of silver, will not have any role in food chain contamination and their intermediate susceptibility could have consequences only in highly polluted environments. (Mertz-PTT)
W91-01420

SEASONAL AND LONG-TERM TRENDS IN TRUCKEE RIVER NUTRIENT CONCENTRATIONS AND TRUCKEE RIVER NUTRIENT CONCENTRATIONS AND LOADINGS TO PYRAMID LAKE, NEVADA: A TERMINAL SALINE LAKE.
Fish and Wildlife Service, Columbia, MO.
D. L. Galat.
Water Research WATRAG, Vol. 24, No. 8, p 1031-1040, August 1990. 5 fig, 4 tab, 48 ref.

Descriptors: *Eutrophication, *Nevada, *Nitrogen, *Nutrient transport, *Path of pollutants, *Phosphorus, *Saline lakes, Effluents, Fluctuations, Lakes, Pollution load, Precipitation, Pyramid Lake, Rivers, Truckee River, Water pollution.

Mass-discharge of phosphorus and nitrogen from Truckee River to Pyramid Lake, Nevada, was estimated for 15 years (1973-1987) and related to changes in quantity and quality of sewage effluent discharged into the river. Effluent nitrogen loadings to Truckee River increased by about 6%/year, whereas phosphorus discharge beginning in 1982 was reduced 90% by phosphorus removal. Water discharged annually by Truckee River to Pyramid Lake varied widely among years, ranging from about 42,000,000 to 2,420,000,000 cubic meters. Anomalous regional precipitation patterns associated with strong El Nino-Southern Oscillation events resulted in below-average Truckee River discharge from 1977 to 1979, and above-average discharge from 1982 to 1984 and 1986. Mass-transport of soluble reactive phosphorus to Pyramid Lake declined from 146 to 94 mg/square m/year after phosphorus removal, whereas total phosphorus loadings increased from 217 to 396 mg/square m/year. There were no significant long-term trends in total nitrogen loadings to Pyramid Lake (mean 1640 mg/square m/year; range 112-5500 mg/square m/year), despite increases in effluent nitrogen loadings to Truckee River. Seasonal and annual fluctuations in fluvial discharge changes in quantity and quality of effluent discharged to Truckee River and in-river biological uptake and transformations were responsible for the variability in in-stream nutrient concentrations and projected loadings to Pyramid Lake. (Author's abstract)
W91-01425

COMMENTS ON THE HYDROCHEMICAL REGULATION OF THE HALOGEN ELEMENTS IN RAINFALL, STEMFLOW THROUGHFALL AND STREAM WATERS AT AN ACIDIC FORESTED AREA IN MID WALES.
Institute of Hydrology, Wallingford (England).
C. Neal, C. J. Smith, J. Walls, P. Billingham, and S. Hill.
Science of the Total Environment STENDL, Vol 91, p 1-11, February 1990. 6 fig, 3 tab, 24 ref

Descriptors: *Acidic water, *Chemistry of precipitation, *Forest watersheds, *Groundwater chemistry, *Halogens, *Path of pollutants, *Wales, Acid rain, Acid streams, Bromine, Chemical analysis, Coniferous forests, Fluorine, Iodine, Marine climates, Seasonal variation, Stemflow, Stream pollution, Throughfall, Watersheds.

Total fluorine, chloride, bromide and total iodine concentration data from a 5 year study of rainfall, throughfall, stemflow and streamwater at the Hafren conifer plantation are presented. Results show four main features. First, in rainfall a strong maritime influence is observed for chloride and bromide, while enrichment occurs for total fluorine and total iodine relative to chloride, reflecting seawater/atmosphere fractionation processes. Second, variation of chloride, bromide and tot

iodine is much lower in the streamwaters compared with the rainfall input, showing the ability of the catchment to damp rainfall chemistry even though 'flashy' hydrograph response is observed. Total fluorine does not exhibit this damping and the reason for this difference remains unclear. Third, there is a net release of total fluorine from the catchment above that supplied from the rainfall, while net losses for bromide and total iodine occur as water passes from rainfall to the stream. Fourth, marked seasonal oscillations occur for streamwater bromide and total iodine concentrations; it is hypothesized that this relates to organic matter breakdown within the catchment during the summer period when biological activity is at its highest. (Author's abstract)
W91-01447

TIME TREND OF PCB CONCENTRATIONS IN SURFACE SEDIMENTS FROM A HYPERTROPHIC, MACROALGAE POPULATED AREA OF THE LAGOON OF VENICE.
Venice Univ. (Italy). Dept. of Environmental Science.
B. Pavoni, C. Calvo, A. Sfriso, and A. A. Orio.
Science of the Total Environment STENDL, Vol. 91, p 13-21, February 1990. 3 fig, 1 tab, 19 ref.

Descriptors: *Algae, *Eutrophication, *Lagoons, *Marine sediments, *Path of pollutants, *Polychlorinated biphenyls, *Water pollution sources, Algal blooms, Anoxia, Biomass, Chemical analysis, Fate of pollutants, Italy, Seasonal variation, Venice.

The preliminary results of a study to investigate the role of macroalgae in the variations of polychlorinated biphenyl (PCB) concentrations in the surface sediments of the lagoon of Venice are reported. The concentrations of PCBs were determined over a period of 1 year in surface sediments sampled monthly and semi-monthly in the lagoon. At the sampling station, due to the poor water circulation and an over-abundance of nutrients, macroalgae thrive in spring-summer and standing crops > 12 kg/sq m were seen. As a consequence of rapid algal decomposition, sediment PCB concentrations were observed to increase. In particular, on occasions when anoxia occurred at the end of July and all the biomass had decayed, PCB concentrations increased by more than one order of magnitude. In March, when macroalgae started to grow, concentrations were 13 ng/g (dry wt); in July-August they exceeded 100 ng/g. The sediment PCB concentrations were restored to the previous values after algal biomass became negligible, in November. Concentrations of PCBs in young algae fronds were 27 +/-12 ng/g and 121 +/-4 ng/g in older fronds. (Author's abstract)
W91-01448

CHEMICAL COMPOSITION AND ACIDITY OF RAINFALL IN THE ALLIGATOR RIVERS REGION, NORTHERN TERRITORY, AUSTRALIA.
Office of the Supervising Scientist for the Alligator Rivers Region, Sydney (Australia).
B. N. Noller, N. A. Currey, G. P. Ayers, and R. W. Gillett.
Science of the Total Environment STENDL, Vol. 91, p 23-48, February 1990. 6 fig, 6 ref, 47 ref.

Descriptors: *Acid rain, *Australia, *Chemistry of precipitation, *Hydrogen ion concentration, *Path of pollutants, Acetates, Air pollution sources, Chemical analysis, Chlorides, Conductivity, Nitrates, Organic acids, Phosphates, Pollutant identification, Rainfall, Sulfates.

Rainfall in the Alligator Rivers Region, Northern Territory, is essentially restricted to the period October to April. Rainwater samples from eight sites show that pH is consistently between 4.0 and 5.0, and confirms previous observations of the widespread occurrence of acidic rainwater across the northern parts of Australia. Measurements of ions (sulfate, nitrate, chloride, phosphate) and weak organic acids (formate and acetate) in rainfall, together with pH and conductivity, have shown the presence of local concentrations of ions and presence of free acidity in excess of that attributed to dissolved carbon dioxide. Much of the acidity was associated with the presence of weak acids; for example, for all Magela samples 47% was weak acids compared with 25.5, 13 and 8% for hydrochloric, sulfuric and nitric acids, respectively. Acidity due to sulfate was therefore low, but sulfate in excess of that derived from sea-salt was of large magnitude; for example, 83% of sulfate for all Magela samples was excess. Possible sources of acidity are natural (burning of vegetation, soil dust, lightning, biogenic emissions from soils and oceans and volcanoes), and anthropogenic (sulfuric acid plant and electricity generating stations and minor emissions from calciners and sulfuric acid aerosols in open vats locally at Jabiru and nearby Nabarlek). The impact of sulfur emissions from the Ranger uranium mine/mill complex (sulfuric acid plant and electricity generating station) on rainwater acidity in the surrounding Jabiru area was examined, but the fate of the sulfur dioxide emissions was not known. Difficulties in establishing the significance of contributions from anthropogenic sources against this background of natural acidity are attributed to a lack of information on the proportions of chloride, sulfate and nitrate from these sources. (Author's abstract)
W91-01449

ZINC IN POOR SANDY SOILS AND ASSOCIATED GROUNDWATER. A CASE STUDY.
Amsterdam Univ. (Netherlands). Landscape and Environmental Research Group.
G. B. M. Pedroli, W. A. C. Maasdam, and J. M. Verstraten.
Science of the Total Environment STENDL, Vol. 91, p 59-77, February 1990. 8 fig, 3 tab, 55 ref.

Descriptors: *Air pollution effects, *Groundwater pollution, *Path of pollutants, *Sandy soils, *Soil chemistry, *Water pollution sources, *Zinc, Cadmium, Chemical analysis, Copper, Forest soils, Groundwater chemistry, Groundwater movement, Heavy metals, Lead, Mineral industry, Pollutant identification, Soil analysis, Soil contamination, Soil types, The Netherlands.

High concentrations of zinc (up to 15 mg/L) were observed in most of the acid recharge groundwater in an area of 30 sq km in use as farmland and as a nature reserve in a coversand landscape at the Dutch-Belgian border. These zinc loads are assumed to be associated with atmospheric deposition from zinc smelters in the region. To explain spatial differences in the zinc content of the groundwater, soil samples were taken from organic and mineral horizons down to the groundwater table of two comparable soil profiles under Scotch pine, which had associated groundwater differing in zinc content by a factor of 40. No appreciable differences could be detected between these two soils. The total and extractable heavy metal contents (Pb, Cu, Cd, Zn) of both soils were comparable with reference situations, only the zinc contents were slightly higher than normal. The complexing capacity of the groundwater corresponding to both soil profiles was small. Longitudinal study of the zinc contents of the heavily loaded groundwater compared with chloride indicates that zinc concentrations increase disproportionately during the growing season. Few references are available on the behavior of zinc and other trace metals in groundwater. Atmospheric input of heavy metals is probably responsible for the locally high zinc concentrations in groundwater, but, to a considerable extent, lateral mobilization and immobilization processes within the phreatic reach regulate these concentrations. (Author's abstract)
W91-01450

CHEMISTRY OF CARBONYL COMPOUNDS IN PO VALLEY FOG WATER.
Consiglio Nazionale delle Ricerche, Bologna (Italy). Ist. FISBAT.
M. C. Facchini, J. Lind, G. Orsi, and S. Fuzzi.
Science of the Total Environment STENDL, Vol. 91, p 79-86, February 1990. 1 fig, 2 tab, 22 ref.

Descriptors: *Acid rain, *Aldehydes, *Carbonyl compounds, *Chemistry of precipitation, *Fog, *Fogwater chemistry, *Path of pollutants, *Water pollution sources, Air pollution, Atmospheric water, Chemical analysis, Formaldehyde, Italy, Laboratory methods, Po Valley, Seasonal variation.

Measurements were made of the free and bound carbonyl compounds in Po Valley fog water samples. Free and then total carbonyls were determined after cleaving the possible adducts by NaOH addition. The hydroxymethansulfonic acid concentration was inferred as the difference between the two measurements, making the assumption that hydroxyalkanesulfonic acids are by far the most abundant adducts of carbonyl compounds in the atmospheric liquid samples. High concentrations of formaldehyde (HCHO) were detected in fog water (from 16 to 567 micromolar; average, 130 micromolar). The oxidant-limiting conditions during fog season (fall-winter months) favor the presence of a large fraction of HCHO in the form of adducts with hydroxymethanesulfonate: 85% of the total HCHO on average. Other carbonyl compounds were detected in the fog water: acetaldehyde, acrolein and acetone, but typically in much lower concentrations than formaldehyde. These other carbonyl compounds do not appear to be present in bound form. (Author's abstract)
W91-01451

CONSOLIDATION AND CONTAMINANT MIGRATION IN A CAPPED DREDGED MATERIAL DEPOSIT.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5E.
W91-01453

GEOGRAPHICAL DISTRIBUTION OF CONTAMINANTS AND PRODUCTIVITY MEASURES OF HERRING GULLS IN THE GREAT LAKES: LAKE ERIE AND CONNECTING CHANNELS 1978/79.
Canadian Wildlife Service, Burlington (Ontario). Ontario Region.
D. V. Weseloh, P. Mineau, and J. Struger.
Science of the Total Environment STENDL, Vol. 91, p 141-159, February 1990. 3 fig, 9 tab, 36 ref.

Descriptors: *Bioaccumulation, *Bioindicators, *Great Lakes, *Gulls, *Lake Erie, *Path of pollutants, *Productivity, Chemical analysis, Chlorinated hydrocarbons, Correlation analysis, DDE, DDT, Data analysis, Dieldrin, Eggs, Fate of pollutants, Halogenated pesticides, Pesticide drift, Pesticide residues, Polychlorinated biphenyls, Water pollution effects.

The distribution and size of colonies, residue levels of DDE, DDT, hexachlorobeneze (HCB), dieldrin, mirex and polychlorinated biphenyls (PCBs) in eggs, productivity and eggshell thickness were determined for herring gulls at 14 sites in Lake Erie and connecting channels. The center of distribution for breeding herring gulls was the Western Basin where approximately 90% of the 6200 nests in the study area were located. PCB and DDE levels ranged from 35 to 140 ppm (wet weight) and from 2.8 to 9.4 ppm, respectively; all other residues were < 0.49 ppm. Most organochlorine residue levels were highest in eggs from colonies in or near the Niagra or Detroit Rivers. Mirex residues were greatest in the Niagra River and decreased significantly to the west. PCB residues were greatest in the Detroit River and decreased significantly to the east. The lowest levels generally came from colonies in the Sandusky Basin and near Pelee Island in western Lake Erie. Discriminant function analysis of six organochlorine contaminants correctly classified 90% or more of the eggs from up to four colonies in one or more years. PCB and HCB levels appeared to have the greatest discriminating power. Herring gull productivity at all colonies (1-1.7 young gulls/pair) was normal and showed no significant geographical variation. Eggshell thickness was greatest in colonies in the Sandusky Basin and least in colonies in the Detroit River and extreme west end of the lake; mean eggshell thickness was 0.350 +/-0.02 mm (6.7% thinning), which was weakly, but significantly correlated to DDE concentration. The variation in contaminants in herring gull eggs on a Basin basis (i.e. Western, Eastern, Sandusky, etc.) paralleled

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those known for sediments, water and fish. In addition to its role as an indicator of lake-wide contamination of the Great Lakes, the herring gull may function as an indicator of 'regional' contamination. This improves the geographical specificity of the herring gull as an indicator species on the Great Lakes, where it is a non-migratory species. (Author's abstract)
W91-01454

PARAFFIN HYDROCARBONS IN THE GONADS OF THE SEA URCHIN STRONGYLOCENTROTUS NUDUS NORMALLY AND AFTER EXPOSURE TO DIESEL OIL (IN RUSSIAN).
Akademiya Nauk SSSR, Vladivostok. Inst. Biologii Morya.
M. A. Vashchenko, and V. I. Svetashev.
Biologiia Moria BIMOD4, No. 5, p 61-67, 1989. 3 fig, 1 tab, 28 ref.

Descriptors: *Aliphatic hydrocarbons, *Animal tissues, *Bioaccumulation, *Echinoderms, *Oil pollution, *Path of pollutants, *Tissue analysis, Gas chromatography, Laboratory methods.

The accumulation of paraffin hydrocarbons in the gonads of the sea urchin Strongylocentrotus nudus exposed to the water soluble fraction (WSF) of light diesel oil was determined using gas chromatography. In the male and female gonads of the sea urchins from the control group (before exposure) and the experimental group (exposed to WSF of light diesel oil for 1,3,7, and 15 days) a homologous series of n-paraffins over the range of C15-C28 and C13-C28, respectively, was found. Gas chromatograms of n-alkanes isolated from the gonads of experimental animals showed a greater unresolved peak and the presence of isoalkanes in the C14-C18 range not found in controls. These isoalkanes were identical to those from WSF of diesel oil. The qualitative composition of n-paraffins over the C19-C28 range was similar for both the control and experimental sea urchins. Hydrocarbon levels in the gonads of experimental animals were 5-20 times higher than in controls. n-Alkane concentration was maximal in male gonads the day after exposure. It was concluded that the gonads of sea urchins exposed to WSF of light diesel oil accumulate hydrocarbons. (Author's abstract)
W91-01456

MONITORING THE EROSION OF AN EXPRESSWAY DURING ITS CONSTRUCTION: PROBLEMS AND LESSONS.
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
For primary bibliographic entry see Field 2J.
W91-01459

SEASONAL DESCRIPTION OF THE QUALITY AND QUANTITY OF SNOWMELT IN A MOUNTAINOUS REGION USING AN INTEGRATED MODEL.
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Hydrologie a Hydrauliky.
For primary bibliographic entry see Field 2C.
W91-01460

RELEASE OF CATIONIC ALUMINIUM FROM ACIDIC SOILS INTO DRAINAGE WATER AND RELATIONSHIPS WITH LAND USE.
University Coll. of Wales, Aberystwyth. Soil Science Unit.
W. A. Adams, A. Y. Ali, and P. J. Lewis.
Journal of Soil Science JSSCAH, Vol. 41, No. 2, p 255-268, June 1990. 5 fig, 10 tab, 24 ref.

Descriptors: *Acid rain, *Acidic soils, *Aluminum, *Cation exchange, *Drainage water, *Leachates, *Soil chemistry, *Solute transport, Acidic water, Cations, Chemical interactions, Hydrogen ion concentration, Ion exchange, Land use, Leaching, Nitrates, Rainfall, Stream discharge, Sulfates, Wales.

Aluminum is usually the dominant exchangeable cation in strongly acidic soils. The concentration of cationic monomeric aluminum (Al(+3)) was determined in streams draining areas of different land use in Wales. Relationships between the concentrations of Al(+3) and companion ions were examined both for streams and for eluates from soil leached in the laboratory with simulated rainwater that ranged in pH and salt concentration. The concentrations of Al(+3) were consistently greater in streams draining Sitka spruce woodland than in streams in adjacent catchments draining rough grazing. In no case was the Al(+3) concentration governed by the solubility product of gibbsite. The concentrations of Al(+3) were very closely correlated with excess anions (total inorganic anions minus basic cations) both for stream water and for eluates from soil leached with simulated rainwater at a constant pH equal to that of the soil (3.8). Exchangeable Al was the source of Al(+3) in leachates from soil in the laboratory. The displacement of exchangeable Al was the dominant process accounting for the levels of Al(+3) in acidic streams. Hydrogen ions were much more important than basic cations in displacing exchangeable Al from the acidic soil used in the laboratory experiments, and probably from soils in the field. The greater excess of inorganic anions in streams from Sitka spruce woodland probably resulted from a greater anion excess in the input water (acid rain) together with a greater NO3 production in the soil. All three major anions--Cl, SO4, and NO3--contributed to the greater anion excess. (Author's abstract)
W91-01479

UPGRADING ANTIQUE SEWERS.
Massachusetts Water Resources Authority, Boston.
K. O'Brien, F. J. Killilea, and S. T. Johnson.
Civil Engineering (ASCE) CEWRA9, Vol. 60, No. 9, p 58-60, September 1990. 2 fig.

Descriptors: *Civil engineering, *Metropolitan water management, *Pumping plants, *Sewer systems, *Upgrading, Boston, Construction methods, Siphons, Urban areas, Water treatment facilities.

People in Boston and surrounding communities expect their public works systems to keep pace with their needs through periodic extension, revision, rehabilitation, and repair. In the most recent project, a $35 million, four-year program, the Massachusetts Water Resources Authority completely restructured the pumping system of the North Metropolitan Sewerage System which required that the existing system serve as building blocks for the new system, which will meet the area's needs through the year 2000. Two major components of the upgraded system are the new pump station and screen house. Design and construction challenges for these components, and for the conduits and connections required to integrate them into the overall system, were compounded by site constraints and the need to keep the existing system operating throughout construction. Construction of the new pump station required a number of diversions, new conduits, and connections as well as modifications to existing facilities. The new pump station was sited near the existing station for easy connection to the two siphons and two sewers that would deliver flows to it. Junction chambers were constructed around the sewers and siphons; as each chamber was completed, the sewers were reactivated until station startup. The screen house required a number of diversions and bypasses. Again, junction chambers were constructed and flows were diverted during construction and then back to their original locations. When the system is brought on-line, its capacity of 125 mgd will meet the needs of the area for the rest of the decade. (Fish-PTT)
W91-01484

PIRLA PROJECT (PALEOECOLOGICAL INVESTIGATION OF RECENT LAKE ACIDIFICATION): AN INTRODUCTION TO THE SYNTHESIS OF THE PROJECT.
Indiana Univ. at Bloomington. Dept. of Biology.
D. R. Whitehead, D. F. Charles, and R. A. Goldstein.
Journal of Paleolimnology JOUPE8, Vol. 3, No. 3, p 187-194, 1990. 4 fig, 20 ref, append. Electric Power Research Institute fund RP-2174-10.

Descriptors: *Acid rain, *Lake acidification, *Lake basins, *Limnology, *North America, *Paleolimnology, Acid lakes, Adirondack Mountains, Biochemistry, Chemical properties, Cores, Florida, Geochemistry, Great Lakes, New England, Regional analysis, Research priorities.

The Paleoecological Investigation of Recent Lake Acidification PIRLA project was designed to assess the magnitude and character of the impact of acid precipitation on North American lake systems. The scenario that stimulated the project is straightforward: there is an obvious spatial pattern of acidic deposition in North America; a significant amount of acidic deposition falls on areas whose bedrock and surficial geology imbue them with high potential sensitivity to acid precipitation; and reconstruction of SO2 and NOx emissions for North America indicate a significant increase in emissions after 1900, and distinct patterns of emission density. The paleolimnological record can provide accurate and detailed information on the biogeochemical trajectories of lake systems: patterns of chemical and biological change that can be read on different scales. The regional research teams, areas to be studied, methods to be utilized, and questions to be approached were developed in intensive discussions among the collaborators in a meeting held in 1983. The areas focused upon include: Adirondack region, Northern New England, Northern Great Lakes States, and Northern Florida. The questions studied in each geographic region addressed evidence of lake acidification in this century; the magnitude, character, and timing of the response; and the relative roles of natural and anthropogenic sources of acidity. The primary message of PIRLA clearly lies in the regional summaries, which provide an interdisciplinary and integrated view of recent acidification trends in each region. (See W91-01499 thru W91-01502) (Fish-PTT)
W91-01498

PALEOECOLOGICAL INVESTIGATION OF RECENT LAKE ACIDIFICATION IN THE ADIRONDACK MOUNTAINS, N.Y.
Indiana Univ. at Bloomington. Dept. of Biology.
D. F. Charles, M. W. Binford, E. T. Furlong, R. A. Hites, and M. J. Mitchell.
Journal of Paleolimnology JOUPE8, Vol. 3, No. 3, p 195-241, 1990. 11 fig, 4 tab, 148 ref, 3 append. Electric Power Research Institute fund RP-2174-10; National Science Foundation Grants BSR-8617622, DEB77-03907, and DEB79-12210; and U.S. EPA/North Carolina State University Acid Deposition Program fund APP-0199-1982.

Descriptors: *Acid lakes, *Acid rain, *Acid rain effects, *Adirondack Mountains, *Cores, *Lake acidification, *Limnology, *New York, *Paleolimnology, Calcium, Chrysophyta, Diatoms, Fish, Manganese, Midges, Sediment analysis, Sulfur, Titanium, Water chemistry, Waterfleas, Watersheds.

The Paleoecological Investigation of Recent Lake Acidification (PIRLA) project prompted analysis of the sediment record of 12 Adirondack lakes, revealing that the 8 clearwater lakes with current pH <5.5 and alkalinity <10 microeq/l have acidified recently. The onset of this acidification occurred between 1920 and 1970. Loss of alkalinity, based on diatom assemblages, ranged from 2 to 35 microeq/L. The acidification trends are substantiated by stratigraphies of diatom, chrysophyte, chironomid, and cladoceran remains, Ca:Ti and Mn:Ti ratios, sequentially extracted forms of Al, and historical fish data. Acidification trends appear to be continuing in some lakes, despite reductions in atmospheric sulfur loading that began in the early 1970s. The primary cause of the acidification trend is clearly increased atmospheric deposition of strong acids derived from the combustion of fossil fuels. Natural processes and watershed disturbances cannot account for the changes in water chemistry that have occurred, but they may play a role. Sediment core profiles provide a clear record of increased atmospheric input of materials associated with the combustion of fossil fuels beginning in the late 1800s and early 1900s. The primary evidence for acidification occurs after that period, and the pattern of water chemistry response to

increased acid inputs is consistent with current understanding of lake-watershed acidification processes. (See W91-01498 thru W91-01502) (Author's abstract)
W91-01499

SEQUENTIALLY EXTRACTED METALS IN ADIRONDACK LAKE SEDIMENT CORES.
Indiana Univ., Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 2H.
W91-01500

CALCULATION AND UNCERTAINTY ANALYSIS OF PB210 DATES FOR PIRLA PROJECT LAKE SEDIMENT CORES.
Harvard Univ., Cambridge, MA. Dept. of Landscape Architecture.
For primary bibliographic entry see Field 2H.
W91-01501

UTILITY OF SCALED CHRYSOPHYTES FOR INFERRING LAKEWATER PH IN NORTHERN NEW ENGLAND LAKES.
Queen's Univ., Kingston (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-01502

MOMENTARY INSTABILITY OF A SATURATED POROUS LAYER WITH A TIME-DEPENDENT TEMPERATURE DISTRIBUTION, AND THE MOST UNSTABLE DISTURBANCE.
Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
T. Green.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2015-2021, September 1990. 7 fig, 13 ref.

Descriptors: *Convection, *Groundwater movement, *Groundwater pollution, *Path of pollutants, Mathematical analysis, Porous media, Temperature gradient.

The stability of fluid with a time-dependent vertical temperature distribution in a horizontal, saturated porous layer is investigated, using the idea of momentary stability and a Galerkin technique. The most unstable disturbance is found by minimizing the critical Rayleigh number over the Fourier amplitudes of that disturbance, using both an iterative and a simplex procedure. As an example, the case in which an originally linear, stable temperature distribution is changed by lowering the temperature of the upper boundary at a constant rate is examined in detail. It showed that the most unstable disturbance is usually large where the base state is gravitationally unstable but there seems to be no simple relation between the two. (Peters-PTT)
W91-01518

SOLUTE TRANSPORT WITH MULTISEGMENT, EQUILIBRIUM-CONTROLLED REACTIONS: A FEED FORWARD SIMULATION METHOD.
Geological Survey, Menlo Park, CA. Water Resources Div.
J. Rubin.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2029-2055, September 1990. 8 fig, 12 tab, 22 ref, append.

Descriptors: *Feed forward method, *Geochemistry, *Mathematical analysis, *Path of pollutants, *Solute transport, *Water chemistry, Chemical reactions, Computer models.

The feed forward method (FF method) is used to formulate operational equations which simulate transport of solutes influenced by equilibrium-controlled reaction networks. The FF method provides increased solution efficiency by adapting its formulations to some of the network's fundamental features. The FF method has been further developed by adapting and testing it for a variety of network conditions. Classes of homogeneous, classical heterogeneous, and ion exchange network segments were studied. Networks may contain only a single class of segments or they may involve two or three segment classes. The FF method was found to be applicable to all the cases tested. In only one of these cases, for the more complex configurations of network segments, the FF method did not attain all of its objectives. A systematic, stepwise approach to method development was used. It revealed, for certain subnetworks, an a priori inadmissibility, irrespective of the method used, and, for some other networks, an a priori irrelevance to transport dynamics. It also demonstrates that when certain subnetworks, belonging to different segment classes, form a single network, synergism (or antagonism) may occasionally arise and decrease (or increase) the difficulty of solving the transport problem. (Author's abstract)
W91-01520

MASS ARRIVAL OF SORPTIVE SOLUTE IN HETEROGENEOUS POROUS MEDIA.
Royal Inst. of Tech., Stockholm (Sweden).
V. D. Cvetkovic, and A. M. Shapiro.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2057-2067, September 1990. 5 fig, 23 ref.

Descriptors: *Groundwater movement, *Mathematical analysis, *Path of pollutants, *Porous media, *Solute transport, *Water chemistry, Desorption, Hydraulic conductivity, Solutes, Sorption, Tracer studies.

The stochastic arrival time analysis of nonreactive solute movement in heterogeneous porous media was extended to consider solutes that undergo sorption-desorption governed by first-order linear kinetics. For an instantaneous solute injection, a general expression for the expected mass flux at any distance from the injection point was derived in terms of the three-dimensional velocity field and the forward-sorption and reverse-sorption rate coefficients. This general expression is reduced for three special cases: (1) equilibrium sorption-desorption where the retardation coefficient is either correlated or uncorrelated with the hydraulic conductivity field, (2) solute degradation where the rate coefficient is uncorrelated with the hydraulic conductivity, and (3) nonequilibrium sorption-desorption with constant sorption rate coefficients. These cases were analyzed for a lognormally distributed and statistically isotropic spatial correlation of the hydraulic conductivity; other assumptions of spatial correlation in the hydraulic conductivity can also be used. The influence of spatial variability in the sorption rate coefficients for nonequilibrium sorption-desorption was investigated for the special case of a stratified porous medium. For equilibrium sorption-desorption, the spatial variability in the retardation coefficient may notably delay the breakthrough of solute at a given location. The spatial variability in the degradation parameter does not influence solute breakthrough significantly for the considered range of parameters. For a stratified porous medium, spatial variability in the sorption rate coefficients has a significant effect on the cumulative mass arrival at a given location. Using the harmonic mean of the sorption rate coefficients most closely approximates the results generated using variable sorption-rate coefficients for the stratified formation case. (Author's abstract)
W91-01521

MEAN SQUARE ERROR OF REGRESSION-BASED CONSTITUENT TRANSPORT ESTIMATES.
Geological Survey, Reston, VA.
E. J. Gilroy, R. M. Hirsch, and T. A. Cohn.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2069-2077, September 1990. 9 fig, 12 ref, append.

Descriptors: *Model studies, *Network design, *Path of pollutants, *Regression analysis, *Sampling, *Solute transport, Errors, Flow equations, Mathematical models, Surface water.

Estimates of long-term transport of constituents commonly are obtained by summing retransformed estimates from regressions of logarithmically transformed response variables. Typical explanatory variables for these regressions include functions of flow, change in flow, time, and time of year. The mean and mean square error of four estimators of long-term transport at periodically measured stations are presented as a function of the observed values of the explanatory variables from the long-term record and summary statistics of the regression data. Estimates of the mean square errors can be used in designing sampling strategies to attempt to minimize the uncertainty in the estimation of long-term transport subject to a constraint on the number of samples to be taken. This uncertainty is expressed in terms of the explanatory variables in the long-term record, the regression coefficients and standard error of the regression and the mean and covariance structure of the explanatory variables used in the regression. (Author's abstract)
W91-01522

STREAM FUNCTIONS AND EQUIVALENT FRESHWATER HEADS FOR MODELING REGIONAL FLOW OF VARIABLE-DENSITY GROUNDWATER. 1. REVIEW OF THEORY AND VERIFICATION.
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2F.
W91-01524

STREAM FUNCTIONS AND EQUIVALENT FRESHWATER HEADS FOR MODELING REGIONAL FLOW OF VARIABLE-DENSITY GROUNDWATER. 2. APPLICATION AND IMPLICATIONS FOR MODELING STRATEGY.
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2F.
W91-01525

PHYSICALLY BASED MODEL FOR PREDICTING SOLUTE TRANSFER FROM SOIL SOLUTION TO RAINFALL-INDUCED RUNOFF WATER.
Agricultural Research Service, Riverside, CA. Salinity Lab.
R. Wallach, and M. T. van Genuchten.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 2119-2126, September 1990. 8 fig, 2 tab, 15 ref, append.

Descriptors: *Agricultural runoff, *Model studies, *Nonpoint pollution sources, *Path of pollutants, *Rainfall-runoff relationships, *Soil solution, *Water pollution sources, Agricultural chemicals, Hydrographs, Infiltration, Infiltration rate, Mathematical models, Overland flow, Pesticides, Soil water, Solute transport.

A model was developed to predict the field outlet concentration hydrograph for chemicals released into overland runoff induced by continuous rainfall on a sloping soil. The model accounts for convective-dispersive solute transport in the soil and also considers rate-limited mass transfer through a laminar boundary layer at the soil surface/runoff water interface. Solutes are assumed to be subject to linear equilibrium sorption onto the solid phase of the soil. Concentration hydrographs for rainfall-induced runoff were derived by treating the runoff zone as a well-mixed reactor characterized by an appropriate residence time distribution. The model was used to predict previously obtained experimental data for runoff from soil boxes with permeable bottoms. Good agreement was obtained between predicted and measured outflow concentrations for relatively low infiltration rates, provided relatively large dispersion coefficients were used in the calculations. Solute concentrations in the soil were also predicted well. Results for relatively high infiltration rates were less accurate, perhaps in part because of an incorrect assumption in the model that the infiltration rate remained constant in time and space during the runoff experiments. (Author's abstract)
W91-01527

THERMAL AND TROPHIC STABILITY OF DEEPER MAINE LAKES IN GRANITE WA-

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TERSHEDS IMPACTED BY ACID DEPOSITION.
Maine Univ. at Orono. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5C.
W91-01530

APPROXIMATE SOLUTIONS FOR CATION TRANSPORT DURING UNSTEADY, UNSATURATED SOIL WATER FLOW.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
For primary bibliographic entry see Field 2G.
W91-01535

STATISTICAL CHARACTERISTICS OF SOME ESTIMATORS OF SEDIMENT AND NUTRIENT LOADINGS.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
For primary bibliographic entry see Field 2J.
W91-01538

EVALUATING GROUND-WATER VULNERABILITY TO PESTICIDES.
Woodward-Clyde Consultants, Oakland, CA.
Y. J. Meeks, and J. D. Dean.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 5, p 693-707, September/October 1990. 4 fig, 2 tab, 15 ref.

Descriptors: *Agricultural engineering, *Groundwater management, *Groundwater pollution, *Path of pollutants, *Pesticides, *Water resources management, Advection, California, Dispersion, Hydrologic properties, Leaching, Recharge, Solute transport, Wells.

A methodology was developed to rank the relative vulnerability of groundwater areas to contamination by agriculturally-applied pesticides. The method uses the advection-dispersion equation for chemical transport in soils to develop the leaching potential index (LPI), which is an indicator of the relative susceptibility of each area. The index incorporates the effects of depth to groundwater, natural and irrigation recharge rates, absorption, and chemical decay. The importance (weighting) of the hydrological factors is physically-based, not subjective as it is in a number of approaches reviewed. The weights are not required to have constant values, as is typical of other methodologies; they are instead dependent on the specific chemical properties of the pesticide under consideration. This methodology was verified by comparing the LPI scores estimated for a 381-sq mi (987-sq km) area located in the San Joaquin Valley, California, with available data on 1,2-dibromochloropropane (DBCP) contamination in groundwater in the same area. The percentage of wells in which DBCP was detected in these square-mile sections was positively correlated with the computed LPI scores for each section, i.e., sections having higher LPI scores tended to have wells with more frequent positive detections of DBCP. This is the first time that such a large-scale verification of similar ranking procedures has been demonstrated, and it will be a useful planning tool for early identification of agricultural areas susceptible to groundwater contamination and efficient management of sampling resources. (Fish-PTT)
W91-01558

STUDY OF POLLUTANT DIFFUSION IN THE JIUJIANG SEGMENT OF THE CHANGJIANG RIVER (IN CHINESE).
Academia Sinica, Qingdao (China). Inst. of Oceanology.
P. Q. Li, L. T. Miao, D. Y. Xia, and X. Y. Wang.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 21, No. 2, p 144-153, March 1990. 8 fig, 5 tab, 5 ref. English summary.

Descriptors: *China, *Diffusion, *Path of pollutants, *Tracers, *Yangtze River, Changjiang River, Diffusion coefficient, Dye releases, Jiujiang, Marine pollution, Surveys, Water quality.

Diffusion in the Changjiang river (Yangtze river) was studied using the fluorescent dye Rhodamine-B as a tracer and a fluorimeter developed by the authors. The results of this study indicated: 1) The Jiujiang port and the region downstream is a straight segment of river and the mean velocity of the water is about 0.5 m/s. The scale of diffusion for 6 kg of Rhodamine-B is 3240 m. 2) The diffusion of a pollutant is rapid even when the winds are moderate, and the dilution factor (DF) varies from one hundred to ten billion within 40 minutes. When there is a strong breeze or the water is disturbed by shipping, the diffusion rate of the pollutant is higher. A six to seven order magnitude of change can occur in about ten minutes after the pollutant is discharged. The pollutant is soon diluted below the level required for good water quality and serious pollution does not occur when minor pollutants are discharged. 3) The log of the concentration of Rhodamine-B is equal to a constant minus 2.9 times the log of the time, so the log of concentration is linear with the log of time and the concentration decreases rapidly. 4) The diffusion coefficient of the river water is 1.23 square m/s in the Jiujiang region. The results show that the diffusion rate of the river is generally more rapid than diffusion in the sea, and the diffusion rate is increased by the disturbance of shipping. However, this increase in the diffusion coefficient is not typical of fresh water in the Jiujiang region. 5) A gradient exists for the water current in the Jiujiang segment of the river which causes an eddy current and enhances exchange between surface and bottom water. The distribution of pollutants into the deeper waters of the river is accelerated by this eddy. Therefore a soluble pollutant can reach the drinking water intake for Jiujiang within five minutes, so the discharge of pollutants from the foreign trade area of the port must be limited. (Author's abstract)
W91-01571

ACCUMULATION OF HEAVY METALS AND THE VARIATION OF AMINO ACIDS AND PROTEIN IN EICHHORNIA CRASSIPES (MART.) SOLMS IN THE DIANCHI LAKE (IN CHINESE).
Academia Sinica, Beijing (China). Research Center for Eco-Environmental Sciences.
Y. X. Lin, and X. M. Zhang.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 21, No. 2, p 179-184, March 1990. 3 tab, 15 ref. English summary.

Descriptors: *Bioaccumulation, *Bioindicators, *China, *Heavy metals, *Marsh plants, *Path of pollutants, Amino acids, Cadmium, Dianchi Lake, Lead, Organic pollutants, Proteins.

The accumulation of heavy metals (Cu, Cd, Hg, and As) by Eichhornia crassipes (Mart.) Solms in the water of Dianchi Lake in Kunming and the variation of the protein and amino acid content were studied. The analytical results of the experiment indicate that Eichhornia crassipes (Mart.) Solms has a good accumulative coefficient for heavy metals. The highest concentration factors were 16,190 for Pb and 14,285 for Cd. The analysis of different parts of the plant showed that the accumulation in the root system is several times higher than the accumulation in the stems and leaves. This may result from the fact that the fibrous root system with its high contact area with water has high absorption capacity, and at the same time microbes adhering to the root system increase the accumulation. The content of protein and amino acids are relatively low in Eichhornia crassipes (Mart.) Solms growing in the water with higher levels of heavy metals. The content of protein in Eichhornia crassipes (Mart.) Solms is 38.35%, the content of amino acids 32%. There are 16 kinds of amino acids in Eichhornia crassipes (Mart.) Solms, not including tryptophan, crysteine and cystine which were not determined. Eichhornia can not only purify sewage, but can also serve as good forage and raw material for paper making as well as bio-energy. In utilizatiing Eichhornia for forage, the concentration of heavy metals and organic pollutants found in the Eichhornia crassipes (Mart.) Solms must be considered. (Author's abstract)
W91-01572

INDUCTION OF HEPATIC MIXED-FUNCTION OXIDASE OF THE MULLET, MUGIL SO-IUY BY CRUDE OIL (IN CHINESE).
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 5C.
W91-01573

POISON RUNOFF: NEW ANSWERS TO A PERVASIVE PROBLEM.
Natural Resources Defense Council, Inc., Washington, DC.
For primary bibliographic entry see Field 5G.
W91-01623

TRIBUTYLTIN AND INVERTEBRATES OF A SEAGRASS ECOSYSTEM: EXPOSURE AND RESPONSE OF DIFFERENT SPECIES.
Cornell Univ., Ithaca, NY. Ecosystems Research Center.
For primary bibliographic entry see Field 5C.
W91-01625

ENVIRONMENTAL FACTORS AFFECTING BENTHIC INFAUNAL COMMUNITIES OF THE WESTERN ARABIAN GULF.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
For primary bibliographic entry see Field 2L.
W91-01626

SEASONAL VARIATION OF THERMOPHILIC CAMPYLOBACTERS IN SEWAGE SLUDGE.
Lancaster Univ. (England). Dept. of Biological Sciences.
K. Jones, M. Betaieb, and D. R. Telford.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 2, p 185-189, August 1990. 1 fig, 3 tab, 12 ref.

Descriptors: *Bacteria, *Bacterial analysis, *Campylobacter, *Digested sludge, *Microorganisms, *Pathogenic bacteria, *Seasonal variation, *Sludge, *Sludge analysis, England, Fate of pollutants, Monitoring, Sludge disposal, Sludge utilization, Wastewater, Wastewater treatment.

The seasonal variation of thermophilic campylobacters in sewage sludge was studied over a 21 month period. The numbers in fresh sludge (from primary sedimentation) vary between approximately 200 and 5000/100 ml for most of the year but there was a large increase in May and June (in May 1988 there were 42,100 campylobacters/100 ml which is 17 times more than in the preceding April). In 1989 there was a similar May/June peak but with lower numbers. This seasonal variation, measured by environmental monitoring, reflects the incidence of infections in the community. The same pattern was found in 2-d old sludge but the numbers were substantially lower (40% lower over the experimental period). Thermophilic campylobacters were virtually absent from digested sludge and sludge prior to land distribution. Survival experiments confirm that campylobacters survive for only a few hours in both sterile and unsterile digested and undigested sludge. These results suggest that it is safe to dispose of Lancaster's digested sludge on land but there is still uncertainty about the ability of campylobacters to survive in sludge in the viable but non-culturable form. (Author's abstract)
W91-01655

EFFECTS OF SUNLIGHT AND AUTOCHTHONOUS MICROBIOTA ON ESCHERICHIA COLI SURVIVAL IN AN ESTUARINE ENVIRONMENT.
Virginia Inst. of Marine Science, Gloucester Point. Dept. of Biological and Fisheries Sciences
M.W. Rhodes, and H. I. Kator.
Current Microbiology CUMIDD, Vol. 21, No. 1, p 65-73, July 1990. 5 fig, 4 tab, 52 ref. NOAA Grant No. NA81AA-D-00025.

Descriptors: *Chesapeake Bay, *Enteric bacteria, *Escherichia coli, *Estuaries, *Fate of pollutants,

Cell mortality, Microbiological studies, Ultraviolet radiation.

The effects of sunlight and the indigenous microbiota on Escherichia coli survival were examined with membrane diffusion chambers deployed in Chesapeake Bay shellfish growing waters. Chambers, fitted with an 'upper' UV and visible light-transmitting copolymer film and 'lower' semipermeable polycarbonate membrane, were deployed parallel to the water surface to maximize light exposure. Maximum values of a coefficient describing changes in culturable cell densities after exposure to sunlight, were 1.7/h and 0.7/h in preliminary tank and in situ experiments, respectively. Mortality and sublethal stress, the latter measured with an electrochemical detection technique, were largest during the first 4 h of exposure. Owing to the light-attenuating properties of Chesapeake Bay water, light-induced cell mortality was significantly reduced at 0.25 m compared with surface exposed cells, and was undetected at 0.5-1.0 m except during seasons of maximal light penetration. Combined exposure to both sunlight and the autochthonous microbiota yielded significantly greater mortality than for either factor alone. (Author's abstract)
W91-01663

COMPARISON OF A GENE PROBE WITH CLASSICAL METHODS FOR DETECTING 2,4-DICHLOROPHENOXYACETIC ACID (2,4-D)-BIODEGRADING BACTERIA IN NATURAL WATERS.
Oregon State Univ., Corvallis. Dept. of Microbiology.
P. S. Amy, M. V. Staudaher, and R. J. Seidler.
Current Microbiology CUMIDD, Vol. 21, No. 2, p 95-101, August 1990. 4 fig, 3 tab, 19 ref.

Descriptors: *Biodegradation, *Experimental data, *Fate of pollutants, *Herbicides, *Pesticides, Colony hybridization, Gene probes, Marys River, Willamette River.

Colony hybridizations with a gene probe for enumeration of bacteria the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) were compared with classical enrichment and radiolabel most-probable-number (MPN) assay methods. UV scans of enrichment cultures revealed 2,4-D degradation with raw sewage occurred in 4-11 days, 4->22 days with Mary's River water, and 5->22 days with Willamette River water. 14C-2,4-D MPN analysis, measuring release of 14CO2, yielded estimates of bacteria per milliliter able to degrade 2,4-D. Raw sewage estimates were 140,000 2,4-D degraders/ml, Mary's River water > 160,000/ml, and Willamette River water 16,000/ml. Activities noted by UV scan enrichment data supported these results. Autoradiograms of colony blots were also used to estimate numbers of 2,4-D-degrading bacteria. These estimates were also supported by the UV scan data from enrichment cultures. Raw sewage counts between 50,000 and 290,000 2,4-D-degrading bacteria/ml, which correlates well with the estimates obtained by 14C-MPN analyses. River waters, both much lower in total bacteria counts and organic carbon than raw sewage, yielded fewer 2,4-D-degrading bacteria than estimated by 14C-MPN. Media composition and cometabolism may account for discrepancies in estimates for 2,4-D-degrading bacteria observed when colony blot and 14C-MPN analyses were compared. Replica plating made it possible to test for 2,4-D biodegradation from colonies reactive in autoradiograms. Five of 12 colonies reacting in the colony hybridization exhibited biodegradation activities. Nonreactive colonies failed to degrade 2,4-D. (Author's abstract)
W91-01664

ANALYTICAL ASYMPTOTIC SOLUTIONS FOR LONGITUDINAL DISPERSION WITH DEAD ZONES.
Contra Costa Water District, Concord, CA.
For primary bibliographic entry see Field 8B.
W91-01672

NITRATES IN GROUND WATER.
S. Chakravarty.
Water Resources Journal, No. 163, p 109-110, December 1989. 1 fig, 6 ref.

Descriptors: *Groundwater pollution, *India, *Nitrates, *Nitrogen removal, *Nonpoint pollution sources, *Water pollution control, *Water pollution treatment, Agricultural chemicals, Agriculture, Biodegradation, Desalination, Dissolved solids, Fertilizers, Membrane processes.

A newly emerging problem in the field of groundwater quality is excessive nitrates arising from increased use of nitrogen fertilizers. A recent survey in India revealed that 1,290 groundwater samples from 11 States had a nitrate content more than 45 mg/L. Most were also found to have a high dissolved solids content. The standard technologies applied for desalination such as reverse osmosis and electrodialysis can also achieve the removal of nitrates. Natural decomposition of nitrates by bacteria can be successfully applied. In many cases, a combination of instantly implemented hydrological measures and agricultural measures adapted to local conditions would be the most suitable way to solve the problem of nitrate load. Close collaboration between the water supplying and agricultural sectors within the affected catchment areas is necessary. (Miller-PTT)
W91-01681

EFFECT OF ENVIRONMENTAL STORAGE CONDITIONS ON THE ORGANIC CONTENT OF SIMULATED COAL LEACHATES.
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 5G.
W91-01689

CAUSES OF TEMPORAL VARIABILITY OF LEAD IN DOMESTIC PLUMBING SYSTEMS.
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
M. R. Schock.
Environmental Monitoring and Assessment EMASDH, Vol. 15, No. 1, p 59-82, July 1990. 8 fig, 6 tab, 38 ref. EPA Contracts 7W-7480-NASA and 7W-7425-NASX.

Descriptors: *Lead, *Pipelines, *Statistical analysis, *Temporal variation, *Water pollution sources, Brass, Carbonates, Chlorine, Hydrogen ion concentration, Orthophosphates, Silicates, Solder, Water conveyance.

Sources of lead in drinking water are primarily lead pipe, lead/tin solder, and brass fixture materials. Lead levels in the water depend upon many solubility factors, such as: water pH, concentrations of substances such as inorganic carbonate, orthophosphate, chlorine, and silicate; temperature; and the nature of the pipe surface. Physical factors such as time and chemical mass transfer are also significant in governing lead levels in non-equilibrium systems. Analytical variability is not particularly significant relative to between-site and within-site variability. Knowledge of temporal variability at each site is necessary to define a statistically valid monitoring program. An analysis of published data covering repetitive measurements at a given site show that the variability of lead concentration at each site tends to be characterized by the frequent occurrence of spikes. Variability expressed as approximate relative standard deviations tend to be about 50-75% in untreated water, regardless of the mean lead concentration. The distributions are frequently not normal for small numbers of samples. Monitoring programs must incorporate controls for the causes of the within-site and between-site variability into their sampling design. The determination of necessary sampling frequency, sample number and sample volume must be made with consideration of the system variability, or the results will be unrepresentative and irreproducible. (Author's abstract)
W91-01698

TRIAZINE HERBICIDE FATE IN A NO-TILLAGE CORN (ZEA MAYS L.)-CROWNVETCH (CORONILLA VARIA L.) 'LIVING MULCH' SYSTEM.
Pennsylvania State Univ., University Park. Dept. of Agronomy.
J. K. Hall, and N. L. Hartwig.
Agriculture, Ecosystems and Environment AEENDO, Vol. 30, No. 3/4, p 281-293, April 1990. 2 fig, 28 ref.

Descriptors: *Crownvetch, *Herbicides, *Maize, *Mulches, *Path of pollutants, *Soil contamination, *Triazine herbicides, Agriculture, Clay loam, Leaching, Pollutant identification, Soil analysis, Soil types.

Chloro-s-triazine herbicide distribution, dissipation and leaching potential were examined in two untilled soils planted to corn (Zea mays L.) in a crownvetch (Coronilla varia L.) 'living mulch' sod. Herbicides studied were simazine (6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine), atrazine, cyanazine and procyazine. Each was applied at 2.2 and 4.5 kg (active ingredient) /ha. Soil profiles were sampled twice yearly in 15 cm increments to 91 or 122 cm deep. These soil fractions were analyzed for parent herbicide residues. Herbicide dissipation and translocation were rapid and extensive under no-tillage management, and herbicide distribution in the different soil profiles was not predictable solely on the basis of water solubility of the chemicals or soil texture. The probability of detecting subsoil levels of these herbicides was as great in the Murrill silty clay loam as in the Morrison sandy loam tested. Simazine and atrazine were more persistent and detected more frequently at lower profile depths than cyanazine and procyazine, which are considerably more water soluble. Redistribution of simazine and atrazine by leaching from early to mid-season was also more evident in each soil. (Author's abstract)
W91-01709

EXAMINATION OF THE RANGE OF COPPER COMPLEXING LIGANDS IN NATURAL WATERS USING A COMBINATION OF CATHODIC STRIPPING VOLTAMMETRY AND COMPUTER SIMULATION.
Water Research Centre, Medmenham (England). Medmenham Lab.
S. C. Apte, M. J. Gardner, J. E. Ravenscroft, and J. A. Turrell.
Analytica Chimica Acta ACACAM, Vol. 235, No. 2, p 287-297, August 15, 1990. 4 fig, 3 tab, 17 ref.

Descriptors: *Chemical analysis, *Copper compounds, *England, *Estuaries, *Heavy metals, *Pollutant identification, *Voltammetry, *Water analysis, Analytical methods, Metal complexes, Organic compounds, Salinity, Water quality control.

Knowledge of the detection capabilities of speciation techniques, gained by calculation and computer simulation, can be combined with experimental measurements to arrive at an understanding of trace metal speciation which is less dependent on operational factors than other approaches. Surface-water samples were collected from the Humber Estuary and its tributaries in two surveys carried out in November 1988 and October 1989. Some supplementary river samples were also taken in February 1990. The sampling sites were chosen primarily to obtain information on freshwater inputs and to obtain a broad range of estuarine salinities. Although concentrations of total dissolved copper can approach the estuarine Environmental Quality Standard value of 5 microgram/L, there is evidence of a substantial excess of complexing ligands at all locations except the outer estuary, where copper levels are much reduced by dilution. Dissolved copper is therefore present almost totally in the form of organic complexes. The range of different types of ligand is also assessed. In sea water there appears to be a range of ligands of differing affinities for copper; the complexing capacity ranges form 20 nM (conditional stability complex of the copper complex (K') > 10 raised to the fourteenth power) to 70 nM (K' > 10 raised to the eighth power). For estuarine samples, ligands with a high affinity for copper seem to be predominant and the overall complexing capacity rises to over 200 nM. In freshwater samples, it is likely that the potential for varying combinations of weak and strong complexes will depend on the

water quality, but a capacity to complex over 200 nM copper is not unusual. (Author's abstract)
W91-01715

ROLE OF AMMONIUM AND NITRATE RETENTION IN THE ACIDIFICATION OF LAKES AND FORESTED CATCHMENTS.
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
P. J. Dillon, and L. A. Molot.
Biogeochemistry BIOGEP, Vol. 11, No. 1, p 23-43, September 1990. 6 fig, 8 tab, 57 ref.

Descriptors: *Acid rain, *Acidification, *Ammonium, *Chemistry of precipitation, *Forest watersheds, *Lakes, *Nitrates, Ecosystems, Freshwater, Nitrogen, Path of pollutants, Streams, Surface water.

The relative contribution of HNO3 to precipitation acidity in Eastern Canada has increased in recent years leading to some concern that the relative importance of NO3(-) deposition in acidification of terrestrial and aquatic ecosystems may increase. To gage the extent of this impact, annual mass balances for NO3(-) and NH4(+) were calculated for several forested catchments and lakes in Ontario. Retention of NH4(+) by forested catchments was consistently high compared to retention of NO3(-) which was highly variable. Retention of inorganic nitrogen was influenced by catchment grade and areal water discharge. In lakes, the reciprocals of retention of NO3(-) and NH4(+) were linearly related to the ratio of lake mean depth to water residence time and retention time did not appear to be a function of degree of acidification of the lakes. Net N consumption-based acidification of lakes, defined as the ratio of annual NH4(+) mass to NO3(-) mass consumption, was negatively correlated with the areal water discharge and N consumption-related acidification was most likely to occur when the areal water discharge was <1.5 m/yr. If retention mechanisms are unaffected by changes in deposition, changes in deposition will still result in changes in surface water concentrations although the changes will be of similar proportions. Therefore, 'NO3(-) saturation' should not be defined by concentrations alone, but should be defined as decreasing long-term, average NO3(-) retention in streams and lakes in response to long-term increases in NO3(-) deposition. Analysis of survey data will be facilitated by grouping lakes and catchments according to similar characteristics. (Author's abstract)
W91-01718

METHANE EMISSIONS FROM FEN, BOG AND SWAMP PEATLANDS IN QUEBEC.
McGill Univ., Montreal (Quebec). Dept. of Geography.
T. R. Moore, and R. Knowles.
Biogeochemistry BIOGEP, Vol. 11, No. 1, p 45-61, September 1990. 4 fig, 5 tab, 40 ref.

Descriptors: *Air pollution sources, *Bogs, *Fens, *Global warming, *Limnology, *Methane, *Methanogenesis, *Quebec, *Swamps, *Wetlands, Aerobic conditions, Anaerobic conditions, Climatic zones, Peat, Seasonal variation, Topography.

A static chamber technique was used weekly from spring thaw to winter freezing to measure methane emissions from ten sites representing subarctic fens and temperate swamps and bogs. Rates of <200 mgCH4/ sq m d were recorded in subarctic fens: within-site emissions were primarily controlled by the evolution of the peat thermal regime, though significant releases during spring thaw were recorded at some sites. Between subarctic fens, topography and water table elevation were important controls on methane emissions, with the general sequence: pool = horizontal fen > string. Emission rates from the two swamp sites were lower (<20 mg CH4/sq m/d), except during the spring thaw and when the sites were saturated. The low water table (<80 cm depth) in abnormally dry years reduced emission rates; rates were also low from a swamp site which had been drained and cleared of vegetation for horticulture. Methane emission rates were also low (< 5 mg CH4/sq m/d) from 2 ombrotrophic bog sites. Laboratory measurements of rates of methane production under anaerobic conditions and methane consumption under aerobic conditions revealed that production rates were generally highest in the surface layers (0 to 25 cm depth); production was high in the fens and very low in the bogs. The swamp samples were able to produce methane under anaerobic conditions, but were also able to consume methane under aerobic conditions. Annual methane emission rates are estimated to be 1 to 10 g CH4/sq m from the fens, 1 to 4 g CH4/sq m from the swamps and <0.2 g CH4/sq m from the bogs and drained swamp. (Author's abstract)
W91-01719

FATE OF CATIONIC SURFACTANTS IN THE MARINE ENVIRONMENT: I. BIOCONCENTRATION OF LONG-CHAIN ALKYLNITRILES AND TRIALKYLAMINES.
Centro de Investigacion y Desarrollo, Barcelona (Spain). Dept. of Environmental Chemistry.
M. Valls, P. Fernandez, and J. M. Bayona.
Chemosphere CMSHAF, Vol. 19, No. 12, p 1819-1827, 1989. 5 fig, 1 tab, 21 ref.

Descriptors: *Alkylnitriles, *Bioaccumulation, *Biological magnification, *Cationic surfactants, *Path of pollutants, *Spain, *Surfactants, *Trialkylamines, Analytical methods, Fate of pollutants, Industrial wastes, Pollutant identification, Polycyclic aromatic hydrocarbons, Sediment analysis, Toxicology.

The occurrence of cationic surfactants in the environment, which account for 10% of the total industrial output, has not been addressed until very recently. It is proposed that the long-chain alkylamines (TAMs) be used as conservative tracers of this class of surfactants because they have been found widely distributed in the aquatic environment but their ecotoxicological implications still remain unknown. The bioconcentration of the (TAMS) and long-chain alkylnitriles (LANs), both of which are present as impurities in surfactant formulations, were assessed. Water, benthic and pelagic biota and sediment samples were collected in coastal areas off Barcelona, Spain, near the mouth of the Besas River, near a dumping site, and examined for the tracers. Long-chain alkylnitriles (LANs) and TAMs were identified for the first time in biota samples at concentrations ranging from 9 to 574 ng/g and from 157 to 825 ng/g (fresh weight basis), respectively. In addition, the simultaneous occurrence in the aquatic environment of LANs and TAMs were also reported for the first time. The bioconcentratio factor values of both LANs and TAMs varied according to the different species but they were comparable to those found for polycyclic aromatic hydrocarbons. (See also W91-01733) (Agostine-PTT)
W91-01723

OBSERVATIONS ON OVERWINTERING JUVENILE CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) EXPOSED TO BLEACHED KRAFT MILL EFFLUENT IN THE UPPER FRASER RIVER, BRITISH COLUMBIA.
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
I. H. Rogers, C. D. Levings, W. L. Lockhart, and R. J. Norstrom.
Chemosphere CMSHAF, Vol. 19, No. 12, p 1853-1868, 1989. 3 fig, 6 tab, 33 ref.

Descriptors: *Bioaccumulation, *British Columbia, *Effluents, *Fish physiology, *Industrial wastes, *Path of pollutants, *Pulp and paper industry, *Salmon, Chlorinated hydrocarbons, Ecology, Fish, Freshwater, Rivers, Toxicology.

Chlorophenols and chloroguaiacols were quantified in juvenile chinook salmon captured near bleached kraft mills in the upper Fraser River in December 1987. Fish captured in April 1988 showed up to 55-fold induction of hepatic mixed function oxidase activity (EROD), and were contaminated with up to 370 ng/kg of 2,3,7,8-trichlorinated dibenzofuran (TCDF) and 68 ng/kg of 2,3,7,8-trichlorinated dibenzodioxin (TCDD). It is concluded that juvenile chinook salmon that spend the winter near the pulp mill outfalls in the Upper Fraser River exhibit a strong biochemical response to unidentified inducing compounds in the bleached kraft mill effluent. In addition to 2,3,7,8-TCDD and 2,3,7,8-TCDF, they also accumulate other organic residues. The ecological consequences for these fish are uncertain and further studies are in progress to explore the ensuing stages of the lifecycle until the fish have successfully adapted to salt water. (Agostine-PTT)
W91-01724

POLYCHLORINATED DIBENZOFURAN (PCDF) AND DIBENZO-P-DIOXIN (PCDD) LEVELS IN ORGANISMS AND SEDIMENTS FROM THE FRIERFJORD, SOUTHERN NORWAY.
Norsk Inst. for Vannforskning, Oslo.
J. Knutzen, and M. Oehme.
Chemosphere CMSHAF, Vol. 19, No. 12, p 1897-1909, 1989. 5 fig, 2 tab, 30 ref.

Descriptors: *Dioxins, *Fjords, *Norway, *Polychlorinated biphenyls, *Sediment contamination, *Water pollution sources, Coasts, Crustaceans, Fish, Industrial wastes, Magnesium, Mussels, Pollutant identification, Sediment analysis, Water pollution.

The contamination of a fjord region by dibenzo-p-dioxins (PCDD) polychlorinated dibenzofuran (PCDF) produced from a Mg-production plant has been studied. Levels in organisms (fish, crustacea, mussels) and sediments were determined. The results were used to estimate the spreading of PCDD/PCDF by coastal currents. The present situation is compared with available information from other contaminated areas and with data for hexachlorobenzene and octachlorostyrene. Compared to data from less contaminated sites, initial results from the sediment studies had 2,3,7,8-TCDD equivalent concentrations that were three orders of magnitude higher. For the characteristic 2,3,7,8-substituted hexachlorodibenzofurans (HxCDFs) of the Mg plant effluent the figures are even higher. The same is valid for PCDD/PCDFs when compared to the content of surface sediments from a lake locality solely contaminated from the atmosphere. Compared to the highest levels reported elsewhere, the Frierfjord sediments contained 50-200 times higher TCDD equivalent levels. (Agostine-PTT)
W91-01726

ASSOCIATION OF BENZO(A)PYRENE WITH DISSOLVED ORGANIC MATTER: PREDICTION OF K(DOM) FROM STRUCTURAL AND CHEMICAL PROPERTIES OF THE ORGANIC MATTER.
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. F. McCarthy, L. E. Roberson, and L. W. Burrus.
Chemosphere CMSHAF, Vol. 19, No. 12, p 1911-1920, 1989. 1 fig, 2 tab, 28 ref. Department of Energy Contract DE-AC05-84OR21400.

Descriptors: *Benzopyrene, *Chemical properties, *Dissolved solids, *Organic matter, *Path of pollutants, *Structural behavior, Groundwater, Humic acids, Pollutant identification, Statistical analysis, Surface water.

The affinity of dissolved organic matter (DOM) for binding a polycyclic aromatic hydrocarbon, benzo(a)pyrene (BaP), was measured for 11 surface and groundwaters and a commercial humic acid. The hydrophobic-acid (HbA) and hydrophobic-neutral (HbN) compositions of the DOM, solution absorptivity at 270 nm (ABS-270), and DOM molar volumes were determined. Waters enriched in HbA material had a larger molar volume and higher aromatic content (as indicated by the ABS-270). There was a good correlation between the size and HbA content of the DOM from the different sources and the Kdom for binding BaP. An excellent predictive relationship was demonstrated between the ABS-270 of a water and the dissolved organic matter partition coefficient (Kdom) for

binding BaP. Based on these results, it is suggested that binding of a BaP to DOM depends not only on the hydrophobicity of DOM, but also on the existence of an open structure within the DOM to provide access of the aqueous solute to hydrophobic domains within the DOM. (Author's abstract)
W91-01727

ANALYSIS OF TARGET AND NONTARGET POLLUTANTS IN AQUEOUS LEACHATES FROM THE HAZARDOUS WASTE SITE IN STRINGFELLOW, CALIFORNIA, VIA ION CHROMATOGRAPHY-PARTICLE BEAM AND INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY.
California Dept. of Health Services, Berkeley. Hazardous Materials Lab. Section.
For primary bibliographic entry see Field 5A.
W91-01728

RATE OF DEGRADATION OF 1,1,1-TRICHLOROETHANE IN WATER BY HYDROLYSIS AND DEHYDROCHLORINATION.
Solvay and Cie S.A., Brussels (Belgium). Central Lab.
R. R. Gerkins, and J. A. Franklin.
Chemosphere CMSHAF, Vol. 19, No. 12, p 1929-1937, 1989. 1 fig, 3 tab, 14 ref.

Descriptors: *Chlorinated hydrocarbons, *Dehalogenation, *Fate of pollutants, *Hydrolysis, *Trichloroethane, Degradation, Dehydrochlorination, Kinetics, Oxidation, Rate constants, Sinks.

It is generally assumed that the only significant tropospheric sink for 1,1,1-trichloroethane is gas-phase oxidation initiated by reactions of its C-H bonds with naturally occurring hydroxyl radicals. This assumption is also the basis for calculating globally averaged tropospheric hydroxyl radical concentrations, from the known rate constant for the reaction of hydroxyl radical with 1,1,1-trichloroethane and data on emission rates and tropospheric concentrations of the latter. Degradation of 1,1,1-trichloroethane in water by hydrolysis and dehydrochlorination may conceivably be a significant sink for this compound in the environment. The kinetics of these reactions have been investigated in initially neutral water (becoming acid as the reaction proceeded), over a wide range of temperature (25 to 120 C). The experimental results were consistent with a mechanism in which hydrolysis and dehydrochlorination reactions occur in parallel, according to first-order kinetics with respect to 1,1,1-trichloroethane. It was concluded that : (1) the reaction occurred solely in the aqueous phase; (2) 1,1-dichloroethylene is not an intermediate in the hydrolysis of 1,1,1-trichloroethane to acetic acid. It was found that the activation energies of the hydrolysis and dehydrochlorination reactions are very close. According to the results, hydrolysis is roughly 2.7 times faster than dehydrochlorination at 25 C, i.e. 1,1-dichloroethylene formation represents about 27% of the overall process. The half-lives of 1,1,1-trichloroethane in water at various temperatures, calculated from the rate constants are compared with values reported in the literature. The half-life at 20 C is found to be 4.7 years. (Agostine-PTT)
W91-01729

COMPARATIVE TOXICITY OF SOLVENT YELLOW 33 (2-(2'-QUINOLINYL)-1,3-INDANDIONE) AND SOLVENT GREEN 3 (1,4-DI-P-TOLUIDINO-ANTHRAQUINONE) DYES TO FRESHWATER ORGANISMS.
Johns Hopkins Univ., Shady Side, MD. Environmental Sciences Group.
For primary bibliographic entry see Field 5C.
W91-01730

SIMPLE METHOD FOR ESTIMATING DERMAL ABSORPTION OF CHEMICALS IN WATER.
ENVIRON Corp., Washington, DC.
T. L. Brown, and J. E. Rossi.
Chemosphere CMSHAF, Vol. 19, No. 12, p 1989-2001, 1989. 1 fig, 1 tab, 17 ref.

Descriptors: *Dermal absorption, *Path of pollutants, *Population exposure, *Public health, *Toxicology, *Water pollution, Mathematical studies, Model studies.

A simple method was developed to estimate dermal absorption from variables describing the conditions of exposure and the physical properties of the chemicals in the water. A semiempirical mathematical model is proposed for estimating the dermal absorption of chemicals from dilute aqueous solutions, such as bath water. Absorption depends on the concentration of the chemical in water, the area of skin exposed, the time of exposure, and a permeation coefficient that depends importantly on the relative solubility of the material in lipids and water, among other factors not so easily modeled. Intakes by dermal absorption can be similar to intakes by ingestion from drinking water under certain circumstances for lipophilic chemicals, but they will usually be considerably lower. (Agostine-PTT)
W91-01731

EVALUATION OF THE POTENTIAL FOR TOXICS EXPOSURE IN THE GREAT LAKES REGION USING STORET DATA.
George Mason Univ., Fairfax, VA. Dept. of Biology.
L. J. Phillips, and G. F. Birchard.
Chemosphere CMSHAF, Vol. 20, No. 6, p 587-598, 1990. 1 fig, 5 tab, 12 ref.

Descriptors: *Data collections, *Great Lakes, *Path of pollutants, *Toxicity, *Water pollution effects, Databases, Lakes, Mathematical studies, Pollutants, Sediments, Statistical methods.

It has been suggested that residents of the Great Lakes region are at a greater risk of exposure to toxic substances than any other subset of the United States population. This project tested the potential for exposure to toxics by using the levels of toxic substances in fish tissue and sediment as surrogates for human exposure. Data were retrieved from the EPA's STORET database and sorted by USGS water resource regions. STORET is a computerized data base maintained for the storage and retrieval of water quality data within the United States. It is the largest data base available for this purpose, containing data for approximately 150 million individual observations from over 680,000 sampling sites. EPA STORET data for 24 toxics from the 18 USGS regions in the continental United States were retrieved in a statistical summary format. These toxics were chosen because they are National Priority Pollutants for which sufficient STORET data were available. The summaries described the 15th, 50th, 85th percentiles, and minimum, maximum, and mean values for these 24 toxics in sediments and fish tissue for the time periods 1978-1981 and 1982-1987. Data were subjected to two types of statistical analysis. In the first analysis the Great Lakes region was compared to the highest ranked region for each toxic. A second test was designed to provide an index of the potential for exposure by region according to the relative ranks of each toxic. The results indicate that the overall potential for exposure to toxics in the Great Lakes region is not higher than other geographical regions. (Agostine-PTT)
W91-01732

FATE OF CATIONIC SURFACTANTS IN THE MARINE ENVIRONMENT, II: PHOTOOXIDATION OF LONG-CHAIN ALKYLAMINES IN AQUEOUS MEDIA.
Centro de Investigacion y Desarrollo, Barcelona (Spain). Dept. of Environmental Chemistry.
M. Valls, J. M. Bayona, J. Albaiges, and M. Mansour.
Chemosphere CMSHAF, Vol. 20, No. 6, p 599-607, 1990. 3 fig, 1 tab, 15 ref.

Descriptors: *Alkylamines, *Cationic surfactants, *Environment, *Fate of pollutants, *Marine environment, *Oxidation, *Surfactants, Mass spectrometry, Nitrogen compounds, Spectroscopy, Water chemistry.

A variety of long-chain alkylamines (NR1R2R3, where Rn = H, CH3, C14H29, C16H33 or C18H37) have been photooxidized in pure water and seawater (wavelength >290 nm). Half-lives of these amines in the two aqueous systems ranged from 25-95 min. and 175-300 min, respectively, depending on the number and molecular weight of the alkyl substituents. According to mass spectral (CGC-MS) and spectroscopic (IR) data, oxidation products in alpha positions with respect to nitrogen have been tentatively identified. Adduct formation between the photosensitizer (acetone) and secondary aliphatic amines is also detected. The stability of photoproducts was dependent of the photooxidation system and in general, they appeared to be more effective than the original amines. (See also W91-01723) (Author's abstract)
W91-01733

POPULATION EXPOSURE TO CHLOROPHENOLS, DIBENZO-P-DIOXINS AND DIBENZOFURANS AFTER A PROLONGED GROUND WATER POLLUTION BY CHLOROPHENOLS.
National Public Health Inst., Kuopio (Finland). Dept. of Environmental Hygiene and Toxicology.
P. Lampi, T. Vartiainen, and J. Tuomisto.
Chemosphere CMSHAF, Vol. 20, No. 6, p 625-634, 1990. 2 fig, 2 tab, 20 ref.

Descriptors: *Chlorinated hydrocarbons, *Chlorophenols, *Groundwater pollution, *Path of pollutants, *Population exposure, *Water pollution effects, Dibenzofurans, Dioxins, Drinking water, Epidemiology, Finland, Risk assessment.

High concentrations of 70 to 140 microgram/L of total chlorophenols were found in the drinking water of about 3,500 inhabitants in southern Finland in 1987. Total chlorophenol levels from 56,000 microgram/L to 190,000 microgram/L were found in the ground water between a sawmill and the water intake plant. In the present study which was carried out 3 months after closure of the water intake plant, an attempt was made to assess the exposure levels of inhabitants in order to provide the basis for epidemiological studies and risk assessment. Based on urinary excretion of chlorophenols it appears that the population using contaminated water, or fish from the contaminated lake, had been exposed to chlorophenols. No increased PCDD/PCDF (polychlorinated dibenzo-p-dioxins/dibenzofurans) concentrations were found in milk samples from mothers who had used the contaminated water. (Author's abstract)
W91-01734

BUTYLTINS IN SEDIMENTS AND BIVALVES FROM U.S. COASTAL AREAS.
Texas A and M Univ., College Station. Dept. of Oceanography.
T. L. Wade, B. Garcia-Romero, and J. M. Brooks.
Chemosphere CMSHAF, Vol. 20, No. 6, p 647-662, 1990. 6 fig, 1 tab, 32 ref. NOAA Grant 50-DGNC-5-00262 and Texas A&M University Sea Grant (R/ES-18).

Descriptors: *Antifoulants, *Estuaries, *Mollusks, *Organotin compounds, *Path of pollutants, *Sediment contamination, *Sediments, Bioavailability, Coasts, Fate of pollutants, Heavy metals.

The concentration of butyltins in sediments from selected U.S. estuarine areas was determined in order to provide information on the role of sediments as long term sinks for butyltin compounds. Butyltin concentrations in sediment samples from U.S. coastal areas ranged from < 5 to 282 ng Sn/g. Butyltins were detected in 75% of the sediment samples analyzed. The predominant butyltin was tributyltin (TBT), which is also the most toxic. Dibutyltin (DBT) and monobutyltin (MBT) were detected in 30% of the sediment samples analyzed. These TBT degradation products were only found when TBT was present, usually at high concentrations. Mean bivalve butyltin concentrations were 18 times higher than mean sediment concentrations. Based on bivalve analyses, bioavailable butyltins were present at all the sites where butyltins were detected in the sediment. The sediments are

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one possible source of these bioavailable butyltins. However, the lack of correlation between sediments and bivalve butyltin concentration indicates that other sources may be predominant. (Author's abstract)
W91-01735

KINETIC STUDY OF THE DECOMPOSITION OF METHYL (1-(BUTYLCARBAMOYL)-1H-BENZIMIDAZOL-2-YL)CARBAMATE (BENOMYL) TO METHYL 1H-BENZIMIDAZOL-2-YLCARBAMATE (MBC).
Brock Univ., St. Catharines (Ontario). Dept. of Chemistry.
R. P. Singh, I. D.. Brindle, C. D. Hall, and M. Chiba.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 38, No. 8, p 1758-1762, August 1990. 3 fig, 4 tab, 14 ref.

Descriptors: *Chemical analysis, *Degradation, *Fate of pollutants, *Fungicides, *Kinetics, *Path of pollutants, *Pesticides, High performance liquid chromatography, Hydrogen ion concentration, Laboratory methods.

The kinetic study of the degradation of benomyl to methyl 1H-benzimidazol-2-ylcarbamate (MBC) in pure water and in aqueous solutions at pH 1-7 has been carried out by using reversed-phase high-performance liquid chromatography (RP-HPLC) at room temperature (21 =/-1 C). The values of first-order rate constants for the degradation reaction were similar in the pH range 2-7, but at high acid concentration (pH 1.0) the rate constant showed a sharp decrease. This may be due to the protonation of benomyl at low pH where a sharp increase in its solubility was also observed. Quantitative conversion of benomyl to MBC was not observed in acetonitrile; instead, due to the reversible nature of the reaction, at equilibrium about 12% benomyl remained intact. The rate constants for the forward reactions in acetonitrile were found to be .00025/s at 21 +/-1C and .00033/s at 25 +/-1C. In mixed solutions of water with buffer, acetonitrile, or methanol the degradation of benomyl slowed down with the increase in water concentration. (Author's abstract)
W91-01739

FATE OF ADDED N-15 LABELLED NITROGEN IN A SAGITTARIA LANCIFOLIA L. GULF COAST MARSH.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2H.
W91-01741

PERSISTENT METABOLITES OF ALKYLPHENOL POLYETHOXYLATES IN THE MARINE ENVIRONMENT.
Venice Univ. (Italy). Dept. of Environmental Science.
A. Marcomini, B. Pavoni, A. Sfriso, and A. A. Orio.
Marine Chemistry MRCHBD, Vol. 29, No. 4, p 307-323, July 1990. 3 fig, 6 tab, 33 ref.

Descriptors: *Environment, *Marine pollution, *Metabolites, *Nonionic surfactants, *Path of pollutants, *Phenols, *Surfactants, Algae, Analytical techniques, Sediments, Venice Lagoon, Water.

The persistent metabolites of the nonionic surfactant nonylphenol polyethoxylates (NPnEO, n=1-18), namely nonylphenol (NP), nonylphenol monoethoxylate (NP1EO) and nonylphenol diethoxylate (NP2EO), were analyzed in marine samples including sediment, artificially resuspended sediment and water. The UV-fluorescence high-performance liquid chromatography determination was carried out after Soxhlet extraction with hexane from the sedimentary matrices followed by clean-up on aminosilica minicolumns. Four sampling campaigns at five representative stations of the Venice lagoon were conducted to ascertain temporal and spatial variability of the examined chemicals. A portable resuspending device allowed us to analyze the first 0.01-0.15 mm sediment layer, where the sum of NP, NP1EO and NP2EO was in the range 0.15-13.7 microgram/g (dry weight basis), at least five times higher than in the underlying 5 cm of sediment. Amounts of resuspended material, and concentrations of NP, NP1EO, NP2EO bound to it, showed a marked seasonal dependence: as much as twice the resuspended material, per unit of sediment surface, was measured in April and July, compared with that in February, but resuspended NP, NP1EO and NP2EO per unit of sediment surface were in February one order of magnitude higher. A major factor responsible for this trend was related to the proliferation of macroalgae which contained an average NP+NP1EO+NP2EO concentration of 0.25 plus or minus 0.15 microgram/g (dry wt.). In water, NPEO oligomers with up to 13 ethoxy units were found at an overall concentration range of 0.6-4.5 microgram/L. (Author's abstract)
W91-01754

EFFECTS OF ORGANIC SUBSTRATES ON DECHLORINATION OF AROCLOR 1242 IN ANAEROBIC SEDIMENTS.
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
L. Nies, and T. M. Vogel.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 9, p 2612-2617, September 1990. 1 fig, 3 tab, 14 ref.

Descriptors: *Acetates, *Biodegradation, *Fate of pollutants, *Glucose, *Methanol, *Microbial degradation, *Polychlorinated biphenyls, *Soil contamination, Anaerobic conditions, Nutrients, Soil bacteria.

The effects of different organic substrates on the abilities of anaerobic sediment enrichments to reductively dechlorinate polychlorinated biphenyls (PCBs) were studied. Sediments collected from a site previously contaminated with PCBs were dosed with additional PCBs (Aroclor 1242;; approximately 300 parts per million (300 micrograms/gram), sediment dry weight) and incubated anaerobically with acetate, acetone, methanol, or glucose. The pattern of dechlorination was similar for each substrate-fed batch; however, the extent and rates of dechlorination were different. Significant dechlorination over time was observed, with the relative rates and extent of dechlorination being greatest for methanol-, glucose-, and acetone-fed batches and least for acetate-fed batches. Dechlorination occurred primarily on the meta- and para-positions of the highly chlorinated congeners, resulting in the accumulation of less-chlorinated, primarily ortho-substituted products. No significant dechlorination was observed in incubation batches receiving no additional organic substrate, even though identical inorganic nutrients were added to all incubation batches. In addition, dechlorination was not observed in autoclaved controls that received substrate and nutrients. (Author's abstract)
W91-01758

INTERACTIONS BETWEEN BACILLUS THURINGIENSIS SUBSP. ISRAELENSIS AND FATHEAD MINNOWS, PIMEPHALES PROMELAS RAFINESQUE, UNDER LABORATORY CONDITIONS.
Environmental Research Lab.-Duluth, MN.
V. M. Snarski.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 9, p 2618-2622, September 1990. 3 fig, 1 tab, 24 ref.

Descriptors: *Bacillus, *Bacteria, *Biocontrol, *Minnow, *Path of pollutants, *Pesticides, *Toxicity, *Water pollution effects, Bacterial growth, Bioaccumulation, Ecological effects, Microbial transport, Spores.

Interactions between Bacillus thuringiensis subsp. israelensis and fathead minnows, Pimephales promelas, were studied in laboratory exposures to two commercial formulations, Vectobac-G and Mosquito Attack. Mortality among fatheads exposed to 2,000,000 to 6,500,000 colony forming units/ml with both formulations was attributed to severe dissolved oxygen depletion due to formulation ingredients rather than to direct toxicity from the parasporal crystal. No adverse effects were observed at 640,000 colony forming units/ml and below. Fathead minnows rapidly accumulated high numbers of spores with 1 hr of exposure to 220,000 colony forming units of Mosquito Attack/ml, producing whole-body counts of 4,000,000 colony forming units/fish. Comparison of counts on gastrointestinal tract samples and whole-body samples and high numbers of spores in feces indicated that ingestion was the major route of exposure. B. thuringiensis subsp. israelensis spore counts decreased rapidly after transfer of fish to clean water, with a drop of over 3 orders of magnitude in 1 day. Spores were rarely detected in fish after 8 days but were detectable in feces for over 2 weeks. These findings suggest that fish could influence the dissemination of B. thuringiensis subsp. israelensis, and possibly other microbial agents, in the aquatic environment. (Author's abstract)
W91-01759

EFFECT OF SULFATE AND ORGANIC CARBON SUPPLEMENTS ON REDUCTIVE DEHALOGENATION OF CHLOROANILINES IN ANAEROBIC AQUIFER SLURRIES.
Oklahoma Univ., Norman. Dept. of Botany and Microbiology.
E. P. Kuhn, G. T. Townsend, and J. M. Suflita.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 9, p 2630-2637, September 1990. 6 fig, 1 tab, 37 ref.

Descriptors: *Biodegradation, *Chlorinated hydrocarbons, *Fate of pollutants, *Groundwater pollution, *Microbial degradation, *Organic carbon, *Pesticides, *Sulfates, Anaerobic conditions, Dyes, Halogenated hydrocarbons, Metabolism, Sulfur.

When di-, tri-, and tetrachloroaniline were incubated in methanogenic groundwater slurries, they were reductively dehalogenated by the aquifer microbiota. 2,3,4-Trichloroaniline was metabolized by two pathways. Primary dehalogenation occurred at either the meta or ortho position of this substrate to form 2,4-and 3,4-dichloroaniline, respectively. 3,4-Dichloroaniline could be stoichiometrically converted to 3-chloroaniline. 2,3,4,5-Tetrachloroaniline was degraded by the sequential removal of halogens from the para and then the ortho position to form 3,5-dichloroaniline. An additional pathway was observed with this substrate when the aquifer slurries were amended with butyrate. That is, halogens could be removed from both the meta and ortho positions of tetrachloroaniline. The amendment of sulfate to methanogenic aquifer slurries slowed the rate of 2,3,4-5-tetrachloroaniline degradation and increased the amount of substrate channeled through the additional pathway. The reported intermediates or end products were identified by their chromatographic mobility and mass-spectral profiles. (Author's abstract)
W91-01760

EFFECTS OF LIGHT, TEMPERATURE, NITRATE, ORTHOPHOSPHATE, AND BACTERIA ON GROWTH OF AND HEPATOTOXIN PRODUCTION BY OSCILLATORIA AGARDHII STRAINS.
Helsinki Univ. (Finland). Dept. of Microbiology.
K. Sivonen.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 9, p 2658-2666, September 1990. 6 fig, 1 tab, 27 ref.

Descriptors: *Cyanophyta, *Eutrophication, *Light intensity, *Nutrients, *Temperature effects, *Toxicity, *Toxins, Aquatic bacteria, Finland, Lakes, Liquid chromatography, Nitrates, Orthophosphates, Oscillatoria, Path of pollutants.

The effects of bacteria, temperature, light, nitrate, and orthophosphate on growth of and hepatotoxin (desmethyl-3-microcystin-RR) production by Oscillatoria agardhii strains were studied under laboratory conditions. Strains were cultivated in Z8 medium under continuous illumination. Growth was determined by measuring dry weight and chlorophyll a, while toxin was analyzed by high-performance liquid chromatography. Two of the three toxic cultures studied produced more toxins

in axenic than in nonaxenic cultures. High toxin production was correlated with high nitrogen concentrations (test range, 0.42 to 84 mg/L) and low light intensity (test range, 12 to 95 microeinsteins/sq m/second). Toxin production depended on phosphorus concentration at low levels of phosphorus (0.1 to 0.4 mg/L) and higher concentrations had no additional effect. The optimum temperature for toxin production and growth of green O. agardhii was 25 C. Red O. agardhii produced almost similar amounts of toxin at temperatures of 15 to 25 C. The lowest toxin production by both strains was at 30 C. (Author's abstract)
W91-01762

DISTRIBUTION AND RATE OF METHANE OXIDATION IN SEDIMENTS OF THE FLORIDA EVERGLADES.
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
For primary bibliographic entry see Field 2H.
W91-01763

RESPONSE OF ATTACHED BACTERIA TO ZINC IN ARTIFICIAL STREAMS.
Indiana Univ.-Purdue Univ. at Fort Wayne. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-01772

DEGRADATION OF PHENOL BY A BACTERIAL CONSORTIUM UNDER METHANOGENIC CONDITIONS.
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Microbiologie Appliquee.
For primary bibliographic entry see Field 5D.
W91-01773

INFLUENCE OF PH ON THE ACCUMULATION OF TRI-N-BUTYLTIN CHLORIDE AND TRIPHENYLTIN CHLORIDE IN CARP.
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
T. Tsuda, S. Aoki, M. Kojima, and H. Harada.
Comparative Biochemistry and Physiology (C) CBPCEE, Vol. 95, No. 2, p 151-153, 1990. 2 fig, 2 tab, 13 ref.

Descriptors: *Antifoulants, *Bioaccumulation, *Biological magnification, *Carp, *Hydrogen ion concentration, *Organotin compounds, *Tributyltin, *Water pollution effects, Path of pollutants.

Bioconcentration factors (BCF) were examined in carp (Cyprinus carpio L.) exposed to organotin compounds at three different pH levels in a continuous flow through system. The order of the BCF in carp at three pH values was pH 7.8 > pH 6.8 > pH 6.0 for both bis(tri-n-butyltin) chloride (Bu3SnCl) and triphenyltin chloride (Ph3SnCl) over the 14 days exposure period. There were significant differences ($P < 0.05$-$P < 0.001$) in the BCF values of both Bu3SnCl and Ph3SnCl between the pH values at 1, 3, 7, 10 and 14 days. Partition coefficients between n-octanol and water (Pow) of both Bu3SnCl and Ph3SnCl increased with increasing pH (pH 5.8-8.0). The increase in the BCF values of Bu3SnCl and Ph3SnCl with increasing pH is probably due to the change of the chemical forms of tributyltin ion to tributyltin hydroxide and tiphenyltin ion to triphenyltin hydroxide. (Author's abstract)
W91-01774

EFFECT OF HEAVY METALS ON THE SEROTONIN AND DOPAMINE SYSTEMS IN THE CENTRAL NERVOUS SYSTEM OF THE FRESHWATER MUSSEL (ANODONTA CYGNEA L).
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
J. Salanki, and L. Hiripi.
Comparative Biochemistry and Physiology (C) CBPCEE, Vol. 95, No. 2, p 301-305, 1990. 4 fig, 17 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Mussels, *Nervous system, *Water pollution effects, Brain, Cadmium, Copper, Enzymes, Lead, Mercury, Path of pollutants, Zinc.

Heavy metals influencing the filtering behavior of mussels cause alterations in the serotonergic and dopaminergic systems in the central nervous system of Anodonta cygnea both in vivo and in vitro. Forty hr exposure of the animals to CdCl2 and ZnCl2 caused a transient parallel decrease in 5-HT and DA levels of the ganglia. Also CuCl2, HgCl2 and PbCl2 lowered 5-HT and DA concentrations during treatment; restoration of 5-HT level was rapid, while that of the DA concentration lasted for several days. In isolated ganglia, uptake of 5-HT and DA was inhibited only at high (.0004 moles/L) heavy metal concentrations; only CuCl2 caused 60% depression of DA uptake in .00001 moles/L. Release of monoamines was influenced in a different way: both spontaneous and K-induced 5-HT release were depressed by Zn but were enhanced by Cu, Hg and Pb ions. Spontaneous DA release was enhanced by Cu, while K-induced DA release was increased by Cd, Cu and Zn ions; Hg depressed both. The results give further evidence that heavy metals influence mussels' behavior by influencing the monoamine systems of the brain. The mechanism, however, has not yet been clarified. (Author's abstract)
W91-01776

LABORATORY STUDIES OF THE FLOW OF SOME ORGANIC SOLVENTS AND THEIR AQUEOUS SOLUTIONS THROUGH BENTONITE AND KAOLIN CLAYS.
General Motors Research Labs., Warren, MI. Environmental Science Dept.
A. S. Abdul, T. L. Gibson, and D. N. Rai.
Ground Water GRWAAP, Vol. 28, No. 4, p 524-533, July/August 1990. 11 fig, 4 tab, 13 ref.

Descriptors: *Clays, *Hydraulic conductivity, *Linings, *Organic solvents, Bentonite, Benzenes, Chlorinated hydrocarbons, Flow rates, Kaolinite, Permeameters, Phenols, Toluene.

The following organic solvents and their aqueous solutions were evaluated: benzene, toluene, p-xylene, nitrobenzene, trichloroethylene, ethyl acetate, 2-butanone and phenol. In each experiment, one pore volume of 0.005 N CaSO4 water solution flowed through the clays, followed by several pore volumes of aqueous solution of one of the organic solvents, and then by about three pore volumes of the neat organic solvent. The hydraulic conductivity for the aqueous organic solutions was not significantly different from those of water. The flow of the neat solvents through either the bentonite or kaolin clay increased by up to two orders of magnitude. The aqueous solutions did not change the physical appearance of the clays. The more hydrophobic solvents caused the clays to shrink, producing distinct large vertical cracks. The hydrophilic solvents typically caused the clays to aggregate and fracture. The kaolin clay appeared to aggregate more readily than the bentonite clay. The higher swelling of the clays in water than in the neat organic solvents likely caused the physical changes in the clays and the rapid flow of the neat solvents through them. (Author's abstract)
W91-01781

NATURAL BIOREMEDIATION OF ORGANIC CONTAMINANTS IN GROUND WATER: CLIFFS-DOW SUPERFUND SITE.
Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab.
G. M. Klecka, J. W. Davis, D. R. Gray, and S. S. Madsen.
Ground Water GRWAAP, Vol. 28, No. 4, p 534-543, July/August 1990. 7 fig, 2 tab, 22 ref.

Descriptors: *Biodegradation, *Cliffs-Dow Superfund Site, *Fate of pollutants, *Groundwater, *Groundwater chemistry, *Groundwater pollution, *Organic compounds, *Site remediation, Industrial wastes, Model studies, Phenols, Superfund sites.

Groundwater in the immediate vicinity of an area previously used for the disposal of charcoal manufacturing wastes has been shown to contain low levels of phenolic and polycyclic compounds. Based on the analysis of samples obtained from monitoring wells, the levels of the organic contaminants are reduced to near or below the detection limit within a distance of 100 meters downgradient of the fill. Examination of the groundwater chemistry indicated that the aquifer is essentially aerobic across the site, except in the immediate vicinity of the fill. At this point, dissolved oxygen is apparently depleted due to the biodegradation of organic contaminants introduced into the groundwater, with a concomitant increase in the inorganic carbon concentration. Laboratory microcosm experiments demonstrated that the naturally occurring microorganisms can readily degrade a mixture of the predominant organic contaminants. Half-lives for biodegradation were in the range of 3 to 8 days for phenolic substrates and 11 to 18 days for naphthalene. Computer model simulations indicated that the attenuation observed in the aquifer cannot be explained in terms of physical processes such as adsorption or dispersion, but is consistent with biological degradation. (Author's abstract)
W91-01782

INDICATORS OF CHEMICAL POLLUTION FROM SEPTIC SYSTEMS.
Geraghty and Miller, Inc., Raleigh, NC.
For primary bibliographic entry see Field 5A.
W91-01785

USE OF RESISTIVITY SOUNDINGS TO DETERMINE LANDFILL STRUCTURE.
Northern Illinois Univ., De Kalb. Dept. of Geology.
P. J. Carpenter, R. S. Kaufmann, and B. Price.
Ground Water GRWAAP, Vol. 28, No. 4, p 569-575 July/August 1990. 5 fig, 2 tab, 33 ref.

Descriptors: *Geophysical methods, *Geophysical surveys, *Groundwater pollution, *Landfills, *Leachates, *Path of pollutants, *Resistivity, *Sounding, *Water pollution sources, Landfill covers, Mapping, Model studies, Waste disposal.

Sixteen Wenner and Schlumberger array electrical soundings were made over portions of the Mallard North landfill in DuPage County, Illinois, to map the gross layered structure of a closed landfill. Sounding curves were fit to standard type curves and values inverted in a least-squares procedure to yield multilayer geoelectrical models. Wood, newspaper, cloth, glass, plastic and metal refuse interspersed with soil exhibited resistivities of 9-19 ohm-m(unsaturated) and 2-7 ohm-m(leachate-saturated). Mature unfractured clay-till cover material exhibited a resistivity of about 30 ohm-m, and its thickness was estimated to within 27% of its true thickness. Larger errors were encountered over fractured and freshly emplaced cover. Soundings were also inverted to yield accurate leachate levels and refuse thickness (errors for both averaged about 30%). Although the soundings produced models with comparable accuracy, the soundings were less sensitive to cover heterogeneities and easier to deploy. Moore's cumulative resistivity interpretation method was found to be unreliable in interpreting this type of resistivity data. However, models generated from electrical resistivity soundings are reasonably accurate in their depictions of internal conditions in this type of landfill. (Author's abstract)
W91-01786

GROUND-SURFACE DELINEATION OF FRACTURES OVER MINED-OUT OPENINGS USING CARBON DIOXIDE EMISSIONS.
Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
For primary bibliographic entry see Field 5G.
W91-01787

MEASUREMENT AND INTERPRETATION OF LOW LEVELS OF DISSOLVED OXYGEN IN GROUND WATER.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7B.
W91-01788

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MODELING THE FATE AND TRANSPORT OF ORGANIC CONTAMINANTS IN LAKE ST. CLAIR.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
G. A. Lang, and T. D. Fontaine.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 2, p 216-232, 1990. 3 tab, 10 fig, 33 ref. EPA Interagency Agreement No. DW13931213-01-0.

Descriptors: *Fate of pollutants, *Lake St Clair, *Mathematical models, *Model studies, *Path of pollutants, *Polychlorinated biphenyls, Cesium, Heavy metals, Lake sediments, Lakes.

In order to understand and predict the transport and fate of organic contaminants in Lake St. Clair, a multisegment, contaminant mass balance model was developed based on the Environmental Protection Agency's TOXIWASP model. The model was calibrated and tested against chloride data and cesium-137 data. It was then used to simulate polychlorinated biphenyl and octachlorostyrene (OCS) dynamics in the lake. The model predicted that during 1971-1983, 3.8 MT of OCS entered the lake, 2.8 MT were flushed from the system, 0.8 MT were lost due to biological degradation and volatilization and 0.2 MT remained in the system. The model also predicted that during 1970-1974, 3.4 MT of PCB entered the lake, 2.1 MT were flushed from the system, 2.2 MT were lost due to biological degradation and volatilization and the system mass of PCB decreased from 1.9 to 1.0 MT. (Author's abstract)
W91-01792

RELATIONSHIP BETWEEN CHLORINATED HYDROCARBONS AND ORGANIC CARBON IN SEDIMENT AND POREWATER.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
P. D. Capel, and S. J. Eisenreich.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 2, p 245-257, 1990. 3 tab, 5 fig, 39 ref.

Descriptors: *Chlorinated hydrocarbons, *Interstitial water, *Lake Superior, *Organic carbon, *Path of pollutants, *Polychlorinated biphenyls, *Sediment-water interfaces, *Toxic wastes, Distribution patterns, Fate of pollutants, Larvae, Model studies, Sediment analysis.

Chlorinated hydrocarbons and organic carbon were measured in the bulk sediment, very fine, low density, sediment particles, porewater and Hexagenia naiads of Lake Superior sediment to examine the distrigution of the hydrophobic organic compounds and how this distribution is influenced by organic carbon. The porewater was divided into filtered and unfiltered fractions. The sediment fractions did not behave the same in their affinity to bind the chlorinated hydrocarbons, nor were all of the chlorinated hydrocarbons bound to the same extent. The affinity for most of the hydrocarbons to the solids were in the order: larvae > fine particles > bulk sediment. The filtered porewater organic carbon (dissolved and/or collodial) was about 1/3 to 2/3 as efficient as the bulk sediment organic carbon at binding these hydrophobic compounds. A three-phase (solid, porewater organic carbon, dissolved) competitive model estimates that < 10% of the chlorinated hydrocarbons in the porewater are dissolved. The remaining fraction is associated with the organic porewater colloids. (Author's abstract)
W91-01795

INORGANIC CONTAMINANTS IN SUSPENDED SOLIDS FROM HAMILTON HARBOUR.
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
T. Mayer, and P. G. Manning.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 2, p 299-318, 1990. 10 tab, 7 fig, 55 ref.

Descriptors: *Hamilton Harbour, *Heavy metals, *Iron, *Lake Ontario, *Phosphorus, *Pollution load, *Sediments, *Water pollution sources, Dredging wastes, Fate of pollutants, Municipal wastewater, Pollutant identification, Spectral analysis, Spoil banks, Suspended solids.

Concentrations of heavy metals and phosphorus were measured in suspended solids collected from Hamilton Harbour, Lake Ontario, in the spring and late summer of 1986. Forms of iron were determined using Mossbauer spectroscopy and related to the concentrations of heavy metals and phosphorus. Two iron forms, wustite and hematite were identified in addition to naturally occurring Fe(2+) from chlorite and clays and Fe(3+) from amorphous iron oxides. The highest metal concentrations are found in deep water and in areas adjacent to outfalls. The concentrations of wustite and hematite are correlated with the concentrations of heavy metals, particularly Zn and Pb. Heavy metals in suspended solids exceed guidelines for open water disposal of dredged sediments. Phosphorus concentrations in suspended solids are high. Higher than average non-apatite inorganic P concentrations in solids are observed in samples taken from the vicinity of municipal discharges. Manganese and iron were released from bottom sediments during summer anoxia in the hypolimnion of the deep water; however, no phosphorus release was observed. The results indicate that wustite and hematite are good tracers of industrial pollution and their distribution is of importance in determining the particle dynamics in Hamilton Harbor. (Author's abstract)
W91-01798

DISTRIBUTION OF HEAVY METALS IN GOVE HARBOUR, NORTHERN TERRITORY, AUSTRALIA.
Northern Territory Univ., Darwin (Australia). School of Chemistry.
N. Peerzada, L. McMorrow, S. Skiliros, M. Guinea, and P. Ryan.
Science of the Total Environment STENDL, Vol. 92, p 1-12, March 1990. 1 fig, 4 tab, 31 ref.

Descriptors: *Aluminum, *Cadmium, *Copper, *Industrial wastes, *Iron, *Lead, *Manganese, *Nickel, *Oysters, *Path of pollutants, *Sediment contamination, *Water pollution, *Water pollution sources, *Zinc, Australia, Bauxite treatment plants, Coastal environment, Heavy metals, Sediment analysis, Water analysis.

The concentration of four metals in waters and eight metals in oysters and sediments from Gove Harbour, Northern Territory, were determined during the dry season of 1987. The measured concentrations in the unfiltered waters were: zinc (1.10-7.28), cadmium (0.10-2.20), copper (0.25-3.45), and lead (0.15-2.87) microgram/L. Heavy metal concentrations (in wet weight, micrograms/gram) obtained for oysters from Gove Harbour were as follows: zinc (60.1-970), cadmium (0.14-4.07), copper (3.77-30.67), lead (not detected-0.46), aluminum (6.50-1123.0), nickel (0.02-0.44), manganese (0.24-2.04), and iron (4.28-981.3). In sediments, the following concentrations, in dry weights (in micrograms/gram) were obtained: zinc (0.09-22.24), cadmium (not detected-0.45), copper (not detected-5.96), lead (not detected-2.98), aluminum (229-16053.5), nickel (0.21-7.70), manganese (13.77-50.24), and iron (759.5-2659.6) Concentrations of zinc, aluminum, and cadmium were higher in the oysters. The level of cadmium exceeded the National Health and Medical Research Council (NHMRC) recommended limit. The levels of these and other metals were higher near a bauxite treatment plant. However, no heavy metal data are available at Gove Harbour to establish natural background levels. (Author's abstract)
W91-01813

VOLATILIZATION OF SELENIUM FROM AGRICULTURAL EVAPORATION POND SEDIMENTS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5G.
W91-01814

POLLUTION BY THE FUNGICIDE PENTACHLORONITROBENZENE IN AN INTENSIVE FARMING AREA IN JAPAN.
Environmental Research Center of Kanagawa Prefecture, Yokohama (Japan).
Y. Fushiwaki, N. Tase, A. Saeki, and K. Urano.
Science of the Total Environment STENDL, Vol. 92, p 55-67, March 1990. 10 fig, 3 tab, 15 ref.

Descriptors: *Agricultural runoff, *Biodegradation, *Farming, *Fate of pollutants, *Fungicides, *Path of pollutants, *Pentachloronitrobenzene, *Pesticides, *Water pollution sources, Agricultural chemicals, Japan, Pentachloroaniline, Pentachlorothioanisole, River sediments, Sediment contamination, Soil contamination.

Environmental pollution by pentachloronitrobenzene (PCNB) was investigated at Tsumagoi, an intensive farming area, where a great amount of PCNB has been applied. High concentrations of PCNB were detected in river water near an area of cabbage cultivation. Further, pentachloroaniline (PCA) and pentachlorothioanisole (PCTA), which are the principal biodegradation products of PCNB, were also detected, and their ratios to PCNB were higher in autumn than in summer. PCNB concentrations in soil were similar to those of river sediments, in which PCNB was concentrated 5,000-10,000 times over levels in river water. The biodegradation rate of PCNB in river water was higher than in river sediment and soil. The formation rates of PCA from PCNB were higher in river sediment and soil than in river water. It is concluded that PCA remains for a long time in the environment and accumulates in river sediment and soil. (Author's abstract)
W91-01815

FATE AND EFFECTS OF PULP MILL CHLOROPHENOLIC 4,5,6-TRICHLOROGUAIACOL IN A MODEL BRACKISH WATER ECOSYSTEM.
Swedish Environmental Research Inst., Karlskrona.
A. Rosemarin, M. Notini, M. Soderstrom, S. Jensen, and L. Landner.
Science of the Total Environment STENDL, Vol. 92, p 69-89, March 1990. 7 fig, 6 tab, 23 ref.

Descriptors: *Algae, *Bioaccumulation, *Ecosystems, *Fucus, *Littoral environment, *Model studies, *Path of pollutants, *Pulp wastes, *Water pollution sources, Baltic Sea, Chlorocatechols, Chloroguaiacols, Chlorophenols, Chloroveratroles, Pulp and paper industry, Sweden, Water pollution.

The fate and effects of the pulp mill effluent compound 4,5,6-trichloroguaiacol (TCG) were tested over 16 months on a model Baltic Sea littoral zone using a Fucus vesiculosus-based mesoscale model ecosystem. Bioaccumulation of TCG and metabolites from water ranged from 50 times for algae up to 700 times for invertebrates and fish, the factor increasing with trophic level. Algae contained chloroguaiacols, chlorocatechols and chloroveratroles and exhibited no major toxic effects. Fucus colonization appeared to be hindered by filamentous algae which covered surfaces otherwise available for new colonization. This unrestricted filamentous algal growth was probably the result of reduced grazing by herbivores, which in turn was apparently caused by reproduction failure in herbivorous crustaceans. Sediment-dwelling organisms appeared less affected than invertebrates in an algal habitat, possibly because of reduced bioavailability of toxic compounds due to binding to sediment particles. TCG and metabolites in the sediment were dominated by catechols; no veratroles were found. Only in the largest size class of sticklebacks was there a dose-related reduction in mean weight. Only 0.5% of the TCG added was recovered in the system after 16 months. Of this, 99% was associated with the sediment. The remainder was divided equally between algae and fauna. The role of algae and sediment in the Baltic Sea littoral zone is therefore paramount to the ultimate fate and effects of such compounds on invertebrates and fish. (Author's abstract)
W91-01816

TRENDS IN THE HEAVY METAL LEVELS IN THE DISSOLVED AND PARTICULATE

PHASE IN THE DUTCH RHINE-MEUSE (MAAS) DELTA.
Warsaw Univ. (Poland). Dept. of Chemistry.
J. Golimowski, A. G. A. Merks, and P. Valenta.
Science of the Total Environment STENDL, Vol. 92, p 113-127, March 1990. 8 fig, 3 tab, 24 ref.

Descriptors: *Cadmium, *Chromium, *Copper, *Heavy metals, *Lead, *Meuse River, *Rhine River, *The Netherlands, *Water pollution sources, *Zinc, Aquatic environment, Chemical analysis, Chemical properties, Chlorophyll, Distribution coefficients, Nutrients, Seston, Statistical analysis, Waal River, Water analysis.

Levels of the heavy metals Cd, Cr, Cu, Pb, and Zn, in both the dissolved and particulate phase, were determined in two sampling campaigns in August 1978 and August 1984 in the Dutch Rhine-Meuse (Maas) Delta. Besides the heavy metal concentrations, other important parameters were determined, such as the concentrations of seston, chlorophyll and nutrients. The concentrations of dissolved Cd and of Cd, Pb, and Cu in particulate matter were much higher in 1978 than in 1984, especially for Cd. This may be due to the strict regulations implemented in Germany to reduce the pollution of natural waters by heavy metals. The correlation between the high Cd content and the chlorophyll content is explained by the binding of Cd to living and dead organisms. The distribution of the metals between the dissolved and the particulate phase, indicated by the distribution quotient Kd, increases from low values of Kd for Cu and Zn, to higher values for Cd and Cr, and the highest values for Pb. The differences are explained by various binding forms of each of these metals in natural waters. (Author's abstract)
W91-01817

RAINWATER ACIDITY AT JABIRU, AUSTRALIA, IN THE WET SEASON OF 1983/84.
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
R. W. Gillett, G. P. Ayers, and B. N. Noller.
Science of the Total Environment STENDL, Vol. 92, p 129-144, March 1990. 2 fig, 7 tab, 30 ref.

Descriptors: *Acid rain, *Air pollution sources, *Australia, *Hydrochloric acid, *Nitric acid, *Path of pollutants, *Precipitation, *Rainfall, *Sulfuric acid, *Water pollution sources, Chemical analysis, Data collections, Formic acid, Meteorology, Organic acids, Water analysis.

Rainwater was collected on an event basis at Jabiru, Australia (12 degrees 40 minutes S, 132 degrees 53 minutes E), from 20 October 1983 until 28 March 1984. Analysis showed that rainwater in this area contained only about 20 microequivalents/liter each of major cations and anions. However, the rainfall was acidic (volume weighted mean pH 4.89). The free acidity was due mostly to the presence of formic acid and other unidentified weak organic acids, although sulfuric, nitric, and hydrochloric acids made a significant contributions, especially early in the Wet season. A strong meteorological influence on ion concentration was evident in the consistent decrease in concentration associated with the change in storm classification from transitional to monsoonal. Concentrations of sulfur dioxide, aerosol sulfate and cloudwater sulfate due to emissions from the Mount Isa smelting complex 1200 km distant were calculated according to a simple dispersion model used previously in Australian plume studies. The calculations suggest that Mt. Isa would contribute little to atmospheric acidity at Jabiru under the normal range of meteorological conditions in the region. (Author's abstract)
W91-01818

SPATIAL AND SEASONAL DIFFERENCES IN THE PCB CONTENT OF THE MUSSEL MYTILUS EDULIS.
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
H. Hummel, R. H. Bogaards, J. Nieuwenhuize, L. de Wolf, and J. M. van Liere.
Science of the Total Environment STENDL, Vol. 92, p 155-163, March 1990. 5 fig, 1 tab, 19 ref.

Descriptors: *Bioaccumulation, *Estuarine environment, *Lipids, *Mytilus, *Path of pollutants, *Polychlorinated biphenyls, *Seasonal variation, *Spatial distribution, Chemical analysis, Mussels, Oosterschelde Estuary, Salinity, The Netherlands, Westerschelde Estuary.

Seasonal and spatial variation in the concentration of polychlorinated biphenols (PCBs), fats (non-polar lipids) and total lipids and the condition of the mussel Mytilus edulis were assessed in three differing water bodies of the Dutch delta area. Highest concentrations of PCBs in the mussel were found in the Westerschelde estuary, with much lower concentrations in the Oosterschelde and the brackish lake Grevelingenmeer. Spatial differences were strongly related to salinity; lower concentrations were found at the more saline stations, pointing to freshwater inputs as being the origin of the PCBs in mussels. The PCB concentration in mussels, on the basis of dry or total weight, in general increased during summer, autumn and winter and decreased strongly during spring. The strong decrease is related to the spawning of gametes. Seasonal changes in the PCB concentrations on the basis of the dry weight were not related to changes in the fat content or the condition of the animals. Only PCBs on a fat basis were negatively related to fat content, indicating a dilution of PCBs during seasonal fat accumulation and concentration of PCBs during fat utilization, in such a way that the total PCB concentration in the animal remains the same. It seems that, besides reproduction, equilibrium partitioning is the most probable mechanism that determines the PCB content of mussels. (Author's abstract)
W91-01819

CHEMICAL COMPOSITION OF BULK PRECIPITATION ACROSS THE MOUNTAINS OF SNOWDONIA, U.K.
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 2B.
W91-01820

MERCURY, CADMIUM AND LEAD IN EELS AND ROACH: THE EFFECTS OF SIZE, SEASON, AND LOCALITY ON METAL CONCENTRATIONS IN FLESH AND LIVER.
Essex Univ., Colchester (England). Dept. of Biology.
N. A. E. Barak, and C. F. Mason.
Science of the Total Environment STENDL, Vol. 92, p 249-256, March 1990. 1 fig, 4 tab, 17 ref.

Descriptors: *Absorption, *Bioaccumulation, *Cadmium, *Eel, *Lead, *Liver, *Mercury, *Muscle, *Path of pollutants, *Roach, *Seasonal variation, Aquatic environment, Brett River, Chelmer River, England, Fate of pollutants, Fish physiology, Heavy metals.

Accumulation patterns of contaminants in fish are dependent both on uptake and elimination rates. The uptake of metals is influenced by many factors, including locality, species, sex, age, and state of gonadal maturation. Elimination of metals is an active biochemical and physiological process. Mercury, cadmium and lead were measured in the liver and flesh of 885 eels and 338 roach collected from four sites on the Rivers Brett and Chelmer, eastern England, over the period November 1985 to November 1987. Concentrations of metals in the liver and flesh of both species were highly correlated at all sites. Generally, mercury in flesh and liver were correlated with fish length in both species. There were fewer significant relationships between length and the concentrations of cadmium and lead. Site differences in mean concentrations were recorded. Seasonal variations in metal concentrations were largely restricted to eels from a more polluted site downstream from the town of Chelmsford. The source of the contamination is unknown. The seasonal effects were mainly detected in livers. This may be related to the differences between organs in relation to the binding strength of metals in body proteins. Weakly bound metals in soft organs, such as the liver, may be more easily influenced by seasonal changes compared with strongly bound metals in flesh. (See also W91-01822) (Author's abstract)
W91-01821

MERCURY, CADMIUM AND LEAD CONCENTRATIONS IN FIVE SPECIES OF FRESHWATER FISH FROM EASTERN ENGLAND.
Essex Univ., Colchester (England).
N. A. E. Barak, and C. F. Mason.
Science of the Total Environment STENDL, Vol. 92, p 257-263, March 1990. 1 fig, 3 tab, 9 ref.

Descriptors: *Absorption, *Bioaccumulation, *Cadmium, *Chubs, *Lead, *Mercury, *Path of pollutants, *Perch, *Pike, *Seasonal variation, Aquatic environment, Aquatic life, Biochemistry, Brett River, Chelmer River, Chemical analysis, England, Fate of pollutants, Fish, Heavy metals, Minnow, Tench.

A total of 146 samples of five species of fish were examined between March and November 1986 in four sites from the Rivers Brett and Chelmer in eastern England. Concentrations of mercury, cadmium, and lead were measured in the flesh and liver of 35 dace, 15 chub, 18 tench, 22 perch, and 56 pike. Variations in heavy metals concentrations between the sites and species were found to be related mainly to size differences of fish. Mercury levels in the flesh were higher than in the liver, while cadmium and lead levels were higher in the liver than in the flesh. (See also W91-01821) (Author's abstract)
W91-01822

DETERMINATION OF TRACE QUANTITIES OF ORGANOTIN COMPOUNDS IN COASTAL WATERS OF GREECE BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY.
Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
For primary bibliographic entry see Field 5A.
W91-01823

DEVELOPMENT OF AN EXPERT SYSTEM EMBEDDING PATTERN RECOGNITION TECHNIQUE FOR GROUNDWATER POLLUTION SOURCE IDENTIFICATION.
California Univ., Davis. Dept. of Civil Engineering.
B. Datta, J. E. Beegle, M. L. Kavvas, and G. T. Orlob.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-185927/AS. Price codes: A08 in paper copy, A01 in microfiche. Completion Report, 1989. 132p, 33 fig, 16 tab, 38 ref, 9 append. USGS Contract 14-08-0001-G1500.

Descriptors: *Computer programs, *Expert systems, *Groundwater pollution, *Mathematical models, *Optimization, *Sensitivity analysis, Algorithms, Bayes Optimal Decision Rule, Computer models, Model studies, Solute transport models, Statistical studies.

A new methodology for the identification of unknown sources of groundwater pollution is developed. This new methodology is based on the concept of statistical pattern recognition. The statistical pattern recognition algorithm uses Bayes' Optimal Decision Rule. The function of the pattern recognition system is to match statistically an observed set of concentrations in the field with a comparable set obtained by simulating groundwater transport for various disposal conditions. In order to make the application of this methodology easier, an Expert System was developed. This Expert System uses the results obtained by applying the pattern recognition algorithm to select a particular set of pollution source locations and magnitudes. The Expert System also has the capability of adding measures of confidence to alternative selections of sources made by the pattern recognition system, such that these solutions can be ranked according to the subjective confidences supplied by the users. The performance of the

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pattern recognition system and the Expert System was evaluated for a selected study area. (USGS)
W91-01825

MODELING ORGANIC CONTAMINANT SORPTION IMPACTS ON AQUIFER RESTORATION.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
C. T. Miller, J. A. Pedit, E. G. Staes, and R. H. Gilbertsen.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-185059/AS. Price codes: A06 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No. 246, (UNC-WRRI-89-246), July 1989. 92p, 20 fig, 6 tab, 79 ref, 3 append. State Project 70078.

Descriptors: *Aquifers, *Groundwater pollution, *Model studies, *Organic wastes, *Sorption, Mathematical models, North Carolina, Oil wastes, Path of pollutants, Sorption equilibrium models, Water pollution sources.

The groundwater resources of the U.S. have been contaminated by a variety of organic pollutants that include solvents, petroleum products, and pesticides. A need exists to understand the movement of contaminants in the subsurface so that: (1) an assessment of the risk due to contamination may be made; (2) an economical and environmentally acceptable response to contamination may be designed; and (3) an appropriate ranking of sites that require clean-up and that are competing for the same fixed pool of resources may be accomplished. Many common organic contaminants sorb to solid surfaces, like soils or aquifer materials. Sorption affects the rate of transport for a given contaminant in the subsurface and may also affect the rate of contaminant degradation. An understanding of the sorption process is, therefore, an important part of understanding the overall movement of a contaminant in the subsurface. This work focuses on the investigation of the sorption process in the subsurface. Specifically four aspects are considered: the measurement of sorption equilibrium for petroleum-based contaminants to a coastal North Carolina aquifer material; determination of the rate of sorption for these systems; development of mathematical models that may be used to simulate the sorption process; and an analysis of the significance of sorption-desorption rates for predicting field-scale transport of organic contaminants. Laboratory results demonstrate the relative importance of sorption as a function of compound type using aquifer material collected from a Camp Lejeune field site. The sorption process is shown to require several days to approach equilibrium, while the final equilibrium is found to be nonlinear. (USGS)
W91-01827

TRITIUM CONCENTRATIONS IN FLOW FROM SELECTED SPRINGS THAT DISCHARGE TO THE SNAKE RIVER, TWIN FALLS-HAGERMAN AREA, IDAHO.
Geological Survey, Idaho Falls, ID. Water Resources Div.
L. J. Mann.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4156, 1989. 20p, 2 fig, 3 tab, 15 ref.

Descriptors: *Path of pollutants, *Radioactive wastes, *Radioactivity, *Springs, *Tritium, Idaho, Idaho National Engineering Laboratory.

Concern has been expressed that some of the approximately 30,900 curies of tritium disposed to the Snake River Plain aquifer from 1952 to 1988 at the INEL (Idaho National Engineering Laboratory) have migrated to springs discharging to the Snake River in the Twin Falls-Hagerman area. To document tritium concentrations in springflow, 17 springs were sampled in November 1988 and 19 springs were sampled in March 1989. Tritium concentrations were less than the minimum detectable concentration of 0.5 pCi/mL (picocuries/mL) in November 1988 and less than the minimum detectable concentration of 0.2 pCi/mL in March 1989; the minimum detectable concentration was smaller in March 1989 owing to a longer counting time in the liquid scintillation system. The maximum contaminant level of tritium in drinking water as established by the U.S. Environmental Protection Agency is 20 pCi/mL. U.S. Environmental Protection Agency sample analyses indicate that the tritium concentration has decreased in the Snake River near Buhl since the 1970's. In 1974-79, tritium concentrations were less than 0.3 +/-0.2 pCi/mL in 3 of 20 samples; in 1983-88, 17 of 23 samples contained less than 0.3 +/-0.2 pCi/mL of tritium; the minimum detectable concentration is 0.2 pCi/mL. On the basis of decreasing tritium concentrations in the Snake River, their correlation to cessation of atmospheric weapons tests tritium concentrations in springflow less than the minimum detectable concentration, and the distribution of tritium in groundwater at the INEL, aqueous disposal of tritium at the INEL has had no measurable effect on tritium concentrations in springflow from the Snake River Plain aquifer and in the Snake River near Buhl. (USGS)
W91-01833

INORGANIC AND ORGANIC GROUNDWATER CHEMISTRY IN THE CANAL CREEK AREA OF ABERDEEN PROVING GROUND, MARYLAND.
Geological Survey, Towson, MD. Water Resources Div.
M. M. Lorah, and D. A. Vroblesky.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4022, 1989. 97p, 3 pl, 11 fig, 16 tab, 49 ref.

Descriptors: *Aromatic compounds, *Chlorinated hydrocarbons, *Fate of pollutants, *Groundwater pollution, *Maryland, *Path of pollutants, *Water quality, Aberdeen Proving Ground, Aliphatic hydrocarbons, Chemical degradation, Coastal aquifers, Inorganic compounds, Microbial degradation, Organic solvents, Physicochemical properties, Unconsolidated aquifers.

Groundwater chemical data were collected from November 1986 through April 1987 in the first phase of a 5-year study to assess the possibility of groundwater contamination in the Canal Creek area of Aberdeen Proving Ground, Maryland. Water samples were collected from 87 observation wells screened in Coastal Plain sediments; 59 samples were collected from the Canal Creek aquifer, 18 from the overlying surficial aquifer, and 10 from the lower confined aquifer. Dissolved solids, chloride, iron, manganese, fluoride, mercury, and chromium are present in concentrations that exceed the Federal maximum contaminant levels for drinking water. Elevated chloride and dissolved-solids concentrations appear to be related from contaminant plumes but also could result from brackish-water intrusion. Excessive concentrations of iron and manganese were the most extensive water quality problems found among the inorganic constituents and are derived from natural dissolution of minerals and oxide coatings in the aquifer sediments. Volatile organic compounds are present in the Canal Creek and surficial aquifers, but samples from the lower confined aquifer do not show any evidence of contamination by inorganic or organic chemicals. The volatile organic contaminants detected in the groundwater and their maximum concentrations (in micrograms/L) include 1,1,2,2-tetrachloroethane (9,000); carbon tetrachloride (480); chloroform (460); 1,1,2-trichloroethane (80); 1,2-dichloroethane (990); 1,1-dichloroethane (3.1); tetrachloroethylene (100); trichloroethylene (1,800); 1,2-trans-dichloroethylene (1,200); 1,1-dichloroethylene (4.4); vinyl chloride (140); benzene (70); and chlorobenzene (39). On the basis of information on past activities in the study area, some sources of the volatile organic compounds include: (1) decontaminants and degreasers; (2) clothing-impregnating operations; (3) the manufacture of impregnite material; (4) the manufacture of tear gas; and (5) fuels used in garages and at the air-field. The high density of most of the detected organic compounds in free-product form would have aided their movement into the aquifers by vertical sinking. The outcrop area of the upper confining unit and an area cut by a paleochannel are most susceptible to contamination because a near-surface impermeable layer is not present. (USGS)
W91-01837

HYDROGEOLOGIC, WATER-LEVEL, AND WATER-QUALITY DATA FROM MONITORING WELLS AT THE U.S. MARINE CORPS AIR STATION, CHERRY POINT, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
L. C. Murray, and K. M. Keoughan.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4200, 1990. 86p, 14 fig, 9 tab, 26 ref.

Descriptors: *Cherry Point, *Groundwater pollution, *Hydrologic data, *Monitoring, *North Carolina, *Observation wells, *Water quality, *Water resources data, Hydrogeology, Pollutant identification, Sedimentary petrology.

Unlined hazardous-waste disposal sites at the U.S. Marine Corps Air Station, Cherry Point, North Carolina, are located near drinking water supply wells that tap the Castle Hayne aquifer. Hydrogeologic and water quality data were collected near two of these sites from 12 monitoring wells installed in May to June 1987. Near the northernmost disposal site, differences in hydraulic head between the surficial, intermediate Yorktown, and Castle Hayne aquifers indicate the potential for migration of contaminants downward into the Castle Hayne. Movement would be impeded, however, by two confining units that separate the three aquifers. Near the southernmost landfill, these units are thin and discontinuous. However, water-level data in this area indicate that water from both the Castle Hayne and Yorktown aquifers flows upward into the surficial aquifer, which reduces the potential for downward contaminant movement. Groundwater in the surficial aquifer at both sites moves laterally away from nearby drinking water supply wells and toward Slocum Creek. Elevated concentrations of trichloroethylene and 1,2-dichloroethene (4,600 and 4,800 ug/L (micrograms per liter), respectively) were detected in water samples collected from the surficial aquifer near the southernmost landfill; smaller concentrations were detected in the Yorktown aquifer (16 and 8 ug/L, respectively). With the exception of iron and manganese, trace metals detected in the wells sampled near both landfills were below U.S. Environmental Protection Agency drinking water standards. Highest concentrations of priority pollutant metals detected were for zinc (60 ug/L) and chromium (36 ug/L). (USGS)
W91-01844

SOURCES AND DISTRIBUTION OF NITRATE IN GROUND WATER AT A FARMED FIELD IRRIGATED WITH SEWAGE TREATMENT-PLANT EFFLUENT, TALLAHASSEE, FLORIDA.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5E.
W91-01857

COMPARING THE EFFECTS OF ACIDIC DEPOSITION ON THE CHEMISTRY OF SMALL STREAMS IN THE SOUTH ISLAND OF NEW ZEALAND WITH THOSE IN THE FICHTELGEBIRGE, F.R.G.
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
A. Stenzel, and R. Herrmann.
Catena, Vol. 17, No. 1, p 69-83, February 1990. 2 fig, 6 tab, 22 ref.

Descriptors: *Acid rain effects, *Acid streams, *Acidic water, *Aluminum, *New Zealand, *Organic acids, *Water chemistry, *Water pollution sources, *West Germany, Conductivity, Deposition, Fluorides, Phosphates, Sediment load, Statistical analysis, Streams, Sulfates, Water sampling.

There are some major differences in the chemical composition of unpolluted clear and brownwater (natural acid) streams in New Zealand and the polluted White Main in Bavaria, West Germany. Sulfate concentrations are 10 to 20 times higher in the White Main and atmospheric inputs of strong acids (H2SO4 and HNO3) cause pH values of 5.0 and lower. Clearwaters in New Zealand show neutral pH values of between 6.6 and 8.0 whereas brownwaters have a pH of 4.0, but their acidity is derived from organic acids. Concentrations of aluminum are low in the New Zealand clearwaters and consist mainly of polymeric species. Brownwaters show relatively high aluminum concentrations, dominated by monomeric aluminum species, but these are complexed with organic acids. In contrast to this, the White Main has high concentrations of the toxic monomeric inorganic form. Inputs of strong mineral acids on natural acid streams may induce a change in the aluminum chemistry and turn the organic nontoxic aluminum species into toxic forms. There is not a significant difference in major cation concentrations between the White Main and New Zealand streams. Variation in the New Zealand water samples is caused by location differences, for example, coastal streams have higher concentrations of sea salt cations than inland waters. (Author's abstract)
W91-01870

TRAVEL TIMES OF SEEPAGE WATER THROUGH MULTILAYERED COVERING SYSTEMS FOR HAZARDOUS WASTE SITES.
Karlsruhe Univ. (Germany, F.R.). Dept. of Applied Geology.
S. Wohnlich.
Environmental Geology and Water Sciences EGWSEI6, Vol. 15, No. 2, p 137-144, March/April 1990. 7 fig, 6 ref.

Descriptors: *Barriers, *Flow velocity, *Hazardous materials, *Infiltration, *Landfill covers, *Lysimeters, *Path of pollutants, *Seep water, *Seepage, *Traveltime, *Waste disposal, Drainage, Field tests, Hydraulic design, Porosity, Soil water, Surface runoff, Tracers.

In a field experiment station near Frankfurt am Main, West Germany, a three-layer covering system was constructed in order to evaluate the amount of seepage water through clay barrier systems and their long-term effectiveness. The test area was equipped with two large-scale lysimeters, excess tubes (for neutron-moisture and gamma-gamma-density measurements), tensiometers, surface runoff and drain discharge recorders and other meteorological instruments. The results of the three-year observation period gave a complete record of the infiltration and seepage process within the different covering layers. With the help of hydrochemical and isotope analyses, as well as with tracer experiments, the velocity of the soil water was determined. Three major waterpaths were found in the vadose zone of the vegetation support layers as well as in the saturated zone of the barrier layer. Very low velocities followed the matrix porosity of the soil. High velocities occur along preferential waterpaths which follow inhomogeneities within the soil. Minor parts of the lysimeter outflow react directly with the precipitation inflow and, therefore, reveal that unretarded flowpaths exist as well. The higher the compaction of the clay, the more dominant is the influence of preferential flow paths. The travel times through the clay barriers are much faster than currently thought. A breakthrough in contaminants occurs much earlier than estimated by assuming homogeneous flow. It is recommended that large scale field tests using simple flexible lysimeters be used to determine the effective flux density at each individual site. (Stoehr-PTT)
W91-01886

CHEMICAL THREAT TO THE ENVIRONMENT IN POLAND.
Lublin Technical Univ. (Poland). Dept. of Water and Wastewater Technology.
A. Pawlowski.
Science of the Total Environment STENDL, Vol. 96, No. 1/2, p 1-21, July 1990. 1 fig, 14 tab, 7 ref.

Descriptors: *Acid rain, *Air pollution, *Environmental quality, *Heavy metals, *Poland, *Political aspects, *Pollution load, *Soil contamination, *Water pollution sources, Acidic soils, Carcinogens, Economic aspects, Environmental effects, Environmental policy, Foods, Human diseases, Nitrous oxide, Sulfur dioxide, Trace elements, Vistula River.

Pollution of the environment in Poland is characterized and the concentrations of SO2, NOx, dust and metals in the air are tabulated. Surface water is classified according to sanitary standards, and the concentrations of heavy metals in the River Vistula are presented. Soil is mainly polluted with trace elements such as mercury, lead, cadmium, zinc, copper and flourine. Eighty-three percent of the cultivated soils in Poland are acidic due to the interaction of sulfur and its compounds deposited on the ground with other atmospheric contaminants. The causes and sources of food contamination include fertilizers, pharmaceutical preparations given to animals, and food processing and packaging. The characteristics of the Polish economy which may influence the nation's pollution problems include the nation's high energy consumption and the inability to manufacture suitable equipment for environmental restoration. In addition, purchasing equipment from abroad is limited due to Poland's shortage of hard currency. Significant changes should not be expected in the next few years without international assistance. There are unsolved problems concerning the influx of SO2 and other pollutants from other countries. Poland also exports air pollutants to other countries. For environmental quality to improve, all the surrounding countries have to agree on implementing beneficial environmental policies. (Stoehr-PTT)
W91-01887

ACID PRECIPITATION MONITORING AND RESEARCH. REVIEW OF CURRENT NORWEGIAN ACTIVITIES.
Oslo Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 5G.
W91-01888

OCCURRENCE OF HEAVY METALS IN WATER, PHYTOPLANKTON, AND ZOOPLANKTON OF A MESOTROPHIC LAKE IN EASTERN POLAND.
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
S. Radwan, W. Kowalik, and C. Kowalczyk.
Science of the Total Environment STENDL, Vol. 96, No. 1/2, p 115-120, July 1990. 2 fig, 1 tab, 17 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Lakes, *Mesotrophic lakes, *Path of pollutants, *Phytoplankton, *Poland, *Zooplankton, Cadmium, Cobalt, Copper, Iron, Lake Piaseczno, Lead, Manganese, Pollutant identification, Water pollution, Zinc.

The concentrations of the heavy metals copper, zinc, manganese, iron, cadmium, lead, and cobalt were determined in phytoplankton, zooplankton and water of the mesotrophic Lake Piaseczno. The zooplankton community consists of three basic groups, Rotaria, Cladocera and Copepoda, which were caught in light traps. Net phytoplankton is represented mainly by Chlorophyta and Conjugatea. The concentrations of heavy metals differed in phytoplankton and zooplankton, especially with respect to Mn, Pb, Cu and Cd. For both communities the highest metal concentrations were exhibitied by iron, zinc and manganese. These levels were many times higher than the levels in water. Manganese was at a higher concentration in the phytoplankton than in the zooplankton, and lead, copper and cadmium were at higher concentrations in the zooplankton than in the phytoplankton. High bioaccumulation indices for both plankton communities were found for iron, manganese and zinc, and very low indices were found for lead and cadmium. This may be evidence of the rate and selective uptake of particular trace metals by the phytoplankton and zooplankton. If the bioaccumulation index for one trace metal is higher than that of a second trace metal, then the former is absorbed more rapidly from water by a given plankton community. (Stoehr-PTT)
W91-01891

ACCUMULATION OF HEAVY METALS IN A LAKE ECOSYSTEM.
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
S. Radwan, W. Kowalik, and R. Kornijow.
Science of the Total Environment STENDL, Vol. 96, No. 1/2, p 121-129, July 1990. 1 tab, 27 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Lakes, *Mesotrophic lakes, *Path of pollutants, *Plankton, Benthos, Fish, Lake Piaseczno, Phytoplankton, Poland, Sediment contamination, Water pollution, Zooplankton.

The concentrations of copper, zinc, iron, manganese, cadmium, nickel, lead, and cobalt were determined in water, bottom sediments, plankton, zoobenthos and ichthyofauna of mesotrophic Lake Piaseczno located in eastern Poland. In water, sediments, plankton and benthos, the most abundant heavy metals were iron, zinc and manganese. In fish zinc, copper and manganese were most abundant. The amount of heavy metals in the biotic components was dependent upon their concentration in water and partly upon the concentration in bottom sediments. A considerably less important role in the translocation of heavy metals is probably played by trophic interactions. (Author's abstract)
W91-01892

ASSESSMENT OF ALUMINUM MOBILIZATION AND PATHWAYS IN THE BIRKENES CATCHMENT, SOUTHERN NORWAY.
Oslo Univ. (Norway). Dept. of Chemistry.
R. Vogt, H. M. Seip, N. Christophersen, and S. Andersen.
Science of the Total Environment STENDL, Vol. 96, No. 1/2, p 139-158, July 1990. 6 fig, 3 tab, 39 ref.

Descriptors: *Acid rain effects, *Acid streams, *Aluminum, *Model studies, *Norway, *Path of pollutants, *Temporal distribution, Lysimeters, Mathematical models, Soil water, Streams, Sulfur compounds, Tracers, Water pollution.

In spite of considerable research efforts the detailed mechanisms involved in acidification, and in particular those controlling aluminum concentrations in water, have not been satisfactorily established. Earlier work on acidification carried out in the Birkenes catchment in sourthern Norway is briefly reviewed. Temporal variation in acidity and aluminum concentrations in stream water are related to variations in ionic loadings. Addition of sodium bromide to two small soil plots in Birkenes resulted in high concentrations of hydrogen in the organic horizon and of aluminum in the eluvial horizon. The experiment supports the hypothesis presented earlier that water pathways are of great significance in determining stream water chemistry. The improvement of existing models for calculating stream water aluminum concentrations may require the use of at least three soil reservoirs in a model to reproduce observed aluminum satisfactorily. (Author's abstract)
W91-01893

ARE MATHEMATICAL MODELS USEFUL FOR UNDERSTANDING WATER ACIDIFICATION.
Oslo Univ. (Norway). Dept. of Chemistry.
A. Stone, and H. M. Seip.
Science of the Total Environment STENDL, Vol. 96, No. 1/2, p 159-174, July 1990. 5 fig, 1 tab, 18 ref, append.

Descriptors: *Acid rain, *Acidic water, *Mathematical models, *Model studies, *Simulation, Chemical analysis, Computer models.

Computer models play an integral part in the effort to understand the complicated processes which

affect ecosystems subjected to acid precipitation. Current research work using the Birkenes (Norway) model attempts to improve the evaluation of the present model structure and subjects the program to a stringent verification process. Simulation results for years which are not included in the calibration period are described. Checking model parameters against data sets not used in the calibration process is essential. The importance of model validation is emphasized. The simulations, though in agreement with the observations, are still deficient is some respects and possible model improvements are necessary. In addition, problems which appeared during model validation were also found during verification procedures. However, computer simulations have provided a powerful tool for evaluating current thinking regarding chemical processes involved in environmental problems such as acid precipitation. (Author's abstract)
W91-01894

ALUMINUM MOBILIZATION IN SOIL AND STREAM WATERS AT THREE NORWEGIAN CATCHMENTS WITH DIFFERENT ACID DEPOSITION AND SITE CHARACTERISTICS.
Senter for Industriforskning, Oslo (Norway).
N. Christophersen, C. Neal, R. Vogt, J. M. Esser, and S. Andersen.
Science of the Total Environment STENDL, Vol. 96, No. 1/2, p 175-188, July 1990. 5 fig, 5 tab, 24 ref.

Descriptors: *Acid rain effects, *Aluminum, *Deposition, *Norway, *Soil chemistry, *Soil water, *Water pollution effects, Cation exchange, Hydrogen ion concentration, Ion exchange, Model studies.

Streamwater, soil water, and soil chemistry data were collected for three Norwegian headwater catchments and comparisons made to allow assessment of the effects of acid deposition on aluminum mobilization. Two of the sites, situated in the most heavily impacted area of southern Norway, show pronounced differences in streamwater chemistry, especially at highflow. At Birkenes I, the pH reaches 4.2 and the inorganic monomeric aluminum reaches 20 microM, compared with a pH of 5-4.6 and aluminum at 3 microM at Birkenes II. The third catchment (Ingabekken) is in a pristine area in mid-Norway where streamwater pH changes from 7.2 at baseflow to 5 at highflow. In this case, aluminum is less than 1 microM. The differences in streamwater chemistry are mirrored in the soil solution composition at the three sites. Major differences also occur in the compositions of exchangeable ions, even though cation exchange capacities are similar. In the pristine area, exchangeable aluminum is low, with the exchange complex being dominated by hydrogen. This contrasts with the impacted sites where exchangeable aluminum is much more abundant, especially at Birkenes I. It is concluded that one of the main changes observed during acidification is the conversion of the soil exchange complex from a hydrogen-dominated form to one where aluminum plays an increasingly important role. Such a transformation is not included in most acidification models and should be the focus of further model development. (Author's abstract)
W91-01895

INTERPRETATION OF METAL CONCENTRATIONS IN ESTUARINE SEDIMENTS OF FLORIDA USING ALUMINUM AS A REFERENCE ELEMENT.
Florida State Dept. of Environmental Regulation, Tallahassee.
For primary bibliographic entry see Field 2L.
W91-01898

ATMOSPHERIC INPUT OF INORGANIC NITROGEN SPECIES TO THE KIEL BIGHT.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
R. Prado-Fiedler.
Helgolaender Meeresuntersuchungen HEMEDC, Vol. 44, No. 1, p 21-30, August 1990. 4 fig, 4 tab, 22 ref. Umweltbundesamt (UBA) grant no. 10204215/4.

Descriptors: *Air pollution, *Chemistry of precipitation, *Kiel Bight, *Nitrogen, *Nitrogen compounds, *Nutrients, *Path of pollutants, *Water pollution sources, Deposition, Phytoplankton, Precipitation.

The atmospheric input of inorganic nitrogen species to the Kiel Bight (south-west Baltic Sea) was measured by collecting marine precipitation samples at Kiel Lighthouse in weekly intervals during a whole year, using wet-only and bulk-sample methods. The temporal patterns of nitrate and ammonium concentrations are highly variable, with less variability during summer. Maximum concentrations were found in winter. The annual precipitation weighted mean concentrations are 124 micromoles/cu dm for nitrate and 172 micromoles/cu dm for ammonium. Nitrite concentrations were low, its contribution to wet deposition being thus negligible (on average only 0.3% of the wet deposition of nitrate plus ammonium). Dry deposition represents approximately one third of the total input of airborne nitrogen species. Wet and dry deposition represents an annual input of around 5000 tons of nitrogen to the Kiel Bight (2571 sq km) which is a significant contribution to the total nitrogen content (5900 tons in winter). Rain does not fall uniformly along a front system and marine rains are usually associated with showers having a typical horizontal cross section of 500 m to 5 dm, the intense episodic input of nitrogen species concentrated in a relatively small area may contribute to the formation of a patch of phytoplankton. Hence, the origin of phytoplankton patchiness may be related to the charateristic pattern of precipitation. (Author's abstract)
W91-01921

URANIUM AND THORIUM IN MUSCLE TISSUE OF FISH TAKEN FROM THE SOUTHERN BALTIC.
Akademia Medyczna, Gdansk (Poland). Dept. of Analytical Chemistry.
P. Szefer, K. Szefer, and J. Falandysz.
Helgolaender Meeresuntersuchungen HEMEDC, Vol. 44, No. 1, p 31-38, August 1990. 1 fig, 4 tab, 43 ref.

Descriptors: *Baltic Sea, *Bioaccumulation, *Biological magnification, *Fish physiology, *Thorium, *Uranium, Cod, Food chains, Herring, Mollusks, Sprat, Tissue analysis.

The determination of uranium (U) and thorium (Th) was carried out on pooled muscle tissue samples of cod (Gadus morhua), herring (Clupea harengus), sprat (Sprattus sprattus) and other species of fish caught in 1981 in the southern Baltic. The mean levels of U in the muscle tissue were 0.30 ng/g for cod (Gadus morhua), 0.29 ng/g for herring (Clupea harengus) and 0.44 ng/g for sprat (Sprattus sprattus) on a wet-weight basis. For Th the concentrations were 0.41 ng/g for cod, 0.38 ng/g for herring, and 0.64 ng/g for herring. For the other species analyzed, the muscle levels of U varied from 0.22-0.42 w.w and of Th from 0.43-1.6 ng/g w.w. Elevated levels of U were also found in whole specimens of stickleback (Gasterosteus aculeatus) (2.6ng/g w.w.). The muscle-levels of U were comparable to the lowest values reported by other authors for Japanese and Black Sea Fish. The ratio of Th/U (by weight) for Gadus morhua, Clupea harengus and Sprattus sprattus was near unity. The average southern Baltic water data for U and Th in fish and other Baltic organisms were used to calculate the concentration factor (CF). The values of CF-U and CF-Th for fish as well as for other representatives of Baltic biocenosis reveal that the soft tissue of mollusks had high concentrations of U and whole specimens of Mesidothea entomon had high concentrations of Th. However, in fish the smallest amounts of the two elements were concentrated. To determine the degree of discrimination of U in respect to Th in Baltic organisms, the discrimination factor DF was estimated and results showed that analyzed organisms exhibit a stronger ability to adsorb and/or take up Th as compared to U. The U and Th transfer along the trophic levels of the food chain was quantitatively estimated by the transfer factor TF. TF values suggested that there is no biomagnification of these elements along the food chain steps leading to fish from their potential diet. (Fleishman-PTT)
W91-01922

NOAA'S STATUS AND TRENDS MUSSEL WATCH PROGRAM: CHLORINATED PESTICIDES AND PCBS IN OYSTERS (CRASSOSTREA VIRGINICA) AND SEDIMENTS FROM THE GULF OF MEXICO.
Texas A and M Univ., College Station. Dept. of Oceanography.
For primary bibliographic entry see Field 5A.
W91-01933

DENITRIFICATION AND NITROUS OXIDE IN THE NORTH SEA.
Plymouth Marine Lab. (England).
C. S. Law, and N. J. P. Owens.
Netherlands Journal of Sea Research NJSRBA, Vol. 25, No. 1/2, p 65-74, May 1990. 7 fig, 1 tab, 26 ref.

Descriptors: *Coastal waters, *Denitrification, *Fate of pollutants, *Nitrogen, *Nitrogen oxides, *North Sea, *Sediment chemistry, German Bight, Nitrates, Nitrification, Norwegian Trench.

In situ sediment denitrification rates were determined in the major areas of deposition of the North Sea, using the acetylene block technique. In addition, nitrous oxide profiles of the water column were determined. Nitrous oxide production generally occurred in the photic zone possibly due to nitrification; and throughout the water column in the German Bight region. Consumption at depth was possibly due to reduction in the anoxic microzones of fecal pellets, concentrated at the thermocline. Saturation of surface waters was 102.2% compared to 130.3% in the German Bight region. Calculated flux of nitrous oxide to the atmosphere was 9.5 times 10 to the 6th power kg per year, over half of which was produced in the German Bight. Sediment denitrification rates varied through three orders of magnitude; the highest value of 150 micromoles per meter squared per day was recorded in the Norwegian Trench. Nitrous oxide production by the sediments was low (1.1 micromoles per meters squared per day max.), and was undetectable at half of the sites. Sediment nutrient profiles exhibited porewater nitrate concentrations exceeding that of the overlying water suggesting that denitrification was fuelled by nitrification, which, in turn was related to other environmental variables. A significant positive relationship existed between in situ denitrification rate and the nitrate content of the upper sediment. Extrapolation of the rate to the total area of deposition in the North Sea suggests that denitrification is responsible for a minimum loss of 7.5-12% of the total annual nitrogen contaminant input. (Author's abstract)
W91-01935

CONCENTRATIONS OF ORGANOCHLORINE COMPOUNDS IN THE HERMIT CRAB PAGURUS BERNHARDUS FROM THE GERMAN BIGHT, DECEMBER 1988 - MAY 1989.
Hamburg Univ. (Germany, F.R.). Inst. fuer Biochemie und Lebensmittelschemie.
R. Knickmeyer, and H. Steinhart.
Netherlands Journal of Sea Research NJSRBA, Vol. 25, No. 3, p 365-376, June 1990. 16 fig, 2 tab, 39 ref.

Descriptors: *Bioaccumulation, *Chlorinated hydrocarbons, *Crabs, *German Bight, *North Sea, *Path of pollutants, DDE, Distribution patterns, Lindane, Polychlorinated biphenyls, Tissue analysis.

The contamination of Pagurus bernhardus with PCB (as the sum of concentrations of 36 individual components) p, p'-DDE, HCB, alpha-HCH and Lindane (gamma-HCH) was determined in samples collected between December 1988 and May 1989 in the German Bight. Consistent values of congener composition were shown to exist in the abdo-

mens when individual congener levels were expressed as percentages of total composition. This value does not appear to be influenced by total concentration, lipid content of the tissue or the sampling position in the German Bight. A comparison of PCB patterns in the hermit crab and zooplankton shows that P. bernhardus accumulated penta-, to decachlorobiphenyls which lack vicinal H atoms in meta-para positions. The body burdens of cyclic organochlorines changed with time, but this change was different for different compounds at the same sampling stations for the same compound. These changes were not correlated to natural seasonal events or changing lipid content of the tissues, but were strongly influenced by their sources. The concentrations of aromatic compounds slightly reflected time integrating characteristics, whereas the alpha/gamma-HCH ratio was useful in identifying sudden changes in the influence of rivers as well as water masses coming from the central North Sea. (Author's abstract)
W91-01941

CHANGE OF WATER QUALITY AND COMPOSITION OF PLANKTON IN THE POND OF RECLAIMED SITE.
Kitakyushu Municipal Inst. of Enviroumental Health Sciences (Japan).
For primary bibliographic entry see Field 5E.
W91-01944

UTILIZATION OF HYDROCARBON SUBSTRATES BY HEAVY OIL-DEGRADING BACTERIA ISOLATED FROM THE SEA WATER OF OIL-POLLUTED BISAN SETO.
Shimonoseki Univ. of Fisheries (Japan). Lab. of Microbiology.
For primary bibliographic entry see Field 5G.
W91-01945

GROUNDWATER TREATMENT WITH ZERO AIR EMISSIONS.
Peroxidation Systems, Inc., Gardena, CA.
For primary bibliographic entry see Field 5G.
W91-01946

ZINC AND COPPER IN FISH FROM NATURAL WATERS AND REARING PONDS IN NORTHERN ITALY.
Bologna Univ. (Italy). Ist. di Biochimica.
L. Carpene, O. Cattani, G. P. Serrazanetti, G. Vedrizzi, and P. Cortesi.
Journal of Fish Biology JFIBA9, Vol. 37, No. 2, p 293-299, August 1990. 1 fig, 7 tab, 20 ref.

Descriptors: *Bioaccumulation, *Copper, *Fish, *Path of pollutants, *Zinc, Absorption, Bass, Goldfish, Heavy metals, Liver, Muscle.

Zinc and copper were detected in several tissues of fresh and saltwater fish. Liver concentrations of heavy metals varied widely, with respect to the storage and detoxication functions of the organ. In muscle tissues the two metals were linked to aerobic metabolism, and were higher in the heart and lower in the white muscle. High levels of zinc were found in the female gonad, while in the brain zinc levels were more constant and possibly regulated better than copper. In sea bass supplemented with artificial diets no correlation was found between the metal content in the diet and that of the tissue. In goldfish attempts to isolate specific metal binding proteins of low molecular weight using gel filtration gave negative results; the metals were mostly bound to ligands excluded from the gel. (Author's abstract)
W91-01958

COMPARATIVE STUDY ON THE TOXICITY, ABSORPTION AND DEPURATION OF FENITROTHION AND ITS OXON IN JAPANESE TIGER SHRIMP.
Kyushu Univ., Fukuoka (Japan). Faculty of Agriculture.
T. Kobayashi, R. M. Rompas, Y. Oshima, and N. Hirada.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 56, No. 6, p 923-928, June 1990. 4 fig, 2 tab, 7 ref.

Descriptors: *Absorption, *Bioaccumulation, *Depuration, *Fenitrothion, *Path of pollutants, *Pesticide toxicity, *Pesticides, *Shrimp, *Toxicity, *Water pollution effects, Degradation, Fenoxon, Juvenile growth stage.

A comparative study was made of the toxicity, absorption and depuration of fenitrothion (dimethyl 3-methyl-4-nitrophenyl phosphorothionate; FS) and its oxon (FO) in Japanese tiger shrimp Penaeus japonicus. It was previously reported that the toxicity of FO to the shrimp was approximately 10-20 times higher than that of FS in the intramuscular administration test, and also that FO showed about 12,000 times higher acetylcholinesterase inhibition compared with FS. In the lethal concentration (LC50) test, however, the toxicity of FO to young and juvenile tiger shrimp was only 1/10-1/50 that of FS, contrary to its toxicity in vivo. The results in the absorption and depuration test of C14-FS and C14-FO for juvenile tiger shrimp juvenile demonstrated that the absorption rate of FS in the shrimp was approximately 40 times that of FO, and that the FS absorbed by the shrimp from surrounding water was rapidly biotransformed to more toxic FO, resulting in the high toxicity of FS to the shrimp compared with FO in the LC50 test. (Author's abstract)
W91-01960

SIMPLE AND RAPID METHOD FOR SCREENING OF HEAVY OIL-DEGRADING BACTERIA FROM MARINE ENVIRONMENT.
Shimonoseki Univ. of Fisheries (Japan). Lab. of Microbiology.
For primary bibliographic entry see Field 5G.
W91-01961

PREDICTION OF MINE DRAINAGE QUALITY IN PENNSYLVANIA.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Div. of Mine Drainage Control and Reclamation.
K. B. C. Brady, and R. J. Hornberger.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 23, No. 5, p 8-15, September/October 1990. 9 fig, 17 ref.

Descriptors: *Acid mine drainage, *Coal mining effects, *Mine wastes, *Pennsylvania, *Water quality, Carbonates, Groundwater pollution, Path of pollutants, Pyrite, Sulfur, Water pollution sources, Weathering.

Numerous factors must be considered to predict post-mining water quality from surface coal mines. Factors considered in Pennsylvania are post-mining water quality on similar or adjacent mine sites, premining water quality, lithologic factors, weathering of overburden, and overburden analysis (a chemical analysis of the rock to be disturbed by mining). Examining of post mining water quality is limited where stratigraphic or chemical changes occur between sites, mining practices such as disposal of high sulfur coal refuse may adversely affect water quality, multiple seam mining has occurred and the observed water quality can not be tied to one particular coal seam or overburden, and hydrologic complications make it difficult to relate water quality to previous mining. Premining water quality can be a useful indicator of overburden chemistry. The presence of predominantly sandstone overburden has been linked to acid mine drainage due to the inability of this lithology to neutralize acid generated by ion exchange. Weathering processes can result in the near surface dissolution of carbonates. Acid-base accounting is the most commonly used method of overburden analysis in Pennsylvania. This technique identifies potentially alkaline and acidic strata by laboratory analysis of rock obtained from drill holes. Neutralization potential and sulfur content of rock should also be tested when evaluating mining strata. Strata with neutralization potentials of <30 tons/1000 tons do not generally contribute significant alkalinity to post mining water quality. Strata with sulfur contents >0.5% and low neutralization potential will generally form acid mine drainage. (Geiger-PTT)
W91-01963

PRESENCE OF POLYCHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS IN FISH-EATING BIRDS AND FISH FROM THE NETHERLANDS.
Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
M. Van den Berg, F. Blank, C. Heeremans, H. Wagenaar, and K. Olie.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 2, p 149-158, March 1987. 3 fig, 8 tab, 37 ref.

Descriptors: *Bioaccumulation, *Dioxins, *Netherlands, *Path of pollutants, *Polychlorinated biphenyls, *Water birds, Animal tissues, Cormorants, Eel, Fish, Food chains, Grebes, Herons, Metabolites, Tissue analysis.

In the period 1980 to 1982, 19 Cormorants (Phalacrocorax carbo), three Grey Herons (Ardea cinerea) and one Great Crested Grebe (Podiceps crisatus) were collected in The Netherlands. The livers of these fish-eating species were analyzed for polychlorinated dibenzo-p-dioxins and dibenzofurans. Only congeners with a 2,3,7,8-chlorine substitution pattern were found in the livers. Major components were 2,3,4,7,8-pentachlorodibenzofuran and 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin. 2,3,7,8-Tetrachlorodibenzo-p-dioxin and 1,2,3,7,8-pentachlorodibenzo-p-dioxin were also present. Six pooled samples of the Eel Anguilla anguilla, showed the same congeneric pattern of chemicals as found in these bird species. In the Eel, 2,3,4,7,8-pentachlorodibenzofuran and 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin were generally present in the 1 to 5 ng/kg range. Since the Eel is the Cormorant's major food, this indicates strong bioaccumulation for both congeners in the liver of the Cormorant. Significant correlations were found between the various congeners retained in the liver of the Cormorant. It is proposed that this is a result of continuous exposure to a relatively stable background mixture, probably originating from fish consumption. Based on the congeneric patterns found in the Cormorant, polychlorinated biphenyls and pentachlorophenol are suggested as major contaminating sources for this species. Using results from the Cormorants, an open one compartment model was applied to estimate concentrations of 2,3,4,7,8-pentachlorodibenzofuran in the Eel. These calculations were in good agreement with the actual measurements found in the Eels. (Author's abstract)
W91-01966

EFFECTS OF SAMPLE PREPARATION ON MEASURED CONCENTRATIONS OF EIGHT ELEMENTS IN EDIBLE TISSUES OF FISH FROM STREAMS CONTAMINATED BY LEAD MINING.
National Fisheries Contaminant Research Center, Columbus, OH. Field Research Station.
For primary bibliographic entry see Field 5A.
W91-01968

HEAVY METAL ACCUMULATIONS AND THEIR RECENT CHANGES IN SOUTHERN MINKE WHALES BALAENOPTERA ACUTOROSTRATA.
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
K. Honda, Y. Yamamoto, H. Kato, and R. Tatsukawa.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 2, p 209-216, March 1987. 8 fig, 2 tab, 39 ref. Ministry of Education, Science and Culture of Japan Project 58030020, 59030053 and 60030060.

Descriptors: *Antarctic, *Bioaccumulation, *Heavy metals, *Marine pollution, *Minke whales, *Path of pollutants, *Water pollution effects, *Whales, Atomic absorption spectrophotometry, Cadmium, Distribution patterns, Food chains, Iron, Lead, Mercury, Seals.

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The concentrations of heavy metals in the livers of southern minke whales, B. acutorostrata, were determined by atomic absorption spectrophotometry, and their accumulation levels and variations were compared to food habit, and biological parameters. The concentration levels and bioconcentration factors of metals in the minke whale were relatively high for iron (Fe) and cadmium (Cd) and low for mercury (Hg), when compared to seals and small-toothed cetaceans from different waters. For most of the metals examined, the concentrations were log-normally distributed. The concentrations of Fe, Cd, and Hg were positively correlated with age, but a correlation was not observed for the other metals. While the hepatic Fe concentration linearly increased with age, the concentrations of Cd and Hg increased up to the age of about 20 years and thereafter decreased year by year. Such unusual age trends of Cd and Hg are considered to be due to recent changes in the amount of food intake by the minke whale, as a result of structural disturbances in the Antarctic marine ecosystem due to commercial whaling. Also, the hepatic concentrations of metals varied between sexes, and with reproductive status of the matured female; the concentration of Fe was lower in females than males, and Fe, Pb, Ni, and Co concentrations in matured females decreased with progress of gestation. (Author's abstract)
W91-01969

MUTAGENIC ACTIVITY OF SURFACE WATERS ADJACENT TO A NUCLEAR FUEL PROCESSING FACILITY.
Georgia Univ., Athens. Dept. of Food Science and Technology.
For primary bibliographic entry see Field 5C.
W91-01972

DRILLING FLUIDS AND THE ARCTIC TUNDRA OF ALASKA: ASSESSING CONTAMINATION OF WETLANDS HABITAT AND THE TOXICITY TO AQUATIC INVERTEBRATES AND FISH.
National Fisheries Contaminant Research Center, Jackson, WY. Jackson Field Station.
D. F. Woodward, E. Snyder-Conn, R. G. Riley, and T. R. Garland.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 5, p 683-697, September 1988. 2 fig, 9 tab, 40 ref. US Dept. of Energy and Battelle Pacific Northwest Laboratory Agreement DW89930699.

Descriptors: *Alaska, *Drilling fluids, *Fish, *Invertebrates, *Oil pollution, *Path of pollutants, *Toxicity, *Tundra, *Wastewater pollution, *Water pollution effects, *Wetlands, Aquatic habitats, Arctic, Bioassay, Chemical analysis, Daphnia, Hydrocarbons, Population exposure, Sediment analysis.

Drilling for oil on the North Slope of Alaska results in the release of large volumes of used drilling fluids into arctic wetlands. These releases, usually come from regulated discharges or seepage from reserve pits constructed to hold used drilling fluids. A study of five drill sites and their reserve pits showed an increase in common and trace elements and organic hydrocarbons in ponds near to and distant from reserve pits. Ions elevated in water were barium, chlorine, chromium, potassium, sulfate, and zinc. Concentrations of copper, chromium, iron, lead and silicon in sediments were higher in near and distant ponds than in control ponds. The predominant organics in drill site waters and sediments consisted of aromatic and paraffinic hydrocarbons characteristic of petroleum or a refined product of petroleum. In 96-hour exposures in the field, toxicity to Daphnia Middendorffiana was observed in water from all reserve pits, and from two of five near ponds, but not from distant ponds. In laboratory tests with Daphnia magna, growth and reproduction were reduced in dilutions of 2.5% drilling fluid (2.5 drilling fluid: 97.5 dilution water) from one reserve pit, and 25% drilling fluid from a second. Growth and reproduction were not affected at these dilutions of fluid from the other three reserve pits. Additional regulations--such as an upper limit on aromatic hydrocarbon content and toxicity to sensitive organisms--are needed to improve safety for aquatic organisms in habitats receiving used drilling fluids. (Author's abstract)
W91-01975

INFLUENCE OF TEMPERATURE AND ORGANIC AMENDMENTS ON THE MOBILIZATION OF SELENIUM IN SEDIMENTS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. J. Calderone, W. T. Frankenberger, D. R. Parker, and U. Karlson.
Soil Biology & Biochemistry SBIOAH, Vol. 22, No. 5, p 615-620, 1990. 6 fig, 3 tab, 25 ref.

Descriptors: *Kesterson Reservoir, *Leaching, *Path of pollutants, *Reservoir sediments, *Sediment contamination, *Selenium, California, Detoxification, Heavy metals, Kinetics, Manure, Proteins, Sediment analysis, Temperature effects, Volatility.

Toxic amounts of selenium have been found in sediments and water at Kesterson Reservoir (Merced County, CA). A sediment column study was established for determination of Se volatilization potential and k Se volatilization rate coefficient derived from a first-order kinetics model. Increasing the temperature from 15 to 35 C promoted volatilization of Se. The amount of Se leached out of the sediments was independent of the initial total Se inventory. Volatilization of Se followed a first-order reaction and was highly dependent on initial Se concentration. The Se volatilization potential ranged from 0.18 to 3.63 mg Se/kg sediment with rate coefficents values ranging from 0.003 to 0.053/day. The addition of organic amendments promoted volatilization, with Se being less available for leaching. The application of gluten, a wheat storage protein, enhanced volatilization of Se (1.7 to 3.2-fold over the control) more strongly than other treatments (e.g. casein, orange peel and cattle manure). Volatilization may be an important dissipation mechanism for detoxification of seleniferous sediments. (Author's abstract)
W91-01990

TRANSPORT OF HEAVY METALS WITHIN A SMALL URBAN CATCHMENT.
Middlesex Polytechnic, Enfield (England). Urban Pollution Research Center.
D. M. Revitt, R. S. Hamilton, and R. S. Warren.
The Science of the Total Environment STENDL, Vol. 93, p 359-373, April 1990. 2 fig, 8 tab, 17 ref.

Descriptors: *Cadmium, *Copper, *Heavy metals, *Lead, *Model studies, *Path of pollutants, *Urban drainage, *Urban runoff, *Zinc, Air pollution, Deposition, Hydrologic models, Hydrology, Runoff, Storm runoff.

A small urban catchment has been monitored for levels of lead, zinc, cadmium and copper in the atmosphere, deposition, surface dust and stormwater runoff. The contribution of local emissions to total deposition was considered and found to be significant only for zinc. In rainfall, the metals are mainly associated with particulates. Wet deposition is more important than dry deposition for lead and zinc, but the processes are comparable for cadmium and copper. The percentage of the dissolved metal level in rainfall (which was observed in the storm runoff) varied from 92% for copper to 13% for lead. The mass of metal removed in runoff is the combined metal input by wet and dry deposition to the road and roof surface less that mass of metal which is: (1) adsorbed onto surface sediments; (2) retained by the gully pots; (3) retained in the roof guttering; (4) deposited in the underground drainage system; (5) lost through resuspension and dispersion; and (6) removed by street sweeping. The hydrologic characteristics of each storm event need to be accommodated for any predictive model of this type to be valuable. Even then, the result will be dependent on specific site characteristics. (Stoehr-PTT)
W91-01992

SUBSTANCE LOAD IN RAINWATER RUNOFF FROM DIFFERENT STREETS IN HAMBURG.
Hamburg Univ. (Germany, F.R.). Inst. fuer Anorganische und Angewandte Chemie.
W. Dannecker, M. Au, and H. Stechmann.
The Science of the Total Environment STENDL, Vol. 93, p 385-392, April 1990. 4 tab, 3 ref.

Descriptors: *Germany, *Hamburg, *Path of pollutants, *Storm runoff, *Urban runoff, *Water pollution sources, Antimony, Arsenic, Cadmium, Chromium, Copper, Heavy metals, Highway effects, Pollutant identification, Runoff, Surface runoff, Vanadium, Zinc.

Twenty-five substances were evaluated in runoff, and wet and bulk deposition samples from different sampling sites in Hamburg, Germany: (1) a street in an industrial area; (2) a thoroughfare; and (3) a small street in a residential area. The runoff from the industrial road and the main street showed similar levels of pollution. The surface water from the industrial area contained higher concentrations of arsenic, while the main street showed higher concentrations of lead, antimony and zinc. The runoff from the residential area was loaded substantially lower. Several elements, copper, chromium, and vanadium were found to be almost completely adsorbed to particles, but several more toxic elements, cadmium and copper, were found at a higher percentage in the soluble phase. (Author's abstract)
W91-01993

POLLUTION OF STREET RUN-OFF BY TRAFFIC AND LOCAL CONDITIONS.
Umweltbundesamt, Berlin (Germany, F.R.).
W. Muschack.
The Science of the Total Environment STENDL, Vol. 93, p 419-431, April 1990. 6 tab, 12 ref.

Descriptors: *Highway effects, *Pollutant identification, *Urban runoff, *Water pollution sources, Chromium, Copper, Drinking water, Heavy metals, Hydrocarbons, Lead, Nickel, Path of pollutants, Precipitation, Rainwater, Runoff, Zinc.

Investigations were performed in the Federal Republic of Germany to determine pollutant concentrations in rainwater in order to obtain a comprehensive picture of the pollution caused by precipitation runoff. Influencing parameters included: exhaust gases, tire abrasion particles, brake lining abrasion dust, leakage of hydrocarbons, and winter street cleaning activities. The analysis of these factors was complemented by the determination of detection limits. After an assessment of all possibilities, 30 substances remained, and 22 were analyzed. Lead, chromium, copper, nickel, and zinc are the elements commonly found in the emissions/particles of the aforementioned parameters. (Stoehr-PTT)
W91-01994

HEAVY METAL ACCUMULATION AND TRANSPORT THROUGH DETENTION PONDS RECEIVING HIGHWAY RUNOFF.
University of Central Florida, Orlando. Dept. of Civil Engineering and Environmental Sciences.
Y. A. Yousef, T. Hvitved-Jacobsen, H. H. Harper, and L. Y. Lin.
The Science of the Total Environment STENDL, Vol. 93, p 433-440, April 1990. 2 fig, 3 tab, 10 ref.

Descriptors: *Heavy metals, *Highway effects, *Path of pollutants, *Settling basins, *Urban runoff, *Water pollution sources, Chemical analysis, Copper, Lead, Municipal wastewater, Nickel, Rainfall, Runoff, Sediments, Zinc.

Heavy metals in highway runoff entering detention and retention ponds are removed, and accumulate in the bottom sediments of these ponds. Removal efficiency is controlled by: particulate metal fraction; detention time in the pond; and physical, chemical and biological interactions. Ponds tested have been in operation for five to fifteen years. Sediment accumulation rates vary between 1 cm/yr to 4 cm/yr. Metal concentrations throughout the sediment show a rapid decline following an exponential decay; the majority of the metals are attenuated in the top 10 to 20 centimeters. This

relatively high concentration of metals in the top layer suggests that the majority of particulate metals may settle out quickly upon entering the pond. Also the metal content in the sediment is generally lower than required standards of metals in municipal wastewater sludges recommended for agricultural use (< 900 microgm of copper, 1000 microgm of lead, 100 microgm of nickel, and 1800 microgm zinc per gram dry weight sediments). The potential release of heavy metals from bottom sediments under pH values of 7.5 to 8.5, by changing the redox potential from strongly oxidized to strongly reduced conditions, is insignificant. But, lowering the pH to 5 may enhance the release of metals. Generally, the amount of metal released is a small proportion of the metal content in the sediments. Based on the United States Environmental Protection Agency Toxicity Characteristics Leaching Procedures (TCLP) tests, disposal of bottom sediments in sanitary landfills may be feasible. Additional research studies are in progress to confirm these conditions. (Stoehr-PTT)
W91-01995

OLLUTANTS ATTACHED TO PARTICLES ROM DRAINAGE AREAS.
arlsruhe Univ. (Germany, F.R.). Inst. fuer Siedngswasserwirtschaft.
. Xanthopoulos, and H. H. Hahn.
he Science of the Total Environment STENDL, ol. 93, p 441-448, April 1990. 1 fig, 3 tab, 8 ref.

escriptors: *Drainage area, *Heavy metals, *Parle size, *Path of pollutants, *Urban runoff, Water pollution sources, Drainage systems, Pollant load, Runoff, Storm runoff, Surface runoff, rban areas, Water pollution.

oxic substances, such as heavy metals or organic iority pollutants, are of particular interest to the llution of natural waters from urban areas. Preinary investigations at four different stations thin the Karlsruhe, Germany, drainage area indie that these substances may exist at high conntration levels. In particular, autumn falling ves cause solid concentrations of 1000-2000 mg pended solids/L. Observed metal concentrans (Pb, Zn, Cu, Cd) in Karlsruhe are at the top l of the spectrum reported so far. The dissolved l the particle-bound phases were examined sepaely after separation using a centrifuge. The low ncentrations in one fraction show that the exam- organic micropollutants (e.g. polycyclic aroic hydrocarbons, PAC) are predominantly ed to solids. The PAC (fluoranthene, benzoranthene, indeno-pyrene, benz-a-pyrene, and z-periylene) contents of the whole sample eed drinking water standards by a factor of 10. e PAC contents of the particles separated by trifuge correspond to the top end of concentras observed in sewage sludge. The polychlori- biphenyl (PCB) load of the total sample c. as clophen A60) is approximately 150 ng/L, does not exceed drinking water standards both individual substances and in total. Examination he pollutants among the various size fractions particulates confirmed that the fine fractions 8-0.2 mm) carry significantly higher loads. The se fraction (> 1 mm) is transported as bed in the sewer system. It is important for the ration of the drainage system, but plays only a or role in the transport of pollutants. The nd fraction (0.2-1 mm) is transported near the om of the sewer, and in times of low disges may sediment out. Since the pollutant load hese two fractions is small they have little ence on the transported amount of pollutants. third fraction (0.08-0.2 mm) is transported in ended form, and depending on the current conditions, occurs in either heterogeneous or ogeneous concentration profiles. The finer s (< 0.08 mm) move more simultaneously the stormwater runoff and are distributed ogeneously. The two latter fractions are most ive in explaining the transport of pollutants in atchment and drainage system. (Stoehr-PTT)
-01996

TRIBUTION OF HYDROCARBON CONTRATIONS FROM URBAN RUNOFF.
ersidad Politecnica de Madrid (Spain). Escuela Tecnica Superior de Ingenieros de Caminos.
M. T. Bomboi, A. Hernandez, F. Marino, and E. Hontoria.
The Science of the Total Environment STENDL, Vol. 93, p 465-480, April 1990. 9 fig, 5 ref.

Descriptors: *Aliphatic hydrocarbons, *Hydrocarbons, *Path of pollutants, *Statistical analysis, *Urban runoff, *Water pollution sources, Frequency distribution, Madrid, Regression analysis, Runoff, Spain, Water sampling.

Hydrocarbon runoff data from Madrid, Spain, have been analyzed in order to determine the effect of time, area characteristics and water flow on the runoff concentration frequency distribution. In this study, aliphatic and aromatic hydrocarbon concentrations obtained from runoff sampling from different areas of Madrid at different times of the year were used. The cumulative frequency distributions of a number of the hydrocarbons are characterized as modal log-normal distributions. This statistical study indicates a linear expression which relates aliphatic hydrocarbons from natural anthropogenic origins, with aromatic hydrocarbons from anthropogenic origins. Basically, those found in this urban runoff have noxious and harmful effects on human health and the environment. Upon consideration (of the concentrations of hydrocarbons from the areas of Madrid with different characteristics, distinct traffic levels, and the varying seasons) this linear expression is very useful for determining these compounds whenever qualities of the city are the same. (Stoehr-PTT)
W91-01998

INFLUENCE OF COMPLEXING AGENTS AND SURFACTANTS ON METAL SPECIATION ANALYSIS IN ROAD RUNOFF.
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5A.
W91-01999

APPLICATION OF MULTIVARIATE ANALYSIS FOR CHARACTERIZATION OF ORGANIC COMPOUNDS FROM URBAN RUNOFF.
Universidad Politecnica de Madrid (Spain). Escuela Tecnica Superior de Ingenieros de Caminos.
For primary bibliographic entry see Field 5A.
W91-02004

IRON AND MANGANESE GEOCHEMISTRY AND THE DISTRIBUTION OF 239, 240 PU AND 241 AM IN THE SEDIMENTS OF THE NORTH EAST IRISH SEA.
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Directorate of Fisheries Research.
S. J. Malcolm, P. J. Kershaw, N. J. Cromar, and L. Botham.
The Science of the Total Environment STENDL, Vol. 95, p 69-87, June 1990. 5 fig, 4 tab, 42 ref.

Descriptors: *Americium, *Geochemistry, *Heavy metals, *Irish Sea, *Iron, *Manganese, *Path of pollutants, *Plutonium, *Radioactive wastes, *Sediment contamination, *Sediment discharge, *Sediment distribution, Leaching, Nuclear powerplants, Sediment-water interfaces, Trace elements.

The geochemical cycling of iron and manganese within the seabed sediments of the northeast Irish Sea has been investigated in an attempt to learn more about the factors controlling the distribution and behavior of plutonium and americium released from the BNF plc nuclear fuel reprocessing plant at Sellafield, England. Enrichment of surface sediment with both iron and manganese results from active diagenetic redox behavior which produces characteristic interstitial water concentration profiles at particular sites. The shape of the interstitial water profiles is controlled by differences in the general bioturbation regimes at each site. This factor has been simulated in simple laboratory tank experiments. Evidence from selective chemical leaching suggests that 40 percent of the plutonium and 80 percent of the americium are associated with the operationally defined iron/manganese oxide phase. However, in the surface sediment there is no apparent correlation between either iron or manganese content and either the plutonium or americium concentrations determined by strong acid digestion of the samples. Fluxes of iron and manganese upward in sediment are similar to those measured at other nearshore sites and indicate a potential for oxide scavenging of trace elements at the sediment/water interface. The behavior of plutonium and americium has probably been dominated by general nonequilibrium conditions resulting from: the recent introduction of the plutonium and americium into the environment, the dominating effects of dispersion from the pipeline source, and the variation with time of the quantities discharged. (Author's abstract)
W91-02006

MASS-BALANCE OF METALS AND IDENTIFICATION OF THEIR SOURCES IN BOTH RIVER AND FALLOUT FLUXES NEAR GDANSK BAY, BALTIC SEA.
Akademia Medyczna, Gdansk (Poland). Dept. of Analytical Chemistry.
P. Szefer.
The Science of the Total Environment STENDL, Vol. 95, p 131-139, June 1990. 2 tab, 28 ref.

Descriptors: *Estuaries, *Fallout, *Heavy metals, *Metals, *Path of pollutants, *Poland, *Rivers, Baltic Sea, Cadmium, Chemical analysis, Cobalt, Copper, Geomorphology, Lead, Manganese, Nickel, Particulate matter, Rainfall, Thorium, Uranium, Water pollution, Zinc.

Metals concentration data are utilized to estimate the total observed metal fluxes in estuarine water of the Vistula River and rain fallout near the coastal zone of Gdansk Bay. The flux ratio (FR) between the observed flux (F) and the theoretical flux (F sub t), as well as the enrichment factor (EF), were calculated for each metal in order to evaluate its origin in estuarine river water and rain fallout. The F sub t value was derived from the mean metal content in the earth's crust and the total quantity of weathered land material. Iron was used as the normalizing element because of the lack of aluminum data. The FR and F values were balanced, and are similar to the EF values for less-mobilized trace metals such as copper and thorium in the Vistula flux and thorium, uranium, manganese and nickel in rain fallout. For these metals no enrichment relative to iron is observed in particulate matter. Additional fluxes in both the river and atmospheric components were found for cadmium, lead, zinc, and copper. This may be due to the influence of natural sources or artificial sources such as pollution. Literature data indicate insignificant contributions of lead, cadmium, zinc and copper from these natural sources, hence it may be concluded that the four metals were of anthropogenic origin. (Author's abstract)
W91-02007

DISTRIBUTION OF ZINC, LEAD, CADMIUM AND COPPER BETWEEN DIFFERENT SIZE FRACTIONS OF SEDIMENTS I. THE LIMSKI KANAL (NORTH ADRIATIC SEA).
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
D. Martincic, Z. Kwokal, and M. Branica.
The Science of the Total Environment STENDL, Vol. 95, p 201-215, June 1990. 4 fig, 4 tab, 34 ref.

Descriptors: *Adriatic Sea, *Cadmium, *Geochemistry, *Heavy metals, *Lead, *Path of pollutants, *Sediment contamination, *Sediments, *Zinc, Carbonates, Clays, Correlation analysis, Organic matter, Particle size, Sediment distribution, Silt, Trace elements.

The grain size distribution of particles and their accumulation in surface sediments of the upper part of Limski Kanal were determined. At all sampling stations, the size fractions containing particles less than 20 micrometers (clay-silt fraction) were predominant, whereas the amount of coarser grains was less than 30%. The quantities of associated metals within these size fractions differed from one sampling station to another. In all sediments, the finest clay-silt fraction (less than 10

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micro meters) contained the high concentration of all metals. The pattern of association of metals with coarser fraction changed substantially between sediments, depending on their chemical characteristics. Generally, they contained amounts of incorporated metals similar to, or even higher than, those found in the clay-silt fraction. These observations are primarily attributed to the quantities of organic and biogenic carbonate. Metal distributions are significantly correlated with the organic material in the sediments. No general trends were observed in the spatial distribution of metals in the sediment less than 300 micro meters from the area studied. The temporal metal variations at some sampling sites coincided with temporal variations in the organic material contents. (See also W91-02010) (Stoehr-PTT)
W91-02009

DISTRIBUTION OF ZINC, LEAD, CADMIUM AND COPPER BETWEEN DIFFERENT SIZE FRACTIONS OF SEDIMENTS II. THE KRKA RIVER ESTUARY AND THE KORNATI ISLANDS (CENTRAL ADRIATIC SEA).
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
D. Martincic, Z. Kwokal, and M. Branica.
The Science of the Total Environment STENDL, Vol. 95, p 217-225, June 1990. 2 fig, 1 tab, 5 ref.

Descriptors: *Adriatic Sea, *Estuaries, *Geochemistry, *Heavy metals, *Path of pollutants, *Rivers, *Sediment contamination, *Sediment distribution, *Sediments, Cadmium, Clays, Copper, Industrial wastes, Lead, Particle size, Silt, Trace elements, Zinc.

The levels of zinc, cadmium, lead and copper in different grain size fractions of recent sediments, collected from the Krka River Estuary and the Kornati Islands during October 1983, were determined. The distributional patterns of these metals mainly depended on the textural characteristics of the sediment. The clay-silt size particles contained the highest amounts of zinc, cadmium and lead. Copper exhibited an irregular particle size distribution. In general, the contents of copper in different grain-size fractions and their distribution throughout the area seemed to be influenced by biological activities. In the coastal region, the concentrations of cadmium in the coarse particles appeared to coincide with the quantities of carbonate present in the sediments. A significant enrichment of lead was observed in the lower part of the Krka River Estuary and in coastal regions with intensive ship traffic. Sediment collected near an industrial waste outflow was found to be enriched with zinc, lead and copper of anthropogenic origin. (See also W91-02009) (Author's abstract)
W91-02010

PHTHALATE ESTERS IN RIVERS OF THE GREATER MANCHESTER AREA, U. K.
Obafemi Awolowo Univ., Ile-Ife (Nigeria). Dept. of Chemistry.
O. S. Fatoki, and F. Vernon.
The Science of the Total Environment STENDL, Vol. 95, p 227-232, June 1990. 1 fig, 1 tab, 17 ref.

Descriptors: *Effluents, *England, *Esters, *Industrial wastes, *Phthalate esters, *Rivers, *Water pollution sources, Chemical analysis, Gas chromatography, Mass spectrometry, Pollutants, Sewage, Wastewater, Water pollution.

Waters from the Rivers Irwell and Etherow and from the Prestwich sewage treatment plant effluent, Manchester, England were analyzed for the presence of phthalate esters using computer-assisted gas chromatography and mass spectrometry (GC and MS). Extraction was with CHCl3. Liquid chromatography clean up was used for compound separation. Several phthalate esters, such as diethyl, butyl-2-monopropyl, di-n-butyl, di-2-ethylhexyl and di-iso-octyl, were found to be present at 0.4 to 33.5 micro grams per liter. A study on uncontaminated waters was undertaken to establish blank levels. The results compare favorably with those reported elsewhere for rivers polluted with industrial chemicals. The occurrence of phthalate esters in Manchester rivers is consistent with the industrial activities of the city. Other probable sources include leaching from disposed plastic wastes. Levels of phthalate esters in the city sewage effluent were considerably lower than those in the Irwell. (Author's abstract)
W91-02011

PENTACHLOROPHENOL: ENVIRONMENTAL PARTITIONING AND HUMAN EXPOSURE.
Oak Ridge National Lab., TN. Office of Risk Analysis.
H. A. Hattemer-Frey, and C. C. Travis.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 4, p 482-489, July/August 1989. 7 tab, 56 ref.

Descriptors: *Bioaccumulation, *Biocides, *Food chains, *Human health, *Human population, *Mathematical models, *Path of pollutants, *Pentachlorophenol, *Public health, *Toxicity, Aquatic life, Equilibrium, Fugacity-food chain model, Soil contamination, Suspended sediments, Water pollution.

Pentachlorophenol (PCP) is used as a wood preservative and a biocide, and is toxic to humans. The Fugacity-Food Chain model estimates the concentration of a chemical in six media (air, water, soil, sediment, suspended sediment in water, and biota in water) and then uses those concentrations to predict the amount of chemical entering the food chain and the average daily intake by the general population. The model contains simplifying assumptions, but given the state of knowledge regarding the environmental transport of chemicals, fugacity models are considered acceptable for exploring the equilibrium partitioning and environmental behavior of organic chemicals. Input parameters required to predict the cross-media partitioning of a chemical include its physicochemical and biochemical properties, bioconcentration/biotransfer factors, estimates of emission rates for the compound into air, water, and soil; and estimates of degradation rate coefficients for reactions that remove the compound from the system. Environmental concentrations of PCP were used to estimate the amount of PCP entering the food chain and the long term, average daily intake of PCP by the general population of the United States. Results show that PCP partitions mainly into soil (96.5%) and that the food chain, especially fruits, vegetables, and grains, accounts for 99.9% of human exposure to PCP. The long term, average daily intake of PCP is estimated to be 16 microg/day, which agrees well with previous estimates of 19 microg per day. (Brunone-PTT)
W91-02016

ACUTE TOXICITY OF SELECTED HERBICIDES AND SURFACTANTS TO LARVAE OF THE MIDGE CHIRONOMUS RIPARIUS.
National Fisheries Contaminant Research Center, Yankton, SD. Field Research Station.
For primary bibliographic entry see Field 5C.
W91-02017

RAPID DISSIPATION OF GLYPHOSATE IN SMALL FOREST PONDS.
Alberta Univ., Edmonton. Dept. of Botany.
L. G. Goldsborough, and A. E. Beck.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 4, p 537-544, July/August 1989. 3 fig, 6 tab, 27 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Glyphosate, *Herbicides, *Path of pollutants, *Ponds, *Toxicity, Metabolites, Sediment contamination, Water chemistry, Water pollution.

Glyphosate, a broad spectrum herbicide, was applied to the water surface of four small boreal forest ponds and six in situ microcosms at a rate of 0.89 kg a.i./ha. Water samples collected over a period of up to 255 days were analyzed for glyphosate and its primary metabolite aminomethylphosphonic acid (AMPA). Glyphosate dissipated rapidly from all ponds, with first order half-lives ranging from 1.5 to 3.5 days. The slowest dissipation rate occurred in the pond with the most calcareous water and sediments. Glyphosate remained at or above the treatment concentration in microcosms containing only water but decreased rapidly in the presence of sediments. AMPA levels in ponds and microcosms were consistently low. Concentrations on microcosm wall samples were temporally variable, probably as a result of adsorption to periphytic biofilms. Glyphosate in the sediments of treated microcosms generally increased with time during the period of observation. These results confirm that glyphosate dissipates rapidly from the surface waters of lentic systems, and suggest that sediment absorption or biodegradation were the major means of glyphosate loss from the water column. These results suggest that effects of glyphosate contamination in water will be minimal, although further work is needed to evaluate possible long term toxicological effects. (Author's abstract)
W91-02018

EFFECTS OF CADMIUM ON MUREX TRUNCULUS FROM THE ADRIATIC SEA: I. ACCUMULATION OF METAL AND BINDING TO A METALLOTHIONEIN-LIKE PROTEIN.
Innsbruck Univ. (Austria). Inst. fuer Zoologie.
R. Dallinger, E. Carpene, G. J. Dalla Via, and P. Cortesi.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 4, p 554-561, July/August 1989. 4 fig, 3 tab, 35 ref. Fonds zar Foerderung der Wessenschaftlichen Forschung, Austria, Project No. P5962.

Descriptors: *Adriatic Sea, *Bioaccumulation, *Cadmium, *Heavy metals, *Metallothioneins, *Mollusks, *Toxicity, *Toxicology, *Water pollution effects, Amino acids, Gel chromatography, Ion exchange chromatography, Molecular structure, Snails, Tissue analysis, Zinc.

Individuals of Murex trunculus from the Adriatic Sea were exposed in the laboratory to cadmium under chronic conditions (0.05 mg/L, up to 30 days). Cadmium contents in the soft parts of the snails increased considerably, the highest concentrations occurring in combined hepatopancreas and kidney tissues. However, high amounts of cadmium were also found in unexposed individuals. No significant changes were observed in the concentrations of zinc. Cytosolic fractions of hepatopancreas and kidney organs were separated by gel and ion exchange chromatography. Variable amounts of cadmium were associated with components with a molecular weight of more than 75000 Daltons. Most of the metal, however, was bound to a protein with an apparent molecular weight of 11000 Daltons. This protein showed low absorption at 280 and a higher one at 254 nm. Amino acid composition revealed high amounts of cysteine (26%), lack of tyrosine, but presence of phenylalanine (4%). On the basis of these features, the protein was identified as a metallothionein-like protein. With increased exposure time, cadmium replaced zinc from this protein with zinc moving towards fractions with a molecular weight of less than 3000 Daltons. Moreover, a spillover effect was observed: the cadmium content of the metallothionein-like protein increased up to a saturation point beyond which excess cadmium was bound to high molecular weight components. (See also W91-02021) (Author's abstract)
W91-02020

UPTAKE AND ELIMINATION OF WATERBORNE CADMIUM BY THE FISH NOEMACHEILUS BARBATULUS L. (STONE LOACH).
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 5C.
W91-02023

SHELL AS A SITE OF LEAD DEPOSITION IN HELIX ASPERSA.
Polytechnic of the South Bank, London (England). Dept. of Biotechnology.
A. Beeby, and L. Richmond.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 4, p 623-628, July/August 1989. 3 fig, 2 tab, 25 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Lead, *Mollusks, *Path of pollutants, *Toxicity, Calcium, Magnesium, Metabolism, Shells, Snails.

Snails from a contaminated urban car park were fed an experimental diet for 64 days. One group received a high lead diet for the duration, and another group was removed from the high lead diet after two days. Shells were analyzed at various intervals to measure lead uptake and loss. Regression analysis of twenty eight shells for each treatment suggests that the weight of lead in the shell increased linearly with time, but loss from the shell was correlated with soft tissue lead levels. The shells of fourteen snails from an uncontaminated site accumulated lead less quickly on the high lead diet and had lower magnesium and calcium concentrations. All snails lost magnesium from the shell following the initial dose, possibly as part of the detoxification mechanism for heavy metals. The shell may lose lead over a number of days, serving as a short term sink for lead which it releases when soft tissue concentrations fall. (Author's abstract)
W91-02025

TOXICITY AND BIOACCUMULATION OF SELENATE, SELENITE AND SELENO-L-METHIONINE IN THE CYANOBACTERIUM ANABAENA FLOS-AQUAE.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5C.
W91-02028

BIOACCUMULATION OF SELENIUM IN BIRDS AT KESTERSON RESERVOIR, CALIFORNIA.
Patuxent Wildlife Research Center, Davis, CA. Pacific Coast Field Station.
For primary bibliographic entry see Field 5C.
W91-02029

GEOGRAPHIC VARIATION OF CHLORINATED HYDROCARBONS IN BURBOT (LOTA LOTA) FROM REMOTE LAKES AND RIVERS IN CANADA.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Central and Arctic Region.
C. G. Muir, C. A. Ford, N. P. Grift, D. A. Metner, and W. L. Lockhart.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 530-542, July/August 1990. 6 fig, 6 tab, 42 ref.

Descriptors: *Bioaccumulation, *Canada, *Chlorinated aromatic compounds, *Fish, *Halogenated pesticides, *Hydrocarbons, *Lakes, *Path of pollutants, *Pesticides, *Polychlorinated biphenyls, Ecosystems, Fate of pollutants, Rivers, Water chemistry, Water pollution.

The variation in levels of polychlorinated biphenyls (PCBs), chlorobenzenes and chlorinated pesticides was studied in burbot (Lota lota) from eight remote locations along a northwesterly transect from northwestern Ontario to the Mackenzie River area in Canada. Significant declines in concentrations of PCB congeners, DDT isomers, lindane, dieldrin, and mirex in burbot liver were found with increasing north latitude. Mean PCB concentrations ranged from 1290 ng/g (lipid wt) at Lake Opeongo, a remote lake in northwestern Ontario, to 301 ng/g in samples from the Mackenzie River at Arctic Red River, Northwest Territories. No significant differences in mean concentrations of toxaphene, alpha-HCH(BHC), trichlorobiphenyls, and tetrachlorobiphenyls were observed between southern and northern sampling sites. Toxaphene was the predominant organochlorine residue in northern fish samples averaging 1400 ng/g (lipid wt) at the three most northerly sites and 1723 ng/g at Lake 625. Airborne contamination was the only major source of organochlorines for most of the locations surveyed. The results were consistent with the hypothesis that inputs of semi-volatile organochlorines to northern aquatic ecosystems increase with increasing north latitude and distance from North American sources. (Author's abstract)
W91-02033

EFFECTS OF XAD-8 FRACTIONS OF DISSOLVED ORGANIC CARBON ON THE SORPTION AND BIOAVAILABILITY OF ORGANIC MICROPOLLUTANTS.
Joensuu Univ. (Finland). Dept. of Biology.
J. Kukkonen, J. F. McCarthy, and A. Oikari.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 551-557, July/August 1990. 3 fig, 3 tab, 23 ref. US DOE Contract DE-AC05-84OR21400.

Descriptors: *Adsorption, *Bioavailability, *Chromatography, *Organic carbon, *Path of pollutants, *Polycyclic aromatic hydrocarbons, *Water pollution, Bioaccumulation, Daphnia, Fate of pollutants, Ion exchange, Polychlorinated biphenyls, Waterfleas.

The dissolved organic carbon (DOC) from a stream water near a peat deposit was fractionated into hydrophobic-acid (HbA), hydrophobic-neutral (HbN) and hydrophilic (Hl) subcomponents by XAD-8 chromatography. The capacity of these fractions and the total (unfractionated) water to bind hydrophobic organic contaminants was measured by equilibrium dialysis, and the effect of binding on contaminant bioavailability was measured in Daphnia magna. Model contaminants were the polycyclic aromatic hydrocarbons, naphthalene (NPH) and benzo(a)pyrene (BaP), and the polychlorinated biphenyl, 2,2',5,5'-tetrachlorobiphenyl (TCB). Both BaP and TCB exhibited high partition coefficients for binding to both the total DOC and the hydrophobic components of the DOC. BaP had a higher affinity for binding to the HbA fraction, while TCB (and three other PCB's) had higher affinity for the HbN fraction. The partition coefficients for binding to the Hl fraction were twofold to tenfold lower than for binding to the hydrophobic fraction. The less hydrophobic compound, NPH, had a much lower partition coefficient, and little difference was seen between the fractions. The total water and the different DOC fractions reduced the uptake and accumulation of BaP and TCB by D. magna in proportion to the capacity of the DOC for binding the contaminants. Data were consistent with the hypothesis that a contaminant bound to DOC (total water or any of the fractions) is unavailable for uptake by biota. Uptake of NPH was not substantially affected by the DOC, consistent with its lower partition coefficient. (Author's abstract)
W91-02034

CHRONIC TOXICITY AND BIOACCUMULATION OF 2,5,2',5'- AND 3, 4, 3',4'-TETRACHLOROBIPHENYL AND AROCLOR 1242 IN THE AMPHIPOD HYALELLA AZTECA.
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
For primary bibliographic entry see Field 5C.
W91-02035

COMPARATIVE TOXICOKINETICS OF 2,2'-DICHLOROBIPHENYLS AND 4,4'-DICHLOROBIPHENYLS IN THE POND SNAIL LYMNAEA STAGNALIS.
Vrije Univ., Amsterdam (Netherlands). Dept. of Pharmacochemistry.
For primary bibliographic entry see Field 5C.
W91-02036

TOXICOLOGICAL EXAMINATION OF WHITEFISH (COREGONUS CLUPEAFORMIS) AND NORTHERN PIKE (ESOX LUCIUS) EXPOSED TO URANIUM MINE TAILINGS.
Environmental Protection Service, Regina (Saskatchewan).
For primary bibliographic entry see Field 5C.
W91-02037

PARTITIONING OF LINDANE BETWEEN SEDIMENT, WATER AND THE CRUSTACEAN METAPENAEUS MACLEAYI.
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
A. C. Just, D. W. Hawker, and D. W. Connell.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 3, p 389-397, 1990. 3 fig, 1 tab, 21 ref.

Descriptors: *Bioaccumulation, *Crustaceans, *Halogenated pesticides, *Lindane, *Path of pollutants, *Sediment chemistry, *Sediment pollution, *Soil water pollution, *Water chemistry, Equilibrium, Organic carbon, Partitioning, Shrimp, Uptake.

The partitioning behavior of lindane between sediment, water and the shrimp Metapenaeus macleayi was investigated. The sediment-to-water partition coefficient was determined with sealed glass vials in laboratory experiments and found to be 9.52 or 2164 on an organic carbon basis. This result is in agreement with relevant literature data and confirms that the organic matter of the sediment is the primary sorption site in this process. The bioconcentration factor was evaluated from laboratory experiments with shrimps in sealed glass jars in which the lindane seawater solution was changed frequently. Under these conditions, effective equilibrium was attained after 24 hours. Measured uptake and clearance rate constants were smaller than predicted on the basis of existing general relationships between measured uptake, clearance rate, and the octanol/water partition coefficient for crustaceans. The bioconcentration factor was found to be 5.50, or 1273 on a lipid basis, which is also smaller than values estimated from general relationships. The sediment-to-prawn bioaccumulation factor was 0.58, which means that biotic concentrations will be significantly less than those observed in sediments. (Author's abstract)
W91-02042

5C. Effects Of Pollution

ASSESSMENT OF CUMULATIVE IMPACTS TO WATER QUALITY IN A FORESTED WETLAND LANDSCAPE.
Clemson Univ., Georgetown, SC. Belle W. Baruch Forest Science Inst.
For primary bibliographic entry see Field 4C.
W91-01017

OUTBREAK OF PONTIAC FEVER DUE TO LEGIONELLA ANISA.
Santa Clara County Health Dept., San Jose, CA.
M. D. Fenstersheib, M. Miller, C. Diggins, S. Liska, and L. Detwiler.
Lancet LANAAI, Vol. 336, No. 8706, p 35-37, July 1990. 1 tab, 8 ref.

Descriptors: *Aerosols, *California, *Human diseases, *Legionella, *Public health, *Water pollution effects, Disinfection, Epidemiology, Infectious diseases, Microbiological studies, Pontiac fever, Water pollution sources, Water treatment.

An outbreak of Pontiac fever occurred among 34 of 56 people attending conferences at a hotel in Santa Clara County, California, in 1988. Two groups had an acute febrile upper respiratory illness, with a mean attack rate of 82% and a mean incubation period of 56 hours. Symptoms resolved spontaneously within 5 days. Legionella anisa, which had not previously been associated with outbreaks of Pontiac fever or legionnaires' disease, was isolated from a decorative fountain in the hotel lobby. In addition, 5 of 8 pairs of serum samples from cases showed a more than four-fold rise in antibody titer to the L. anisa recovered from the fountain. 42% of the hotel employees had titers greater than or equal to 256 against L. anisa, whereas none of 48 serum samples from matched controls had titers greater than or equal to 128. The findings raise concern about water treatment protocols for extent of disease that might be caused by exposure to aerosols containing L. anisa and other Legionella species. (Author's abstract)
W91-01032

MOLYBDENUM AND SULFATE AS CONTROLS ON THE ABUNDANCE OF NITRO-

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GEN-FIXING CYANOBACTERIA IN SALINE LAKES IN ALBERTA.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
For primary bibliographic entry see Field 2H.
W91-01034

GROWTH AND VOLTINISM OF LOTIC MIDGE LARVAE: PATTERNS ACROSS AN APPALACHIAN MOUNTAIN BASIN.
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 2H.
W91-01038

MECHANISM FOR THE HYDROGEN SULFIDE-INDUCED GROWTH LIMITATION IN WETLAND MACROPHYTES.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2H.
W91-01042

GREIGITE AND THE MAGNETIC PROPERTIES OF SEDIMENTS.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
For primary bibliographic entry see Field 2H.
W91-01050

ALDICARB FOOD POISONINGS IN CALIFORNIA, 1985-1988: TOXICITY ESTIMATES FOR HUMANS.
California Dept. of Health Services, Emeryville. Environmental Epidemiology and Toxicology Branch.
L. R. Goldman, M. Beller, and R. J. Jackson.
Archives of Environmental Health AEHLAU, Vol. 45, No. 3, p , May/June 1990. p 141-147, 2 fig, 2 tab, 17 ref.

Descriptors: *Aldicarb, *California, *Public health, *Toxicity, *Water pollution effects, Agriculture, Cucumbers, Insecticides, Lethal limit, Watermelon.

Three outbreaks of food poisoning involving watermelons or cucumbers, and caused by the carbamate pesticide aldicarb, occurred in California between 1985 and 1988. For each outbreak, and for an outbreak of aldicarb poisoning associated with English cucumbers previously reported in the literature, dosages of aldicarb sulfoxide that caused the illness were estimated. Estimated dosages ranged between 0.0011 and 0.06 mg/kg body weight, and most were well below the 0.025 mg/kg Lowest Observed Effect Level (LOEL) for subclinical blood cholinesterase depression previously reported for humans. These findings are consistent with aldicarb sulfoxide (ASO) illnesses that have occurred in other states. Aldicarb appears to be more toxic than previously suspected. Scientific and regulatory implications are examined. (Author's abstract)
W91-01052

EFFECT OF IRRIGATION WITH SEWAGE EFFLUENT ON DECOMPOSITION OF LITTER IN PINUS RADIATA FORESTS.
New Zealand Forest Service, Rotorua. Forest Research Inst.
For primary bibliographic entry see Field 3C.
W91-01067

PHYSIOLOGICAL RESPONSE OF YELLOW-POPLAR SEEDLINGS TO SIMULATED ACID RAIN, OZONE FUMIGATION, AND DROUGHT.
Agricultural Research Service, Delaware, OH.
B. Roberts.
Forest Ecology and Management FECMDW, Vol. 31, No. 4, p 215-224, April 1990. 2 fig, 1 tab, 25 ref.

Descriptors: *Acid rain, *Drought, *Ozone, *Poplar trees, *Seedlings, *Water pollution effects, Air pollution, Hydrogen ion concentration, Photosynthesis, Plant physiology, Simulation analysis, Water deficity.

One year old containerized seedlings of yellow poplar (Liriodendron tulipifera L.) were exposed to simulated acid rain (pH 3.0, 4.0, 5.5), ozone (O3) fumigation (0, o.o5, 0.1, 0.2 ppm), and drought (1,2, or 3 one-week drying cycles) from late May until mid-October. Measurements of net photosynthesis (P), leaf stomatal conductance (G) and xylem water-potential (Z) were made on seedlings from each treatment during June, July and August. Seedlings treated with simulated acid rain at pH 3.0 showed reductions in P (29%), G (33%) and Z (17%) when compared with similar seedlings treated with simulated acid rain with pH 5.5. For seedlings fumigated with ozone, there were no significant differences in P or G between the controls and the other ozone treatments. For seedlings subjected to drought, P increased with increasing stress but Z declined. Interactions involving drought and ozone together had a greater impact on Z than either factor alone. For certain stress combinations, particularly those involving drought, it appears that one factor may exert a dominant role over another in determining the overall physiological response. (Author's abstract)
W91-01068

TOXICOLOGY OF CHEMICAL MIXTURES: EXPERIMENTAL APPROACHES, UNDERLYING CONCEPTS, AND SOME RESULTS.
National Toxicology Program, Research Triangle Park, NC.
R. S. H. Yang, H. L. Hong, and G. A. Boorman.
Toxicology Letters TOLED5, Vol. 49, No. 2/3, p 183-197, December 1989. 7 tab, 18 ref.

Descriptors: *Chemical analysis, *Toxicology, *Water pollution effects, Denver, Hazardous wastes, Lake Ontario, Love Canal, New York, Public health, Salmon, Sediment contamination, Waste disposal.

The toxicology of chemical mixtures reflects an actual human exposure situation, yet there is no standard protocol or consensus methodology for investigating the toxicology of mixtures. Thus, experimentation is required just to develop a broadly applicable evaluation system. Several examples are illustrated to present the different experimental designs and the concepts behind each. These include the health effects studies of Love Canal soil samples, the Lake Ontario Coho salmon, the water samples repurified from secondary sewage in the City of Denver Potable Water Reuse Demonstration Plant, and the National Toxicology Program (NTP) effort on a mixture of 25 frequently detected groundwater contaminants derived from hazardous waste disposal sites. In the last instance, an extensive research program has been ongoing for the last two years at the NTP, encompassing general toxicology, biochemical toxicology, myelotoxicology, genetic toxicology, neuro-behavioral toxicology, and hepato-, and renal toxicology. (Lantz-PTT)
W91-01075

HOUSEHOLD EXPOSURE MODELS.
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
T. E. McKone.
Toxicology Letters TOLED5, Vol. 49, No. 2/3, p 321-339, December 1989. 1 fig, 7 tab, 25 ref.

Descriptors: *Drinking water, *Model studies, *Volatile organic compounds, *Water pollution effects, Air pollution, Potable water, Public health.

Human exposure to volatile organic compounds (VOCs) in tap water is often assumed to be dominated by ingestion of drinking water. The relative importance of inhalation and dermal exposure in a typical household was studied using a three-compartment model to simulate the 24-h concentration history of VOCs in the shower, bathroom and remaining household volumes as a result of tap water use. Mass transfers from water to air are derived from measured data for radon and used to estimate mass transfer properties for VOCs. The model is used to calculate a range of concentrations and human exposures in U.S. dwellings. The estimated estimate of household-inhalation uptake to ingestion uptake is in the range of 1-6 for VOCs. A dermal absorption model is used to assess exposure across the skin boundary during baths and showers. The ratio of dermal exposure to ingestion exposure is in the range of 0.6 to 1. Inhalation of volatile chemicals transported from potable water supplies to indoor air has the potential for being as important as, or more important than, the direct ingestion of these compounds as a route of exposure from potable water supplies. The dermal absorption of chemicals from bath and shower water is based on limited data defining the permeability of the skin to chemical transport. (Lantz-PTT)
W91-01076

STEMMING THE TIDE OF MARINE DEBRIS POLLUTION: PUTTING DOMESTIC AND INTERNATIONAL CONTROL AUTHORITIES TO WORK.
Perkins Coie, Washington, DC.
For primary bibliographic entry see Field 5G.
W91-01093

EFFECTS OF LAKE ACIDIFICATION ON AQUATIC MACROPHYTES--A REVIEW.
Imperial Coll. at Silwood Park, Sunninghill (England). Dept. of Biology.
A. M. Farmer.
Environmental Pollution ENPOEK, Vol. 65, No. 3, p 219-240, 1990. 2 tab, 94 ref.

Descriptors: *Acid rain effects, *Aquatic plants, *Lake acidification, *Literature review, *Water pollution effects, Ammonium, Competition, Ecosystems, Hydrogen ion concentration, Macrophytes, Nitrates, Physiological ecology, Plant nutrients, Plant physiology, Species composition.

Acidification of lakes results in a number of chemical, physical and biological changes. With lake acidification, different communities of freshwater macrophytes arise, in response to the pH change. The studies often emphasize the replacement of calcicole species and others such as the isoetids with Juncus bulbosus and Sphagnum spp. in acidifying lakes. Various alterations in lake conditions affect the physiology of the macrophytes, particularly with changes in the availability of carbon, a change from nitrate to ammonium as a nitrogen source and the effects of an alteration in the lake light climate. It is very unlikely that the responses of one species will be the same in all parts of a lake. The population biology, community ecology and ecosystem functioning of macrophytes show that sometimes competitive processes may seem more important in determining community change than physiological processes. It is important to undertake experimental studies at the correct scale to determine which factors may be causally related to the floristic evidence. (Author's abstract)
W91-01105

INTERACTION BETWEEN COMPONENTS OF ELECTROPLATING INDUSTRY WASTES, INFLUENCE OF THE RECEIVING WATER ON THE TOXICITY OF THE EFFLUENT.
Institut National de la Sante et de la Recherche Medicale, Villeneuve d'Ascq (France). Microbe Ecotoxicology Unit 146.
A. Le Du, D. Dive, and A. Philippo.
Environmental Pollution ENPOEK, Vol. 65, No. 3, p 251-267, 1990. 7 fig, 3 tab, 28 ref.

Descriptors: *Heavy metals, *Metal-finishing wastes, *Path of pollutants, *Stream pollution, *Synergistic effects, *Toxicity, *Water pollution effects, Cadmium, Copper, Dilution, Effluents, Electroplating, Hazard assessment, Mineralization, Nickel, Organic matter, Principal component analysis, Protozoa, Water chemistry, Zinc.

A copper-cadmium-nickel-zinc mixture was assessed in seven different river waters to study metal toxicity to the ciliate protozoan Colpidium campylum, the interactions occurring between metals, and the influence of the receiving water on toxicity. In the range of concentrations tested which is representative of electroplating industry wastes, the main part of the toxicity can be attributed to copper and to copper-cadmium synergy. A

classification of waters, based on a principal component analysis (PCA), was used to examine the main parameters of the water, which can affect the toxicity of metal mixtures. The mineralization of the water, more than the total organic matter, appears to be an important parameter for the expression of toxicity. A strategy for the estimation of ecotoxicological hazard assessment, based upon a simplified factorial experiment enables the study of the toxicity of an effluent, the influence of river water on its toxicity, and the effects of contact time and dilution in a two-step bioassay. By applying PCA to data from very different waters, it may be possible to estimate the ecotoxicological risk associated with the discharge of an effluent, on the basis of the chemistry of the receiving water. (Author's abstract)
W91-01106

GREEN OYSTERS CAUSED BY COPPER POLLUTION ON THE TAIWAN COAST.
National Taiwan Univ., Taipei. Inst. of Oceanography.
B. Han, and T. Hung.
Environmental Pollution ENPOEK, Vol. 65, No. 4, p 347-362, 1990. 4 fig, 6 tab, 35 ref.

Descriptors: *Bioaccumulation, *Copper, *Oysters, *Path of pollutants, *Taiwan, *Water pollution effects, Aquaculture, Heavy metals, Marine pollution, Shellfish.

The first case of green oysters (Crassostrea gigas) broke out along the Charting mariculture area of southwestern Taiwan in January, 1986. The green color was found to be due to high copper content in the oyster tissue. Since then, a long-term survey around this area shows that total dissolved copper ranges from 4.99 to 23.6 microg/L and particulate copper ranges from 1.09 to 5.51 microg/L in sea water. The green oysters collected from the Erjhin Chi estuary on January 26, 1989 gave the highest copper content, 4401 plus or minus 79 ppm dry weight. Other green oyster cases were occasionally observed in the Hsiangsan and Anpin mariculture areas. Meanwhile, an experiment of copper accumulation in oysters was conducted at three stations (southwestern Taiwan) for up to 90 days. Multiple regression analysis indicates that the food pathway may predominate in copper accumulation by green oysters. This bioaccumulation experiment shows that the total uptake of copper per oyster is an exponential function of exposure time for the first two weeks with an accumulation rate of 214 ppm copper/day and then levels off. The average values of concentration factors for oysters (about 10,000) were very close to steady-state values under the natural conditions at each station. (Author's abstract)
W91-01108

EFFECTS OF ACIDIC IRRIGATION ON SOIL MICROORGANISMS AT KEVO, NORTHERN FINLAND.
Turku Univ. (Finland). Dept. of Biology.
M. Kytoviita, H. Fritze, and S. Neuvonen.
Environmental Pollution ENPOEK, Vol. 66, No. 1, p 21-31, 1990. 1 fig, 4 tab, 26 ref.

Descriptors: *Acid rain effects, *Finland, *Simulated rainfall, *Soil organics, *Water pollution effects, Acid rain, Bacterial physiology, Litter, Microorganisms, Soil bacteria, Soil fungi.

Increasing rates of pollution in the northern hemisphere have led to a large number of studies concerning different aspects of acidification. Effects of simulated acid rain (a mixture of sulfuric acid and nitric acid; pH 3) on soil microbiology were studied in a field experiment in northern Finland. Irrigated control plots received the same amount of spring water (pH 6) as the acid treated plots. Fungal lengths and total bacterial numbers were studied after the treatments had continued for three growing seasons. The numbers of bacteria in five physiological groups (those utilizing starch, protein, pectin, xylan, or cellulose) were measured by most probable number (MPN) techniques. The lengths of total and FDA stained fungal hyphae were not significantly different between the acid treated and the control plots. The counts of total bacteria were not significantly different between treatments, but the MPNs of all five physiological groups of bacteria were approximately 60% lower in the acid treated plots than in the controls. The results of the present study suggest that changes in soil microbial activity caused by moderate acidification may be important in a long term perspective and a reduction in the amounts of bacteria utilizing cellulose, starch, pectin, xylan and protein may at least partially explain the lower mass loss of litter on acid treated soils. (Brunone-PTT)
W91-01109

BIOACCUMULATION AND TOXICITY OF ZINC IN THE GREEN ALGA, CLADOPHORA GLOMERATA.
Polytechnic of Central London (England). Applied Ecology Research Group.
B. M. McHardy, and J. J. George.
Environmental Pollution ENPOEK, Vol. 66, No. 1, p 55-66, 1990. 4 fig, 2 tab, 24 ref.

Descriptors: *Algae, *Bioaccumulation, *Chlorophyta, *Toxicity, *Water pollution effects, *Zinc, Algal growth, Aquatic plants, England, Path of pollutants, Plant physiology.

The bioaccumulation and toxicity of zinc in Cladophora glomerata from two populations in the River Roding, Essex, UK, were examined in experimental laboratory flowing-water channels. Plants were subjected to concentrations ranging from 0 to 4.0 mg/L at current velocities of 20 to 33 cm/sec for up to three hours. Zinc in algal tissue was then quantified and toxicity was assessed by the ability of the alga to grow in a recovery medium after the experimental treatment. There was little difference in zinc bioaccumulation between Cladophora from the site showing mild organic pollution and that from the site subjected to considerable inputs from urban and motorway runoff. Uptake of zinc increased with increasing concentration in the test solution and was linear and proportional up to 0.4 mg/L. Three stages of uptake were identified with the most dramatic accumulation occurring in the first ten minutes. Experimental concentration factors ranged from 1900 to 5200, which were in agreement with those previously obtained in the field. Cellular damage was evident in Cladophora subjected to 0.4 mg/L zinc and this increased with increasing zinc concentration, thus leading to the conclusion that, at times, the levels of zinc found in the river could be potentially damaging. (Author's abstract)
W91-01111

MOLLUSC THAIS HAEMASTOMA - AN EXHIBITOR OF 'IMPOSEX' AND POTENTIAL BIOLOGICAL INDICATOR OF TRIBUTYLTIN POLLUTION.
Liverpool Univ., Port Erin (England). Dept. of Marine Biology.
S. K. Spence, S. J. Hawkins, and R. S. Santos.
Marine Ecology (PSZNI) MAECDR, Vol. 11, No. 2, p 147-156, 1990. 5 fig, 1 tab, 22 ref.

Descriptors: *Antifoulants, *Bioindicators, *Gastropods, *Imposex, *Mollusks, *Organotin compounds, *Water pollution effects, Animal physiology, Aquatic animals, Azores, Bioaccumulation, Marine pollution, Tributyltin.

In the Azores, the gastropod Thais haemastoma shows varying degrees of imposex, the induction of male sex characters in the female. It is inferred that imposex in T. haemastoma is caused by tributyltin (TBT) associated with boats using organotin-based antifoulant paints. The two indices (relative penis size and vas deferens sequence) employed previously for Nucella lapillus, were used without alteration. T. haemastoma is only the third species reported as exhibiting 'effective sterilization' of the female. Unlike N. lapillus, T. haemastoma has a planktonic larva, allowing populations to be sustained even when local TBT pollution is high. This makes T. haemastoma potentially a better indicator species, as monitored populations can be maintained by the influx of larvae. T. haemastoma may thus provide a cheap method of assessing the extent of TBT contamination in warm waters, particularly in the Mediterranean and Atlantic Islands. Preliminary examination of material from a marina in Spain showed a high incidence of 'sterile' animals. (Author's abstract)
W91-01118

COMPARISON OF THE ACIDIFICATION EFFICIENCIES OF NITRIC AND SULFURIC ACIDS BY TWO WHOLE-LAKE ADDITION EXPERIMENTS.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W91-01143

EPIPHYTIC ALKALINE PHOSPHATASE ON NATURAL AND ARTIFICIAL PLANTS IN AN OLIGOTROPHIC LAKE: RE-EVALUATION OF THE ROLE OF MACROPHYTES AS A PHOSPHORUS SOURCE FOR EPIPHYTES.
North Carolina State Univ. at Raleigh. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-01146

EFFECT OF MERCURY AND SELENIUM ON THE GILL FUNCTION OF MYTILUS EDULIS.
University Coll. of Swansea (Wales). Dept. of Earth Sciences.
S. Micallef, and P. A. Tyler.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 6, p 288-292, June 1990. 2 fig, 1 tab, 34 ref.

Descriptors: *Bioindicators, *Mercury, *Mussels, *Selenium, *Water pollution effects, Gills, Heavy metals, Marine pollution, Mytilus, Toxicity.

The effect of selenium and mercury on the filtration, oxygen consumption, and associated processes of ciliary activity of Mytilus edulis was studied. Mussels were exposed to mercury (50 microgram Hg/L) and selenium (50 microgram Se/L) or to a combination of mercury (50 microgram Hg/L) and selenium in an equidosal (50 microgram Se/l) or an equimolar (19.7 microgram Se/L) ratio for 120 hours. The filtration rate in mussels exposed to mercury and combined treatments was severely affected within 2 hours. Mussels exposed to selenium showed a reduced filtration rate intermediate between the controls and the other treatments. The effect of the individual and combined treatments on ciliary activity was transient, while the effect on oxygen consumption was not significant. Under these laboratory conditions selenium in its reduced chemical form failed to protect mussels against mercury toxicity. (Author's abstract)
W91-01159

BIOFILM CHARACTERISTICS IN COASTAL WATERS OF BOMBAY.
Naval Chemical and Metallurgical Lab., Bombay (India).
For primary bibliographic entry see Field 2L.
W91-01170

RECOVERY OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE FROM WATER SAMPLES ON XAD RESINS AND THE EFFECT OF CHLORINE ON ITS MUTAGENICITY.
Health Effects Research Lab., Research Triangle Park, NC. Genetic Toxicology Div.
For primary bibliographic entry see Field 5A.
W91-01181

WATERSHED 89: THE FUTURE FOR WATER QUALITY IN EUROPE. VOLUME II.
For primary bibliographic entry see Field 5G.
W91-01211

WATER QUALITY EVALUATION IN LAKES OF GREECE.
National Centre for Marine Research, Athens (Greece).
For primary bibliographic entry see Field 2H.
W91-01212

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IS IT POSSIBLE TO REGAIN AN ECOLOGICAL BALANCE IN A LAKE WITH BLOOMS OF NUISANCE MICROORGANISMS.
National Inst. of Public Health, Oslo (Norway). Dept. of Water and Hygiene.
H. C. Utkilen.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 205-209, 3 fig, 1 tab, 12 ref.

Descriptors: *Algal blooms, *Cyanophyta, *Eutrophication, *Lake restoration, *Phosphorus, *Water pollution control, *Water pollution treatment, Algal growth, Aquatic bacteria.

Cyanobacteria (blue-green algae) blooms can cause several problems in a water source, rendering it less suitable for drinking or recreational purposes. Such problems occurred in the Norwegian lake Mjosa, where a bloom of Oscillatoria bornetii f. tenuis produced the off-flavor component geosmin. This resulted in an attempt to stop and reverse the ongoing eutrophication by decreasing the phosphorus loading to the lake. The plan which included building new sewage treatment plants, banning the use of phosphorus-containing detergents, and reducing agricultural runoff to the lake was initiated in 1976 and lasted until 1981. During this period the theoretical phosphorus loading of the lake was reduced from 380 ton/yr to 220 ton/yr. From 1979, the cyanobacteria level was negligible. However, after 1981 the phosphorus concentration in the lake increased again and larger amounts of cyanobacteria causing problems reappeared. The experience from lake Mjosa therefore shows that it is possible to stop and even reverse eutrophication, but the effort to reverse pollution has to be an ongoing process. (See also W91-01211) (Author's abstract)
W91-01220

CYANOBACTERIAL TOXINS IN EUROPEAN WATERS: OCCURRENCE, PROPERTIES, PROBLEMS AND REQUIREMENTS.
Dundee Univ. (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W91-01221

WELL-WATER METHAEMOGLOBINAEMIA: THE BACTERIAL FACTOR.
Norsk Hydro, Porsgrunn. Research Centre.
O. C. Cockman, and D. D. Bryson.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 239-244, 15 ref.

Descriptors: *Drinking water, *Enteric bacteria, *Human diseases, *Nitrates, *Public health, *Water pollution effects, *Well water, Escherichia coli, Nitrites, Potable water, Water pollution sources.

Excessive amounts of nitrate in drinking water are assumed to increase the risk of infant well-water methemoglobinemia. Recent research suggests that methemoglobinemia is a very rare and disappearing disease in young bottlefed infants. Methemoglobinemia is multifactorial in origin, and although the relative importance of each causal factor has not been studied, it is associated with the use of water from private wells. The condition is linked with nitrate in water through clinical association. Since enteritis can also cause methemoglobinemia, the elimination of nitrate from drinking water cannot totally prevent outbreaks of methemoglobinemia. Effective prevention criteria should also stress water microbial purity. There is strong evidence that potable water with 50 mg NO3(-)/L is safe. Experience also indicates that potable water with up to 100 mg/NO3(-)/L is also safe. (See also W91-01211) (Author's abstract)
W91-01224

NECESSITY OF BIOASSAYS IN WATER QUALITY MONITORING.
Institut fuer Wasserforschung G.m.b.H. Dortmund, Schwerte (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W91-01225

INTERFACE OF HEALTH EFFECTS AND CHEMISTRY AT WATER TREATMENT PLANTS.
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
For primary bibliographic entry see Field 5F.
W91-01226

MICROPOLLUTANTS IN WATER USED FOR RENAL DIALYSIS: AN INTERNATIONAL PERSPECTIVE.
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
S. Bragg, S. J. Sollars, and R. Perry.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 265-276, 1 fig, 10 tab, 41 ref.

Descriptors: *Aluminum, *Dialysis, *Disinfection, *Public health, *Renal dialysis, *Water pollution effects, *Water treatment, Bacteria, Calcium, Copper, Fluorides, Lead, Magnesium, Membrane processes, Nitrates, Organic compounds, Sulfates, Trace elements, Trace metals, Water pollution prevention, Zinc.

With the number of renal dialysis patients increasing in Europe and North America, the full importance of the quality of the water used for renal dialysis is being recognized. Aluminum intoxication in dialysis patients, first described in the early 1970's, highlighted the need for adequate treatment of water used to prepare dialysate. Other potential contaminants include calcium, magnesium, copper, lead, zinc, fluorides, sulfate, nitrate, chloramines, organic materials, and bacteria. Some of these, e.g. chloramines, may arise as a result of water treatment practice, while others, such as trace organic materials, are increasingly present in the environment and may not be completely removed at the water treatment stage. Use of aluminum sulfate as a coagulant in water treatment may be a source of high aluminum contents in dialysis water. Chloramines, chloroform, and other halogenated alkyls may be generated when chlorine is used for water disinfection. Bacterial growth may occur in water distribution systems, particularly if there are stagnant sections. Water softeners, sediment filters, carbon filters, reverse osmosis and deionizers are used in purifying dialysis water. Standards have been set by the European and American communities for the levels of trace compounds and elements permissible in dialysis water based on extensive research studies. Although monitoring trace impurities in dialysis water and the blood of dialysis patients may add up to 10% of the total cost of renal dialysis, such an investment might, in the long run, reduce overall costs of health care for dialysis patients. (See also W91-01211) (Geiger-PTT)
W91-01227

COMPLEXITY, ENTROPY AND ENVIRONMENTAL EFFECT.
Queen Mary Coll., London (England). School of Biological Sciences.
P. Johnston, and R. Stringer.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 283-291, 4 fig, 24 ref.

Descriptors: *Entropy, *Environmental effects, *Toxicity, *Toxicology, *Water pollution effects, Cleanup, Daphnia, England, Evaluation, Selenium.

The identification of an ecotoxicological problem usually occurs after the scope of the problem has become too wide to address in simple remedial terms. After a potential toxicological effect has been identified for a material then a wide evaluation generally follows. This causes a delay between the time a pollutant is identified and the time action is taken to eliminate it. The data generated to evaluate the toxic effects of inorganic selenium on Daphnia magna illustrates the time consuming process of a toxicological evaluation. Conceptual evaluations show that human use of energy will inevitably be associated with environmental degradation which can be regarded as an increase in entropy. Anthropogenically mobilized contaminants tend not to become evenly distributed throughout the environment as assumed by dischargers. Instead they selectively partition into environmental or biological compartments with which they have an affinity as a result of free energy considerations, or undergo entropy decreases as a result of biological energy input. Given the inability to predict the degree to which an ecosystem will be compromised by interaction with any given contaminant or to evaluate the degree of compromise once it has been established, dischargers of any materials to the wider environment should consider the precautionary principle axiomatic to the formulation of environmental legislation. (See also W91-01211) (Geiger-PTT)
W91-01229

TOXICITY OF WATER EXTRACTS OF HAZARDOUS WASTE.
Wyzsza Szkola Inzynierska, Zielona Gora (Poland).
E. S. Kempa, A. Jedrczak, M. Piontek, and A. Solski.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 297-305, 4 fig, 2 tab, 9 ref.

Descriptors: *Bioassay, *Bioindicators, *Hazardous wastes, *Industrial wastes, *Sludge, *Toxicity, *Water pollution effects, Aquatic plants, Cadmium, Chromium, Copper, Daphnia, Heavy metals, Metal-finishing wastes.

The toxicity of industrial wastes is measured by the content of noxious, chemically active substances and particularly by their solubility in water. The chemical composition of the water extracts does not fully reflect their noxious impact on the organisms living in the freshwater ecosystems. At improperly protected landfills, leachates often penetrate onto the aquifers causing pollution or even contamination of surface water and groundwater resources. Forty industrial solid wastes and sludges and their water extracts were analyzed for their toxicity to Lemna minor L., Daphnia magna Straus, and Dugesia tigrina Girard. A considerable differentiation in toxicity was observed. The most toxic turned out to be three electroplating sludges containing top limiting concentrations of heavy metals (cadmium, copper, and chromium). The animal organisms, especially Daphnia magna, were more sensitive to the water extracts of the tested wastes. The toxicity of sludges and wastes was expressed by the degree of water extracts: Group I, extremely toxic wastes (dilution < 1%), Group II, hazardous wastes (dilution from 1 to 10%), Group III, wastes of low toxicity (dilution from 10 to 100%), and Group IV, non-toxic wastes. (See also W91-01211) (Geiger-PTT)
W91-01231

COPPER TOXICITY TO PARATYA AUSTRALIENSIS: I. INFLUENCE OF NITRILOTRIACETIC ACID AND GLYCINE.
Chisholm Inst. of Tech., Melbourne (Australia). Center for Stream Ecology.
H. R. Daly, I. C. Campbell, and B. T. Hart.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 997-1006, August 1990. 5 tab, 2 fig, 40 ref.

Descriptors: *Amino acids, *Chemical speciation, *Copper, *Ion-selective electrodes, *Metal complexes, *Nitrilotriacetic acid, *Shrimp, *Toxicity, *Toxicology, *Water pollution effects, Bioassay, Heavy metals, Lethal limit, Mortality.

It is now widely accepted that the toxicity, bioavailability, and transport of heavy metals in aquat

systems are dependent upon the physicochemical forms, or speciation, of the particular metal. The relationship between copper speciation and acute toxicity to the Australian freshwater shrimp, Paratya australiensis was determined using a combination of copper ion selective electrode measurements, complexing resins and computer calculations to measure the speciation in test solutions. 48 hour LC50 values for P. australiensis exposed to copper in Melbourne tap water were 43 micrograms Cu/L (total copper) and 22 micrograms Cu/L (measured for Cu(++) ion). With a 1 micromolar concentration of NTA the 48 hour values were 109 and 25 micrograms Cu/L (calculated), respectively, and for 20 micromolar glycine solutions the values were 130 and 39 micrograms Cu/L (measured), respectively. A number of problems were encountered with the use of the copper ion selective electrode in waters containing added complexing agents. In solutions containing nitrilotriacetic acid or glycine, uncomplexed copper(II) ions were found to be the most acutely toxic form of copper to the shrimp. However, at least one other species, the singly charged complex (Cu-Glycine)(+), also appears to be mildly toxic. The results of this study demonstrate the importance of considering metal speciation when assessing the impact of heavy metals on aquatic organisms. (See also W91-01259 and W91-01260) (Author's abstract)
W91-01258

COPPER TOXICITY TO PARATYA AUSTRALIENSIS: II. INFLUENCE OF BICARBONATE AND IONIC STRENGTH.
Chisholm Inst. of Tech., Melbourne (Australia). Center for Stream Ecology.
M. R. Day, I. C. Campbell, and B. T. Hart.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 1007-1011, August 1990. 1 fig, 3 tab, 22 ref.

Descriptors: *Bicarbonates, *Chemical speciation, Copper, *Ionic interference, *Metal complexes, Shrimp, *Sodium chloride, *Toxicity, *Toxicology, *Water pollution effects, Alkaline water, Bioassay, Cations, Heavy metals, Ion-selective electrodes, Lethal limit, Mortality.

Experiments were conducted as part of a study on the relationship between the physicochemical forms of copper and its toxicity to the Australian freshwater shrimp, Paratya australiensis. The acute toxicity of copper to P. australiensis was shown to decrease in solutions of increasing alkalinity brought about by the addition of sodium bicarbonate, NaHCO3. This effect could not be explained entirely in terms of changes in copper speciation in the solutions. Estimates of the free copper(II) ion concentration of the LC50 values were made using both copper ion selective electrode measurements and chemical equilibrium computer calculations. Whereas there were discrepancies between the estimates obtained using these methods, both indicated an apparent increase in tolerance of P. australiensis to the free copper (II) ion in more alkaline waters. An additional set of experiments, in which sodium chloride was added to test waters in place of sodium bicarbonate, demonstrated that the increased tolerance of P. australiensis to copper in higher alkalinity waters was caused by a combination of physiological effects associated with increased ionic strength of the test waters and, to a lesser extent, changes in metal speciation in test waters. (See also W91-01258 and W91-01260) (Author's abstract)
W91-01259

COPPER TOXICITY TO PARATYA AUSTRALIENSIS: III. INFLUENCE OF DISSOLVED ORGANIC MATTER.
Chisholm Inst. of Tech., Melbourne (Australia). Center for Stream Ecology.
M. R. Daly, M. J. Jones, B. T. Hart, and I. C. Campbell.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 1013-1018, August 1990. 1 fig, 3 tab, 22 ref.

Descriptors: *Chemical speciation, *Copper, *Dissolved solids, *Metal complexes, *Shrimp, *Toxicity, *Toxicology, Bioassay, Heavy metals, Ion-selective electrodes, Lethal limit, Mortality, Natural waters.

Experiments were conducted as part of a study on the relationship between the physicochemical forms of copper and its toxicity to the Australian freshwater shrimp, Paratya australiensis. The influence of dissolved organic matter on the toxicity of copper to P. australiensis was measured using water collected from three sites in Victoria, Australia. A two-ligand model was used to describe copper complexation in these test waters. The binding characteristics of the ligands (i.e., total ligand concentrations and conditional stability constants) were determined using a method combining ion selective electrode and anodic stripping voltammetry. Ion selective measurements and the two-ligand model were each used to estimate the concentration of copper(II) (the major toxic species) at the LC50 values. Both methods overestimated by a factor of approximately 1.5 to 3 the expected copper(II) concentration at the LC50 values, based on earlier experiments in Melbourne tap water. The agreement seems remarkably good given the many assumptions used in making the comparison and the difficulties encountered with the use of ion selective electrodes in natural waters. (See also W91-01258 and W91-01259) (Author's abstract)
W91-01260

COMPARISON OF MEASURED INSTREAM BIOLOGICAL RESPONSES WITH RESPONSES PREDICTED USING THE CERIODAPHNIA DUBIA CHRONIC TOXICITY TEST.
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
K. W. Eagleson, D. L. Lenat, L. W. Ausley, and F. B. Winborne.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 1019-1028, August 1990. 1 fig, 1 tab, 26 ref.

Descriptors: *Bioassay, *Bioindicators, *Daphnia, *Effluents, *Model testing, *Toxicity, *Toxicology, *Water pollution effects, Chronic toxicity, Data collections, Industrial wastewater, Mortality, Municipal wastewater, North Carolina, Stream pollution, Wastewater disposal, Water quality standards.

Regulation of surface water discharge of toxic substances through the use of whole effluent toxicity testing is being used with increasing frequency for state and federal programs. In this study, instream toxicity was predicted with whole effluent toxicity tests. These results were then compared to the observed instream response of the aquatic community. Forty-three comparisons were conducted in freshwater flowing systems using Ceriodaphnia dubia chronic toxicity test procedures and standardized qualitative sampling of benthic macroinvertebrates. In 88% of the comparisons there was agreement between both measures. These data suggest that the use of effluent toxicity testing results as a regulatory tool is effective and appropriate. Comparisons used whole effluent toxicity limitations similar to those being written in North Carolina's NPDES permits for discharge to surface waters. (Author's abstract)
W91-01261

EFFECT OF SEDIMENT SPATIAL VARIANCE AND COLLECTION METHOD ON CLADOCERAN TOXICITY AND INDIGENOUS MICROBIAL ACTIVITY DETERMINATIONS.
Wright State Univ., Dayton, OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W91-01262

ACUTE TOXICITIES OF FIVE SYNTHETIC PYRETHROID INSECTICIDES TO DAPHNIA MAGNA AND CERIODAPHNIA DUBIA.
Texas Christian Univ., Fort Worth. Dept. of Biology.
L. E. Mokry, and K. D. Hoagland.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 1045-1051, August 1990. 4 tab, 25 ref.

Descriptors: *Daphnia, *Insecticides, *Permethrins, *Pesticide toxicity, *Pyrethrins, *Toxicity, *Toxicology, *Water pollution effects, Bioassay, Median tolerance limit, Mortality.

The acute toxicities of four recently developed pyrethroid insecticides (bifenthrin, cyfluthrin, lambda cyhalothrin and tralomethrin) were experimentally compared to the acute toxicity of a first generation pyrethroid (permethrin), in static-flow, 48-hour bioassays with Daphnia magna and Ceriodaphnia dubia. The four new generation pyrethroids exhibited greater toxicity in comparison to permethrin, which had 48 hour LC50s of 1.25 micrograms/L for D. magna and 0.55 micrograms/L for C. dubia. LC50s for D. magna and C. dubia were 0.32 and 0.07 for bifenthrin, 0.17 and 0.14 for cyfluthrin, 1.04 and 0.30 for lambda cyhalothrin, and 0.15 and 0.26 micrograms/L for tralomethrin, respectively. Tralomethrin and cyfluthrin were most toxic to D. magna, and C. dubia was equally or more sensitive the D. magna to all of the insecticides. This indicates higher biological activity of the newer pyrethroids than permethrin to nontarget organisms. (VerNooy-PTT)
W91-01263

YOLK RETINOIDS (VITAMIN A) IN EGGS OF THE HERRING GULL AND CORRELATIONS WITH POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS.
Ottawa Univ. (Ontario). Dept. of Biology.
P. A. Spear, D. H. Bourbonnais, R. J. Norstrom, and T. W. Moon.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 1053-1061, August 1990. 3 fig, 3 tab, 36 ref.

Descriptors: *Bioindicators, *Birds, *Dioxins, *Eggs, *Gulls, *Polychlorinated biphenyls, *Polycyclic aromatic hydrocarbons, *Teratogenic effects, *Toxicology, *Vitamins, *Water pollution effects, Correlation analysis, Great Lakes, High performance liquid chromatography, Monitoring.

Little is known of the combined effects associated with chronic, low-level exposure of wildlife to the polyhalogenated dibenzo-p-dioxins (PCDDs for chlorinated compounds), dibenzofurans (PCDFs), certain biphenyls and other related compounds. To examine possible effects upon egg yolk retinoids, herring gull (Larus argentatus) eggs were collected at early (i.e., days 2-12) and late (i.e., approximately day 20) phases of incubation. Analysis of egg yolks by reversed-phase high-performance liquid chromatography revealed compounds that comigrated with all-trans-retinyl palmitate standards. The retinol concentration and the molar ratio of retinol to retinyl palmitate changed significantly between the early and late phases of incubation. Within the 2 to 12 day period of incubation, however, retinoid values were constant. Gull eggs were collected from two breeding colonies on the Great Lakes in 1986 and from five colonies in 1987. In 2 to 12 day eggs, retinol and retinyl palmitate concentrations were significantly different between gull colonies. The molar ratio of retinol to retinyl palmitate was significantly different between colonies and correlated with several indices of polychlorinated dibenzo-p-dioxin and dibenzofuran concentrations quantified in gull eggs from these collection sites. Significant correlations existed between the molar ratio of retinoids and 2,3,7,8-tetrachloro-dibenzodioxin (TCDD), toxic equivalents of PCDDs and PCDFs and the sum of PCDD and PCDF concentrations. These results, and data from a previous study of vitamin A stores support the hypothesis that chlorinated dioxins and possibly other contaminants are affecting the vitamin A status of wild birds. Changes in yolk retinoids may prove to be an early indicator of such effects as embryo mortality and teratogenesis of the type currently observed in Great Lakes birds. (Author's abstract)
W91-01264

TOXICITY OF FLUORANTHENE IN SEDIMENT TO MARINE AMPHIPODS: A TEST OF

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THE EQUILIBRIUM PARTITIONING APPROACH TO SEDIMENT QUALITY CRITERIA.

Environmental Research Lab.-Narragansett, Newport, OR. Mark O. Hatfield Marine Science Center.
R. C. Swartz, D. W. Schults, T. H. Dewitt, G. R. Ditsworth, and J. O. Lamberson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 1071-1080, August 1990. 5 fig, 4 tab, 33 ref. EPA Agreement CX812-792-01-0.

Descriptors: *Amphipods, *Bioassay, *Fluoranthene, *Marine pollution, *Polycyclic aromatic hydrocarbons, *Sediment contamination, *Toxicity, *Toxicology, *Water pollution effects, Environmental quality, Equilibrium, Interstitial water, Model studies, Mortality, Path of pollutants, Population exposure.

The toxicity to the marine benthic amphipods, Rhepoxynius abronius and Corophium spinicorne, of fluoranthene in sediment was determined in relation to the equilibrium partitioning (EP) approach to the development of sediment quality criteria. Toxicity tests were conducted with well-sorted fine sands at three levels of organic carbon (OC), 0.18, 0.31, and 0.48%. Measured interstitial water concentrations of fluoranthene less than 50 microg/L were highly correlated with predictions based on the EP model. LC50s based on total fluoranthene concentrations increased significantly with increasing sediment OC. LC50s based on fluoranthene concentration in interstitial water were not significantly different between 0.18 and 0.48% OC or between 0.31 and 0.48%, but the LC50 at 0.31 was significantly higher than that at 0.18% OC. The regression of sediment OC on bulk fluoranthene LC50 was linear, indicating that the concentration of fluoranthene in interstitial water was constant at equitoxic conditions, as predicted by the EP model. The 10-day LC50 of fluoranthene in interstitial water (23.8 microg/L) was intermediate between the acute (40 microg/L) and chronic (16 microg/L) EPA water quality standards for fluoranthene. The epibenthic, tube-dwelling Corophium was less sensitive to test sediments than the infaunal, free-borrowing Rhepoxynius, possibly because of different routes of exposure to fluoranthene. There was a close correspondence between estimates of sediment quality for fluoranthene based on distinctly different methodologies including EP, apparent effects threshold, toxicity tests applied to experimentally spiked sediment and toxicity tests applied to field-collected sediment. (Author's abstract)
W91-01265

ASSESSMENT OF THE ONTARIO MINISTRY OF THE ENVIRONMENT PROTOCOLS FOR CONDUCTING DAPHNIA MAGNA ACUTE LETHAL TOXICITY TESTS WITH PULP AND PAPER MILL EFFLUENTS.

Pulp and Paper Research Inst. of Canada, Pointe Claire (Quebec).
T. G. Kovacs, and S. M. Ferguson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 8, p 1081-1093, August 1990. 3 fig, 9 tab, 36 ref.

Descriptors: *Bioassay, *Daphnia, *Laboratory methods, *Pulp and paper industry, *Quality control, *Toxicity, *Toxicology, *Water pollution effects, Canada, Effluents, Mortality, Performance evaluation, Testing procedures, Variation coefficient, Water quality standards.

The Ontario Ministry of the Environment protocols for conducting Daphnia magna acute lethal toxicity tests were evaluated for pulp and paper mill effluents. The evaluation included an interlaboratory study and an intralaboratory assessment using different dilution waters, test containers and pH adjustment. When the tests were conducted under similar conditions, the results (i.e, 48-hour LC50s) from four participating laboratories were similar. With one exception, the coefficients of variation for interlaboratory testing ranged from 3.0 to 17%. However, within a laboratory, the ratio of the highest to lowest LC50 values for a particular effluent ranged from 1.9 to 3.8 when using different dilution waters and ranged from 1.3 to 1.9 when the test solution pH was adjusted to the same level as the dilution water pH. The D. magna were found to be 1.5 to 4.0 times less sensitive than rainbow trout and 1.6 to 3.0 times less sensitive than Ceriodaphnia affinis to pulp and paper mill effluents, and dehydroabietic acid. (Author's abstract)
W91-01266

EUTROPHICATION: ASSESSMENT, RESEARCH AND MANAGEMENT WITH SPECIAL REFERENCE TO SCOTLAND'S FRESHWATERS.

Institute of Terrestrial Ecology, Edinburgh (Scotland).
A. E. Bailey-Watts.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 3, p 285-294, June 1990. 6 fig, 86 ref.

Descriptors: *Algal growth, *Eutrophication, *Limnology, *Literature review, *Nutrient concentrations, *Scotland, *Water quality management, Algal blooms, Freshwater, Nitrogen, Phosphorus, Pollution load, Research, Water quality control.

In response to the extraordinarily high profile currently maintained by algae, aspects of pure and applied research on eutrophication were investigated. In addition to restating a number of issues which were raised decades ago when the importance of this environmental problem was first recognized, the following aspects are explored using data collected mainly over the last 20 years and referring primarily to Scottish studies: (i) algal-nutrient relations and the contrasting manner in which nitrogen and phosphorus enter freshwaters and are sequestered by planktonic organisms; (ii) estimates of the loadings of phosphorus to freshwaters from various sources; (iii) the effects on the perception of algal problems and the use to which the waters are intended; (iv) the extent and limitations of existing scientific knowledge about eutrophication, and its application to the formulation and execution of eutrophication control strategies; and (v) the arguments for maintaining in-depth limnological surveillance programs. (Author's abstract)
W91-01277

APPRAISAL OF THE POTENTIAL HEALTH IMPACTS OF SEWAGE DISPOSAL TO UK COASTAL WATERS.

Saint David's Univ. Coll., Lampeter (Wales). Centre for Research into Environment and Health.
For primary bibliographic entry see Field 5B.
W91-01278

INTERACTION OF CARBON TETRACHLORIDE WITH BETA-NAPHTHOFLAVONE-MEDIATED CYTOCHROME P450 INDUCTION IN WINTER FLOUNDER (PSEUDOPLEURONECTES AMERICANUS).

Louisiana State Univ., Baton Rouge. School of Veterinary Medicine.
K. M. Kleinow, B. F. Droy, D. R. Buhler, and D. E. Williams.
Toxicology and Applied Pharmacology TXAPA9, Vol. 104, No. 2, p 365-374, June 15, 1990. 3 fig, 1 tab, 25 ref. Mount Desert Island Biological Laboratory--Marine and Freshwater Biomedical Sciences Specialized Research Center Grant EHA 1 P30 ES03828-02.

Descriptors: *Bioassay, *Chlorinated hydrocarbons, *Cytochromes, *Fish physiology, *Flounders, *Naphthoflavone, *Toxicity, Animal tissues, Biochemical tests, Histology, Immunology, Liver, Sublethal effects, Tissue analysis.

Cytochrome P450-dependent activity in fish has been shown to be induced by exposure to low levels of environmental pollutants. This response to environmental xenobiotics has focused attention upon P450 induction as a possible biological monitoring tool. In this study, the interaction between beta-naphthoflavone induction (BNF; 100 mg/kg) and carbon tetrachloride (CCl4; 1 mL/kg) hepatotoxicity was examined in the flounder. Treatment groups composed of control, BNF, CCl4, and BNF/CCl4 were compared in terms of cytochrome P450 isozyme content (LM sub 4b; LM sub 2), catalytic activity, isozyme distributions, SGOT-STPT levels and pathology. CCl4 administration resulted in significant reductions in both the constitutive P450 (LM sub 2) and the BNF-inducible isozyme (LM sub 4b) as well as elevations in SGPT and SGOT levels. The decline in LM sub 4b isozyme content was reflected by stoichiometric decreases in ethoxyresorufin-O-deethylase activities. BNF/CCl4 coadministration was protective in part against CCl4 hepatotoxicity. Immunohistochemistry indicated that LM sub 4b was diffusely distributed throughout the liver. These interactions have demonstrated a multiple P450 isozyme involvement, the protective nature of BNF against CCl4 hepatotoxicity in the flounder, the ability to maintain an inductive response in face of CCl4 coadministration, and the diffuse distributional pattern of LM sub 4b in the flounder liver. (Author's abstract)
W91-01279

INDUCTION OF PEROXISOME PROLIFERATION IN RAINBOW TROUT EXPOSED TO CIPROFIBRATE.

Massachusetts Univ., Amherst. School of Public Health.
J. H. Yang, P. T. Kostecki, E. J. Calabrese, and L. A. Baldwin.
Toxicology and Applied Pharmacology TXAPA9, Vol. 104, No. 3, p 476-482, July 1990. 2 fig, 2 tab, 27 ref. US Army Medical Research and Development Command Contract DAMD17-88-C-8051.

Descriptors: *Biochemical tests, *Ciprofibrate, *Fish physiology, *Path of pollutants, *Peroxisomes, *Toxicity, *Trout, *Water pollution effects, Bioassay, Enzymes, Immunoassay, Liver, Sublethal effects, Tissue analysis.

A number of chemicals, especially those used as hypolipidemic drugs and phthalate ester plasticizers, have been identified as peroxisome proliferators. While considerable information on interspecies comparison is available in mammalian models, there is a general lack of information on responses of fish species to peroxisome proliferators. Rainbow trout (Salmo gairdneri), average body weight of 450 grams, were treated with 15, 25, or 35 mg/kg of ciprofibrate via intraperitoneal injection every other day for 2 to 3 weeks. The effects on hepatic peroxisomal acyl-CoA oxidase, polypeptide PPA-80, catalase, and liver weight were measured. The treatment of trout with ciprofibrate showed significant dose-related increases in peroxisomal acyl-CoA activity, polypeptide PPA-80 and catalase after 3 weeks of exposure. Peroxisomal oxidase activity showed a significant ($p = 0.008$) increase (78%) at 35 mg/kg and a marginal ($p = 0.1$) increase (27%) at 25 mg/kg after 3 weeks of exposure. Densitometric analysis of polypeptide PPA-80 and catalase showed increases up to 48 and 236% at 35 mg/kg, respectively. Morphometric analysis on livers of trout administered 35 mg/kg for 3 weeks showed a 2.3-fold increase of peroxisomal volume density, as compared to control. This study demonstrates the induction of peroxisome proliferation in rainbow trout administered ciprofibrate, a known peroxisome proliferator in rodents. (Author's abstract)
W91-01280

ECOLOGICAL CORRELATION BETWEEN ARSENIC LEVEL IN WELL WATER AND AGE-ADJUSTED MORTALITY FROM MALIGNANT NEOPLASMS.

National Taiwan Univ., Taipei. Inst. of Public Health.
C. J. Chen, and C. J. Wang.
Cancer Research CNREA8, Vol. 50, No. 17, p 5470-5474, September 1990. 1 fig, 4 tab, 29 ref. National Science Council, Republic of China NSC 78-0412-B002-79.

Descriptors: *Arsenic, *Cancer, *Mortality, *Statistical analysis, *Taiwan, *Water pollution effects, *Well water, Bioaccumulation, Blackfoot disease

Epidemiology, Public health, Regression analysis, Statistical studies.

A significant dose-response relation between ingested arsenic and several cancers has recently been reported in four townships of the endemic area of blackfoot disease, a unique peripheral artery disease related to the chronic arsenic exposure in southwestern Taiwan. This study was carried out to examine ecological correlations between arsenic levels of well water and mortality from various malignant neoplasms in 314 precincts and townships of Taiwan. The arsenic content of water in 83,656 wells was determined by a standard mercuric bromide stain method from 1974-1976, while mortality rates of 21 malignant neoplasms among residents in study precincts and townships from 1972-1983 were standardized to the world population in 1976. A significant association with the arsenic level in well water was observed for cancers of the liver, nasal cavity, lung, skin, bladder and kidney in both males and female as well as for prostate cancer in males. These associations remain significant after adjusting for indices of urbanization and industrialization through multiple regression analyses. The multivariate-adjusted regression coefficient indicating an increase in age adjusted mortality per 100,000 person-years for every 0.1 ppm increase in arsenic level of well water was 6.8 and 2.0, 0.7 and 0.4, 5.3 and 5.3, 0.9 and 1.0, 3.9 and 4.2, as well as 1.1 and 1.7 respectively, in males and females for cancers of the liver, nasal cavity, lung, skin, bladder and kidney. The multivariate-adjusted regression coefficient for the prostate cancer was 0.5. These weighted regression coefficients were found to increase or remain unchanged in further analyses in which only 170 southwestern townships were included. (Author's abstract)
W91-01292

ELATIVE SENSITIVITIES OF DIFFERENT IFE STAGES OF ISOGNOMON CALIFORNI-UM TO CADMIUM TOXICITY.
awaii Univ., Honolulu. Kewalo Basin Marine ammal Lab.
H. Ringwood.
rchives of Environmental Contamination and oxicology AECTCV, Vol. 19, No. 3, p 338-340, ay/June 1990. 1 fig, 15 ref.

escriptors: *Bioassay, *Cadmium, *Heavy tals, *Mollusks, *Toxicity, *Toxicology, *Water llution effects, Bivalves, Embryonic growth ge, Estuaries, Growth stages, Juvenile growth ge, Larvae, Salinity, Water pollution.

rine organisms that occur in coastal and estuae habitats may be exposed to toxic concentrans of trace metals. When acute toxicity (meas-d on the basis of LC50) is used as a measure of tive sensitivity, it has generally been found that al stages of fish and invertebrates are killed at er concentrations of metals than adults. Emos, four different ages of larvae, juveniles and lts of a Hawaiian bivalve, Isognomon californi, were exposed to a range of cadmium concenions at two salinities to determine 48-hour 50 and to compare the relative sensitivities of various life stages. The Cd 48-hour LC50 of ryos, 3-day and 10-day old larvae were similar, bout 0.5 mg/L. Older larvae, 24 and 36-day, showed a similar sensitivity to each other but r LC50s (4.0 mg/L) were approximately one er of magnitude higher than those of the nger stages. Newly settled juveniles were less itive than embryonic or larval stages and ts were the least sensitive. There was a general d to increased toxicity with decreased salinity, salinity effects were not significant with late ae, juveniles, or adults. (Mertz-PTT)
-01308

LUENCE OF CADMIUM AND ZINC ON MIUM TURNOVER IN THE ZEBRAFISH, CHYDANIO RERIO.
ala Univ. (Sweden). Dept. of Zoology.
icklund, L. Norrgren, and P. Runn.
ives of Environmental Contamination and cology AECTCV, Vol. 19, No. 3, p 348-353, June 1990. 2 fig, 2 tab, 16 ref.

Descriptors: *Bioaccumulation, *Bioassay, *Cadmium, *Fish physiology, *Heavy metals, *Path of pollutants, *Toxicology, *Water pollution effects, *Zinc, Chronic toxicity, Radioactive tracers, Synergistic effects, Toxicity, Water pollution, Zebra fish.

A study was made of the dynamics of non-dietary cadmium in fish exposed to different concentrations of cadmium and zinc in water. Zebrafish, Brachydanio rerio, were exposed to Cd and Zn for various periods. The fate of a short pulse of the radioactive tracer 109Cd (3 or 9 days) was studied during a post-pulse period of 53 or 83 days. The majority of the 109 Cd taken up in the gills during the pulse period was retained in the gill tissue and slowly transferred to the internal organs or lost to the water during the post-pulse period. The retention of tracer in the gills after a 3-day 109Cd pulse was increased by Zn but not by Cd. Continuous exposure to stable Cd increased the rate of turnover of the retained 109Cd. Both Cd and Zn increased the tracer accumulation in the liver and kidney. The results also indicated that the effect of Zn on the Cd turnover might be lost if the environmental Zn is withdrawn before the start of the 109 Cd pulse. A tendency for increased mortality in the fish exposed to 1 microgram Cd/L for 2-3 months suggested that low concentrations of Cd is toxic to the fish during chronic exposure. The increased Cd uptake and transfer in the gills, caused by Zn, could have deleterious effects on the fish. It might also reflect a change in the form of transport and in the intracellular handling of the metal, which protects the fish from Cd toxicity. However, a Zn pre-exposure did not decrease the mortality, which suggests that Zn did not protect the fish from Cd toxicity. (Mertz-PTT)
W91-01310

EFFECTS OF TRIBUTYLTIN ON DEFENSE-RELATED ACTIVITIES OF OYSTER HEMOCYTES.
Maryland Univ., Cambridge. Horn Point Environmental Labs.
W. S. Fisher, A. Wishkovsky, and F.-L. E. Chu.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 354-360, May/June 1990. 5 fig, 1 tab, 36 ref. University of Maryland Sea Grant College NA86-AA-D-FG-006.

Descriptors: *Antifoulants, *Biocides, *Oysters, *Toxicity, *Toxicology, *Tributyltin, *Water pollution effects, Bioassay, Chemiluminescence, Crassostrea, Mollusks, Paints, Salinity, Water pollution.

Tributyltin compounds are used in marine antifouling paints as a biocide. Initial reports on the effects of tributyltin on economically important oysters, Crassostrea gigas, demonstrated shell abnormalities. Subsequent research on bivalve molluscs has found tributyltin to affect chromosomes, sex ratio and gamete production, and embryo and larval survival. Several defense-related activities of hemocytes from oysters (Crassostrea virginica and C. gigas) were assayed in vitro with different levels of tributyltin (0.4-4000 parts per billion) to determine whether defense-related cell mechanisms were affected. Chemiluminescence, a presumptive indicator of phagocytic activity, was reduced with increasing concentrations of tributyltin and preincubation with tributyltin appeared to eliminate chemiluminescence. Locomotion of hemocytes was also retarded by tributyltin, but the ability of the hemocytes to spread to an ameboid shape was not affected. In vitro salinity regulation of oceanic oyster hemocytes to lower salinities was not affected by tributyltin exposure and salinity regulation of estuarine oyster hemocytes to higher salinities was retarded only after a salinity change from 12 parts per trillion to 36 parts per trillion. (Mertz-PTT)
W91-01311

MACROINVERTEBRATE COMMUNITY RESPONSES TO COPPER IN LABORATORY AND FIELD EXPERIMENTAL STREAMS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
W. H. Clements, D. S. Cherry, and J. Cairns.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 361-365, May/June 1990. 3 fig, 2 tab, 22 ref.

Descriptors: *Copper, *Heavy metals, *Macroinvertebrates, *Streams, *Toxicity, *Toxicology, *Water pollution effects, Caddisflies, Dechlorinated water, Laboratory methods, Mayflies, Water pollution.

Macroinvertebrate community responses to copper in laboratory streams receiving dechlorinated tap water and field streams receiving natural river water were compared. Since both tap water and natural river water were taken from the same source in these experiments, several of the important water quality parameters known to influence heavy metal toxicity were similar. Despite the fact that field streams were initially dominated by metal-sensitive Ephemeroptera, effects of Cu were greater in the laboratory. After 10 days of exposure to Cu (11.3 microgram/L), macroinvertebrate abundance was reduced by 75% in laboratory streams compared to 44% in field streams. In the field, the number of taxa was reduced by 10% in treated streams compared to 56% in the laboratory. The response of dominant taxa to Cu exposure was also greater in the laboratory. In the field, abundance of metal-tolerant caddisflies (Hydropsychidae:Trichoptera) was similar in control and treated streams (11.3 microgram/L). These organisms were reduced by 71% in laboratory streams at similar Cu levels. The greater impact of Cu observed in laboratory streams may have resulted from the inability of certain taxa to acclimate to laboratory conditions. The usefulness of community-level toxicity tests in the laboratory may be limited due to the overestimation of metal toxicity. Further research should be conducted in field mesocosms receiving water directly from the system under investigation. (Author's abstract)
W91-01312

ACUTE TOXICITY OF BORON, MOLYBDENUM, AND SELENIUM TO FRY OF CHINOOK SALMON AND COHO SALMON.
National Fisheries Contaminant Research Center, Yankton, SD. Field Research Station.
S. J. Hamilton, and K. J. Buhl.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 366-373, May/June 1990. 7 tab, 39 ref.

Descriptors: *Acute toxicity, *Boron, *Fish physiology, *Molybdenum, *Salmon, *Selenium, *Toxicology, *Water pollution effects, Brackish water, Freshwater, Growth stages, Oncorhynchus, Selenates, Selenites, Toxicity, Water pollution.

The acute toxicities of boron, molybdenum, and various forms of selenium, individually and in environmentally relevant mixtures, to swim-up and advanced fry of chinook salmon (Oncorhynchus tshawytscha) and coho salmon (O. kisutch) were determined in site-specific fresh and brackish waters. Boron and molybdenum were relatively nontoxic (96-hour LC50 > 100 mg/L) to both life stages of both species. Selenite was significantly more toxic than selenate to both species. Swim-up fry tested in fresh water were significantly more sensitive than advanced fry in brackish water to selenate and selenite. No mortalities occurred in any concentrations tested of seleno-DL-methionine; however, in the highest concentration (21.6 mg Se/L), at least 50% of the fish showed pronounced surfacing behavior. Coho salmon were more sensitive than chinook salmon to both selenate and selenite at either life stage; only the swim-up fry of coho salmon were more sensitive than chinook salmon to boron. In additional tests with swim-up chinook salmon, differences in the characteristics of the dilution water did not significantly modify the relative toxicities of boron, selenate, and selenite. In binary mixture studies, the joint acute toxic action of selenate and selenite, combined in various ratios, was additive to both species. Based on a comparison of the individual acute values for chinook salmon to the expected environmental concentrations, the margin of safety for boron was only 56 in fresh and 46 in brackish water. The margins of safety for selenate and sele-

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nite exceeded 275 in both fresh and brackish waters. However, the margin of safety for both selenate and selenite in the mixture test was 145 in fresh water and 220 in brackish water. (Author's abstract)
W91-01313

SELENIUM ACCUMULATION AND ELIMINATION IN MALLARDS.
Patuxent Wildlife Research Center, Laurel, MD.
For primary bibliographic entry see Field 5B.
W91-01314

BEHAVIORAL INDICATORS OF SUBLETHAL TOXICITY IN RAINBOW TROUT.
National Fisheries Contaminant Research Center, Columbia, MO.
E. E. Little, R. D. Archeski, B. A. Flerov, and V. I. Kozlovskaya.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 380-385, May/June 1990. 2 tab, 29 ref.

Descriptors: *Agricultural chemicals, *Chronic toxicity, *Fish behavior, *Toxicity, *Toxicology, *Trout, *Water pollution effects, Carbaryl, Chlordane, Dimethylamine salts, Methyl parathion, Oncorhynchus, Pentachlorophenol, Sublethal effects, Tributyl phosphorotrithioate, Water pollution.

Four measures of behavior--spontaneous swimming activity, swimming capacity, feeding behavior, and vulnerability to predation--were assessed as indicators of sublethal toxicity in rainbow trout (Oncorhynchus mykiss) in 96-hour exposures to sublethal concentrations of six agricultural chemicals: carbaryl, chlordane, dimethylamine salt of 2,4-dichlorophenoxyacetic acid, tributyl phosphorotrithioate, methyl parathion, and pentachlorophenol. After exposures, behavioral changes consistently demonstrated sublethal toxicity, but effects on specific behaviors varied with contaminants and the concentrations were altered by the water quality criterion concentration for chlordane (2 microgram/L), and at a concentration of tributyl phosphorotrithioate (5 microgram/L) that had previously been shown to inhibit growth and survival after a 90-day exposure. Feeding behavior was inhibited most by exposure to tributyl phosphorotrithioate, 2,4-dichlorophenoxyacetic, and methyl parathion. Vulnerability to predation was heightened most by exposure to carbaryl and pentachlorophenol. Although all chemicals inhibited spontaneous swimming activity, only carbaryl, tributyl phosphorotrithioate, and 2,4-dichlorophenoxyacetic influenced swimming capacity. (Author's abstract)
W91-01315

SPECIES-SPECIFIC REACTION OF LIVER ULTRASTRUCTURE IN ZEBRAFISH (BRACHYDANIO RERIO) AND TROUT (SALMO GAIRDNERI) AFTER PROLONGED EXPOSURE TO 4-CHLOROANILINE.
Heidelberg Univ. (Germany, F.R.). Dept. of Zoology 1.
T. Braunbeck, B. Storch, and H. Bresch.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 405-418, May/June 1990. 32 fig, 68 ref. Federal Republic of Germany UFOPLAN (environmental research program) FE-Nr. 10603046 and German Research Foundation DFG Sto 75/9.

Descriptors: *Chloroaniline, *Fish, *Fish physiology, *Pesticide toxicity, *Pesticides, *Toxicity, *Toxicology, *Trout, *Water pollution effects, *Zebra fish, Chronic toxicity, Tissues, Water pollution.

The morphological alterations of hepatocytes of female zebrafish, Brachydanio rerio, and fingerling rainbow trout, Salmo gairdneri, following prolonged exposure to 0.04, 0.2, and 1 mg/L of 4-chloroaniline were investigated by means of light and electron microscopy. Changes in peroxisomes were visualized by cytochemical demonstration of catalase activity after incubation in the alkaline diaminobenzidine medium. The amount of storage products was illustrated by the silver impregnation technique. In a dose-dependent manner, the reaction of female zebrafish liver is characterized by a disturbance of hepatocytic compartmentation, progressive fenestration and fractionation of the rough endoplasmic reticulum, a decrease in the number of peroxisomes and catalase activity, stratified inclusions in mitochondria, and an augmentation of lysosomes and myelinated bodies. Trout hepatocytes display nuclear inclusions, fractionation and vesiculation of the endoplasmic reticulum, and an increase in mitochondria, but a decrease of peroxisomes and catalase activity. Whereas glycogen stores are exhausted at 1 mg/L 4-chloroaniline, lipid deposits are amplified. An elevated rate of hepatocytic mitosis as well as the occurrence of glycogen-condensing cells probably derived from hepatocytes indicate the induction of proliferative processes in trout liver. Evaluation and comparison of results with earlier reports suggest that despite the unspecificity of some alterations, the combination of pathological symptoms yields a syndrome specific for the species and the substance studied. As a consequence, histological and cytological investigations are recommended as a routine supplement in an integrated test schedule for the assessment of sublethal effects of pollutants in the aquatic environment. (Author's abstract)
W91-01317

LONG-TERM TOXICITY TEST COMPRISING REPRODUCTION AND GROWTH OF ZEBRAFISH WITH 4-CHLOROANILINE.
Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.).
H. Brsch, H. Beck, D. Ehlermann, H. Schlaszus, and M. Urbanek.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 419-427, May/June 1990. 4 fig, 1 tab, 28 ref. Federal Environmental Agency (FRG) UFOPLAN (environmental research program) FE-Nr. 10603046.

Descriptors: *Bioassay, *Bioindicators, *Fish physiology, *Pesticide toxicity, *Testing procedures, *Toxicity, *Toxicology, *Water pollution effects, Chronic toxicity, Fish eggs, Long-term test, Reproduction, Zebra fish.

A long-term test over three generations was conducted, using zebrafish (Brachydanio rerio) as the test species and concentrations of 1, 0.2, and 0.04 mg/L 4-chloroaniline as a model substance. The effect of the compound on the ecologically important parameters of reproduction and growth was studied. Reduction in egg release by fish raised under 4-chloroaniline was the most sensitive parameter in the test. Compared to the toxic threshold concentration for growth (0.4 mg/L), egg release was affected by a ten-fold lower concentration (0.04 mg/L). Results show that long-term study is the most appropriate method to assess the chronic toxicity of a substance on fish. Long-term tests start with eggs from unexposed parents and continue into a second generation, because sexual maturity of fish from the first generation will not show disturbances in growth or reproduction caused by abnormal development of gonads. To reveal such effects the test should either begin with adult fish exposed to the test substance and continue through the growth of at least one generation, or a test should be started with eggs from unexposed parents and then should be conducted until sexual maturity of the second generation. (Mertz-PTT)
W91-01318

ACID PRECIPITATION AND FOOD QUALITY: INHIBITION OF GROWTH AND SURVIVAL IN BLACK DUCKS AND MALLARDS BY DIETARY ALUMINUM, CALCIUM, AND PHOSPHORUS.
Patuxent Wildlife Research Center, Laurel, MD.
D. W. Sparling.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 457-463, May/June 1990. 5 fig, 4 tab, 27 ref.

Descriptors: *Acid rain effects, *Aluminum, *Calcium, *Ducks, *Phosphorus, *Water pollution effects, *Waterfowl, Black ducks, Diets, Growth, Mallards, Mortality.

In areas impacted by acid precipitation, water chemistry of acidic ponds and streams often changes, resulting in increased mobilization of aluminum and decreased concentration of calcium carbonate. Aluminum binds with phosphorus and inhibits its uptake by organisms. Thus, invertebrate food organisms used by waterfowl may have inadequate Ca and P or elevated Al for normal growth and development. Acid rain and its effects may be one of the factors negatively impacting American black ducks (Anas rubripes) in eastern North America. One-day old mallards (A. platyrhynchos) and black ducks were placed on one of three Ca:P regimens: low:low, normal:normal, and low:high with each regimen divided further into three or four Al levels for 10 weeks. 45% of the black ducks died on nine different diets whereas only 28% of the mallards died on three different diets. Mortality was significantly related to diet in both species. Growth rates for body weight, culmens, wings, and tarsi of both species on control diet exceeded those on many treatment diets but the differences were less apparent for mallards than for black ducks. Differences among treatments were due to both Ca:P and Al levels. Over a period of two to three weeks, high Al diets coupled with low Ca and P were most toxic to ducklings. Al was toxic even when Ca and P levels approximated generally accepted dietary levels. Elevated levels of P may reduce mortality of birds on high Al compared with those on diets with low Ca and P, but comparable Al levels. (Mertz-PTT)
W91-01320

EFFECT OF PH ON THE ACCUMULATION KINETICS OF PENTACHLOROPHENOL IN GOLDFISH.
Washington State Univ., Pullman. Coll. of Pharmacy.
For primary bibliographic entry see Field 5B.
W91-01321

METABOLIC EFFECTS OF KRAFT MILL EFFLUENTS ON THE EEL ANGUILLA ANGUILLA L.
Aveiro Univ. (Portugal). Dept. of Biology.
M. A. Santon, F. Pires, and A. Hall.
Ecotoxicology and Environmental Safety EESADV, Vol. 20, No. 1, p 10-19, August 1990. 10 fig, 4 tab, 21 ref. Protugese INIC Contract 85 CNA/6.

Descriptors: *Eel, *Fish physiology, *Kraft mill wastes, *Pulp and paper industry, *Pulp wastes, *Water pollution effects, Anguilla, Portugal, Tissues, Wastewater, Water pollution.

In Portugal, large quantities of Kraft pulp mill wastes are discharged into estuarine and free waters and young fish and their prey may be affected by prolonged exposure to dilute concentrations of kraft and pulp mill effluents. Yellow eels (Anguilla anguilla L.) with an average weight of 60 g were caught in June/July at the Aveiro Lagoon on the Portugese West Coast, transported to the Department of Biology, Aveiro University and kept in aerated aquaria for 1 week before the experiment started. The eels were then exposed for 1 and 3 weeks to 75 and 50% of the kraft pulp mill effluent. The eels exposed to the kraft pulp mill effluent developed an increase in red blood cell number per cubic millimeter and several biochemical changes, such as an increase in plasma lactate and sodium and a decrease in plasma pyruvate and potassium. Histological examination of the experimental eels exposed to the 50% kraft pulp mill effluent revealed deep alteration of the tissue structure, such as disruption of the skin and edematous hypertrophy of covering epithelial cells in secondary gill lamellae. The kidney had damage of the renal tubules. The liver developed necrosis supported by a significant decrease in glutamic oxaloacetic transaminase and glutamic pyravic transaminase activity. The spleen had an increase in blood content as well as in pigment centers. Previous results indicated that kraft pulp mill effluent causes tissue damage and consequent metabolic changes in the eel Anguilla anguilla L. (Mertz-PTT)
W91-01323

IN VIVO RECOVERY OF GLYCOGEN METABOLISM IN HEMOLYMPH AND TISSUES OF A FRESHWATER FIELD CRAB BARYTELPHUSA GUERINI ON EXPOSURE TO HEXAVALENT CHROMIUM.
Osmania Univ., Hyderabad (India). Dept. of Zoology.
N. B. R. K. V. Gopal, A. M. Chandravathy, S. Sultana, and S. L. N. Reddy.
Ecotoxicology and Environmental Safety EESADV, Vol. 20, No. 1, p 20-29, August 1990. 5 tab, 30 ref.

Descriptors: *Bioassay, *Chromium, *Crabs, *Crustaceans, *Toxicity, *Water pollution effects, Barytelphusa, Chromates, Chronic toxicity, Dichromate, Physiology, Tissues, Water pollution.

Hexavalent chromium most often appears as a water-soluble chromate or dichromate, both powerful oxidants that can easily penetrate biologic membranes and irritate cells. These compounds are extensively manufactured and utilized by many industries; often they are found in industrial effluents. The in vivo toxic effects of hexavalent chromium (20 mg/L) on hemolymph glucose, tissue glycogen, total free sugars, and active and total phosphorylases of an edible, freshwater crab Barytelphusa guerini were studied. In a 15-day exposure span followed by a 15-day postexposure recovery, the time-course alterations in these constituent segments of the glycogen metabolism indicate an inconsistent depletion in metabolite levels and elevated enzyme activities during exposure period as well as hyperglycemia. The persisting trend of the alterations in glycogen metabolism observed in the tissues of crabs even after their transfer to toxicant-free water suggests the retention and slow elimination of this metal species. However, the pattern of biochemical alterations are not time-dependent, and deviation in responses to Cr(VI) exposure suggests that the differential uptake into tissues and a subsequent redistribution of this anionic metal may possibly account for the varied disturbances in the tissues and reflect the susceptibility of crabs to chromium toxicity. (Mertz-PTT)
W91-01324

EFFECT OF COPPER SULFATE ON HEMATOLOGY, BLOOD CHEMISTRY, AND HEPATO-SOMATIC INDEX OF AN INDIAN CATFISH, HETEROPNEUSTES FOSSILIS (BLOCK), AND ITS RECOVERY.
Andhra Univ. (India). Dept. of Zoology.
K. S. Singh and T. V. Reddy.
Ecotoxicology and Environmental Safety EESADV, Vol. 20, No. 1, p 30-35, August 1990. 1 tab, 25 ref.

Descriptors: *Algicides, *Bioassay, *Catfish, *Copper sulfate, *Fungicides, *Toxicity, *Water pollution effects, Fish, Fish physiology, Heteropneustes, Parasiticide, Tissues, Water pollution.

Copper sulfate is one of the oldest chemicals used as an algacide, a fungicide, and a parasiticide in fish culture, and is commonly considered to be 100% effective. Apart from its help to pisciculturists, it has a serious disadvantage of being toxic to fish. The effect of CuSO4 (0.25 parts per million) on hematology, blood chemistry, and hepato-somatic index was studied in the Indian catfish, Heteropneustes fossilis (Bloch). Analysis of various parameters was made after 24 hours, and 5, 10, 20, and 30 days of CuSO4 exposure. Subsequently, some fish were allowed recovery periods of 24 hours and 5 days in normal water. Fish were normal in the early periods of CuSO4 intoxication, but later they became lethargic and began surfacing frequently to gulp air. There were numerous immature erythrocytes and broken fragments of blood corpuscles visible in the Neubauer chamber when the cells were counted. Physicological functions, such as hematopoiesis, metabolism in general, excretory and respiratory failure, and ionic imbalance were affected. The results indicate that hematological and biochemical parameters and hepato-somatic index values are good indicators of CuSO4 intoxication in H. fossilis (Bloch). (Mertz-PTT)
W91-01325

EFFECT OF 3,4-DICHLOROANILINE AND METAVANADATE ON DAPHNIA POPULATIONS.
Centre for Technology and Policy Studies TNO, Apeldoorn (Netherlands). Dept. of Biology.
N. van der Hoeven.
Ecotoxicology and Environmental Safety EESADV, Vol. 20, No. 1, p 53-70, August 1990. 10 fig, 1 tab, 16 ref, append.

Descriptors: *Bioassay, *Daphnia, *Dyes, *Model studies, *Toxicity, *Water pollution effects, Aquatic populations, Dichloraniline, Growth, Kooijman model, Metavanadate, Pollutants, Population dynamics, Population exposure, Toxicants, Water pollution.

To compare the effects of toxicants on individuals with those on populations, a population model was developed for daphnids based on some facts about the development of individual daphnids and on some more general assumptions. The Kooijman model provides reasonable predictions on the individual level. The parameters in the model have a physical interpretation, making it possible to translate the effect of a toxicant to a change in parameter value. It can only be extended to population levels by extensive computer simulations. Fourteen continuously fed populations of Daphnia magna were exposed to 3,4-dichloroaniline or metavanadate and monitored for 20 (two controls), 14 (six with metavanadate), and 8 (six with 3,4-dichloroaniline) weeks. The controls showed a damped oscillation. Low concentrations of either 3,4-dichloroaniline or metavanadate stimulated the first population peak. High concentrations of metavanadate rendered population peaks less regular, and at the highest metavanadate concentration, one population perished. High concentrations of 3,4-dichloroaniline slightly reduced population size. Four periodically fed populations of D. magna were also monitored. The more they were fed, the larger they grew. In the continuously fed populations, ephippia were formed at and just after the population peaks. No ephippia were noted in the periodically fed populations. Metavanadate promoted the formation of ephippia, and 3,4-dichloroaniline depressed sexual reproduction at all concentrations tested. The population dynamics of the controls were compared with those predicted by Kooijman's model for growth and reproduction of individual daphnids. In general, there is reasonable agreement between model predictions and observations, but some adjustments to the model may be necessary. (Mertz-PTT)
W91-01326

INCORPORATION OF A SUBACUTE TEST WITH ZEBRA FISH INTO A HIERARCHICAL SYSTEM FOR EVALUATING THE EFFECT OF TOXICANTS IN THE AQUATIC ENVIRONMENT.
Swedish Environmental Research Inst., Stockholm.
A. H. Neilson, A. S. Allard, S. Fischer, M. Malmberg, and T. Viktor.
Ecotoxicology and Environmental Safety EESADV, Vol. 20, No. 1, p 82-97, August 1990. 12 tab, 69 ref.

Descriptors: *Bioassay, *Bioindicators, *Chlorinated hydrocarbons, *Fish physiology, *Pesticide toxicity, *Phenolic pesticides, *Toxicity, *Water pollution effects, Hydrogen ion concentration, Testing procedures, Water pollution, Zebra fish.

Single-species laboratory tests were used to assess the acute toxicity of halogenated phenolic compounds. Subacute, preexposure and postexposure tests were examined. 4,5,6-trichloroguaiacol and 3,4,5-trichlorophenol were tested in each system. Other compounds tested included a range of chlorophenols, bromophenols, nitrophenols, 2,4,5-trichloroanisol, 2,4,6-tribromoanisole, and 1,2,3-trichlorobenzene. No single test system was most sensitive to all of the compounds examined, substantial variations in the sensitivity of the various organisms were noted, and there was no correlation between the toxicities assayed with different test systems. The zebra fish (Brachydanio rerio) embryo/larvae system was used to examine subacute effects using two of the compounds, and a protocol was developed with 6 weeks preexposure to the toxicant. Preexposure decreased the lowest observable effect concentration by a factor of about 4, and the effect was completely reversible during a 6-week postexposure period in the absence of the toxicant. An enclosed system for carrying out the zebra fish embryo/larvae test was developed and evaluated with three neutral volatile compounds: the median survival time and the frequency of occurrence of deformation were examined as end points. The effect of pH on toxicity was evaluated in buffered media for four of the test systems: toxicity increased markedly at the lower pH values, and it could be shown that the ionized forms of the phenols were not the only contributors to toxicity. It is proposed that the zebra fish system incorporating preexposure could be incorporated into a hierarchical system using a range of organisms for assessing acute toxicity in single species under laboratory conditions and multicomponent systems simulating natural ecosystems. (Mertz-PTT)
W91-01327

ENVIRONMENTAL IMPACT OF NORTH SEA OIL.
Dundee Univ. (Scotland). Dept. of Biological Sciences.
A. M. Jones.
Science Progress SCPRAY, Vol. 73, No. 292,4, p 457-468, 1989. 2 fig, 1 tab, 36 ref.

Descriptors: *Environmental effects, *Environmental impact, *North Sea, *Oil industry, Environmental policy, Impact assessment, Oil pollution, Resources development.

The North Sea is a geographically large area of continental shelf water bordered by several countries. It has a surface area of some 575,000 square km and a volume of about 54,000 cubic km. The exploitation of gas began in 1965, while that of oil began in 1969. The development of North Sea oil has been a complex technological exercise and the potentials for impact have been many and varied. The impacts range from the development of the offshore exploration and extraction facilities, often taking place in a hostile environment and at the limits of the current technology, to the socioeconomic consequences of the, often temporary, high-wage economy associated with the construction phase of development. The major threats posed by the development of North Sea oil have so far been avoided through the joint activities of industry, planners and scientists. Most incidents have been local in effect and even in major accidents little real damage has resulted. The unpredictability of many inputs led to a need for monitoring programs to ensure that undesirable trends do not develop in sensitive areas or as a result of new technology being applied. The techniques of monitoring have been the source of much debate and have suffered from a lack of geographical integration: the need for more fundamental understanding of ecological change remains a problem for ecologically based programs. The difficulties of interpretation at the community and/or population level have led to the investigation of more physiological and cellular-level approaches to monitoring which offer considerable promise but which have not yet overcome the general problem of relating the observations to specific contaminants in a multiple-stress situation which is so common. There is good evidence that this approach is valuable, however, in indicating stressed populations and this is an important first step in monitoring objectives. (Mertz-PTT)
W91-01329

DECOMPOSITION RATE, CHEMICAL COMPOSITION AND NUTRIENT RECYCLING OF NYMPHAEA ALBA L. FLOATING LEAF BLADE DETRITUS AS INFLUENCED BY PH, ALKALINITY AND ALUMINIUM IN LABORATORY EXPERIMENTS.
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 2H.
W91-01332

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SPIROGYRA SPECIES AND ACCOMPANYING ALGAE FROM POOLS AND DITCHES IN THE NETHERLANDS.
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
J. Simons, and A. P. van Beem.
Aquatic Botany AQBODS, Vol. 37, No. 3, p 247-269, August 1990. 4 fig, 10 tab, 33 ref.

Descriptors: *Algae, *Chlorophyta, *Ditches, *Ponds, *Spirogyra, *The Netherlands, *Water pollution effects, Acidity, Alkalinity, Nutrients, Species diversity.

In ditches and moorland pools zygnematacean algae, especially Spirogyra make up an important and often dominant component of floating algae. Of the total number of 60 Spirogyra species recorded in the Netherlands, 47 species were recorded in ditches and pools. Sirogonium was represented by only one species, S. sticticum (Engl. Bot) Wille, and Mougeotia and Zygnema by seven and six species, respectively. In hardwater ditches, especially at sites with relatively low pollution, Spirogyra forms a richly diversified component with up to approximately 20 species per site. At hardwater sites with appreciable pollution Spirogyra is suppressed or replaced by massive growths of algae such as Cladophora, Vaucheria, Enteromorpha or Hydrodictyon. At low alkaline and slightly acid sites, the number of species per site is considerably lower. Under conditions with pH values <5, Spirogyra does not occur and is replaced by Mougeotia, Zygnema, Klebsormidium, Microspora, and some others. Periodicity was observed in Spirogyra with a peak in spore production occurring in the second half of May and the first half of June. Spores were more frequently observed in hardwater habitats than in low-alkaline environments. Most species have wide ranges of occurrence; 22 species were found in low alkaline and slightly acid habitats, but most of these species are not restricted to such environments. Presumably they are adapted to nutrient-poor conditions. In eutrophic hardwater ditches, Spirogyra granulata Jao and S. singularis Nordst. appeared to be very tolerant to pollution. Species such as Spirogyra nitida (Dillw.) Link and S. majuscula Kutz. seem to indicate seepage of groundwater in otherwise nutrient-rich environments. (Author's abstract)
W91-01333

PHOSPHATE (32P)-UPTAKE CAPABILITIES OF NATURAL PICOPLANKTON AND ULTRAPLANKTON COMMUNITIES IN LAKES OF DIFFERING DEGREES OF EUTROPHICATION.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Oekophysiologie.
H. Rai, and T. R. Jacobsen.
Archiv fuer Hydrobiologie AHYBA4, Vol. 118, No. 4, p 421-435, June 1990. 4 fig, 3 tab, 40 ref.

Descriptors: *Aquatic bacteria, *Eutrophic lakes, *Eutrophication, *Germany, *Limnology, *Phosphates, *Phytoplankton, Carbon, Differential fractionation, Orthophosphates, Particle size, Picoplankton, Radioisotopes, Tracer studies, Ultraplankton.

Differential fractionation of P32 as PO4 uptake in North Germany Baltic lakes of varying trophic states was done to distinguish the activity of phytoplankton and bacterioplankton. In all the lakes studied, orthophosphate uptake was overwhelmingly associated with the smallest size particles (<1 microm). Therefore, it is inferred that the bacterioplankton (<1 microm) are responsible for the uptake of orthophosphate in situ conditions, regardless of the ambient phosphorus concentrations of the lakes. P32-uptake kinetics of size-fraction planktonic cells were conducted in mesotrophic Schohsee to determine size preference of phosphate uptake. Uptake rates in the 0.2-10 microm fraction were more than 60% (61-98%) of the 10-250 microm size particles. These findings are consistent with earlier studies that inferred that small cells should have extraordinary uptake capabilities for phosphate. Picoplankton and ultraplankton along with the heterotrophic bacteria are the major trophic groups responsible for phosphate and carbon metabolism in the lakes studied. (Author's abstract)
W91-01336

LONG TERM PATTERNS IN NUTRIENTS, PHYTOPLANKTON AND ZOOPLANKTON OF LAKE KINNERET AND FUTURE PREDICTIONS FOR ECOSYSTEM STRUCTURE.
Kinneret Limnological Lab., Tiberias (Israel).
M. Gophen, S. Serruya, and S. Threlkeld.
Archiv fuer Hydrobiologie AHYBA4, Vol. 118, No. 4, p 449-460, June 1990. 6 fig, 1 tab, 21 ref.

Descriptors: *Eutrophication, *Lake Tiberias, *Limnology, *Nutrients, *Phytoplankton, *Water pollution effects, *Zooplankton, Algae, Fisheries, Israel, Jordan River, Lakes, Monitoring, Nitrogen, Phosphorus.

Long-term records on nutrients, phytoplankton and zooplankton for Lake Kinneret, Israel were examined and indicated that there was reason for concern over future water quality. The discharge of the river and the concentration of major nutrient species in the river were monitored at least once monthly since October 1967 at a station 11 km above the lake and at stations on three Jordan headwater rivers (20-30km above Lake Kinneret). It was concluded that nutrient loading from the Jordan River has changed qualitatively in recent years, with ammonia and soluble phosphorus increasing relative to other forms of nitrogen and phosphorus. Total N in Lake Kinneret has been decreasing and total P has been increasing, resulting in an overall decline in the N:P ratio. Zooplankton biomass has been decreasing, as stocking of commercially favored fish species has increased and fishing pressure on dominant zooplanktivorous fish has decreased. Changes in nutrient loading and in fishery management appear to favor future development of less desireable species of algae in Lake Kinneret. (White-Reimer-PTT)
W91-01337

EPIPHYTIC ZOOBENTHOS DENSITY AND BIOMASS WITHIN LOW ALKALINITY, OLIGOTROPHIC LAKES ON THE CANADIAN SHIELD.
Toronto Univ. (Ontario). Inst. for Environmental Studies.
R. France.
Archiv fuer Hydrobiologie AHYBA4, Vol. 118, No. 4, p 477-499, June 1990. 3 fig, 4 tab, 86 ref.

Descriptors: *Acid rain effects, *Alkalinity, *Benthic fauna, *Canada, *Oligotrophic lakes, *Precambrian Shield, Biomass, Chlorophyll a, Correlation analysis, Depth, Hydrogen ion concentration, Lake morphometry, Light penetration, Littoral communities, Macroinvertebrates, Nitrogen, Ontario, Phosphorus, Population density, Standing crops.

The phytofaunal macroinvertebrate communities within the shallow littoral zones of 19 Ontario Shield lakes were examined during the ice-free seasons of 1984 and 1985. Neither total zoobenthos density nor biomass were linearly correlated with lake pH, alkalinity, total phosphorus (TP), total nitrogen, or chlorophyll-a concentrations. However, the standing crops of several taxa were significantly related to these and other limnological variables without discernable trends with regard to the summed totals. For example, lakes of high alkalinity (>3.5 mg CaCO3/L) had a large percentage of their total biomass composed of gastropods and turbellarians in contrast to lakes of low alkalinity (<1.0 mg/L) which were dominated by odonates and water mites. Secchi depth was the best trophic predictor of total density (r= -0.67) and total biomass (r=-0.63). The possibility of some dependence of littoral zoobenthos on allochthonous energy sources, and the potential for buffering within macrophyte beds, are both unknown, which, together with the narrow range of chemical variables in these lakes (e.g pH from 5.5 to 6.7 and TP from 5 to 14 mg/cu m), may explain the absence of strong chemical correlates of zoobenthos standing crop. There was a hyperbolic relationship between phytofaunal biomass and lake mean depth. The best single predictor of total biomass for the subset of 8 intensively sampled lakes was maximum depth (r=-0.92). The most productive direction towards predicting littoral zoobenthos standing crop may be the development of models relating macroinvertebrates to macrophytes and basin morphometry. (Author's abstract)
W91-01338

OCCURRENCE OF LIMNIC MICRO-CRUSTACEANS IN RELATION TO PH AND HUMIC CONTENT IN SWEDISH WATER BODIES.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W91-01350

CULTURAL EUTROPHICATION OF WEST POINT LAKE--A 10-YEAR STUDY.
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
D. R. Bayne, W. C. Seesock, C. E. Webber, and J. A. McGuire.
Hydrobiologia HYDRB8, Vol. 199, No. 2, p 143-156, July 24, 1990. 6 fig, 4 tab, 34 ref.

Descriptors: *Eutrophic lakes, *Eutrophication, *Georgia, *Phytoplankton, *Primary productivity, *Water pollution effects, *West Point Lake, Algae, Chlorophyll a, Conductivity, Nutrient enrichment, Reservoirs, Seasonal variation, Wastewater pollution.

Mean annual phytoplankton primary productivity of West Point Lake in Atlanta, Georgia, increased significantly during a 10-year period from 1976 (550 mg C/sq m/d) to 1985 (1580 mg C/sq m/d). The increased productivity was apparently caused by nutrient enrichment of the lake waters resulting from the significant increase in volume of treated sewage effluent and urban runoff associated with expanded urbanization of the Atlanta, Georgia, metropolitan area. With the exception of 1985, when conductivity and total phosphorus concentrations were significantly higher, monthly measurements of nutrient concentrations in the headwaters of the reservoir failed to reflect the eutrophication that was occurring. Multiple regression analysis revealed that, during the cool season, chlorophyll a was the most important variable in terms of explaining variations in primary productivity. During the warm season, specific conductance was most important. Volume of treated wastewater entering the reservoir was significantly related to primary productivity during both the cool and warm seasons. Except for 1985 when the mean annual chlorophyll a concentration (19.7 microg/L) was significantly higher than all other years, the chlorophyll content of the lake remained fairly stable (6.9-13.6 microg/L). Increased productivity in the absence of higher algal biomass was caused by more efficient photosynthesis by the algal community. The improved photosynthetic efficiency apparently occurred because of a shift in algal dominance from relatively large diatoms to relatively small green and blue-green taxa. (Author's abstract)
W91-01354

SHORT TERM BIOTIC RESPONSE BEFORE AND DURING THE TREATMENT OF AN ACID MINE DRAINAGE WITH SODIUM CARBONATE.
Q.C. Services, Teton, ID.
For primary bibliographic entry see Field 5G.
W91-01358

DISTRIBUTION OF SHORT CHAIN CARBOXYLIC ACIDS IN EUTROPHIC DRAINAGE CHANNELS.
Sussex Univ., Brighton (England). School of Biological Sciences.
For primary bibliographic entry see Field 5B.
W91-01359

PHARMACOKINETIC MODELING IN AQUATIC ANIMALS. I. MODELS AND CONCEPTS.
Dow Chemical Co., Midland, MI. Environmental Toxicology and Chemistry Research Lab.

For primary bibliographic entry see Field 5A.
W91-01361

SURVIVAL OF EARLY LIFE STAGES OF BROWN TROUT (SALMO TRUTTA L.) IN RELATION TO ALUMINIUM SPECIATION IN UPLAND WELSH STREAMS.
University Coll., Cardiff (Wales). School of Pure and Applied Biology.
N. S. Weatherley, A. P. Rogers, X. Goenaga, and S. J. Ormerod.
Aquatic Toxicology AQTODG, Vol. 17, No. 3, p 213-229, September 1990. 3 fig, 3 tab, 48 ref, append.

Descriptors: *Acid rain effects, *Fish populations, *Trout, *Water pollution effects, Aluminum, Fish eggs, Hydrogen ion concentration, Lethal limit, Survival.

The survival of artificially implanted eggs, alevins and parr of brown trout (Salmo trutta (L.)) was assessed in streams of different acidity. Chemical analysis included detailed aluminum speciation of surface and interstitial water samples, taken over the duration of intragravel life stages. Egg survival, from two minutes after fertilization to hatching, was usually above 71%, and was independent of the mean concentration of total monomeric aluminum over the range 3-397 micrograms/L. The survival of alevins exposed for 28 days (before 'swim up') or 42 days ('swim up') was most strongly related to mean monomeric aluminum concentration and to pH. For 28 and 42 day exposures, LC50 values for monomeric aluminum were approximately 19 and 15 micrograms/L, respectively, or 79 and 72 micrograms/L for 0.45 micrometer filterable aluminum. The 21 day LC50 of parr ca. 3 month old, was between 84 and 105 micrograms/L mean filterable aluminum concentration. During a simulated acid episode of mean pH 4.8 and 880 micrograms filterable aluminum/L parr showed 100% mortality after 18 hours. As exemplified in this study, chemical variables show wide and rapid fluctuations, and are often co-correlated. These features confuse interpretation of field experiments or prediction from laboratory data. (Author's abstract)
W91-01362

MOLLUSCICIDAL AND PISCICIDAL PROPERTIES OF COPPER(II) TETRAOXOSULFATE(VI) ON BULINUS GLOBOSUS (MORELET) AND CLARIAS ANGUILLARIS (L).
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Biological Sciences.
J. Ebele, A. A. Oladimeji, and J. A. Daramola.
Aquatic Toxicology AQTODG, Vol. 17, No. 3, p 231-238, September 1990. 5 fig, 16 ref.

Descriptors: *Copper compounds, *Fish, *Snails, *Toxicology, *Water pollution effects, Bioaccumulation, Bioassay, Copper tetraoxosulfate, Ecotoxicology, Fish physiology, Gills, Lethal limit, Toxicity.

The lethal effects of a chemical molluscicide, copper(II) tetraoxosulfate (VI), on Clarias anguillaris and Bulinus globosus were investigated. The fish were exposed to various concentrations of the chemical in 48, 72 and 96-h static bioassay, while the exposure time for the snails was 24 hours. The LC50 for the various treatments were calculated after corrections were made for natural responsiveness. The molluscicidal concentration was found to be lower than the piscicidal concentration. The histopathology of the gills of the fish revealed a general damage of the gill filaments probably leading to impairment of ion and oxygen uptake. Even though the molluscicidal concentration of copper(II) tetraoxosulfate is sublethal to C. anguillaris, consideration should be given to a long term accumulation of copper in the fish which in the end might reach the lethal concentration for the fish. Furthermore there exists the danger of subsequent passage of copper along the trophic chain which, in this case involves man. (Lantz-PTT)
W91-01363

STRUCTURE-TOXICITY RELATIONSHIPS FOR SELECTED WEAK ACID RESPIRATORY UNCOUPLERS.
Tennessee Univ., Knoxville. Coll. of Veterinary Medicine.
M. Cajina-Quezada, and T. W. Schultz.
Aquatic Toxicology AQTODG, Vol. 17, No. 3, p 239-251, September 1990. 3 fig, 3 tab, 34 ref.

Descriptors: *Dyes, *Organic acids, *Phenols, *Quantitative analysis, *Toxicity, *Toxicology, *Water pollution effects, *Weak acids, Bioassay, Biological studies, Data interpretation, Model studies, Regression analysis, Statistical models.

The relative biological response (log BR) for each of 30 select substitute phenols and anilines was evaluated using the 48-h Tetrahymena pyriformis population growth test system. Simple linear regression analysis of log BR versus log Kow (1-octanol/water partition coefficient) was used to formulate a quantitative structure-activity relationship (QSAR). The equation, log BR = 0.438 (log Kow) + 0.157; n = 27, r-squared = 0.933, s = 0.151, f = 348.02, is a highly predictive model. An evaluation of data on fathead minnow mortality for these same compounds shows a similar QSAR, log LC50 = -0.590(log Kow) -3.247; n = 11, r-squared = 0.917, s = 0.287, f = 99.04. These relationships are the respective QSARs for the respiratory uncoupling mechanism of action of selected weak acids. Moreover, the toxic response in the two systems are highly correlated (r-squared = 0.915). (Author's abstract)
W91-01364

EFFECT OF CADMIUM ON VITELLOGENIN METABOLISM IN ESTRADIOL-INDUCED FLOUNDER (PLATICHTHYS FLESUS (L.)) MALES AND FEMALES.
Odense Univ. (Denmark). Biological Inst.
A. F. Povlsen, B. Korsgaard, and P. Bjerregaard.
Aquatic Toxicology AQTODG, Vol. 17, No. 3, p 253-262, September 1990. 4 fig, 3 tab, 24 ref.

Descriptors: *Cadmium, *Fish physiology, *Flounders, *Vitellogenin, *Water pollution effects, Bioaccumulation, Biological studies, Estradiol, Liver, Toxicity.

The hepatic synthesis of vitellogenin can be induced in male teleosts by treatment with estradiol. During vitellogenesis in nature the metabolic demand on the liver of the female teleost is very large, considering that the weight of the ovary may increase to one-fourth or more of the body weight due to vitellogenic growth of the oocytes. It is well established that cadmium accumulates in the liver and kidney of teleost fish and may induce synthesis of metallothioneins in the liver. One injection of 2 mg cadmium/kg body wt reduced the ratio of RNA to DNA in the liver to less than half of the control value and significantly depressed the concentration of vitellogenin in the plasma of estradiol-injected female flounders. A dose of 0.5 mg cadmium/kg body wt had no effect. In estradiol-induced flounder males cadmium treatment had a significant reducing effect on the level of circulating vitellogenin in the combined estradiol-cadmium treated group compared to the estradiol treated group. No effect of cadmium was observed on the ratio of hepatic RNA to DNA in the male fish. By gel fractionation, it was found that 88% of the accumulated cadmium in the cadmium estradiol treated group and only 49% in the cadmium treated group were bound to small cytosol proteins (metallothioneins) indicating that estradiol interferes with the cadmium accumulating ability of the liver. (Lantz-PTT)
W91-01365

METABOLIC RESPONSE OF GRASS SHRIMP PALAEMONETES KADIAKENSIS RATHBUN, TO ACUTE EXPOSURE OF SUBLETHAL CHANGES IN PH.
Texas A and M Univ., College Station. Dept. of Biology.
D. L. McCulloch.
Aquatic Toxicology AQTODG, Vol. 17, No. 3, p 263-274, September 1990. 4 fig, 1 tab, 49 ref.

Descriptors: *Acid rain effects, *Hydrogen ion concentration, *Shrimp, *Sublethal effects, *Water pollution effects, Animal physiology, Bioassay, Biological studies, Oxygen, Stress, Toxicity.

The effects of sublethal changes in environmental pH on the grass shrimp Palaemonetes kadiakensis were determined using changes in metabolic rate and critical oxygen concentration as indicators of stress. Oxygen consumption was measured using a computer automated intermittent flow respirometer which allowed multiple sampling of a single individual without exposing it to prolonged oxygen stress. Metabolic rate and critical oxygen concentration were determined using a quadratic model with plateau nonlinear regression procedure. Sublethal changes in pH (6.5, 9.0) did not have a significant effect on metabolic rate. Temporary disturbances in hemolymph acid-base status caused by acute pH stress, may not elicit a metabolic response when not accompanied by necrosis of the gill epithelium. An effect of pH on the critical oxygen concentration was found. When the pH was 6.5, significantly higher than the control (pH 7.8), or 9.0, significantly lower than the control. Shifts in critical oxygen concentration were attributed to changes in blood oxygen affinity caused by hemolymph acidosis or alkalosis. (Author's abstract)
W91-01366

EFFECTS OF SUBLETHAL EXPOSURE TO CHLORINE ON THE UPTAKE OF POLYCHLORINATED BIPHENYL CONGENERS BY RAINBOW TROUT, SALMO GAIRDNERI (RICHARDSON).
Tennessee Univ., Knoxville. Graduate Program in Ecology.
M. C. Black, and J. F. McCarthy.
Aquatic Toxicology AQTODG, Vol. 17, No. 3, p 275-289, September 1990. 6 fig, 1 tab, 31 ref. DOE Contracts DE-AC06-76OR00033 and DE-AC05-84OR21400.

Descriptors: *Chlorine, *Polychlorinated biphenyls, *Sublethal effects, *Trout, *Water pollution effects, Bioassay, Biological studies, Ecotoxicology, Fish physiology, Gills, Oxygen, Toxicity.

Chlorine-induced changes in fish gill histopathology and respiration may alter the uptake of co-contaminants which are accumulated by passive diffusion across gill membranes. The effect of chlorine exposure on gill histopathology, respiratory functions, and uptake if three polychlorinated biphenyl (PCB) congeners by rainbow trout (Salmo gairdneri) were determined. Trout gill lamellar lesions occurring during a 24-h exposure to 0.04 mg/L chlorine included proliferation of mucous cells, hyperplasia of epithelial cells, clubbed lamellae, and lamellar fusion. These types of pathological changes would be expected to result in increased diffusion distances of the gill membrane and decreased functional gill surface area. Reductions in oxygen and PCB uptake efficiencies measured in concomitant exposures to chlorine and PCBs using a fish metabolic chamber were consistent with the histopathological results. Increases in trout ventilation compensated for the lowered uptake deficiencies. As a result of ventilatory compensation, there was little change in the oxygen consumption for PCB accumulation by trout throughout the exposure to chlorine. Correlations between oxygen and PCB uptake may provide a basis for estimating toxicant uptake using oxygen uptake data as the basis for extrapolation. (Author's abstract)
W91-01367

PHYTOPLANKTON DYNAMICS IN THREE ROCKY MOUNTAIN LAKES, COLORADO, U.S.A.
Geological Survey, Denver, CO.
D. M. McKnight, R. L. Smith, J. P. Bradbury, J. S. Baron, and S. Spaulding.
Arctic and Alpine Research ATLPAV, Vol. 22, No. 3, p 264-274, August 1990. 4 fig, 5 tab, 39 ref.

Descriptors: *Acid rain effects, *Limnology, *Mountain lakes, *Phytoplankton, *Population dy-

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namics, *Water pollution effects, Algae, Algal blooms, Colorado, Nitrates, Photosynthesis, Rocky Mountains, Snowmelt.

In 1984 and 1985 seasonal changes in phytoplankton were studied in a system of three lakes in Loch Vale, Rocky Mountain National Park, Colorado, to determine the effects of urban atmospheric deposition. Three periods were evident: (1) A spring bloom, during snowmelt, of the planktonic diatom Asterionella formosa, (2) a midsummer period of minimal algal abundance, and (3) a fall bloom of the blue-green alga Oscillatoria limnetica. Seasonal phytoplankton dynamics in these lakes are controlled partially by the rapid flushing rate during snowmelt and the transport of phytoplankton from the highest lakes to the lower lakes by the stream, Icy Brook. During snowmelt, the A. formosa population in the most downstream lake has a net rate of increase of 0.34/d, which is calculated from the flushing rate and from the A. formosa abundance in the inflow from the upstream lake and in the downstream lake. Measurement of photosynthetic rates at different depths during the three periods confirmed the rapid growth of A. formosa during the spring. The decline in A. formosa after snowmelt may be related to grazing by developing zooplankton populations. The possible importance of seasonal variations in nitrate concentrations were evaluated in in situ enrichment experiments. For A. formosa and O. limnetica populations, growth stimulation resulted from 8 or 16 micromolar amendments of calcium nitrate and sulfuric acid, but the reason for this stimulation could not be determined from these experiments. (Author's abstract)
W91-01368

RELATIONSHIPS AMONG DEPTH TO FROZEN SOIL, SOIL WETNESS, AND VEGETATION TYPE AND BIOMASS IN TUNDRA NEAR BETHEL, ALASKA, U.S.A.
Gettysburg Coll., PA. Dept. of Biology.
M. F. Gross, M. A. Hardisky, J. A. Doolittle, and V. Klemas.
Arctic and Alpine Research ATLPAV, Vol. 22, No. 3, p 275-282, August 1990. 3 fig, 3 tab, 51 ref. NASA Biospheric Research Program Grant NAGW-374.

Descriptors: *Air pollution effects, *Alaska, *Biomass, *Frozen ground, *Global warming, *Soil water, *Vegetation, Bethel, Soil environment, Tundra.

Investigators in this program participated in NASA's Biospheric Research Program Global Tropospheric Experiment (GTE) in Alaska in order to assess gas flux and vegetation characteristics of moist and wet tundra. Because wetland soils are often anaerobic, much of the organic carbon produced by wetland vegetation and buried when the vegetation dies decomposes under anoxic conditions. Among the gases released during decomposition is methane, a 'greenhouse gas' the concentration of which is increasing globally at the rate of about 1% per year. Wet tundra and its vegetation may play a major role in future biogeochemical cycling because there is a larger component of buried, partially decomposed organic matter in tundra soils, and because most models suggest that warming induced by the greenhouse effect will be relatively large in polar regions. The organic matter is not decomposing rapidly at present because of cold soil temperatures. In order to detect any future additional gas flux caused by greenhouse-effect warming, it is first necessary to have baseline data on current gas flux. Carbon sequestering through photosynthesis, and released through respiration, are strongly influenced by vegetation and temperature, including the effect of temperature on the depth of the biologically active layer. Therefore, changes in gas flux can, theoretically, be inferred by changes in vegetation condition (biomass or species distribution) or in depth of the thawed layer. Assessing changes in the tundra on a global scale will require the use of remote sensing to study vegetation and depth to frozen soil. Ground-penetrating radar (GPR) is a rapid, accurate way of measuring thickness of the active layer and depth to frozen soil remotely, while vegetation type can be surveyed for a large area of tundra quickly using satellite imagery. If any consistent relationship exists among vegetation type, biomass, soil wetness, and depth to frozen soil in tundra in the Bethel region of southwestern Alaska, a remote sensing-based assessment of vegetation type or of depth to frozen soil could possibly be used as a predictor of gas flux. (Lantz-PTT)
W91-01369

IMPLICATIONS OF AQUATIC ANIMAL HEALTH FOR HUMAN HEALTH.
Harvard Medical School, Boston, MA. Dept. of Pathology.
C. J. Dawe.
Environmental Health Perspectives EVHPAZ, Vol. 86, p 245-255, June 1990. 1 tab, 78 ref.

Descriptors: *Aquatic animals, *Environmental protection, *Path of pollutants, *Public health, *Public policy, *Water pollution effects, Environmental policy, Management planning, Policy making, Water pollution prevention.

Human health and aquatic animal health are organically related at three distinct interfaces. Aquatic animals serve as important contributors to the nutritional protein, lipid and vitamin requirements of humans; as carriers and transmitters of many infections and parasitic diseases; and as indicators of toxic and carcinogenic substances that they can convey, in some part from aquatic environments to humans and other terrestrial animals. Transcending these relationships, but less visible and definable to many, is the role that aquatic animals play in the sustenance of this integrated planetary ecosystem. The negative values of aquatic animals as disease vectors are far outweighed by their positive values as nutritional sources and as sustainers of a relatively stable equilibrium in the global ecosystem. In the immediate future, increased and improved monitoring of aquatic habitats can be expected to determine the extent to which aquatic animals cycle anthropogenic toxic and carcinogenic chemicals back to human consumers. In the long-term, methods are particularly needed to assess the effects of these pollutants on reproductive success in aquatic communities and in human communities as well. As inputs of habitat-degrading substances change in quality and quantity, it becomes increasingly urgent to evaluate the consequences in advance, not in retrospect. A new, more realistic and comprehensive philosophy regarding aquatic environmental preservation and equally new and comprehensive philosophy technological advances reflective of this philosophy will be required. (Lantz-PTT)
W91-01375

FISH HEALTH AND ENVIRONMENTAL HEALTH.
National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.
R. A. Murchelano.
Environmental Health Perspectives EVHPAZ, Vol. 86, p 257-259, June 1990. 22 ref.

Descriptors: *Bioindicators, *Biomonitoring, *Cancer, *Fish, *Monitoring, *Water pollution effects, Bioaccumulation, Boston Harbor, Flounders, Water quality.

Surveys conducted to evaluate the health of marine bottom fishes have been conducted in the eastern and western North Atlantic for the past 15 years, usually in conjunction with fish stock assessment cruises. The health of the fish sampled was evaluated using certain integumental and skeletal lesions and anomalies as markers to signify compromised health status. The results of these surveys indicate that fish health is poorer in coastal waters that have been anthropogenically degraded. Monitoring programs to determine the status and trends in levels in inorganic and organic contaminants in fish tissue and sediments have disclosed high levels of chemical contaminants in several coastal areas of the northern US. Histopathological examination of liver tissues of winter flounder, Pseudopleuronectes americanus, from Boston Harbor, one of the more chemically contaminated sites, has revealed a high prevalence of hepatocarcinoma. (Author's abstract)
W91-01376

ALUMINUM IN DOMESTIC WATER: OVERLOAD MAY BE HAZARDOUS TO DIALYSIS PATIENTS.
Louisiana State Univ. Medical Center, Shreveport.
K. Abreo, M. Sella, and S. T. Brown.
Journal of Environmental Health JEVHAH, Vol. 52, No. 5, p 289-290, March/April 1990. 1 fig, 1 tab, 16 ref.

Descriptors: *Aluminum, *Dialysis, *Domestic water, *Kidneys, *Louisiana, *Public health, *Water treatment, Clarification.

Since contamination of dialysis water can be a major source of aluminum accumulation, aluminum content was measured in domestic and dialysis water in all 59 dialysis units in Louisiana, and correlated with red cell indicies, a reversible marker of aluminum overload. Findings suggest that aluminum sulfate added to domestic water as a coagulant was responsible for increased aluminum levels. Since high aluminum levels pose a potential risk to patients with renal failure, aluminum free chemicals should be used for water clarification. Results of this study suggest that there is an increased likelihood of high aluminum content in domestic or drinking water derived from slowly flowing or stagnant surface sources to which aluminum sulfate has been added for clarification. Water treatment facilities could lower aluminum content of water by utilizing non-aluminum containing coagulants. (Lantz-PTT)
W91-01382

RELATIONS BETWEEN ACID RAIN AND VESICULAR-ARBUSCULAR MYCORRHIZA.
Utrecht Rijksuniversiteit (Netherlands). Dept. of Plant Ecology.
B. Heijne, G. W. Heil, and D. van Dam.
Agriculture, Ecosystems and Environment AEENDO, Vol. 29, No. 1-4, p 187-192, February 1990. 3 tab, 14 ref.

Descriptors: *Acid rain effects, *Air pollution effects, *Fungi, *Grasses, *Nitrogen, *Phosphorus, *Potassium, *The Netherlands, Nitrogen oxides, Sulfur dioxide, Vesicular-arbuscular mycorrhiza.

In the Netherlands, the air pollution of SO2 and NOx generally increases from the northwest to the southeast. Plants from dry grass heathland (Violion caninae) were sampled in May and at the end of September 1987, in both northern and southern Netherlands. Percentages of root length infected with vesicular-arbuscular mycorrhiza were calculated. Determination of nitrogen, phosphorus and potassium content of shoots and roots indicated there was a seasonal effect. In spring vesicular arbuscular mycorrhiza infection was lower than at the end of the summer. Plants of Viola canina which grew close to the border of an arable field (1-2 m), had a lower vesicular-arbuscular mycorrhiza infection than those growing the center of the heather vegetation. No correlation was found between the amount of vesicular-arbuscular mycorrhiza infection and the amount of acid rain as determined by the National Institute of Public Health and Environmental Hygiene. (Author's abstract)
W91-01410

TIME TREND OF PCB CONCENTRATIONS IN SURFACE SEDIMENTS FROM A HYPERTROPHIC, MACROALGAE POPULATED AREA OF THE LAGOON OF VENICE.
Venice Univ. (Italy). Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W91-01448

LITHIUM IN DRINKING WATER AND THE INCIDENCES OF CRIMES, SUICIDES, AND ARRESTS RELATED TO DRUG ADDICTIONS
California Univ., San Diego, La Jolla. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W91-01483

PIRLA PROJECT (PALEOECOLOGICAL IN-
VESTIGATION OF RECENT LAKE ACIDIFI-
CATION): AN INTRODUCTION TO THE SYN-
THESIS OF THE PROJECT.
ndiana Univ. at Bloomington. Dept. of Biology.
or primary bibliographic entry see Field 5B.
V91-01498

ALEOECOLOGICAL INVESTIGATION OF
ECENT LAKE ACIDIFICATION IN THE ADI-
ONDACK MOUNTAINS, N.Y.
idiana Univ. at Bloomington. Dept. of Biology.
or primary bibliographic entry see Field 5B.
/91-01499

TILITY OF SCALED CHRYSOPHYTES FOR
NFERRING LAKEWATER PH IN NORTHERN
EW ENGLAND LAKES.
ueen's Univ., Kingston (Ontario). Dept. of Biol-
gy.
or primary bibliographic entry see Field 2H.
91-01502

HERMAL AND TROPHIC STABILITY OF
EEPER MAINE LAKES IN GRANITE WA-
ERSHEDS IMPACTED BY ACID DEPOSI-
ON.
aine Univ. at Orono. Dept. of Geological Sci-
ces.
E. Stauffer, and B. D. Wittchen.
ater Resources Research WRERAQ, Vol. 26,
. 3, p 2143-2151, September 1990. 6 fig, 2 tab, 32
. OWRT Grant 5-6-44942.

scriptors: *Acid rain effects, *Lake acidifica-
n, *Limnology, *Maine, *Thermal stratification,
rophic level, *Water pollution effects, *Water
lution sources, Deep water, Granites, Hypolim-
n, Oxygen deficit, Stratification, Transparency.

id deposition can lead to lake and watershed
dification, increases in lake transparency, and
uctions in thermal stability and hypolimnetic
gen deficits. On the basis of lake surveys during
gust-September 1985, it was determined to what
ent the deeper (maximum depth > 17m) Maine
es in acid-sensitive granitic watersheds have
istered changes in temperature and oxygen
tification compared to the earliest scientific sur-
s of the state's lakes performed in 1938-1942.
er correcting for small but geographically con-
ent interannual differences in summer hypolim-
c temperatures related to spring turnover, and
ther-dependent differences in mixed layer
th, there has been no significant change in
mal stratification in these Maine lakes over
roximately 43 years. On the basis of specific
orical contrasts in the late summer metalimne-
hypolimnetic, and bathylimnetic oxygen con-
rations there has been no significant change in
trophic state or transparency. (Author's ab-
ct)
1-01530

DUCTION OF HEPATIC MIXED-FUNC-
N OXIDASE OF THE MULLET, MUGIL
IUY BY CRUDE OIL (IN CHINESE).
demia Sinica, Qingdao (China). Inst. of Ocean-
y.
eng, and F. Y. Liu.
anologia et Limnologia Sinica (Hai Yang Yu
Chao) HYHCAG, Vol. 21, No. 2, p 192-195,
ch 1990. 1 tab, 8 ref. English summary.

criptors: *Bioindicators, *Enzymes, *Fish
iology, *Oil pollution, *Water pollution ef-
, China, Fauna, Huiquan Bay, Mullet, Qing-

ction of hepatic aryl hydrocarbon hydroxylate
H), an enzyme, by crude oil in the liver of
l so-iuy was used as a bioindicator. Magil so-
s a shore-dwelling fish which is found in
uan Bay, Qingdao. The fish used in the study
captured in 1986. After 3 to 5 day's exposure
water with an oil concentration of 0.13-0.16
, enzyme activity increased by six to eight-
n comparison with uninduced controls. After
-days exposure or longer, the specific activity of the enzyme reached maximum levels without obvious change. Magil so-iuy is a mullet with limited home range. It is, therefore, possible to use this organism to monitor for petroleum pollution by testing for hepatic AHH activity. (Author's abstract)
W91-01573

AUTOTROPHIC AND HETEROTROPHIC ATP POOLS IN MICROBIAL COMMUNITIES: SUGGESTIONS FOR SEPARATION AND FOR BACTERIAL GROWTH RATE EVALUATION.
Parma Univ. (Italy). Ist. di Ecologia.
For primary bibliographic entry see Field 5A.
W91-01595

SUBSTRATE-ECTOENZYME INTERACTION: SIGNIFICANCE OF BETA-GLUCOSIDASE ACTIVITY FOR GLUCOSE METABOLISM BY AQUATIC BACTERIA.
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
For primary bibliographic entry see Field 2H.
W91-01597

TRIBUTYLTIN AND INVERTEBRATES OF A SEAGRASS ECOSYSTEM: EXPOSURE AND RESPONSE OF DIFFERENT SPECIES.
Cornell Univ., Ithaca, NY. Ecosystems Research Center.
J. R. Kelly, D. T. Rudnick, R. D. Morton, L. A. Buttel, and S. N. Levine.
Marine Environmental Research MERSDW, Vol. 29, No. 4, p 245-276, 1990. 8 fig, 5 tab, 38 ref, append. EPA Cooperative Agreement Nos. CR812685, CR812685-02, and CR812685-03.

Descriptors: *Antifoulants, *Bioaccumulation, *Marine environment, *Sea grasses, *Tributyltin, *Water pollution effects, Bioindicators, Carbon radioisotopes, Ecosystems, Invertebrates, Marine animals, Marine plants, Microenvironment, Radioactive tracers.

In shallow coastal waters certain dissolved or suspended particulate chemicals may become concentrated in seagrass beds. Tributyltin, released to marine waters from certain antifouling paints, has come under recent regulation because of high toxicity and growing use. (C14)-labeled tributyltin chloride (TBT-Cl) was delivered to the water column of seagrass (Thalassia testudinum) microcosms held in the laboratory under flow-through conditions. Benthic macroinvertebrate abundances across a three treatment logarithmic dose gradient were compared to untreated control microcosms. Within 3 to 6 weeks, statistically significant mortality appeared in the high treatment (22.2 microg/L). Sensitive species included surface deposit feeders of several phyla, as well as a suspension feeding mollusk. Results suggested that effects can arise because TBT is rapidly accumulated in surface sediments, as well as in Thalassia tissues. Concentration of tracer in plant tissues, animals, and sediments suggested that measurement of TBT (and total butyltin) in these components of seagrass beds would provide a better indicator of exposure regimes than occasional measurements in the water. A propensity for accumulation, along with a biological vulnerability, suggests a sentinel role for seagrass ecosystems in some shallow coastal areas. Experimental findings demonstrated concern for some key invertebrates within beds proximal to TBT sources, and ecological risks could radiate through webs dependent on these vegetated shallows. (Author's abstract)
W91-01625

ENVIRONMENTAL FACTORS AFFECTING BENTHIC INFAUNAL COMMUNITIES OF THE WESTERN ARABIAN GULF.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
For primary bibliographic entry see Field 2L.
W91-01626

INTEGRATION OF LONG-TERM FISH KILL DATA WITH AMBIENT WATER QUALITY MONITORING DATA AND APPLICATION TO WATER QUALITY MANAGEMENT.
Post, Buckley, Schuh and Jernigan, Inc., Columbia, SC.
A. H. Trim.
Environmental Management EMNGDC, Vol. 14, No. 3, p 389-396, March/April 1990. 3 fig, 3 tab, 13 ref.

Descriptors: *Coastal zone management, *Estuarine fisheries, *Fishkill, *Monitoring, *Pesticides, *Statistical analysis, *Water pollution effects, *Water quality management, Coastal waters, Data interpretation, Water pollution sources.

Almost half (354) of all fish kills (805) in South Carolina, between 1978 and 1988 occurred in the coastal zone. These kills were analyzed for causative, spatial, and temporal associations as a distinct data set and integrated with ambient water quality monitoring data. Estuarine kills as a result of natural causes accounted for 42.8% followed by man-induced (35.1%) and undetermined causes (22.1%). Although general pesticide usage was responsible for 53.9% of man-induced kills, weed control activities around resorts and municipal areas accounted for slightly more kills (20.9%) than did agricultural (19.8%) or vector control (13.2%) uses. A dramatic decline in agricultural-related kills has been observed since 1986 when the integrated pest management approach was adopted by many farmers. When taken with the few kills (12.0%) resulting from wastewaters, this suggests that these two land-use activities have been successfully managed via existing programs (IPM and NPDES, respectively) to minimize their contributions to estuarine fish kills. Ambient trend monitoring data demonstrated no coastal-wide dispersion of pesticide pollution. These data confirmed the nature of fish kills to be site-specific, near-field events most closely associated with the contiguous land-use practices and intensities. Typically, fish kill data are considered as event-specific data related to that event only. This analysis has shown, however, that a long-term data set, when integrated with ambient water quality data, can assist in regulatory and resource management decisions for both short-term and long-term planning and protection applications. (Author's abstract)
W91-01635

LACK OF EFFECT OF DRINKING WATER BARIUM ON CARDIOVASCULAR RISK FACTORS.
Cincinnati Univ., OH. Coll. of Medicine.
For primary bibliographic entry see Field 5F.
W91-01666

INDUCTION OF ALKOXYRESORUFIN METABOLISM: A POTENTIAL INDICATOR OF ENVIRONMENTAL CONTAMINATION.
Barcelona Univ. (Spain). Dept. of Microbiology.
R. A. Lubet, F. P. Guengerich, and R. W. Nims.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 2, p 157-163, March/April 1990. 4 fig, 1 tab, 28 ref.

Descriptors: *Alkoxyresorufin, *Bioassay, *Bioindicators, *Water pollution effects, Biochemistry, Chlorinated hydrocarbons, DDT, Dioxins, Monitoring, Organic compounds, Pesticides, Polycyclic aromatic hydrocarbons, Rats.

Methods of biochemical monitoring of individual animals for exposure to environmental contaminants are of great potential use. The hepatic metabolism of various alkoxyresorufins, which are highly specific substrates for certain forms of cytochrome(s) P450, is highly induced by a variety of environmental contaminants. Thus, the o-dealkylation of pentoxy-, or benzyloxyresorufin was induced greater than 20-fold in the rat by alpha-hexachlorocyclohexane, 2,4,5,2',4',5'-hexabromobiphenyl, DDT and Aroclor-1254, while the metabolism of ethoxyresorufin was highly induced by 5,6-benzoflavone, 3,4,5,3',4',5'-hexabromobiphenyl and Aroclor-1254. Additionally, rats exposed to diets containing as little as 12 ppm DDT displayed >5 fold increase in the rate of hepatic o-dealkylation of benzyloxyresorufin. Induction of the hepatic

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metabolism of these resorufin ethers in 9000 xg supernatant fractions taken from rats exposed to potential environmental contaminants may constitute a valuable diagnostic indicator of the presence of a variety of pollutants, including polycyclic aromatic hydrocarbons, organochlorine pesticides, polyhalogenated biphenyls and 2,3,7,8-tetrachlorodibenzo-p-dioxin. These results suggest the potential applicability of these substrates in detecting chemical contamination in the environment. (Author's abstract)
W91-01685

EFFECTS OF TRIBUTYLTIN ON SURVIVAL, GROWTH, MORPHOMETRY, AND RNA-DNA RATIO OF LARVAL STRIPED BASS, MORONE SAXATILIS.
Maryland Univ., Solomons. Chesapeake Biological Lab.
A. E. Pinkney, L. L. Matteson, and D. A. Wright.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 2, p 235-240, March/April 1990. 2 fig, 5 tab, 28 ref.

Descriptors: *Antifoulants, *Bass, *Pesticides, *Toxicity, *Tributyltin, *Water pollution effects, Bioassay, Biological studies, Ecotoxicology, Larvae, Mortality, Nucleic acids.

Three experiments were conducted on the effects of tributyltin (TBT). In the first experiment, thirteen day old larvae were exposed to 0, 0.067, 0.766, or 2.284 micrograms TBT/L for six days. All larvae exposed to 2.24 micrograms/L died by day 5; exposure to 0.766 micrograms/L significantly reduced survival relative to controls (59.8% vs. 81.8%). Significant, concentration dependent decreases in body depth occurred in larvae exposed to 0.067 and 0.766 micrograms/L. In experiment 2, all 16 day old larvae exposed to 1.489 micrograms/L died by day 6. Survival, weight, and morphometry parameters were not significantly different in larvae exposed to 0, 0.052, or 0.444 micrograms/L for 7 days. Notochord length and dry weight decreased significantly in larvae exposed to 0.514 micrograms/L. Weight and morphometry parameters were more sensitive indicators of sublethal stress than RNA-DNA ratio. Maximum TBT concentrations reported in Chesapeake Bay marinas are likely to cause increased larval mortality. Longer term studies are needed to assess effects at <0.050 micrograms/L, which may be more representative of habitat conditions. (Author's abstract)
W91-01687

EFFECTS OF ACID-MINE DRAINAGE ON THE CHEMICAL AND BIOLOGICAL CHARACTER OF AN ALKALINE HEADWATER STREAM.
Thomas Hunt Morgan School of Biological Sciences, Lexington, KY.
T. M. Short, J. A. Black, and W. J. Birge.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 2, p 241-248, March/April 1990. 3 fig, 3 tab, 46 ref. Kentucky Natural Resources Memorandum of Agreement No. 5429.

Descriptors: *Acid mine drainage, *Benthic fauna, *Heavy metals, *Water pollution effects, Aluminum, Biological studies, Chemical analysis, Chubs, Copper, Fish, Headwaters, Hydrogen ion concentration, Iron, Kentucky, Manganese, Midges, Zinc.

Distribution of metals in water and sediments, as the well as spatial alteration in benthic macroinvertebrate and fish assemblages, was assessed in an alkaline headwater stream in eastern Kentucky receiving runoff from an abandoned surface mine. Concentrations of aluminum, copper, iron, manganese, and zinc generally increased 2 to 3 orders of magnitude in the receiving water immediately below where the mine runoff entered the creek. Metals in the water column were transported downstream largely in association with suspended particulates, and declined in concentration progressively in a linear fashion commensurate to distance below the mine drainage outfall. In contrast, metal enrichment of sediments occurred spatially in a non-incremental pattern and varied among locations in conjunction with site specific changes in concentration levels of sediment organic matter. Benthic macroinvertebrate and fish fauna were eliminated for a distance of 0.3 km below the outfall, presumably owing to the presence of high levels of dissolved metals and low pH. Recovery of stream benthos occurred 1.0-2.0 km further downstream and was characterized by numerical dominance of collector-gatherer trophic groups consisting primarily of midge larvae (Chironomidae: Orthocladiini). Fish fauna in downstream reaches consisted exclusively of creek chubs (Semotilus atromaculatus) and stoneroller minnows (Campostoma anomalum). Metal levels in water and sediments remained elevated in regions of biological recovery and, as a consequence, downstream communities were comprised predominantly of metal tolerant taxa. (Author's abstract)
W91-01688

USE OF THE MUSSEL WATCH AND MOLECULAR MARKER CONCEPTS IN STUDIES OF HYDROCARBONS IN A TROPICAL BAY (TODOS OS SANTOS, BAHIA, BRAZIL).
Centro de Investigacion y Desarrollo, Barcelona (Spain). Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 5A.
W91-01690

EFFECTS OF PESTICIDES ON SOME BIOCHEMICAL PARAMETERS OF CARP (CYPRINUS CARPIO L).
Jozsef Attila Univ., Szeged (Hungary). Dept. of Biochemistry.
B. Asztalos, J. Nemcsok, I. Benedeczky, R. Gabriel, and A. Szabo.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 2, p 275-282, March/April 1990. 12 fig, 1 tab, 34 ref.

Descriptors: *Biochemistry, *Carp, *Pesticides, *Water pollution effects, Biological studies, Copper sulfate, Enzymes, Fish physiology, Liver, Methidathion, Paraquat, Tissue analysis.

Treatments with copper sulfate (CuSO4), paraquat (PQ) and methidathion (MD) caused tissue damage and stress effects in carp. These effects were indicated by increased lactate dehydrogenase (LDH), glutamic oxaloacetic transaminase (GOT), and glutamate dehydrogenase (GIDH) enzyme activities and elevated blood sugar levels. Copper sulfate, administered together with PQ and MD, was synergistic in terms of tissue damage and stress effects. Isoenzyme patterns showed organ-specific tissue damage, and the administered chemical and isoenzymes indicating liver damage were detectable in the blood. The combination of CuSO4 and MD caused local cell necrosis, which was observable in the liver tissue by light microscopy. Electron microscopic studies revealed the presence of damaged parenchymal cells with electron transparent cytoplasms, myelin figures, and altered mitochondria ER and Golgi. (Author's abstract)
W91-01691

CO2 CLIMATE SENSITIVITY AND SNOW-SEA-ICE ALBEDO PARAMETERIZATION IN AN ATMOSPHERIC GCM COUPLED TO A MIXED-LAYER OCEAN MODEL.
National Center for Atmospheric Research, Boulder, CO.
G. A. Meehl, and W. M. Washington.
Climatic Change CLCHDX, Vol. 16, No. 3, p 283-306, June 1990. 11 fig, 23 ref.

Descriptors: *Albedo, *Carbon dioxide, *Climatology, *Data interpretation, *Global warming, *Model studies, Air temperature, Computer models, Ice, Oceans, Snow, Temporal variation.

A model (altered from a revised 1984 version) is run to equilibrium for 1 X CO2 and 2 X CO2 experiments. The 1 X CO2 (control) simulation produces a global mean climate (GCM) that is about 1 degree warmer than the original version, and sea ice extent is reduced. The model with the altered parameterization displays heightened sensitivity in the global means, but the geographical patterns of climate change due to increased CO2 are quantitatively similar. The magnitude of the climate change is affected not only in areas directly influenced by snow and ice changes, but also in other regions of the globe, including the tropics where sea surface temperature, evaporation and precipitation over the oceans is greater. With the less sensitive formulation, the global mean surface air temperature increase is 3.5 C and the increase of global mean precipitation is 7.12%. The revised formulation produces a globally averaged surface air temperature increase of 4.04 C and a precipitation increase of 7.25%, as well as greater warming of the upper tropical troposphere. Sensitivity of surface hydrology is qualitatively similar between the two cases with the larger magnitude changes in the revised snow and ice-albedo scheme experiment. Variability of surface air temperature in the model is comparable to observations in most areas except in high latitudes during winter. In those regions, temporal variation of the sea-ice margin and fluctuations of snow cover dependent on the snow ice-albedo formulation contribute to larger than observed temperature variability. This study highlights an uncertainty associated with results from current climate GCMs that use highly parameterized snow-sea-ice albedo schemes with simple mixed layer ocean models. (Author's abstract)
W91-01694

RELATIONSHIP BETWEEN WATER QUALITY AND CADDISFLY ASSEMBLAGE STRUCTURE IN FAST-RUNNING RIVERS. THE RIVER CADAGUA BASIN.
Universidad del Pais Vasco, Bilbao (Spain). Lab. de Ecologia.
For primary bibliographic entry see Field 5A.
W91-01697

OBSERVATIONS ON OVERWINTERING JUVENILE CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) EXPOSED TO BLEACHED KRAFT MILL EFFLUENT IN THE UPPER FRASER RIVER, BRITISH COLUMBIA.
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
For primary bibliographic entry see Field 5B.
W91-01724

COMPARATIVE TOXICITY OF SOLVENT YELLOW 33 (2-(2'-QUINOLINYL)-1,3-INDANDIONE) AND SOLVENT GREEN 3 (1,4-DI-P-TOLUIDINO-ANTHRAQUINONE) DYES TO FRESHWATER ORGANISMS.
Johns Hopkins Univ., Shady Side, MD. Environmental Sciences Group.
D. T. Burton, D. J. Fisher, and R. L. Paulson.
Chemosphere CMSHAF, Vol. 19, No. 12, p 1959-1970, 1989. 2 fig, 4 tab, 15 ref. U.S. Army Biomedical Research and Development Laboratory, Fort Detrick, Maryland Contract 85MM5505.

Descriptors: *Aquatic life, *Bioassay, *Dyes, *Toxicity, *Water pollution effects, Algae, Amphipods, Aquatic insects, Comparison studies, Crustaceans, Fish, Invertebrates, Midges, Solvent green 3, Solvent yellow 33, Waterfleas.

The toxicity of Solvent Yellow 33 and Solvent Green 3 mixtures used as components of smoke munitions by the military was studied. The acute toxicity of the dyes to an array of nine freshwater aquatic organisms from various trophic levels was determined. Fish exposed to the two dyes for 96 h included the fathead minnow (Pimephales promelas), bluegill (Lepomis macrochirus), channel catfish (Ictalurus punctatus) and rainbow trout (Salmo gairdneri). Invertebrates, which were exposed for 48 h, included the water flea (Daphnia magna), amphipod (Gammarus pseudolimnaeus), midge larva (Paratanytarsus parthenogeneticus) and the mayfly larva (Hexagenia bilinata). Growth of the green alga Selenastrum capricornutum was also determined for both dyes. Solvent Yellow 33 and s Solvent Green 3 mixture (30:70 mixture of Solvent Yellow 33 and Solvent Green 3) were not acutely toxic to seven of nine freshwater species when tested at the solubility limits of the dyes in freshwater. A solubility limit solution of the Solvent

Green 3 mixture killed 50% of the rainbow trout ested for 96 hr but was nontoxic when diluted by 50%. Both dyes caused a reduction in green algal growth at solubility limits. The Solvent Green 3 mixture was the most detrimental causing a 98-99% reduction in growth after 5 days of exposure. (Agostine-PTT)
W91-01730

VALUATION OF THE POTENTIAL FOR OXICS EXPOSURE IN THE GREAT LAKES EGION USING STORET DATA.
eorge Mason Univ., Fairfax, VA. Dept. of Biol-gy.
or primary bibliographic entry see Field 5B.
/91-01732

OPULATION EXPOSURE TO CHLORO-HENOLS, DIBENZO-P-DIOXINS AND DI-ENZOFURANS AFTER A PROLONGED ROUND WATER POLLUTION BY CHLORO-HENOLS.
ational Public Health Inst., Kuopio (Finland). ept. of Environmental Hygiene and Toxicology.
or primary bibliographic entry see Field 5B.
91-01734

REAMWATER ACIDIFICATION IN RELA-ON TO ACID PRECIPITATIONS--VEGETA-ON AND BEDROCK INFLUENCES, CONSE-UENCES FOR TROUT POPULATIONS: THE OSGES MASSIF CASE STUDY (ACIDIFICA-ON DES EAUX DE SURFACE SOUS L'IN-UENCE DES PRECIPITATIONS ACIDES : OLE DE LA VEGETATION ET DU SUBSTRA-M, CONSEQUENCES POUR LES POPULA-ONS DE TRUITES. LE CAS DES RUIS-AUX DES VOSGES).
ntre National de la Recherche Scientifique, asbourg (France). Centre de Sedimentologie et Geochimie de la Surface.
Probst, J.-C. Massabuau, J.-L. Probst, and B. tz.
mptes Rendus de l'Academie des Sciences rie 2) CRASEV, Vol. 311, No. 3, p 405-411, gust 1990. 3 fig, 1 tab, 13 ref. English summary.

scriptors: *Acid rain, *Acid rain effects, *Acid ams, *Mountain streams, *Trout, *Vegetation cts, *Vosges (mountains), Aluminum, Bedrock, fer capacity, Drinking water, France, Soil es.

acidification state of 39 streams in the Vosges sif was studied. Streamwaters were sampled ce under two contrasting hydrological condi-s: autumn low water (period 1) and spring w-melting (period 2). The streams were sepa-d into five groups according to their chemical position (using both cations and anions). It is d that of the 39 streams sampled, 11 are really and 21 lose all buffering capacity during w-melting and are very sensitive to the influ-of acid atmospheric input. The 11 acid ms are located on the western side of the ges. A clear relationship has been indicated een the lack of trout and the stream acidifica-The presence of trout appears to be limited by value lower than 5.6 and by Al concentration er than 180-200 ppb/L. The maximum Al con-ration reaches 475 ppb/L during low water and 800 ppb/L during snow-melt. These es are distinctly higher than EEC tolerance s for drinking water. The impact of acid at-heric inputs on soils which are already acid poor in exchangeable bases (podzolic series), on sensitive bedrocks, has certainly led to n acidification and hence to trout disappear-(Agostine-PTT)
01738

CT OF SUBMERSED AQUATIC VEGETA-N ON PHYTOPLANKTON AND WATER LITY IN THE TIDAL FRESHWATER PO-AC RIVER.
ge Mason Univ., Fairfax, VA. Dept. of Biol-

rimary bibliographic entry see Field 2H.
01743

INTERACTIONS BETWEEN BACILLUS THURINGIENSIS SUBSP. ISRAELENSIS AND FATHEAD MINNOWS, PIMEPHALES PROMELAS RAFINESQUE, UNDER LABORATORY CONDITIONS.
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5B.
W91-01759

ISOLATION AND CHARACTERIZATION OF HEPATOTOXIC MICROCYSTIN HOMOLOGS FROM THE FILAMENTOUS FRESHWATER CYANOBACTERIUM NOSTOC SP. STRAIN 152.
Helsinki Univ. (Finland). Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W91-01761

EFFECTS OF LIGHT, TEMPERATURE, NITRATE, ORTHOPHOSPHATE, AND BACTERIA ON GROWTH OF AND HEPATOTOXIN PRODUCTION BY OSCILLATORIA AGARDHII STRAINS.
Helsinki Univ. (Finland). Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W91-01762

FATE OF MACROZOOBENTHOS IN HYPERTROPHIC LAKES: IN SITU REARING EXPERIMENTS WITH THE LARVAE OF TOKUNAGAYUSURIKA AKAMUSI (CHIRONOMIDAE).
National Inst. for Environmental Studies, Ibaraki (Japan). Environmental Biology Div.
Takamura, and T. Iwakuma.
Archiv fuer Hydrobiologie AHYBA4, Vol. 119, No. 1, p 65-78, July 1990. 6 fig, 1 tab, 31 ref.

Descriptors: *Eutrophic lakes, *Eutrophication, *Japan, *Midges, *Sedimentation rates, *Water pollution effects, Anaerobic conditions, Benthos, Biomass, Lake sediments, Larvae.

Larval chironomid, Tokunagayusrika akamusi, were reared in submerged glass bottles in Lakes Teganuma and Kasumigaura, central Japan. The larvae neither grew nor survived in very hypertrophic Lake Teganuma, though they grew and survived well in the less hypertrophic Lake Kasumigaura. Anaerobic conditions of the sediment in the rearing bottles of Lake Teganuma, which were induced by high sedimentation rates of newly deposited matter, were responsible for the complete mortality of the larvae. Anaerobic conditions were also observed in the sediment surface of Lake Taganuma. It was suggested that even in shallow lakes fully circulated by wind, hypertrophic conditions accompanied by massive primary production may depress macrozoobenthos biomass through anaerobic conditions in the lake-bottom sediments. (Author's abstract)
W91-01769

IMPROVED DETECTION OF ACID MINE WATER STRESSED COLIFORM BACTERIA ON MEDIA CONTAINING CATALASE AND SODIUM PYRUVATE.
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
For primary bibliographic entry see Field 5A.
W91-01770

RESPONSE OF ATTACHED BACTERIA TO ZINC IN ARTIFICIAL STREAMS.
Indiana Univ.-Purdue Univ. at Fort Wayne. Dept. of Biological Sciences.
D. Dean-Ross.
Canadian Journal of Microbiology CJMIAZ, Vol. 36, No. 8, p 561-566, August 1990. 5 fig, 2 tab, 23 ref.

Descriptors: *Aquatic bacteria, *Path of pollutants, *Species diversity, *Water pollution effects, *Zinc, Heavy metals, Resistance, Streams, Tolerance, Toxicity.

To study the response of natural communities of attached bacteria to Zn, artificial streams were dosed with Zn at levels of 0, 0.01, 0.1, 0.5, 1.0, and 10.0 mg/L in duplicate treatment groups. Changes in total biomass, chlorophyll a content, total bacterial numbers, and heterotrophic activity were measured over a 5-week exposure period. The adaptation of the culturable bacterial community to Zn was assessed by comparing viable counts on unsupplemented medium with counts on media supplemented with several concentrations of Zn. The structure of that portion of the bacterial community capable of growth on nutrient agar was assessed by characterizing randomly selected colonies with respect to 20 nutritional capabilities and grouping the strains by numerical taxonomy. Streams receiving 0.5, 1.0, and 10.0 mg Zn/L were significantly inhibited with respect to all variables studied when compared with streams receiving 0, 0.01, or 0.1 mg Zn/L. Bacteria developed tolerance to the exposure concentration of Zn but were resistant to higher Zn concentrations. Increasing concentrations of Zn produced alterations in the structure of the culturable bacterial community, resulting in differing assemblages of bacterial groups and a decrease in diversity as measured by the Shannon-Wiener index and rarefaction. These results suggest that streams receiving 0.5 mg Zn/L or more may be adversely impacted. (Author's abstract)
W91-01772

INFLUENCE OF PH ON THE ACCUMULATION OF TRI-N-BUTYLTIN CHLORIDE AND TRIPHENYLTIN CHLORIDE IN CARP.
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
For primary bibliographic entry see Field 5B.
W91-01774

EFFECTS OF INGESTED CRUDE OIL ON THYROID HORMONES AND ON THE MIXED FUNCTION OXIDASE SYSTEM IN DUCKS.
Trondheim Univ. (Norway). Dept. of Zoology.
B. M. Jenssen, M. Ekker, and K. Zahlsen.
Comparative Biochemistry and Physiology (C) CBPCEE, Vol. 95, No. 2, p 213-216, 1990. 3 tab, 37 ref.

Descriptors: *Ducks, *Hormones, *Oil pollution, *Thyroid, *Toxicology, *Water pollution effects, Ecological effects, Enzymes, Metabolism, Oil.

Ingestion of Statfjord A crude oil from the North Sea has no apparent effect on the metabolic rate of ducks according to previous studies. This may be because this particular oil does not affect plasma concentrations of thyroid hormones and enzyme activities in the mixed function oxidase (MFO) system of ducks. To test this hypothesis, plasma concentrations of thyroid hormones (thyroxine and triiodothyronine), and levels of hepatic cytochrome P-450 and enzyme activities (NADPH cytochrome C reductase and GSH-S-transferase) in the MFO system were measured in domestic ducks (Anas platyrhynchos) which had ingested this crude oil. Daily oral dosing of 5 ml crude oil/kilogram body weight for 6 consecutive days resulted in a 53% increase in plasma triiodothyronine concentration and a 56% increase in the hepatic cytochrome P-450 level. The changes in these parameters were apparently not sufficient to cause any rise in metabolic heat production. This apparent contradiction is probably because activation of the MFO-system is energetically inexpensive. Also, possible metabolic effects caused by increased plasma-triiodothyronine concentration and activation of the MFO-system may have been masked by an inhibitory effect of the crude oil on mitochondrial electron transport and coupled phosphorylation. (Author's abstract)
W91-01775

EFFECT OF HEAVY METALS ON THE SEROTONIN AND DOPAMINE SYSTEMS IN THE CENTRAL NERVOUS SYSTEM OF THE FRESHWATER MUSSEL (ANODONTA CYGNEA L).
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
For primary bibliographic entry see Field 5B.

W91-01776

EFFECTS OF WATER-BORNE CADMIUM ON PLASMA CORTISOL AND GLUCOSE IN THE CICHLID FISH OREOCHROMIS MOSSAMBICUS.
Dar es Salaam Univ. (Tanzania). Dept. of Zoology and Marine Biology.
H. B. Pratap, and S. E. Wendelaar Bonga.
Comparative Biochemistry and Physiology (C) CBPCEE, Vol. 95, No. 2, p 313-317, 1990. 48 ref.

Descriptors: *Cadmium, *Cichlid, *Glucose, *Stress analysis, *Tilapia, *Toxicology, *Water pollution effects, Adaptation, Ecological effects, Fish, Heavy metals, Toxicity.

Freshwater cichlids Oreochromis mossambicus (tilapia) were exposed to 10 micrograms Cd/L in ambient water for 2, 4, 14, and 35 days. Plasma cortisol and glucose levels were determined to evaluate if cadmium induced a typical stress response in these fish. Exposure to cadmium for 2, 4, and 14 days elicited a significant elevation of plasma cortisol levels. A significant hyperglycemia occurred on days 2 and 4 in cadmium-exposed fish. During long-term exposure to cadmium (35 days), the plasma cortisol and glucose levels returned to control values. This recovery after 35 days indicates the ability of tilapia to adapt to low cadmium concentrations in the ambient water. (Author's abstract)
W91-01777

MORPHOLOGICAL DEFORMITIES IN CHIRONOMIDAE(DIPTERA) LARVAE FROM THE LAC ST. LOUIS AND LAPRAIRIE BASINS OF THE ST. LAWRENCE RIVER.
National Hydrology Research Inst., Saskatoon (Saskatchewan).
W. F. Warwick.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 2, p 185-208, 1990. 9 tab, 8 fig, 42 ref.

Descriptors: *Aquatic insects, *Heavy metals, *Midges, *Polychlorinated biphenyls, *St Lawrence River, *Toxic wastes, *Water pollution effects, Benthos, Ecological effects, Larvae, Species diversity, Wastewater pollution, Water pollution sources.

Morphological deformities in chironomid communities were compared with indices of chemical contamination in the Lac St. Louis and Laprairie Basins of the St. Lawrence River. The most severely deformed larvae in Lac St. Louis were found in close proximity to the industrial complex around Beauharnois, Quebec, an area known to be seriously contaminated by polychlorinated biphenyls and heavy metals. Further away, and particularly in areas shielded from the main flow of the St. Lawrence by the Iles de la Paix complex, the frequency and severity of deformities decreased. Interpretation of contaminant responses was less easily accomplished in the Laprairie basin where the introduction of untreated domestic sewage imposed extremely severe environmental conditions for benthos. Comparison of contemporary and subfossil community diversities indicated that extensive changes have taken place in the structure of these communities in recent times. The presence of deformities in contemporary chironomid communities suggests that these changes have been brought about by chemical contaminants. (Author's abstract)
W91-01790

EFFECTS OF VARIOUS BIOPHYSICOCHEMICAL CONDITIONS ON TOXIGENICITY OF VIBRIO CHOLERAE 01 DURING SURVIVAL WITH A GREEN ALGA, RHIZOCLONIUM FONTANUM, IN AN ARTIFICIAL AQUATIC ENVIRONMENT.
London School of Hygiene and Tropical Medicine (England). Dept. of Tropical Hygiene.
For primary bibliographic entry see Field 2H.
W91-01801

EFFECTS OF ACIDIFICATION ON LEAF DECOMPOSITION IN STREAMS.
Oak Ridge National Lab., TN. Environmental Sciences Div.
P. J. Mulholland, A. V. Palumbo, J. W. Elwood, and A. D. Rosemond.
Journal of the North American Benthological Society JNASEC, Vol. 6, No. 3, p 147-158, September 1987. 5 fig, 3 tab, 35 ref. Electric Power Research Institute Contract No. RP2326-1 and U.S. DOE Contract No. DE-AC05-84OR21400.

Descriptors: *Acid rain effects, *Acid streams, *Acidification, *Aluminum, *Decomposing organic matter, *Decomposition, *Leaves, *Mountain streams, *Water pollution effects, Biomass, Carbon, Hydrogen ion concentration, Leaf decomposition, Microbial degradation, Microorganisms, Nitrogen, Phosphorus, Streams, Water chemistry.

Effects of acidification on leaf decomposition in streams were studied in four second-order streams in the Great Smokey Mountains National Park. The streams ranged in pH from 4.5 to 6.4 at baseflow. Mass loss of leaves incubated in mesh bags placed in pools in each stream was measured periodically over 15 wk beginning in late August. Measurements were also made of C, N, P, and Al in leaves, microbial biomass (adenosine triphosphate (ATP)) and respiration rate and bacterial production (thymidine uptake) associated with leaves, and the number and biomass of macroinvertebrates in leaf bags. Rates of leaf mass loss were significantly lower in streams with pH less than or equal to 5.7 compared with a stream with a pH of 6.4. Although rate of leaf mass loss among the streams varied directly with pH, differences between streams with pH values between 4.5 and 5.7 were not significant. Microbial ATP and respiration rates and bacterial production rates followed the same pattern as leaf mass loss rate, i.e., low for more acidic streams and highest in the stream with the highest pH. Accumulation of aluminum by the leaf-microbe complex was also greatest in the most acidic streams. The number and biomass of macroinvertebrates shredders found in leaf bags was lowest at the highest pH site and therefore cannot account for the higher rate of lead mass loss found at this site. The results suggest that the lower rate of leaf decomposition in the more acidic streams is due largely to low rates of microbial activity. (Author's abstract)
W91-01803

FATE AND EFFECTS OF PULP MILL CHLOROPHENOLIC 4,5,6-TRICHLOROGUAIACOL IN A MODEL BRACKISH WATER ECOSYSTEM.
Swedish Environmental Research Inst., Karlskrona.
For primary bibliographic entry see Field 5B.
W91-01816

TENTATIVE IDENTIFICATION OF ORGANIC COMPOUNDS AT THE WESTSIDE WASTEWATER TREATMENT PLANT (HIGH POINT, NC) AND IMPLICATIONS FOR AQUATIC TOXICITY.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5D.
W91-01826

INVERTEBRATE COMMUNITIES OF SMALL STREAMS IN NORTHEASTERN WYOMING.
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2H.
W91-01850

ACIDIFICATION IN NORWAY - LOSS OF FISH POPULATIONS AND THE 1000 LAKE SURVEY 1986.
Norsk Inst. for Vannforskning, Oslo.
B. O. Rosseland, and A. Henriksen.
Science of the Total Environment STENDL, Vol. 96, No. 1/2, p 45-56, July 1990. 8 fig, 29 ref.

Descriptors: *Acid rain effects, *Fish populations, *Fishkill, *Lakes, *Norway, *Water pollution effects, Acidic water, Aluminum, Chemistry of precipitation, Deposition, Lake restoration, Nitrates, Sulfur compounds, Surveys, Water pollution.

Several regional surveys have demonstrated that lakes and watersheds in Norway are affected by acid precipitation. In autumn of 1986, the Norwegian Institute for Water Research (NIVA) conducted the 1000-Lake Survey on behalf of the Norwegian State Pollution Control Authority (SFT). The greatest loss of freshwater fish populations was found in Telemark, East Agder, West Agder, and Rogaland counties. This damage correlated well with pH and the concentrations of calcium and labile aluminum in the lakes. The number of barren lakes in Sorlandet and southern Vestlandet has doubled from 1971 to 1975. The chemical changes were characterized by a decrease in calcium and sulfate and an increase in aluminum and nitrate. There was little change in pH. The total land area affected by acidification damage increased from 33000 sq km in 1974 to 1979 to 36000 sq km in 1986. In 1986, over 18000 sq km were totally damaged compared with 13000 sq km in 1974 to 1979. This reflects an increase of nearly 40%. The greatest increase was registered in eastern Norway. Data from the 1000-Lake Survey indicated that 52% of the lakes in southern Norway were endangered. A 30% reduction in loadings of sulfur compounds would lead to the restoration of 28% of these lakes. A further reduction of 50% would ensure viable conditions for fish in 49% of the lakes, given a constant nitrate level in the lakes. The data provides hope for improving the environmental conditions of Norway's lakes. (Author's abstract)
W91-01889

ACID PRECIPITATION: BIOLOGICAL MONITORING OF STREAMS AND LAKES.
Bergen Univ. (Norway). Zoological Museum.
For primary bibliographic entry see Field 5A.
W91-01890

ALUMINUM MOBILIZATION IN SOIL AND STREAM WATERS AT THREE NORWEGIAN CATCHMENTS WITH DIFFERENT ACID DEPOSITION AND SITE CHARACTERISTICS.
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W91-01895

EFFECTS OF TRIBUTYLTIN WITHIN A THALASSIA SEAGRASS ECOSYSTEM.
Cornell Univ., Ithaca, NY. Ecosystems Research Center.
J. R. Kelly, S. N. Levine, L. A. Buttel, K. A. Carr, and D. T. Rudnick.
Estuaries ESTUDO, Vol. 13, No. 3, p 301-310, September 1990. 1 fig, 6 tab, 18 ref. EPA Cooperative Agreement Nos. CR811649, CR812685, CR812685-02, and CR812685-03.

Descriptors: *Antifoulants, *Sea grasses, *Tributyltin, *Water pollution effects, Bioassay, Biological studies, Biomass, Carbon radioisotopes, Chlorophyll, Detritus, Mortality, Tributyltin chloride.

Flow-through seagrass core microcosms were used to examine responses of species and processes to a logarithmic gradient of dosing with 14-C labeled tributyltin-chloride (TBT-CL). Experiments involved delivery of TBT-CL to the water column of replicate cores of a treatment (n = 16) once per week; one-half of the cores were sacrificed after three weeks of dosing, the others were dosed for 3 weeks. Initial water column concentrations for the three treatments averaged 0.205, 2.23, and 22.2 micrograms/L, expressed as TBT+ cation, but these concentrations dropped rapidly. Retained 14-C tracer, an estimate of total organotin species, was distributed to sediments, plants and other biological tissues, all of whose tracer concentration increased with time. Measures to indicate responses of both autotrophic and heterotrophic organisms were made; in general, treatment effects were demonstrable statistically only at the highest dose level. Accumulation of chlorophyll and biomass on glass slides was highest when suspended for the entire experiment in the water of the hig

st treatments; this unexpected result was perhaps n indirect effect related to reduced grazing activi- y in the microcosms. The highest dose of TBT- CL resulted in a virtual population mortality of a ew macrobenthic species and decreased loss of lant material in litter bags, both demonstrated ithin the first 3 weeks of dosing. Reduced litter oss was coincident with mortality of an amphipod Cymadusa compta) capable of shredding plant aterial, and a causal relation between the two fects is plausible. Thus, if concentrated to similar vels in a Thalassia bed, TBT+ may have direct ecies-level effects and process-level effects, po- ntially causing ecosystem changes via disruption a species-process linkage influential in seagrass trital food web dynamics. (Author's abstract) 91-01906

ECRUITMENT FAILURE OF THE BAY CALLOP, ARGOPECTEN IRRADIANS CONENTRICUS, DURING THE FIRST RED TIDE, TYCHODISCUS BREVIS, OUTBREAK REORDED IN NORTH CAROLINA.
orth Carolina Univ., Morehead City. Inst. of arine Sciences.
C. Summerson, and C. H. Peterson.
tuaries ESTUDO, Vol. 13, No. 3, p 322-331, ptember 1990. 3 fig, 5 tab, 25 ref. Department of mmerce Federal Grant NA86AA-D-SG046, oject R/MRD-6.

scriptors: *Estuaries, *North Carolina, *Red e, *Scallops, *Water pollution effects, Back und, Bogue Sound, Core Sound, Ecosystems, heries, Mortality, Population dynamics, Season- variation.

the presence of the first recorded red tide (Pty- odiscus brevis) outbreak in North Carolina tumn 1987) recruitment of bay scallops (Argo- ten irradians concentricus) in the state's most ductive scallop beds was a virtual failure. Re- itment averaged across all of Bogue Sound and k Sound was only 2% of the mean of three vious red tide-free (control) years. Only from tral Core Sound northward, where the red tide urred later and not as intensively, was bay lop recruitment normal (93% of control years). rtality of adult scallops from early December 7 to late January 1988, while red tide was at m concentrations but fishing was prohibited, 21%. No comparable natural mortality data t for control years because intense fishing mor- y in this period is confounded with natural tality. Data on abundance of articulated pairs mpty shells strongly suggest that the red tide ed mortality of both adult and newly recruited scallops. Bay scallop recruitment in autumn again failed to restock the traditionally pro- ive scallop beds in western Bogue Sound and ack Sound, perhaps because the only concen- ons of spawners surviving the red tide in cen- Core Sound and further north, were too far nt for successful transport of bay scallop e in sufficient abundance to these traditional This potential explanation implies a continu- mpact of the red tide on North Carolina's bay op fishery until spawning populations increase ack Sound and western Bogue Sound. (Au- s abstract) -01908

TOPLANKTON BIOMASS AND POTEN- NUTRIENT LIMITATION OF PHYTO- NKTON DEVELOPMENT IN THE SOUTH- TERN NORTH SEA IN SPRING 1985 AND

gische Anstalt Helgoland (Germany, F.R.) rimary bibliographic entry see Field 2L. 01937

IARY PRODUCTION AND NITROGEN MILATION IN THE NORTH SEA NG JULY 1987.
outh Marine Lab. (England).
rimary bibliographic entry see Field 2L. 01938

NGES IN SPATIAL DISTRIBUTION OF IARY PRODUCTION, PHOTOSYNTHET- IC PIGMENTS AND PHYTOPLANKTON SPECIES COMPOSITION DURING TWO SURVEYS IN THE GERMAN BIGHT.
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
For primary bibliographic entry see Field 2L. W91-01939

CHANGES IN SUBLITTORAL ZOOBENTHOS IN THE GERMAN BIGHT WITH REGARD TO EUTROPHICATION.
Alfred-Wegener-Inst. fuer Polar- und Meeresforschung, Bremerhaven (Germany, F.R.).
E. Rachor.
Netherlands Journal of Sea Research NJSRBA, Vol. 25, No. 1/2, p 209-214, May 1990. 1 fig, 2 tab, 26 ref.

Descriptors: *Benthic fauna, *Eutrophication, *North Sea, *Population dynamics, *Water pollution effects, *Water quality trends, Biomass, Food habits, German Bight, Population density, Species composition.

Comparisons of benthic macrofauna biomass data from early and recent investigations indicate overall increases. These findings are supported by long-term density trends in macrozoobenthos populations from different areas of the German Bight. Examples are given which show that deep-dwelling and long-lived species derive less benefit from changing conditions than animals which (1) live near the sediment surface, (2) have an adaptive feeding behavior, and (3) grow and reproduce quickly. Thus, the observed changes are reflected in the dominance structure of the benthic fauna. These changes are interpreted as being influenced and driven by increased eutrophication. (Author's abstract)
W91-01940

SUCCESSION OF THE PLANKTON COMMUNITY DURING COASTAL RECLAMATION WITH THE SOLID WASTES.
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
For primary bibliographic entry see Field 5E. W91-01943

CHANGE OF WATER QUALITY AND COMPOSITION OF PLANKTON IN THE POND OF RECLAIMED SITE.
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
For primary bibliographic entry see Field 5E. W91-01944

EFFECTS OF LOW PH ON THE CHORION OF RAINBOW TROUT, ONCORHYNCHUS MYKISS, AND BROWN TROUT, SALMO TRUTTA F. FARIO.
Munich Univ. (Germany, F.R.). Zoologisches Inst.
B. Kugel, R. W. Hoffmann, and A. Friess.
Journal of Fish Biology JFIBA9, Vol. 37, No. 2, p 301-310, August 1990. 4 fig, 36 ref.

Descriptors: *Acid rain effects, *Acid streams, *Acidic water, *Fish eggs, *Hydrogen ion concentration, *Trout, *Water pollution effects, Embryonic growth stage, Hatching.

The effect of low pH on egg shells (chorion) of rainbow trout, Oncorhynchus mykiss Walbaum (formerly Salmo gairdneri), and brown trout, Salmo trutta, were studied in stream water and dechlorinated tap water. Eggs of rainbow trout and brown trout were exposed to the poorly buffered creek, Hochfallbach in the Bavarian Forest. The average pH during low pH exposure was 5.5, with a minimum pH of 4.9 for several days. Green eggs were exposed for about 2 months and eyed eggs were exposed for about 1 month. In the laboratory, both rainbow and brown trout eggs were incubated as controls in poorly buffered, aerated and dechlorinated tap water at pH 7.3-7.6, or in tap waters artificially acidified with sulfuric acid to a pH 4.0-4.5 or 5.6-6.0. Results of chorion morphological studies showed that the plugs of the outer layer of the chorion, which block the channels of the underlying layer, developed distinctive vacuolization at low pH exposure in both stream and laboratory tests. This may lead to loss of chorional semi-permeability. Chorions were incompletely degraded at low pH inducing hatching problems. Partially hatched alevins showed only a small local zone of dissolution of the chorion around the head of the embryo preventing the larvae from being freed for hatching. Results were similar in both rainbow and brown trout eggs. (Geiger-PTT)
W91-01959

COMPARATIVE STUDY ON THE TOXICITY, ABSORPTION AND DEPURATION OF FENITROTHION AND ITS OXON IN JAPANESE TIGER SHRIMP.
Kyushu Univ., Fukuoka (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 5B. W91-01960

EFFECT OF SHORT-TERM EXPOSURE TO PENTACHLOROPHENOL AND OSMOTIC STRESS ON THE FREE AMINO ACID POOL OF THE FRESHWATER AMPHIPOD GAMMARUS PSEUDOLIMNAEUS BOUSFIELD.
Michigan State Univ., East Lansing. Pesticide Research Center.
R. L. Graney, and J. P. Giesy.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 2, p 167-176, March 1987. 1 fig, 4 tab, 34 ref. NOAA Grant NA82RAH00002-ORD-32049.

Descriptors: *Amino acids, *Gammarus, *Osmotic pressure, *Pentachlorophenol, *Pesticide toxicity, *Toxicity, *Water pollution effects, Amphipods, Biochemical effects, Bioindicators, Phenolic pesticides, Salt stress, Sublethal effects.

The effects of acute stressors on the concentration of free amino acids (FAA) in the freshwater amphipod Gammarus pseudolimnaeus were investigated. Forth-eight hours of exposure to acutely toxic concentrations of pentachlorophenol (0.86, 1.16, 1.51, 1.80, and 2.24 mg/L) resulted in a significant decrease in the total FAA pool at the greater concentrations and a significant change in the FAA profile at the lesser concentration. Hyperosmotic conditions did not alter the FAA concentrations while hypoosmotic conditions caused a significant decrease in the total FAA pool. Pentachlorophenol exposure did not impair the ability of amphipods to resist hypoosmotic conditions; however, osmotic stress did influence the organisms ability to recover from toxicant exposure, as measured by changes in the concentration of FAA. The observed alterations in the concentration of total FAA in stressed amphipods is probably related to a disruption in the osmoregulatory ability of the organism. Changes in the FAA pool has potential as an in-situ biochemical indicator of toxicant-induced stress in freshwater invertebrates. (Author's abstract)
W91-01967

ACUTE TOXICITIES AND HEMATOLOGICAL EFFECTS OF TWO SUBSTITUTED NAPHTHOQUINONES IN CHANNEL CATFISH.
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
A. A. Andaya, and R. T. Di Giulio.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 2, p 233-238, March 1987. 7 tab, 34 ref.

Descriptors: *Algicides, *Blood, *Catfish, *Fungicides, *Naphthoquinones, *Toxicity, *Toxicology, *Water pollution effects, Animal tissues, Median tolerance limit, Mortality, Sublethal effects, Tissue analysis.

The acute toxicities and hematological effects of menadione (2-methyl-1,4-naphthoquinone) and dichlone (2,3-dichloro-1,4-naphthoquinone) were examined in yearling channel catfish (Ictalurus punctatus). These compounds served as models for quinones, which comprise a diverse group of com-

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pounds that enter aquatic systems from numerous sources. The 96-hour LC50s measured were 720 micrograms/L and 42 micrograms/L for menadione and dichlone, respectively. In subsequent experiments, fish were exposed for 21 days to concentrations of 0, 0.25, 0.50, and 0.75 times the LC50 value of each compound. For both compounds, generally dose-dependent increases in methemoglobin concentrations and dose-dependent reductions in hemoglobin concentrations and hematocrit ratios were observed. These results are consistent with the hypothesis that these compounds are toxic in part due to their ability to undergo redox cycling and thereby generate reactive oxygen species. However, other modes of action, such as direct enzyme inhibition, may also be important. (Author's abstract)
W91-01970

TOXICITY OF FIVE SHALE OILS TO FISH AND AQUATIC INVERTEBRATES.
National Fisheries Contaminant Research Center, Columbia, MO.
D. F. Woodward, E. E. Little, and L. M. Smith.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 2, p 239-246, March 1987. 4 tab, 26 ref.

Descriptors: *Bioassay, *Fish, *Invertebrates, *Oil pollution, *Oil shale, *Toxicity, *Toxicology, *Water pollution effects, Food chains, Hazard assessment, Median tolerance limit, Minnow, Mortality, Oil characterization, Oil spills, Squawfish, Sublethal effects, Trout.

The chemical composition and toxicity of three shale crude oils (Tosco, Paraho, and Geokinetics), a hydrotreated oil (Paraho HDT), and a refined shale oil (Paraho JP-4) were assessed to determine the potential hazards to native fish species and food chain organisms from accidental spills of such materials. Colorado squawfish (Ptychocheilus lucius), fathead minnow (Pimephales promelas), cutthroat trout (Salmo clarki), and colonies of aquatic invertebrates were exposed to water-soluble fractions of the shale oils for 96 hours to determine concentrations lethal to 50% of the exposed organisms (LC50). The behavior of surviving fish was also measured to determine sublethal influences of exposure. The composition of the five water-soluble fractions was similar to that of the crude and refined shale oils from which they were made. Hydrotreated and refined oils contained fewer aromatic compounds than the crude shale oils. Cutthroat trout, a species endemic to oil shale regions, was less tolerant of shale oil exposure than the other species tested; the LC50 concentrations were 1.8 mg/L for Geokinetics, 2.1 mg/L for Tosco, and 1.3 mg/L for Paraho. Exposure to concentrations of one half to one-eighth those causing mortality reduced the swimming capacity of squawfish and significantly impaired their ability to capture prey. The number of organisms colonizing plate samplers declined with increasing oil concentration. The genera Baetis and Isoperla were most sensitive to shale oil exposure; significant mortality occurred at the lowest concentration (0.5 to 0.7 mg/L) tested for each shale oil. (Author's abstract)
W91-01971

MUTAGENIC ACTIVITY OF SURFACE WATERS ADJACENT TO A NUCLEAR FUEL PROCESSING FACILITY.
Georgia Univ., Athens. Dept. of Food Science and Technology.
O. C. Pancorbo, P. J. Lein, and R. D. Blevins.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 5, p 531-537, September 1987. 2 tab, 4 fig, 30 ref.

Descriptors: *Ames test, *Bioassay, *Mutagenicity, *Nuclear fuel, *Radioactive wastes, *Toxicology, *Water pollution effects, Industrial wastes, Mutagens, Path of pollutants, Phosphates, Pollutant identification, Radioisotopes, Spatial distribution, Stream pollution, Wastewater pollution.

Surface waters adjacent to a nuclear fuel processing facility (Nuclear Fuel Services, Inc, Erwin, TN) were extracted, using XAD-resin adsorption followed by solvent elution, and the extracts were assayed for mutagenic potential by the Ames Salmonella-mammalian microsome test. Dose-related mutagenic responses with TA102 (+S9) were produced with the extracts of water samples obtained from a creek receiving wastewater from the processing facility (specific mutagenic activities of 7,250 to 8250 net revertants per liter equivalent of water). The creek water extracts were not mutagenic with TA102 in the absence of S9, or with any other tester strain, (i.e., TA97, TA98, TA100, and TA1535) in the presence or absence of S9. Surface water samples downstream and upstream of Martin creek were not mutagenic, apparently indicating the lack of persistence of the observed mutagenicity. The major constituent in the mutagenic creek water extracts was identified as tributyl phosphate (TBP) by gas chromatography-mass spectrometry. However, TBP was not mutagenic with TA102 (+S9) at doses ranging from 196 micrograms/plate to 9.8 nanograms/plate. Because tester strain TA102 detects oxidative mutagenesis due to x-rays and ultraviolet radiation, it is possible that the observed mutagenicity of creek water extracts was due to radionuclides complexed to TBP. (Author's abstract)
W91-01972

EFFECT OF HEAVY METALS ON BAY SCALLOPS, SURF CLAMS, AND BLUE MUSSELS IN ACUTE AND LONG-TERM EXPOSURES.
National Marine Fisheries Service, Milford, CT. Milford Lab.
D. A. Nelson, J. E. Miller, and A. Calabrese.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 5, p 595-600, September 1988. 3 fig, 3 tab, 18 ref.

Descriptors: *Chronic toxicity, *Clams, *Heavy metals, *Mytilus, *Scallops, *Toxicity, Bioassay, Copper, Juvenile growth stage, Lead, Median tolerance limit, Mortality, Mussels, Selenium, Water pollution effects, Zinc.

Juvenile Argopecten irradians and Spisula solidissima were exposed to copper (Cu), lead (Pb), selenium (Se) or zinc (Zn) in a 96-hour static bioassay. The order of toxicity for both bivalve species was the same: Cu > Se > Z, > Pb. With the exception of lead, A. irradians were more sensitive than S. solidissima to the metals tested. Juvenile Mytilus edulis were exposed in 96-hour static bioassays to cadmium (Cd), Cu, mercury (Hg), or silver (Ag). The order of toxicity was Cu = Hg = Ag > Cd. M. edulis was as sensitive to Cd as A. irradians. In a 126-day exposure, 45 young-of-the-year A. irradians or S. solidissima, or 45 adult M. edulis were exposed to Cu, using a proportional diluter apparatus. Copper was added to test tanks at concentrations of 0.002, 0.010, or 0.020 mg/L, while control tanks received untreated seawater. Of the three species exposed to the three concentrations of Cu, young-of-the-year S. solidissima were the most sensitive, followed by young-of-the-year A. irradians. Least sensitive was the adult M. edulis. (Author's abstract)
W91-01973

DRILLING FLUIDS AND THE ARCTIC TUNDRA OF ALASKA: ASSESSING CONTAMINATION OF WETLANDS HABITAT AND THE TOXICITY TO AQUATIC INVERTEBRATES AND FISH.
National Fisheries Contaminant Research Center, Jackson, WY. Jackson Field Station.
For primary bibliographic entry see Field 5B.
W91-01975

RISK ASSESSMENT OF DRINKING WATER IN A RESERVOIR CONTAMINATED BY PAHS ORIGINATED FROM ROAD TRAFFIC.
Ehime Prefecture Inst. of Public Health, Matsuyama (Japan).
T. Ishimaru, H. Inouye, and T. Morioka.
The Science of the Total Environment STENDL, Vol. 93, p 125-130, April 1990. 3 fig, 5 tab, 7 ref.

Descriptors: *Air pollution, *Carcinogens, *Drinking water, *Highway effects, *Polycyclic aromatic hydrocarbons, *Reservoirs, *Risks, *Water pollution sources, Aromatic compounds, Assessments, Chemical analysis, Surface runoff, Water analysis.

The loads of polycyclic aromatic hydrocarbons (PAHs) originating from road traffic were measured, and units of per vehicle per meter were estimated as follows: 0.07 ng per vehicle per meter for benzo-a-pyrene, 0.83 ng per vehicle per meter for dibenzanthracene, and 5.77 ng per vehicle per meter for total PAHs. This unit was applied to the risk estimation of drinking water from a reservoir where there are plans to construct a new highway in the near future. Currently, the concentration of PAHs in the reservoir water is estimated to be 3.3 to 101 ng/L for individual PAHs. Assuming standard oral exposure to PAHs in raw water for the drinking water supply, the estimated lifetime risk of carcinogenesis was calculated to be < 1 in 10 million, which is not considered significant. (Author's abstract)
W91-01991

SLURRY-EXPLOSIVE PLANT WASTE WATERS: ENVIRONMENTAL IMPACT AND TREATMENT.
Ravishankar Univ., Raipur (India). Dept. of Chemistry.
J. K. Moitra, and G. S. Pandey.
The Science of the Total Environment STENDL, Vol. 95, p 191-199, June 1990. 1 fig, 3 tab, 13 ref.

Descriptors: *Biological wastewater treatment, *Environmental impact, *Explosives wastes, *Groundwater pollution, *Industrial wastewater, *Slurries, *Wastewater treatment, *Water pollution effects, Acid-charred waste, Ammonium, Effluents, Nitrates, Sludge, Sludge utilization, Wastewater, Water hyacinth, Water quality.

Slurry-explosives are produced by mixing an oxidizing solution of nitrates of ammonium and calcium, thiourea, ethylene glycol, guargum and water with a solid fuel mix consisting of aluminium powder, starch, tamarind kernelpowder, gilsonite and sulfur, in a hydraulically operated mixer, to give a slurry. The major portion of wastewaters produced during the continuous washing process of the cartridges that hold the slurry. The impact of the discharged wastewater on groundwater quality is noticeable up to a distance of 10 km from the coffer dam. The presence of ammonium and nitrate ions was found up to distance of 5 and 6.5 km, respectively. However, from pH, total dissolved solids and calcium hardness data, the impact of the wastewater can be inferred up to a distance of 10 km. Acid-charred waste from an oxalic acid plant, domestic sewage sludge, and the water hyacinth were used as treatment materials for these wastes. Acid-charred waste was found to be 60 percent effective, and domestic sewage sludge was found to be 95 percent effective in the removal of the nitrogenous content of the wastewaters. The water hyacinth (Eichhornia crassipes) removes nitrate and ammonium efficiently when these ions are present below toxicity limits. If cultivated in the vicinity of a slurry-explosive manufacturing plant, the water hyacinth could play a role in the control of contamination of groundwater by nitrogenous compounds in the discharged wastewaters. (Author's abstract)
W91-02008

ECOLOGICAL MECHANISMS IMPORTANT FOR THE BIOTIC CHANGES IN ACIDIFIED LAKES IN SCANDINAVIA.
Goeteborg Univ. (Sweden). Dept. of Zoology.
J. A. Stenson, and M. O. G. Eriksson.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 4, p 201-206, July/August 1989. 78 ref.

Descriptors: *Acid rain effects, *Aquatic animals, *Ecosystems, *Lake acidification, *Limnology, *Path of pollutants, *Scandinavia, Decomposition, Food chains, Heavy metals, Invertebrates, Predation, Survival, Toxicity, Transparency.

The problem of acidification of freshwaters affected by long distance transported pollutants affects many of the lakes in Scandinavia. Besides direct

ffects, such as reduced reproduction or survival
f fish and invertebrates due to low pH or expo-
ure to toxic metals, many indirect effects are also
nportant factors. These indirect effects include
cological mechanisms such as a shift of top preda-
ors from fish to invertebrates and a reduced de-
omposition rate due to decreased abundance of
etritivores; as well as feedback effects on the
biotic environment, such as reduced productivity
nd turnover rate of nutrients and an increase in
ater transparency. Impaired reproduction among
asserine birds has been related to exposure of
uminum through the intake of insects emerging
om acidified waters. Adverse effects on duck
opulations due to reduced abundance or quality
food organisms has been emphasized more in
orth America than in Scandinavia, but combined
fects of acidity and predation pressure from acid-
lerant fish contribute to low abundances of wa-
rfowl. (Brunone-PTT)
91-02015

CUTE TOXICITY OF SELECTED HERBI-
DES AND SURFACTANTS TO LARVAE OF
HE MIDGE CHIRONOMUS RIPARIUS.
ational Fisheries Contaminant Research Center,
nkton, SD. Field Research Station.
J. Buhl, and N. L. Faerber.
chives of Environmental Contamination and
xicology AECTCV, Vol. 18, No. 4, p 530-536,
y/August 1989. 4 tab, 24 ref.

scriptors: *Aquatic insects, *Bioassay, *Herbi-
es, *Midges, *Surfactants, *Toxicity, *Water
lution effects, Alachlor, Bromoxynil, Butylate,
ect larvae, Lethal limit, Metribuzin, Storms,
allate.

e acute toxicities of eight commercial herbicides
two surfactants to early fourth instar larvae of
midge Chironomus riparius were determined
er static conditions. The formulated herbicides
ed were Eradicane (EPTC), Fargo (triallate),
so (alachlor), ME4 Brominal (bromoxynil),
nrod (propachlor), Rodeo (glyphosate), Sencor
tribuzin), and Sutan (+) (butylate); the two
actants were Activator N.F. and Ortho X-77.
ddition, technical grade alachlor, metribuzin,
achlor, and triallate were tested for compari-
with the formulated herbicides. The relative
city of the commercial formulations, based on
ent active ingredient, varied considerably. The
0 values ranged from 1.23 mg/L for Fargo to
) mg/L for Rodeo. Fargo, ME4 Brominal, and
rod were moderately toxic to midge larvae;
o, Sutan (+), and Eradicane were slightly
; and Sencor and Rodeo were practically non-
. The 48-hour EC50 values of the two surfac-
were nearly identical and were considered
erately toxic to midges. For two of the herbi-
, in which the technical grade material was
d, the inert ingredients in the formulations had
nificant effect on the toxicity of the active
dients. Fargo was twice as toxic as technical
e triallate, whereas Sencor was considerably
oxic than technical grade metribuzin. A com-
on of the slope function values indicated that
oxic action of all compounds occurred within
atively narrow range. In general. the relative
of toxicity to Chironomus riparius was simi-
o those for other freshwater invertebrates.
mum concentrations of each herbicide in bulk
f during a projected critical runoff event
calculated as a percentage of the application
ost in a given volume of runoff. A compari-
etween estimated maximum herbicide concen-
ns in runoff and results of acute tests indicat-
at Ramrod, ME4 Brominal, and Lasso pose
reatest direct risk to midge larva during a
event. (Author's abstract)
02017

ROINVERTEBRATE AND PERIPHYTON
ONSE TO STREAMBED AGITATION
RELEASE OF SUBSTRATE-TRAPPED
ROCARBONS.
Univ., Moscow. Dept. of Plant, Soil and
nological Sciences.
Pontasch, and M. A. Brusven.
ves of Environmental Contamination and
ology AECTCV, Vol. 18, No. 4, p 545-553,
July/August 1989. 6 fig, 1 tab, 29 ref.

Descriptors: *Aquatic plants, *Cleanup operations, *Hydrocarbons, *Idaho, *Macroinvertebrates, *Oil spills, *Periphyton, Chlorophyll a, Mixing, Sediment chemistry, Species diversity.

Following a spill of more than 94.4 cubic m of unleaded gasoline into Wolf Lodge Creek in northern Idaho, impacted areas were mechanically agitated to release substrate-trapped hydrocarbons by dragging a bulldozer blade with a tightly wound chainlink fence attached to it backward over the substrate. Portions of two riffles were left unagitated to determine if differential recovery of benthic macroinvertebrates and periphyton in cleaned versus uncleaned areas of the stream would occur. Chlorophyll a concentrations and densities of most macroinvertebrates were significantly lower ($P < or = 0.05$) in raked areas 12 days after stream cleaning. However, macroinvertebrate and periphyton community compositions were very similar 1 month after stream cleaning and for the remainder of the study. In spite of similar recovery times of macroinvertebrates and periphyton in raked and nonraked areas, the cleaning process is viewed as beneficial because it minimized possible chronic effects on the biota without causing substantial additional impact. (Author's abstract)
W91-02019

EFFECTS OF CADMIUM ON MUREX TRUNCULUS FROM THE ADRIATIC SEA: I. ACCUMULATION OF METAL AND BINDING TO A METALLOTHIONEIN-LIKE PROTEIN.
Innsbruck Univ. (Austria). Inst. fuer Zoologie.
For primary bibliographic entry see Field 5B.
W91-02020

EFFECTS OF CADMIUM ON MUREX TRUNCULUS FROM THE ADRIATIC SEA: II. OXYGEN CONSUMPTION AND ACCLIMATION EFFECTS.
Innsbruck Univ. (Austria). Inst. fuer Zoologie.
G. J. Dalla Via, R. Dallinger, and E. Carpene.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 4, p 562-567, July/August 1989. 4 fig, 1 tab, 21 ref.

Descriptors: *Adriatic Sea, *Bioaccumulation, *Bioassay, *Cadmium, *Heavy metals, *Mollusks, *Oxygen requirements, *Toxicity, *Toxicology, *Water pollution effects, Acclimatization, Biomass, Snails.

Marine snails (Murex trunculus) from the Adriatic Sea were exposed to cadmium in the laboratory under chronic (0.05 mg/L) and acute (5 mg/L) conditions. More than 5 mg/L cadmium were required to lethally damage Murex trunculus during an exposure of 96 hours. Compared with untreated animals, chronic exposure of Murex trunculus to 0.05 mg/L cadmium results in an elevated rate of oxygen consumption. The difference between the two groups of snails increases with time. After one month, a 10% greater loss in biomass in treated animals than in controls was observed, reflecting the higher energy expenditure during exposure to 0.05 mg/L cadmium. An acute cadmium shock of 5 mg/L caused depression of oxygen consumption both in the control and in long term pre-exposed snails to 0.05 mg/L. If pre-exposure to a low concentration of cadmium lasted for a short time only (18 hours) a subsequent acute cadmium shock did not lead to a depression of the rate of oxygen consumption. (See also W91-02020) (Author's abstract)
W91-02021

EFFECT OF WATERBORNE AND DIETARY CADMIUM ON PLASMA IONS OF THE TELEOST OREOCHROMIS MOSSAMBICUS IN RELATION TO WATER CALCIUM LEVELS.
Dar es Salaam Univ. (Tanzania). Dept. of Zoology and Marine Biology.
H. B. Pratap, H. Fu, R. A. C. Lock, and S. E. W. Bonga.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 4, p 568-575, July/August 1989. 2 tab, 59 ref.

Descriptors: *Cadmium, *Calcium, *Fish physiology, *Heavy metals, *Toxicity, *Toxicology, *Water chemistry, *Water pollution effects, Bioaccumulation, Cichlid, Metabolism, Tilapia.

The effects of cadmium administered via ambient water or food on plasma ions of the African freshwater cichlid Oreochromis mossambicus were studied for 2, 4, 14 and 35 days, in low calcium (0.2 mM) and high calcium (0.8 mM) water. In low calcium water, an environmentally relevant concentration of 10 microg/L water-borne cadmium induced a significant and dramatic hypocalcemia on days 2 and 4. Recovery of plasma calcium was observed on days 14 and 35. Hypermagnesemia was observed on day 2, but normal levels were already found on day 4. In high calcium water adapted fish, the extent of hypocalcemia and hypermagnesemia was less pronounced than in fish from low calcium water. Water-borne cadmium caused no significant changes in plasma phosphate, sodium, potassium or osmolality. On days 2 and 4, dietary cadmium (averaging 10 microg cadmium/fish/day) caused hypermagnesemia and hypocalcemia in low calcium water adapted fish. Recovery was observed on days 4 and 14, respectively. In fish from high calcium water, dietary cadmium caused a significant reduction in plasma calcium on day 4 only; plasma magnesium was unaffected. Hyperphosphatemia was apparent on day 14, irrespective of the water calcium concentration. No changes in plasma sodium, potassium, or osmolality were found. The results show that sublethal concentrations of cadmium, administered via the water as well as via the food, affect calcium and magnesium metabolism in tilapia. High water calcium ameliorates the effects of both water and dietary cadmium on plasma calcium and magnesium levels. (Author's abstract)
W91-02022

UPTAKE AND ELIMINATION OF WATERBORNE CADMIUM BY THE FISH NOEMACHEILUS BARBATULUS L. (STONE LOACH).
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
P. E. T. Douben.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 4, p 576-586, July/August 1989. 4 fig, 7 tab, 49 ref.

Descriptors: *Bioaccumulation, *Bioassay, *Cadmium, *Fish physiology, *Heavy metals, *Metabolism, *Toxicity, *Water pollution effects, Feeding, Growth rates, Stone loach, Temperature effects.

Fish, Nemacheilus barbatulus L. (stone loach), were exposed to cadmium in water to study rates of uptake and loss in three experiments: one during which they were exposed for up to 4 days to 1.0 mg/L cadmium and subsequently kept in clean water for up to another 8 days at 8 C, 16 C, and 18 C; a second one during which fish were exposed to a range of cadmium concentrations in water (0.08 to 0.93 mg/L); and a third one during which they were starved or fed with Tubifex while some were exposed to 0.067 mg/L cadmium. All levels were well below those that are acutely toxic. Results showed that fed fish did not change weight while all starved fish lost weight, at a higher rate for exposed fish than for control fish. Size of the fish affected rates of uptake and loss of cadmium. These rates increased with temperature. Bioconcentration factors decreased with size of fish, increased with temperature up to about 16 C and decreased as the concentration of cadmium in water increased. Feeding appears to increase the rate of intake of cadmium from the water. Metabolic rate governed rates of uptake and loss. (Author's abstract)
W91-02023

EFFECTS OF DIET, WATER HARDNESS, AND POPULATION SOURCE ON ACUTE AND CHRONIC COPPER TOXICITY TO CERIODAPHNIA DUBIA.
S. E. Belanger, J. L. Farris, and D. S. Cherry.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 4, p 601-611, July/August 1989. 2 fig, 5 tab, 28 ref.

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Descriptors: *Bioassay, *Copper, *Diets, *Heavy metals, *Toxicity, *Toxicology, *Water pollution effects, *Waterfleas, Hardness.

The effects of diet, water hardness, and population source on acute toxicity, and diet and water hardness on chronic toxicity of copper to Ceriodaphnia dubia were investigated. A diet of three algae (Chlamydomonas rheinhardti, Ankistrodesmus falcatus, and Chlorella vulgaris, hereafter referred to as CAC) cultured in vitamin-enriched media was superior to synthetic diets consisting of yeast, Cerophyll, and trout chow (YCT). Neonates from mothers reared on CAC were 1.4 to 1.5 times more resistant to copper than those reared on YCT or yeast and Cerophyll. Forty-eight hour LC50s of copper to C. dubia increased from 35 to 79 microg/L at water hardness of 94 and 170 mg calcium carbonate/L. Three populations of Ceriodaphnia derived from three US Environmental Protection Agency laboratories showed no differential copper sensitivity. Chronic copper impairment was measured by neonate production in the 7-day life cycle test. Chronic values were 7.9 and 10.1 microg/L at water hardnesses of 94 and 170 mg/L respectively. A comparison of daily water renewal and renewal on days 3 and 5 only was made, showing that neonate production was significantly greater using day 3 and 5 renewals (Friedmann's Rank Sum Test, $p < 0.005$), even though copper concentrations were comparable between the two tests. Therefore, handling stress may have occurred using daily changes. It is recommended that future tests and US EPA guidelines should address deleting YCT and including multi-algal diets for culturing and chronic testing of Ceriodaphnia. (Author's abstract)
W91-02024

PHYSIOLOGICAL RESPONSES TO SEVERE ACID STRESS IN FOUR SPECIES OF FRESHWATER CLAMS (UNIONIDAE).
Helsinki Univ. (Finland). Dept. of Zoology.
K. Pynnonen.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 471-478, July/August 1990. 5 fig, 6 tab, 28 ref.

Descriptors: *Acid rain effects, *Acidic water, *Bioassay, *Mollusks, *Water pollution effects, Calcium, Chlorides, Clams, Finland, Hardness, Hydrogen ion concentration, Physiology, Potassium, Sodium.

Four species of freshwater clam, Anodonta anatina, A. cygnea, Unio pictorum, and U. tumidus were exposed for 2 weeks to acidified soft water (pH 4.0 to 4.5, calcium 4.6 mg/L) and for 4 weeks to acid in hard water conditions (calcium 18.5 mg/L). The exposures caused a decrease in sodium ions, potassium ions and chloride ions and a rapid increase of calcium ions in the hemolymph. The elevation of the hemolymph calcium ions was positively correlated with the decrease in the hemolymph pH in all species studied. Low ambient calcium ion level accelerated the pH decrease and calcium ion increase in the hemolymph. Sodium and chloride ion concentrations changed less rapidly in the soft conditions. Although there were minor changes in the mineral composition of the calcium concretions in the gills, the amount of calcium in the concretions did not change during the exposure. There was no correlation between the thickness of the shell and the ionic response, but all four species responded to low ambient pH in the same way. (Author's abstract)
W91-02026

MORPHOMETRIC AND X-RAY ENERGY DISPERSIVE APPROACH TO MONITORING PH-ALTERED CADMIUM TOXICITY IN ANABAENA FLOS-AQUAE.
Herbert H. Lehman Coll., Bronx, NY. Dept. of Biological Sciences.
L. C. Rai, T. E. Jensen, and J. W. Rachlin.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 479-487, July/August 1990. 6 fig, 7 tab, 36 ref. Minority Biomedical Research Grant No. 4-42433, Faculty Research Award Program Grant 6-67202.

Descriptors: *Acid rain effects, *Algae, *Cadmium, *Cyanophyta, *Heavy metals, *Hydrogen ion concentration, *Morphology, *Toxicity, *Trace elements, *Water pollution effects, Absorption, Bioassay, Monitoring.

Cyanobacteria are a group of procaryotic photosynthetic microbes with a genome plasticity that allows them to grow in some of the harshest environments. To date, there is no information on the combined effects of pH and cadmium toxicity on ultrastructural changes in algae; nor have the ultrastructural effects of pH alone been documented. Cadmium toxicity and uptake as influenced by different pH values were investigated in the freshwater cyanophyte Anabaena flos-aquae, using morphometric analysis, x-ray energy dispersive analysis and atomic absorption spectrophotometry. A general reduction in cell dimension, thylakoid surface area, number and volume of polyhedral bodies, polyphosphate bodies, cyanophycin granules, lipid bodies, membrane limited crystalline inclusions, volume and number of wall layers and mesosomes was observed. These reductions were more pronounced in both acidic and alkaline medium than at pH 7.2. At 0.12 microM cadmium, the uptake increased with alkaline pH values, and uptake was greater at pH 7.2 than at either acid or alkaline pHs. Lysis of cell wall at 1.18 microM cadmium showed the following decreasing trend: pH 4.0 > pH 5.5 > pH 10 > pH 9.0 > pH 7.2. A total loss of lipid bodies at 1.18 microM cadmium resulted at all pH values listed. These techniques could be successfully employed for bioassay studies of metal toxicity to algae. In particular, cell wall lysis and loss of lipids by algae are good indicators of pH effects and metal toxicity in the aquatic ecosystem. (Author's abstract)
W91-02027

TOXICITY AND BIOACCUMULATION OF SELENATE, SELENITE AND SELENO-L-METHIONINE IN THE CYANOBACTERIUM ANABAENA FLOS-AQUAE.
California Univ., Davis. Dept. of Land, Air and Water Resources.
P. Kiffney, and A. Knight.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 488-494, July/August 1990. 1 fig, 6 tab, 29 ref. DOI-USGS Project No. 140800001G and Univ. of California Salinity/Drainage Task Force Project No. 86-9.

Descriptors: *Bioaccumulation, *Cyanophyta, *Heavy metals, *Selenium, *Toxicity, *Water pollution effects, Amino acids, Bacterial physiology, Chlorophyll a, Food chains, Metabolism.

A laboratory investigation was conducted to study the toxicity and bioaccumulation of seleno-L-methionine, selenate and selenite in the cyanobacterium Anabaena flos-aquae. The first sublethal effects of seleno-L-methionine, selenite and selenate occurred at 0.1, 3.0 and 3.0 mg/L, respectively with a decrease in chlorophyll a concentration ($P < 0.0001$). Selenium bioconcentration factors were in the order of seleno-L-methionine, selenite, and selenate. Significant decreases in intracellular selenium concentration were observed at both the no effect and low level effect at each oxidation state tested in the given experiment ($P < 0.0001$). The preferential uptake of selenite and seleno-L-methionine was explained by the additional energy consuming metabolic steps necessary for the alga to reduce and incorporate selenate into sulfur amino acids. The mechanism by which algae regulate selenium to ameliorate toxicity is still not known. The poisoning of the upper trophic levels in selenium contaminated systems is due to the bioconcentration of selenium by primary producers and the subsequent biomagnification of the toxic organic forms of selenium up the aquatic food chain. Therefore, this cyanobacterium is a potentially dangerous food source in the aquatic food chain in selenium contaminated systems. (Brunone-PTT)
W91-02028

BIOACCUMULATION OF SELENIUM IN BIRDS AT KESTERSON RESERVOIR, CALIFORNIA.
Patuxent Wildlife Research Center, Davis, CA. Pacific Coast Field Station.
H. M. Ohlendorf, R. L. Hothem, C. M. Bunck, and K. C. Marois.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 495-507, July/August 1990. 3 fig, 8 tab, 45 ref, append

Descriptors: *Bioaccumulation, *Birds, *California, *Kesterson Reservoir, *Selenium, *Toxicity, *Water pollution effects, Depuration, Food chains, Heavy metals, Physiology, Tissues.

Selenium concentrations in tissues of birds collected during the 1984 to 1985 nesting seasons at Kesterton Reservoir (an area receiving high selenium irrigation drainage water) were determined. These concentrations were compared with those from birds from reference sites within California's Central Valley, and relate to foodchain selenium concentrations at the study sites. Within years selenium in livers of adult birds collected early and late in the nesting season changed significantly at both Kesterton and the primary reference site (Volta Wildlife Area). These changes were related to the length of time birds had been present at the study sites and the associated accumulation (at Kesterton) or depuration (at Volta) of selenium. All species showed significant location differences which were greatest in species that occurred at Kesterton throughout the year or fed more consistently within the reservoir. There were few species differences in selenium for birds at the reference sites (where food chain selenium levels were normal (<or = 2 microg/g dry weight)). At Kesterton (where bird foods generally contained >5 microg selenium/g), species patterns varied by year, probably because of varying periods of residence and other factors. Selenium concentrations in kidneys and livers of American coots (Fulica americana) were significantly correlated ($r = 0.9845$); selenium concentrations in breast muscle and livers of juvenile ducks (Anas spp.) also were correlated ($r = 0.8280$). Body weights of adult coots were negatively correlated with liver selenium concentration. Late-season resident breeding birds or pre-fledgling juvenile birds reared at a site usually provided the best indication of site-specific selenium bioaccumulation. (Author's abstract)
W91-02029

EXPRESSION OF RESULTS FROM GROWTH INHIBITION TOXICITY TESTS WITH ALGAE.
Vandkvalitetsinstitutet, Hoersholm (Denmark).
N. Nyholm.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 518-527, July/August 1990. 4 fig, 2 tab, 14 ref.

Descriptors: *Algal growth, *Bioassay, *Bioindicators, *Growth rates, *Toxicity, *Toxicology, Biomass, Dose-response relationships, Plant physiology.

Results from six growth inhibition toxicity tests with the freshwater green algae Selenastrum capricornutum and Scenedesmus subspicatus have been analyzed using both biomass measurements and estimates of the specific growth rate to quantify the toxic response. For exponentially growing cultures, biomass derived effective concentrations (EC's) decrease with time, but reach asymptotic values in the course of some days. The final (asymptotic) values are smaller than EC figures derived from growth rates, and the differences are greater, the smaller the slope of the dose response curve. EC50 values differed by up to a factor of 6. Standard test protocols for routine testing should prescribe the use of some appropriate measure of the specific growth rate, rather than the biomass as the response variable. (Author's abstract)
W91-02031

EFFECTS OF PARAQUAT ON MORTALITY AND CARDIORESPIRATORY FUNCTION OF CATFISH FRY PLECOSTOMUS COMMERSONI.
Universidad Nacional de Lujan (Argentina). Lab. of Ecotoxicology.
M. C. Tortorelli, D. A. Hernandez, G. Rey Vazquez, and S. Salibian.

Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 523-529, July/August 1990. 4 fig, 5 tab, 19 ref. CONICET (Resol. 0318-9780/86 and CIC-Bs.As (Resol. 7500-7587/86).

Descriptors: *Catfish, *Fish physiology, *Herbicides, *Paraquat, *Toxicity, *Toxicology, *Water pollution effects, Gills, Microscopy, Morphology, Mortality.

The effects of a paraquat commercial herbicide formulation on an early stage of the development of Plecostomus commersoni were evaluated. Mortality, opercular ventilation rate, cardiac contraction rate and body length were examined every twelve hours. The effects of the paraquat formulation on the morphology of the branchial epithelium were also examined by light microscopy. The assayed paraquat formulation significantly affected cardiac contraction and opercular ventilation. Ecotoxicologically, this could represent an important deleterious effect for early development of the catfish. Mortality data may not be sufficient for an appropriate evaluation of secondary environmental hazards associated with the application of paraquat formulation because the LC-50 values for Plecostomus commersoni fry were higher than the recommended individual application rate of paraquat for aquatic weed control (0.1 to 2.0 mg/L), and the estimated maximum acceptable toxicant concentration (MATC) resulted in a concentration similar to the application rate when calculated from acute toxicity. When the MATC was estimated from opercular ventilation or cardiac contraction rates, it was lower and fell within the recommended single application rates. (Author's abstract)
W91-02032

GEOGRAPHIC VARIATION OF CHLORINATED HYDROCARBONS IN BURBOT (LOTA LOTA) FROM REMOTE LAKES AND RIVERS IN CANADA.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Central and Arctic Region.
For primary bibliographic entry see Field 5B.
W91-02033

CHRONIC TOXICITY AND BIOACCUMULATION OF 2,5,2',5'- AND 3, 4, 3',4'-TETRACHLOROBIPHENYL AND AROCLOR 1242 IN THE AMPHIPOD HYALELLA AZTECA.
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
J. Borgmann, W. P. Norwood, and K. M. Ralph.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 558-564, July/August 1990. 4 fig, 3 tab, 25 ref.

Descriptors: *Amphipods, *Aroclors, *Bioaccumulation, *Tetrachlorobiphenyl, *Toxicity, *Toxicology, Aquatic fauna, Biomagnification, Food chains, Invertebrates, Mortality, Polychlorinated biphenyls.

The addition of 100 microg/L of Aroclor 1242 or 2,5,2',5'-tetrachlorobiphenyl (TeCB) during 10 week chronic toxicity tests with Hyalella azteca resulted in complete mortality. There were no effects on survival, growth or reproduction after addition of 30 microg/L. Toxic effects were observed at tissue levels of between 30 and 180 microg/g on a wet weight basis, and tissue levels appear to be a better indicator of toxicity than levels in water. No toxic effects were observed after addition of up to 2700 microg/L of the coplanar congener 3,4,3',4'-TeCB. H. azteca has the ability to avoid accumulating in excess of 140 microg/g 3,4,3',4'-TeCB. The amount taken up was proportional to the amount added in water up to 100 microg/L, but was constant at higher additions, possibly accounting for its relatively low toxicity. The low toxicity of the coplanar congener, as compared to the non-coplanar 2,5,2',5'-TeCB, is in direct contrast to the high toxicity of coplanar PCB congeners to mammals and may be associated with slower rates of aromatic hydrocarbon metabolism in amphipods. Polychlorinated biphenyl levels measured in amphipods from Lake Ontario are approximately 100-fold below levels associated with toxicity in H. azteca, but are above levels which, through biomagnification up the food chain, lead to salmonid residues in excess of 2 microg/g, a tolerance limit for human consumption. (Author's abstract)
W91-02035

COMPARATIVE TOXICOKINETICS OF 2,2'-DICHLOROBIPHENYLS AND 4,4'-DICHLOROBIPHENYLS IN THE POND SNAIL LYMNAEA STAGNALIS.
Vrije Univ., Amsterdam (Netherlands). Dept. of Pharmacochemistry.
M. Wilbrink, M. Treskes, T. A. De Vlieger, and N. P. E. Vermeulen.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 565-571, July/August 1990. 4 fig, 2 tab, 30 ref.

Descriptors: *Dichlorobiphenyls, *Mollusks, *Path of pollutants, *Polychlorinated biphenyls, *Snails, *Toxicity, *Toxicology, *Water pollution effects, Temporal distribution.

Pond snails (Lymnaea stagnalis (L.)) were treated with 2,2'-dichlorobiphenyl (DCB) or 4,4'-DCB, to examine the toxicokinetic profile of these compounds. Snails were treated orally with 210 microg 4,4'-DCB (impregnated on food) for 14 hours, or snails were injected with 50 microg of 2,2'-DCB or 4,4'-DCB in the foot. At different times after starting feeding or injection, tissues (albumen gland, digestive gland and digestive tube, central nervous system, remainder parts), hemolymph and feces were analyzed for unchanged 2,2'-DCB or 4,4'-DCB. The results showed that in the case of oral administration of 4,4'-DCB after 144 hr, 97.5% of the dose was excreted unchanged in the feces. During the first 48 hours, 4,4'-DCB was found in all tissues. Thereafter, an exponential elimination was found (The rate constant of elimination varied from 0.010 to 0.021 per hour, half life from 33 to 60 hours and the apparent clearance from 0.02 to 0.3 g/hr for the different tissues). After injection, the compounds were found in all the above mentioned tissues, especially in the digestive gland. There was a clear difference between snails injected with 2,2'-DCB and 4,4'-DCB. Firstly, the rate constant of elimination 2,2'-DCB was higher (0.028 per hr vs 4,4'-DCB: 0.001 per hr). Secondly, 2,2'-DCB was lethal; 63% of the animals died after 72 hours. (Author's abstract)
W91-02036

TOXICOLOGICAL EXAMINATION OF WHITEFISH (COREGONUS CLUPEAFORMIS) AND NORTHERN PIKE (ESOX LUCIUS) EXPOSED TO URANIUM MINE TAILINGS.
Environmental Protection Service, Regina (Saskatchewan).
D. T. Waite, S. R. Joshi, H. Sommerstad, G. Wobeser, and A. A. Gajadhar.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 578-582, July/August 1990. 1 fig, 3 tab, 10 ref.

Descriptors: *Bioaccumulation, *Canada, *Pike, *Radioactive wastes, *Toxicity, *Toxicology, *Uranium, *Water pollution effects, *Whitefish, Enzyme activity, Fecundity, Fish parasites, Histopathology, Lake Athabasca, Langley Bay, Mine tailings, Sediment chemistry.

Operation of the Gunnar uranium mine, in northern Saskatchewan, Canada, from 1955 to 1964, resulted in the deposition of radioactive tailings in Langley Bay, a small bay connected to Lake Athabasca. The sediments, water, macrophytes and fish of this area have been contaminated with uranium mine tailings. The parasite infestation, blood hematocrit, histopathology and condition factor of the Langley Bay whitefish and northern pike populations were compared with those from Lake Athabasca. Parasite infestations of the control area were very similar to those of Langley Bay. Differences in parasite fauna probably reflect habitat differences rather than debilitation from exposure to radionuclides. The highest concentrations of radionuclides were found in the gut contents and bone of whitefish from Langley Bay. Kidney tissue contained higher radionuclide concentrations than other soft tissues. The concentrations of radionuclides and other heavy metals in the tissues and environment of Langley Bay whitefish had not caused overt histopathological changes in these fish. No significant differences could be found, in any of the physiological parameters measured, between the contaminated and control populations. Many other aspects of the health of these fish populations have not been studied including: genetic make-up; fecundity; blood plasma chemistry; and, enzyme function. The lack of information in the literature on the uptake rates and mechanisms for natural radionuclides has hampered toxicological studies of these populations. (Brunone-PTT)
W91-02037

SUBLETHAL AND ACUTE TOXICITY OF THE ETHYLENE GLYCOL BUTYL ETHER ESTER FORMULATION OF TRICLOPYR TO JUVENILE COHO SALMON (ONCORHYNCHUS KISUTCH).
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
J. A. Johansen, and G. H. Geen.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 610-616, July/August 1990. 3 fig, 4 tab, 20 ref.

Descriptors: *Fish physiology, *Herbicides, *Salmon, *Toxicity, *Triclopyr, *Water pollution effects, Dose-response relationships, Fish behavior, Fishkill, Oxygen requirements, Uptake.

The toxicity of Garlon 4, the ethylene glycol butyl ether ester formulation of the herbicide triclopyr, to juvenile coho salmon (Oncorhynchus kisutch) was investigated at several lethal and sublethal concentrations. Fish behavior, random activity, and oxygen uptake were monitored. Coho salmon exhibited three distinct responses related to concentration and duration of exposure: (1) at concentrations greater than 0.56 mg/L fish were initially lethargic, then regressed to a highly distressed condition characterized by elevated oxygen uptake and finally death, (2) at 0.32 to 0.43 mg/L fish were lethargic throughout the exposure period with reduced oxygen uptake, and (3) at concentrations <= 0.10 mg/L fish were hypersensitive to stimuli, exhibiting elevated activity and oxygen uptake levels during photoperiod transitions. Whole body residue analysis showed that uptake of the ester and subsequent hydrolysis to the acid form in the fish was rapid, with significant accumulation of the acid in the tissues. This result suggests that some threshold tissue concentrations were associated with the observed results. For juvenile coho salmon the 96 hour LC40 of Garlon 4 was 0.84 mg/L. (Author's abstract)
W91-02039

EFFECTS OF SHORT-TERM PULSES OF ATRAZINE ON ATTACHED ALGAL COMMUNITIES IN A SMALL STREAM.
Texas Christian Univ., Fort Worth. Dept. of Biology.
T. A. Jurgensen, and K. D. Hoagland.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 617-623, July/August 1990. 4 fig, 6 tab, 46 ref.

Descriptors: *Algae, *Atrazine, *Ecosystems, *Herbicides, *Stream biota, *Toxicology, *Water pollution effects, Algal toxicity, Biomass, Nebraska, Plant physiology, Sedimentation.

The impact of short-term atrazine exposures on attached algal community composition and standing crop was investigated during the summer in a small, spring-fed stream in western Nebraska. Replicate trays of clay tiles were anchored to the stream bed, allowed to colonize for two weeks, then enclosed in situ with plexiglass boxes and exposed to a pulse of atrazine at 0, 2, 30, or 100 microg/L for 24 hours. A second 24-hour atrazine pulse was applied two weeks later. Atrazine did not have a significant effect on cell densities of the dominant algae or the ash-free dry weight biomass of the periphyton community. The absence of observed treatment effects was likely due to the low but realistic levels of atrazine used and the tran-

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sient nature of the application. Sediment deposition had a much greater influence on the attached algal community than short term pulses of the herbicide. (Author's abstract)
W91-02040

COMPARATIVE TOXICITIES OF SELECTED INDUSTRIAL CHEMICALS TO MICROORGANISMS AND OTHER AQUATIC ORGANISMS.
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
D. D. Vaishnav, and E. T. Korthals.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 4, p 624-628, July/August 1990. 2 fig, 2 tab, 23 ref. EPA Cooperative Agreement No. CR809234.

Descriptors: *Aquatic life, *Copepods, *Fish, *Microorganisms, *Toxicity, *Toxicology, *Water pollution effects, *Waterfleas, Alcohols, Barnacles, Bioassay, Biodegradation, Growth rates, Ketones, Naphthalenes, Phenols, Statistical analysis.

Microorganisms are particularly suitable for use in rapidly screening chemical toxicity because they are relatively easy to handle, have rapid growth rates, provide reproducible results, and are inexpensive to grow and maintain. Biodegradation rates of 25 narcotic industrial chemicals were determined nanometrically using resting cells prepared from preacclimated mixed cultures of microorganisms. These chemicals included straight-chain and cyclic alcohols and ketones as well as naphthalene and phenol. Chemical concentrations that would reduce maximum rates by 50% (BIC50) were estimated from rate inhibition data. Subsequently, the BIC50 and acute toxicities of chemicals to daphnids, barnacle larvae, copepods, and fish (bleak, fathead minnow and golden orfe) were correlated. The r-squared and F-statistics for all six linear correlations were significant (alpha = 0.001). This result suggests, for chemicals having a non-specific mode of toxic action, the biodegradation inhibition test may be used to estimate concentrations which would be toxic to higher aquatic organisms. A comparisons of toxicity data showed microorganisms were less sensitive to test chemicals than the other species. Chemical concentrations causing 50% inhibition of the maximum rates of microbial degradation to the six aquatic organisms correlated well for selected narcotic industrial chemicals. The test may also be adapted for evaluating colored or turbid samples, and the bioavailable chemicals in sediment or soil. (Brunone-PTT)
W91-02041

PARTITIONING OF LINDANE BETWEEN SEDIMENT, WATER AND THE CRUSTACEAN METAPENAEUS MACLEAYI.
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W91-02042

5D. Waste Treatment Processes

INFLUENCE OF WATER CHEMISTRY ON SUSPENDED SOLIDS IN COAL MINE SEDIMENTATION PONDS.
Kentucky Agricultural Experiment Station, Lexington. Dept. of Agronomy.
V. P. Evangelou.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 428-434, July/September 1990. 3 fig, 5 tab, 25 ref.

Descriptors: *Coal spoil, *Kentucky, *Salinity, *Sedimentation basins, *Suspended solids, *Waste disposal, *Waste treatment, *Water quality, Coal mine effects, Conductivity, Dispersion, Flocculation, Repulsion, Sediment control.

In Kentucky, water quality in coal mine sedimentation ponds is lowered by high concentrations of suspended solids. Spoil samples from surface mine sites in eastern and western Kentucky were equilibrated with distilled water to evaluate their effects on suspended solids. The results demonstrate that small changes in salt concentration have large effects on suspended solid concentration. Furthermore, it was determined that for the ranges of water chemistry encountered in such environments, there is a linear relationship between the repulsive index (RI) and suspended solids. Increasing the electrical conductivity reduces RI and increases the rate of settling. The trapping efficiency of sedimentation ponds during base flow is highly dependent on the physicochemical forces dictating dispersion/flocculation processes. (Author's abstract)
W91-01013

INFLUENCE OF IMMOBILIZATION SUPPORTS ON KINETIC CONSTANTS OF ANAEROBIC PURIFICATION OF OLIVE MILL WASTEWATER.
Instituto de la Grasa y sus Derivados, Seville (Spain).
J. A. Fiestas, A. Martin, and R. Borja.
Biological Wastes BIWAED, Vol. 33, No. 2, p 131-142, 1 fig, 12 tab, 4 ref, 1990.

Descriptors: *Anaerobic digestion, *Industrial wastewater, *Kinetics, *Wastewater treatment, Automation, Bacteria, Biological treatment, Biological wastewater treatment, Chemical oxygen demand, Computer programs, Fluidized bed process, Montmorillonite.

Studies are made of the anaerobic digestion of olive mill wastewater (OMW) using bioreactors housing various suspended supports for immobilization of the microorganisms. The OMW inhibited the digestion as the digester loadings increased, and support medium affected the inhibition. Data were obtained by applying the international Time Series Processor (TSP) computer program version 4.0 through the Roediger equation. These data show the influence of the different supports used to immobilize the bacteria on the biomethanation of OMW; this is of relevance to the development of fluidized-bed processes. Olive mill wastewater inhibits anaerobic digestion by itself, probably through some inhibitor it may contain along with biodegradable material. The inhibition was also observed in the presence of the supports tested, and was enhanced by polyvinyl chloride. The critical inhibition concentration ranged between 18 and 20 g chemical oxygen demand/L for the reference digester and for those containing saponite, Pangel and Pansil. The supports influenced both the rate of gas production and the coefficients of yields. Recommending a particular support is rather difficult as their kinetic features do not match their coefficients of yield; however, montmorillonite seems to be suitable for using media of low charge densities. (Lantz-PTT)
W91-01055

START-UP IN ANAEROBIC TREATMENT OF NATURAL-RUBBER EFFLUENT.
Regional Research Lab., Trivandrum (India).
A. Pandey, L. G. Radhika, and S. V. Ramakrishna.
Biological Wastes BIWAED, Vol. 33, No. 2, p 143-147, 3 tab, 7 ref. 1990.

Descriptors: *Anaerobic digestion, *Industrial wastewater, *Rubber, *Wastewater treatment, Bacteria, Biological treatment, Biological wastewater treatment, Hydrogen ion concentration, Methane.

In setting up an anaerobic process for industrial wastewater treatment one of the major problems is the acclimatization of the bacterial population to the particular effluent. Natural rubber industry effluent, which is a highly complex waste, car significantly upset a balanced living system which is well-set and acclimatized for biomethanation. The present investigation was undertaken to focus the attention on the start-up of anaerobic digestion of natural rubber effluent, and on the problems encountered during the process. Laboratory experiments were carried out to compare the controlled and uncontrolled start-up of the anaerobic treatment of natural rubber effluent. It was found that a pH-controlled start-up was much more promising than an uncontrolled one. The biogas production was higher and a shorter period for stabilization was required in the pH-controlled systems. (Lantz-PTT)
W91-01056

MECHANISMS OF COMPRESSIBLE SLUDGE CAKE SHRINKAGE.
Stevens Inst. of Tech., Hoboken, NJ. Dept. of Civil, Environmental and Coastal Engineering.
B. R. Bierck, and R. I. Dick.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 4, p 663-682, July/August 1990. 14 fig, 1 tab, 25 ref, append. NSF Grant CEE-8414614.

Descriptors: *Activated sludge process, *Filtration, *Mathematical models, *Sludge cake, *Wastewater treatment, Filter media, Synchrotron X-ray fluorometry, Young-Laplace equation.

Shrinkage can bring about a significant consolidation of saturated filter cakes, and can result in the production of a filtrate that must be omitted from specific resistance calculations. Shrinkage results when curved air/liquid interfaces, which are bounded by solids, form at filter cake surfaces following the formation of the cake. The resultant decrease in pore water pressure is described by the Young-Laplace equation, which is used to express mathematically the effective stress which is causing shrinkage. In-situ pore water pressure measurements corroborate the onset of shrinkage of a kaolin filter cake. Synchrotron x-rays were used to monitor temporal and spatial changes in the concentration of cake-suspended solids. Significant shrinkage of an activated sludge filter cake was observed. Data on the concentration of cake-suspended solids are combined with filtrate production data to obtain singular values of the mass deposited per unit volume of filtrate of the cake-suspended solids produced by a kaolin slurry and an activated sludge. When shrinkage was ignored, calculated specific resistance valves for the kaolin slurry and activated sludge were in error by 10% and 23%, respectively. If the specific resistance test is to be standardized, means for accounting for effects of shrinkage must be included. (King-PTT)
W91-01150

IMMOBILIZED-CELL DEGRADATION OF CHLOROPHENOLS.
Pennsylvania Univ., Philadelphia. Dept. of Systems Engineering.
W. K. Shieh, J. A. Puhakka, E. Melin, and T. Tuhkanen.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 4, p 683-697, July/August 1990. 7 fig, 24 ref.

Descriptors: *Biodegradation, *Biological wastewater treatment, *Chlorinated hydrocarbons, *Phenols, *Wastewater treatment, Bacteria, Biological treatment, Gas chromatography, Mass spectrometry, Microcarriers, Organic carbon, Parachlorophenol, Phenolic pesticides, Secondary wastewater treatment.

The ability of immobilized cells grown under oxic and fluidized conditions to degrade 4-chlorophenol (4-CP) and 2,4-dichlorophenol (2,4-DCP) is evaluated under different dilute rate conditions. Microcarriers with 6.5 micron pores are employed for cell immobilization and retention. Results indicate that with feed 4-CP and 2,4-DCP concentrations at 35.7 and 45.3 mg/l, good and stable removal performance is achievable at empty-bed hydraulic retention times as low as one hour. Stoichiometric release of chloride and removal of total organic carbon are also observed, implying that complete mineralization of 4-CP and 2,4-DCP is attainable. This observation is further validated with gas chromatography/mass spectrometry (GC/MS) data obtained in the 2.4-DCP experimentation. Colonization of immobilized cells on the microcarrier surface is a slow but selective process. Extensive growth of filamentous bacteria is observed, with rod-shaped bacteria grown underneath and adhered to the filaments. Detachment of immobilized cells from the microcarrier surface is negligible. The formation of microbial films on the micro-

carrier surface with measurable thickness is absent. (Author's abstract)
W91-01151

FIELD PERFORMANCE OF ACTIVATED CARBON ADSORPTION FOR SEWAGE AIR.
National Univ. of Singapore. Dept. of Civil Engineering.
L. C. C. Koe, and N. C. Tan.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 4, p 721-734, July/August 1990. 7 fig, 4 tab, 9 ref.

Descriptors: *Activated carbon, *Advanced wastewater treatment, *Hydrogen sulfide, *Odor control, *Wastewater treatment, Carbon column, Wastewater management.

Sewage at the inlet works of a municipal wastewater treatment plant, was simultaneously pumped through two pilot columns, one filled with an alkali-impregnated carbon material, while the other was filled with a nonalkali-impregnated grade. Odor and H2S concentrations at the influent and effluent ports of the carbon columns were continuously monitored for about eight months. The odor and H2S concentrations of the influent sewage air varied significantly throughout the study period, averaging 120 standard odor units/cubic m and 5.3 ppm, respectively. Breakthrough of odor at the effluent ports occurred earlier than that for H2S, and the initial breakthrough odor was exerted mainly by non-H2S compounds. Although the alkali-impregnated carbon was capable of removing a much larger quantity of H2S than the nonalkali-impregnated grade, its effectiveness in removing other odorous but non-H2S gaseous compounds was less significant. The cost of using nonalkali-impregnated activated carbon for odor removal was comparable to that of the alkali-impregnated carbon. This cost comparison, however, ignores the effect of regeneration of the carbons. (Author's abstract)
W91-01155

VIRUS REMOVAL BY SAND FILTRATION OF SEPTIC TANK EFFLUENT.
Arkansas Univ., Little Rock. Dept. of Electronics and Instrumentation.
M. A. Gross, and D. Mitchell.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 4, p 711-720, July/August 1990. 3 fig, 2 tab, 16 ref.

Descriptors: *Sand filters, *Sand filtration, *Septic tanks, *Septic wastewater, *Soil disposal fields, *Viruses, *Wastewater management, Enteroviruses, Physical treatment, Secondary wastewater treatment, Wastewater treatment, Water quality.

Septic tank effluent (STE) is applied to stratified sand filter columns at a rate of 6.1 cm/day or 1.5 l/day/sq ft demonstrated the ability of the sand filter to remove enteric viruses. The sites of virus retention were determined. Seven 10-cm diameter sand columns were constructed of 2 cm of dry, coarse sand, 10 cm of dry, fine sand, and 25 cm of coarse sand, with the sand layers separated by 5 cm of 1.9-cm rounded gravel. Household septic tank effluent containing poliovirus vaccine, type 1, strain LSc, is applied to the filters, and influent and effluent samples are collected. Enterovirus analyses were performed using plaque assays in buffalo green monkey kidney cell cultures. Following the filter runs, the columns were dissected into 2.5 cm discs and the discs were assayed for enteroviruses. The sand filter columns were found to retain all viruses when the virus loading remains less than 33,00.00 PFU/L (plaque-forming units per liter). Analyses of the filter discs showed that most viruses are retained in the top few centimeters of biologically active sand; mass balance reveals virus inactivation in the sand filter. (Author's abstract)
W91-01156

EFFECTS OF AMMONIA ON ANAEROBIC DIGESTION OF SIMPLE ORGANIC SUBSTRATES.
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
D. M. Heinrichs, H. M. Poggi-Varaldo, and J. A. Oleszkiewicz.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 4, p 698-710, July/August 1990. 6 fig, 4 tab, 25 ref, append.

Descriptors: *Ammonia, *Anaerobic digestion, *Inhibition, *Wastewater treatment, Biodegradation, Biological treatment, Biological wastewater treatment, Microbial degradation, Nitrogen, Wastewater reactors.

The effects of ammonia on mesophilic digestion of acetate, propionate, acetate-propionate mixtures and lactate were studied in batch serum bottles. The un-ionized ammonia nitrogen (UAN) affected the acetate-utilizing microorganisms in the acclimated mixed cultures to a greater extent than propionate utilizing bacteria of other trophic groups. Effects of the un-ionized ammonia on soluble organic carbon (SOC) removal and methane/biogas generation were less severe in bottles supplemented with sulfate, suggesting the development of an SOC sink mediated by sulfate-reducing bacteria. Analysis of the inhibition patterns of methane/biogas production has shown that UAN displayed a moderate half-kill dose (in the range of 10 millimoles) and demonstrated a high sensitivity exponent. This suggests the potential for a sudden failure response by an anaerobic system subjected to an increasing ammonia concentration in the reactor. (King-PTT)
W91-01157

REVIEW OF OZONE GENERATING FACILITIES IN SOME U.S. WATER AND WASTEWATER TREATMENT PLANTS.
Northeast Ohio Regional Sewer District, Cleveland, OH.
For primary bibliographic entry see Field 5F.
W91-01165

UNDERSTANDING THE EFFECTS OF OZONATION ON A COMBINED MUNICIPAL/INDUSTRIAL SECONDARY EFFLUENT.
North Dakota State Univ., Fargo. Dept. of Civil Engineering.
R. Zimmerman, and D. Richard.
Ozone: Science and Engineering OZSEDS, Vol. 12, No. 2, p 107-114, 1990. 5 fig, 6 ref.

Descriptors: *Biochemical oxygen demand, *Effluents, *Ozonation, *Wastewater treatment, Industrial wastewater, Municipal wastewater, Organic matter, Ozone.

An increase in the biodegradability of secondary effluent after ozonation, as measured by CBOD5 (carbonaceous BOD5), generally has been considered to be due to the conversion of non-biodegradable organic material. Experiments on a specific combined municipal/industrial waste containing a high percentage of malting plant wastewater showed that an increase in CBOD5 realized at the waste treatment plant was due to a shift in the oxygen uptake curve. Ozonation was found to affect both non-biodegradable and biodegradable organic matter and resulted in improved overall effluent quality despite the observed increase in CBOD5. As an indication of effluent quality, the CBOD5 test is felt to be inadequate. (Author's abstract)
W91-01166

EVALUATION OF EMPIRICAL PROCESS DESIGN RELATIONSHIPS FOR OZONE DISINFECTION OF WATER AND WASTEWATER.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
G. R. Finch, and D. W. Smith.
Ozone: Science and Engineering OZSEDS, Vol. 12, No. 2, p 157-175, 1990. 7 fig, 3 tab, 16 ref.

Descriptors: *Ozonation, *Wastewater treatment, *Water treatment, Disinfection, Escherichia coli, Ozone, Performance evaluation, Statistical methods.

Research to examine the dose-response of Escherichia coli ATOCC 11775 in an ozone demand-free phosphate buffer solution and in a high quality secondary wastewater effluent with a total organic carbon content of 8 mg/l and a chemical oxygen demand of 26 mg/l was undertaken. The studies were conducted in bench scale batch reactors for both water types. In addition, studies using secondary effluent also were conducted in pilot scale, semi-batch reactor to evaluate scale-up effects. It was found that the ozone dose was the most important design parameter in both types of water. Contact time was of some importance in the ozone demand-free water and had no detectable effect in the secondary effluent. Contact time was of some importance in the ozone demand-free water and had no detectable effect in the secondary effluent. Pilot plant data confirmed the results obtained at bench-scale for the secondary effluent. Regression analysis of the logarithm of the E. coli response on the logarithm of the utilized ozone dose revealed that there was lack-of-fit using the model form which has been used frequently for the design of wastewater disinfection systems. This occurred as a result of a marked tailing effect from the log-log plot as the ozone dose increased and the kill increased. It was postulated that this was caused by some unknown physiological differences within the E. coli population due to age or some other factor. (Author's abstract)
W91-01167

EFFECT OF SELECTED RCRA COMPOUNDS ON ACTIVATED SLUDGE ACTIVITY.
Sirrine Environmental Consultants, Greenville, SC.
V. T. Volskay, C. P. Grady, and H. H. Tabak.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 5, p 654-664, July/August 1990. 6 fig, 10 fig, 25 ref. EPA Cooperative Agreement CR-813382-01-0.

Descriptors: *Activated sludge, *Inhibition, *Resource Conservation and Recovery Act, *Wastewater treatment, Butanoic acid, Butyric acid, Chlorinated hydrocarbons, Fate of pollutants, Kinetics, Mathematical models, Model studies, Organic compounds, Respiration, Toxicity.

A pilot plant study was undertaken to better understand the fate and effects of 33 organic compounds listed in the Resource Conservation and Recovery Act (RCRA) on the activated sludge process. Eleven were insufficiently inhibitory to justify further testing and eight had responses that varied over time making it impossible to quantify their efforts. The kinetic impacts of the remaining 14 (carbon tetrachloride, chlorobenzene, chloroform, 1,2-dichloroethane, 1,2-dichloropropane, 2,3-dimethyl phenol, methylene chloride, nitrobenzene, phenol, tetrachoroethylene, toluene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, and trichloroethylene) were quantified by measuring the Monod kinetic parameters for butyric acid degradation in the presence of several inhibitor concentrations using a respirometric-based assay. Attempts to model the effects of inhibitor concentration on the Monod kinetic parameters with classical linear, reversible inhibition models were unsuccessful but it was possible to model them with a general inhibition model proposed by Han and Levenspiel. (Author's abstract)
W91-01171

NONPRIORITY ANALYSIS OF THE WASTEWATER STREAMS OF FOUR DYE MANUFACTURING FACILITIES.
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Food Science.
For primary bibliographic entry see Field 5A.
W91-01172

GIARDIA IN WASTEWATER: EFFECT OF TREATMENT.
Pittsburgh Univ., PA. School of Engineering.
L. W. Casson, C. A. Sorber, J. L. Sykora, P. D. Gavaghan, and M. A. Shapiro.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 5, p 670-675, July/August 1990. 2 fig, 9 tab, 7 ref.

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Descriptors: *Activated sludge, *Giardia, *Giardiasis, *Human diseases, *Secondary wastewater treatment, *Wastewater treatment, Biological wastewater treatment, Disinfection, Primary wastewater treatment, Trickling filters, Water quality.

Giardiasis is one of the most commonly identified waterborne intestinal diseases in the U.S.A. person infected with Giardia lamblia may shed on the order of ten to the eighth cysts/day, which may be collected in wastewater. Studying the removal of giardia cysts by selected unit processes during wastewater treatment at three wastewater treatment plants in the U.S. was the objective of this research. Background data were obtained during a nationwide study of cyst concentration in raw and treated wastewaters. These data suggest seasonal and geographic differences in Giardia cyst concentrations in raw wastewater. More intensive sampling indicated that cysts are removed with varying effectiveness during primary clarification and almost completely removed in the biological treatment processes. However, a direct comparison of cyst removal efficiencies showed that cyst concentrations in the trickling filter effluent were higher than in the activated sludge process effluent. These data also suggest that cysts are concentrated in the mixed liquor suspended solids and, thus in the sludges. (Author's abstract)
W91-01173

PERFORMANCE OF FOUR FULL-SCALE NITRIFYING WASTEWATER TREATMENT PLANTS INCORPORATING SELECTORS.
CH2M/Hill, Denver, CO.
G. T. Daigger, and G. A. Nicholson.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 5, p 676-683, July/August 1990. 8 fig, 2 tab, 20 ref.

Descriptors: *Activated sludge, *Bulking sludge, *Nitrification, *Secondary wastewater treatment, *Wastewater facilities, *Wastewater treatment, Aerobic sludge, Anaerobic sludge, Anoxic sludge, Biological treatment, Filamentous bulking, Selectors.

The effect of installing selectors to control filamentous bulking at four full-scale nitrifying wastewater treatment plants was evaluated. The results indicate that a selector can be effective in controlling filamentous sludge bulking. Little difference in effectiveness was observed for aerobic, anaerobic, or anoxic selectors. Long-term operating data indicate that selectors, coupled with an appropriate aeration basin configuration, are capable of producing a nonbulking activated sludge with a sludge volume index (SVI) of less than 150 ml/g. Average SVI's in the 60 to 90 ml/g range can be expected with values as low as 20 to 30 ml/g observed on occasion. An aerobic selector was not effective in controlling bulking in a complete-mix nitrifying system using surface mechanical aerators. (Author's abstract)
W91-01174

CHEMOSTAT STUDIES OF A MIXED CULTURE GROWING ON PHENOLICS.
Melbourne Univ., Parkville (Australia). Dept. of Microbiology.
M. J. Hobson, and N. F. Mills.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 5, p 684-691, July/August 1990. 6 fig, 2 tab, 35 ref.

Descriptors: *Biological treatment, *Culturing techniques, *Growth chambers, *Phenols, *Secondary wastewater treatment, *Wastewater treatment, Bacterial growth, Chemostat, Industrial wastes, Inhibition, Kinetics.

Phenolics are common constituents of aqueous effluent from coal-conversion processes, coking plants, petroleum refineries, and several chemical industries including pharmaceutical, fertilizer, and dye manufacturers. The growth of a mixed culture in a two-stage chemostat with growth limited by phenolics was studied. The first stage provided a fully viable, adapted population that was fed at a constant rate to the second stage, where the concentration of phenolics could be varied. The population exhibited inhibition kinetics at high concentrations of phenolics. The viability of the culture decreased with increasing dilution rate, or with increasing phenolic concentration. The nonviable population did not utilize significant amounts of substrate, but ignoring viability can lead to a significant underestimate of the growth rate. The maintenance requirements were insignificant at noninhibitory levels of phenolics, but rose to 0.15 g/gh at inhibitory levels, possibly due to the need to repair damaged cell membranes. (King-PTT)
W91-01175

ECONOMIC CONSIDERATIONS IN WASTEWATER TREATMENT WITH DUCKWEED FOR EFFLUENT AND NITROGEN RENOVATION.
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
G. Oron.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 5, p 692-696, July/August 1990. 4 fig, 4 tab, 18 ref.

Descriptors: *Agronomy, *Ammonia removal, *Duckweed, *Economic aspects, *Farm wastes, *Wastewater treatment, Agricultural engineering, Biological treatment, Domestic wastewater, Fertilizers, Irrigation.

Duckweed is one of the floating aquatic macrophytes with a preference for ammonia uptake. The ammonia is assimilated into valuable nitrogen compounds that can subsequently be used for animal feed or agricultural fertilization. Outdoor experiments were conducted in shallow miniponds which were 20 to 30 cm deep to evaluate the performance of the duckweed species, Lemna gibba, as a stripper for domestic wastewater. The results indicate that under adequate operational conditions the quality of accepted secondary effluents meets irrigation reuse criteria. The annual yields of dry duckweed which is harvested two to three times a week, is anticipated to be about 55 tons/ha, with a protein content close to 30%. The benefit of the additional byproduct means a reduction in wastewater expenses in the range of $0.020 to $0.050/cubic m. (Author's abstract)
W91-01176

PERFORMANCE OF LAGOON INTERMITTENT SAND FILTER SYSTEMS.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. Rich, and E. J. Wahberg.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 5, p 697-699, July/August 1990. 4 tab, 7 ref.

Descriptors: *Ammonia removal, *Sand filters, *Wastewater lagoons, *Wastewater treatment, Activated sludge, Biological oxygen demand, Biological treatment, Lagoon performance, Suspended solids.

The performance of nine lagoon intermittent sand filter systems were evaluated with respect to the biological oxygen demand (BOD), total suspended solids (TSS), and NH3 nitrogen removed. All systems were located either in South Carolina or Georgia and had permitted flow limits ranging from 303 cubic m/d to 12869 cubic m/d. The average 50% values for BOD, TSS and NH3-N were found to be 19, 25, 3.1 mg/l. The superior performance of the lagoon intermittent sand filter systems over aerated lagoons and most activated sludge systems was demonstrated. (Author's abstract)
W91-01177

PROCESS CONTROL STRATEGY FOR THE BIOLOGICAL REDUCTION OF PHOSPHOROUS AND AMMONIA NITROGEN UTILIZING THE A/O PROCESS.
PSC Environmental Services, Limerick, PA.
J. C. Hale.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 23, No. 2, p 37-41, March/April 1990. 9 fig.

Descriptors: *Activated sludge process, *Ammonia, *Biological wastewater treatment, *Nitrification, *Phosphorous removal, Regulations, *Wastewater treatment, Advanced wastewater treatment, Process control, Sludge treatment.

The A/O Process is a process control wastewater treatment system which biologically reduces phosphorous and ammonia nitrogen without the use of chemical addition. Two currently operative treatment plants are the Patapsco WWTP in Baltimore, Maryland which utilizes this process for phosphorous removal, and the Oaks WWTP in Oaks, Pennsylvania which uses the A/O process for ammonia nitrification. Since it is much more sensitive than conventional activated sludge methods, constant monitoring is necessary to control the return and waste sludge and oxygen flows. By utilization and analysis of the indicator parameters; namely, oxygen uptake and sludge generation rates, effluent quality, and SVI, the A/O Process can be effectively controlled within each plant to achieve full compliance with NPDES permit requirements. (D'Agostino-PTT)
W91-01187

WATERSHED 89: THE FUTURE FOR WATER QUALITY IN EUROPE. VOLUME II.
For primary bibliographic entry see Field 5G.
W91-01211

PHYSICO-CHEMICAL TREATMENT OF WASTEWATER: EXPERIENCE AND FUTURE DEVELOPMENT.
Energy and Waste Systems Ltd., Westbury (England).
D. E. Smith.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 307-318, 6 fig, 5 tab, 10 ref.

Descriptors: *Coagulation, *Lime, *Physicochemical treatment, *Wastewater treatment, Bacteria, Clarification, Coliforms, Disinfection, Parasites, Seawater, Sludge blanket reactors, Suspended solids, Viruses, Wastewater reactors.

Using lime-based coagulants in a high-rate upward flow blanket (UFSB) clarification process, substantial amounts of suspended solids and the biochemical load associated with these solids can be removed from sewage. Furthermore, on dilution in seawater, treated effluent from the process has shown enhanced T90 data with respect to bacteria die-off, making the process particularly effective in bacterial reduction for estuarine and marine discharge. The single stage UFSB process is extremely good at removing solids (up to 90%) from highly contaminated wastewater, and the blanket process allows results seen in laboratory settlement tests to be obtained, or even improved upon, at full scale under diurnal flow regimes. Insoluble biochemical oxygen demand is reduced and typical reductions of 50-70% have been achieved. The process can be quickly and easily retrofit to existing works to uprate performance. The removal of large populations of bacteria from sewage has resulted in Sandown Bay, England being in compliance with the European Community Directive for bathing Waters despite the short sea outfall extending only 300 meters below low water. Recent laboratory work has shown that there is great potential for the removal of salmonella, parasites, ascaris and viruses in the blanket process under the good clarification and highly alkaline conditions. Initial studies suggest that the system would enable the Engleberg guidelines for the reuse of wastewater in agriculture and aquaculture to be met in a high-rate, low-cost process as a useful alternative to stabilization ponds. (See also W91-01211) (Geiger-PTT)
W91-01232

DISINFECTION AND SCREENING OF SEWAGE TO IMPROVE THE QUALITY OF BATHING WATER AT A U.K. SEASIDE RESORT.

/essex Scientific Services, Bristol England).Technical Services.
I. J. Tarbox, and S. B. Tuckwell.
N: Watershed 89: The Future for Water Quality Europe. Volume II. Proceedings of the AWPRC Conference held in Guildford, UK, 17-0 April, 1989. Pergamon Press, New York. 1989. 319-330, 8 fig, 10 ref.

escriptors: *Disinfection, *England, *Swimming, Wastewater treatment, *Water pollution control, Water quality, Chlorination, Coliforms, Environental effects, Fish, Toxicity, Water quality conol, Weston Bay.

essex Water's surveys highlighted the need for medial action at Weston-super-Mare, England. A mporary scheme to disinfect sewage discharged sea was proposed while long-term requirements ere determined. Discharge water was chlorinated the outfall site. Noncompliance with 95% limits coliforms were noted due to tidal action and e presence of particulate matter in crude sewage at needed to be macerated to better expose bacteI populations to chlorine. Biological surveys of intertidal regions and rocky outcrops within eston Bay have not shown any detectable shortm effects on fauna or flora due to organochlorformation. Tests with peracetic acid products owed that a switch to alternative disinfectants uld be too costly at the present time. Trials with eens at Black Rock Pumping Station did not prove bacterial quality, but an overall improvent in the bathing water's quality is anticipated m screening. A scheme to install a flash mixer t and contact tank is expected to further imve the quality of bathing water. (See also W91-11) (Geiger-PTT)
1-01233

ATER QUALITY STANDARDS FOR BACRIOPHAGES.
ksinstituut voor de Volksgezondheid en Milieuiene, Bilthoven (Netherlands).
primary bibliographic entry see Field 5G.
1-01238

TE OF ENTAMOEBA HISTOLYTICA RING SEWAGE TREATMENT USING ANROBIC DIGESTERS.
versity Coll., Cardiff (Wales). Dept. of Microogy.
E. F. Medhat, and D. A. Stafford.
Watershed 89: The Future for Water Quality Europe. Volume II. Proceedings of the VPRC Conference held in Guildford, UK, 17-April, 1989. Pergamon Press, New York. 1989. 1-390, 5 fig, 2 tab, 29 ref.

criptors: *Amebas, *Anaerobic digestion, otozoans, *Sludge digestion, *Wastewater ment, Acetates, Escherichia coli, Fatty acids, hane, Pollutant identification, Starch, Volatile s.

fate of Entamoeba histolytica was investigated ng the anaerobic digestion of activated and ary sludges. Anaerobic digesters appeared to nate E. histolytica within hours of their addi- A close inter-relationship existed between the ile fatty acids concentrations in the digester E. histolytica survival. E. histolytica survived w volatile fatty acid concentrations of 100- mg/L, but survival of the ameba declined rly with increasing volatile fatty acids concen-n. E. histolytica cell numbers died off within in a thermophilic digester (55 C), while still ucing good methane gas quality. However, in sophilic digester (25-37 C), E. histolytica sur- up to 120 hr. The presence of acetate apd to inhibit the uptake of the natural subs of the protozoan, namely Escherichia coli and rice grains. Since E. histolytica can grow in river waters and can cause disease in ns in subtropical climates, the discharge into waters and application to land of treated ge should be discouraged unless sufficient di-n of sludges is ensured to remove this pathoSee also W91-01211) (Geiger-PTT)
01241

AUTOTHERMAL FLUID BED FOR SLUDGE INCINERATION.
SEGHERS (N.V.) Engineering, Willebroek (Belgium).
For primary bibliographic entry see Field 5E.
W91-01244

ANAEROBIC DIGESTION OF INDUSTRIAL AND AGRICULTURAL WASTES.
CLEAR Ltd., Cardiff (Wales).
S. P. Etheridge, and U. E. A. Leroff.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 417-426, 5 fig, 1 tab, 12 ref.

Descriptors: *Anaerobic digestion, *Farm wastes, *Industrial wastes, *On-site wastewater treatment, *Waste disposal, *Waste treatment, *Wastewater treatment, Agricultural runoff, Europe, Fertilizers, Food-processing wastes, Manure, Municipal wastes, Sludge disposal, Solid waste disposal, Water quality standards.

The future of water quality in Europe depends on the ability to reduce the pollution load of wastewaters discharged to the environment and the subsequent ability to clean abstracted water for reuse. The prospect of European unity in 1992 will allow commercial competition for waste treatment and all European technologies in this area will become fully cross-fertilized. Increasing standards will result in increased treatment and disposal costs which will be passed on to the consumer. Anaerobic treatment systems will become an attractive option for wastewater treatment because they produce little sludge and so do not incur expensive tankering charges. Farm wastes are some of the most concentrated wastes produced and their runoff results in serious water pollution problems. Anaerobic digestion of agricultural wastes is most attractive due to its short payback time (4-5 yr). Several low cost agricultural digesters, including flexible liner digesters and fiberglass plugflow digesters, offer quicker payback periods. Due to recent advances in anaerobic digestion technology, more industrial wastewaters are becoming amenable to anaerobic treatment. These advances include the development of the fixed film reactors such as the Upflow Anaerobic Sludge Blanket and the Anaerobic Attached Film Expanded Bed digester. Moisture limitations for anaerobic digestion can now be controlled to make high solids digestion possible. As emission standards cause the costs of incineration to rise, anaerobic digestion will offer an attractive alternative for the treatment and disposal of municipal solid wastes. (See also W91-01211) (Geiger-PTT)
W91-01245

INDUSTRIAL EFFLUENTS: MINIMIZING ENVIRONMENTAL IMPACT.
Watson Hawksley, High Wycombe (England).
A. V. Gray.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 427-436, 4 fig, 9 tab.

Descriptors: *Environmental effects, *Environmental impact, *Industrial wastewater, *Wastewater treatment, *Water pollution control, Case studies, Chemical oxygen demand, Cost analysis, Food-processing wastes, Lime, Physicochemical treatment, Oil industry, Recycling, Sludge disposal, Waste characteristics, Waste disposal, Water quality standards.

The strategy and methodology employed in ensuring minimal environmental impact from the disposal of industrial effluents involves definiation of the problem and all its component parts, data collection and monitoring (effluent characterization) comparison with appropriate environmental standards, evaluation of technically feasible options, and recommendations for implementation. Three case studies are reviewed to illustrate some of the problems faced. In the first case, a treated waste from a petrochemical industry was being discharged into a small estuary without meeting water quality standards for ammonia. In this case cordial liaison between the regulatory agency and the industrialist led to an agreement to substantially improve the discharged waste quality by providing for a fully nitrified effluent, possibly by employing an extended aeration plant or an oxygen activated sludge facility to achieve the necessary 87% ammonia reduction. In the second case a building materials manufacturer experienced a buildup of waste sludge due to lime neutralization of acid scrubber gases. It was recommended that the system be operated not as a closed-loop but with a blow-down or draw-off from the recirculated water with clean water added for volume make-up. Operation of the plant in this manner permitted a stable condition to be achieved within the recirculated liquors. Studies of disposal options led to the choice to lime treat the blow down liquors, allow sufficient settlement for solids removal, and then recirculate the treated supernatants back to one of the process stages. In the third case, a food processing industry exceeded consent conditions (in particularly COD) for discharging trade effluents to sewers. To remedy this situation, cost analyses and feasibility studies have demonstrated that an on-site treatment plant using physicochemical treatment plus wastes/sludge disposal off-site or sludge consolidation on site would be viable options. (See also W91-01211) (Geiger-PTT)
W91-01246

ADVANCED NITROGEN REMOVAL PROCESSES FOR DRINKING AND WASTE WATER TREATMENT.
Biwater Ltd., Heywood (England).
B. Lacamp, and M. M. Bourbigot.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 437-443, 5 fig, 4 tab, 31 ref.

Descriptors: *Biofiltration, *Biological treatment, *Biological wastewater treatment, *Drinking water, *Nitrogen removal, *Wastewater treatment, *Water treatment, Aeration, Aerobic digestion, Ammonia, Denitrification, Nitrates, Nutrient removal, Suspended solids.

Biological methods are commonly used for nitrogen removal in wastewater and water treatment. However, in urban areas where space is scarce, basin volume may not be sufficient for purification of activated sludges. Biological Aerated Filters (BAF), an innovative technology for plant upgrading can combine aerobic degradation of pollutants with physical retention of suspended solids in one reactor. In BAF, a high concentration of active biomass can be retained in the packed bed, while nitrifying bacteria can be attached to the filter media. Removal efficiency becomes independent of clarification and sludge settling, and ammonia oxidation can be achieved without sludge age requirements. In drinking water treatment, use of fixed film processes have become widespread for nitrate and ammonia removal due to their similarity to conventional filters. These biological processes all profit from natural phenomena of nutrient removal while reducing costs and improving water quality. (See also W91-01211) (Author's abstract)
W91-01247

WASTES FROM ANIMAL BREEDING: WATER QUALITY STANDARDS IN AN INTEGRATED PERSPECTIVE OF TREATMENT AND VALORIZATION FOR PORTUGAL AND SOUTHERN EUROPE.
Universidade Nova de Lisboa (Portugal). Faculdade de Ciencias e Tecnologia.
J. Santos Oliveira, and M. I. Alves Pereira.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 445-454, 3 fig, 7 tab 23 ref.

Descriptors: *Animal wastes, *Feedlot wastes, *Portugal, *Waste recovery, *Wastewater treat-

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ment, *Water pollution control, Europe, Hogs, Nutrients, Recycling, Stabilization lagoons.

Waste deriving from the raising of animals constitutes a problem which could reach serious proportions in rural areas of southern Europe. In these areas, the occurrence of dry periods justifies value-enhancement strategies for reutilization of the liquid wastes generated by animal husbandry. High-rate algal ponds (stabilization lagoons), use of wastes generated by pig farms as feed (nutrient recovery), and reutilization of liquid wastes for irrigation and fertilization make it possible to recycle a considerable proportion of the nutrients in these wastes. The standards governing the discharge of liquid wastes should take these factors into account and incorporate an ecologically-based strategy of integrated management of resources, rather than a strictly bio-destructive one. The establishment of low-energy-cost technologies for solid/liquid separation (sedimentation and filtration techniques) can help to minimize negative effects and maximize the benefits of integrated management of animal wastes. Portugal has drawn up permit requirements for pig breeders to ensure that liquid residues from raising livestock meet discharge standards. (See also W91-01211) (Geiger-PTT)
W91-01248

CONTROL OF NITROGENOUS POLLUTION.
Surrey Univ., Guildford (England). Dept. of Chemical Engineering.
M. A. Winkler, and V. S. Manoranjan.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 463-473, 4 ref.

Descriptors: *Denitrification, *Nitrogen removal, *Wastewater treatment, *Water pollution control, *Water quality control, *Water treatment, Ammonia, Electrodialysis, Fertilizers, Ion exchange, Nitrates, Nitrogen compounds, Physicochemical treatment, Reverse osmosis.

Nitrogen compounds found in water can contribute to many aspects of environmental pollution. In water, nitrogenous pollutants can have toxic effects, including acting as carcinogen precursors, stimulate deoxygenation and eutrophication in rivers and interfering with purification processes. Nitrogenous pollutants are very common, occurring in domestic, agricultural and industrial wastes; distributed as fertilizers and formed naturally by living organisms and lightning. Techniques for conversion and removal of nitrogen compounds from water and wastewater are well developed. In wastewater treatment, ammonia is oxidized microbiologically to nitrate, which is then removed by microbiological denitrification where sufficient substrate is available. In high-nitrogen industrial wastewaters, substrate may have to be added. A wide range of nutrient waste-products can be used for this purpose. In water purification, there may be insufficient dissolved oxygen for ammonia oxidation and/or organic substrate for microbiological denitrification. Several physicochemical methods, such as reverse osmosis, electrodialysis and ion-exchange processes are commercially available. (See also W91-01211) (Author's abstract)
W91-01250

WATER QUALITY MANAGEMENT IN ISTANBUL: CREATING A CLEANER ENVIRONMENT.
Istanbul Water and Sewerage Administration, Turkey.
For primary bibliographic entry see Field 5G.
W91-01254

VARIABILITY REDUCTION MODEL FOR WASTEWATER TREATMENT.
Surrey Univ., Guildford (England). Dept. of Chemical Engineering.
V. S. Manoranjan, and M. A. Winkler.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 515-518, 6 ref.

Descriptors: *Mathematical models, *Variability, *Wastewater treatment, Optimization, Process control, Statistical methods, Systems analysis.

Mathematical models and controlled experiments have been useful in understanding the mechanisms of various process steps in wastewater treatment. However, it is nevertheless difficult to forecast accurately the output quality of a full-scale treatment plant from knowledge of the input to the plant due to random fluctuations in feed. Time-series models could predict the output quality as part of a feed-forward/feed-back control system, but the predicted effluent quality may not fall within the required target range. Statistical optimization techniques have been successfully used in Japan to reduce the variability of manufacturing processes. Such techniques known collectively as the Taguchi method, modify the system to reduce its sensitivity to the causes of variability, rather than attempt to control the actual sources of variability. In the Taguchi procedures, the normal and test settings of the control factors are established and the noise factors and their ranges are identified. The noise and control factor matrices are then constructed. These matrices are intelligent subsets of control and noise spaces which provide appropriate coverage of these spaces. Standard methods of statistical experimental design can be used, such as mutually orthogonal Latin squares but fractional replication and Graeco-Latin squares require less test runs. The signal to noise ratio is evaluated for each combination of variables tested, and from these data, the settings that maximize the performance measure can be predicted. Maximizing the performance measure is equivalent to reducing variability, which means that the predicted settings should also give minimum variation in the output quality of the treatment plant. In wastewater treatment, controlling the sources of variability is usually impossible or expensive. The present technique may be amenable to modifications to make it suitable for wastewater treatment processes. (See also W91-01211) (Author's abstract)
W91-01255

ODOUR CONTROL FOR THE 1990S--HIT OR MISS.
WRc Engineering, Swindon (England).
S. J. Toogood.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 3, p 268-275, June 1990. 8 ref.

Descriptors: *Biological wastewater treatment, *Odor control, *Public nuisance, *Ventilation, *Wastewater treatment, Adsorption, Air pollution control, Biofiltration, Chemical treatment, Dispersion, Model studies, Odor-producing algae, Odors, Oxidation.

A general strategy for dealing with odor problems at a sewage works, once the use of preventative measures alone has been ruled out is presented. A strategy for dealing with nuisance emphasizes a fully integrated approach, involving covering, ventilation design, and odor treatment. Some of the options for treatment are compared, including adsorption, dry oxidizing packings, wet chemical scrubbing and biological odor control processes (i.e., biofilters and bioscrubbers). The objective of any odor control scheme is to eliminate nuisance, not eliminate odors. The use of dispersion models can be used to determine the extent of remedial works, and acting early in the complaint process can result in a cost effective solution. It is concluded that biological treatment is the most generally applicable method to the sewage works. (VerNooy-PTT)
W91-01275

GRAVEL BED HYDROPONIC SYSTEMS USED FOR SECONDARY AND TERTIARY TREATMENT OF SEWAGE EFFLUENT.
Portsmouth Polytechnic (England). School of Biological Sciences.
J. E. Butler, R. F. Loveridge, M. G. Ford, D. A. Bone, and R. F. Ashworth.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 3, p 276-284, June 1990. 5 fig, 4 tab, 9 ref.

Descriptors: *Biofilms, *Biological wastewater treatment, *Contact beds, *Gravel, *Hydrophytes, *Hydroponics, *Reeds, *Secondary wastewater treatment, *Tertiary wastewater treatment, *Wastewater treatment, Biochemical oxygen demand, Databases, Design criteria, Developing countries, Dolerite, Effluents, Limestone, Rural areas.

Gravel bed hydroponic (GBH) systems planted with emergent hydrophytes, such as Phragmites australis (the common reed), treat domestic sewage effluents to acceptable environmental standards in an economic and efficient manner. Biochemical oxygen demand (BOD), ammonia, and coliform bacteria can be reduced by over 90% and dissolved oxygen (DO) substantially increased. In temperate zones, such as Europe, GBH systems can be used to replace conventional small rural treatment works, and for tertiary treatment of final effluents. In tropical and arid zones, GBH systems can provide locally-managed, cost-effective alternatives to high-technology systems which are inappropriate for use in developing countries. In the UK, the final effluent of the biological treatment works at one site was taken as feed water for three beds of different characteristics. Samples were collected monthly to provide successive sampling cohorts. The results form a multivariate database which will be used to identify design parameters for GBH systems. In Egypt, settled sewage from Abu Attwa is used as feed water after the grit, silt and heavy solids which bypass the overloaded works have been removed by resettlement in a dedicated humus tank. Preliminary results of this secondary GBH treatment reveal significant reductions in BOD on all beds, with dolerite and limestone aggregates in 100 m channels performing most efficiently. Results from both the Egyptian and UK field-scale GBH trials have demonstrated a relationship between bed length and the extent of sewage treatment. (VerNooy-PTT)
W91-01276

DESORPTION OF ODOR SUBSTANCES FROM WATER BODIES TO THE ATMOSPHERE.
Hyogo Prefecture Environmental Science Inst., Kobe (Japan).
For primary bibliographic entry see Field 5G.
W91-01282

FATE OF SELECTED CHLORINATED ORGANIC COMPOUNDS DURING SEMI-CONTINUOUS ANAEROBIC SLUDGE DIGESTION.
Rentokil Ltd., East Grinstead (England). Research and Development Div.
R. S. K. Buisson, P. W. W. Kirk, and J. N. Lester.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 3, p 428-432, May/June 1990. 4 tab, 25 ref.

Descriptors: *Anaerobic digestion, *Biological treatment, *Chlorinated hydrocarbons, *England, *Pesticides, *Sludge treatment, *Wastewater treatment, Biodegradation, Digestion, Herbicides, Pollutants, Polychlorinated biphenyls.

The predominant sewage sludge treatment process in the United Kingdom is mesophilic anaerobic digestion. The fate of chlorinated organic micropollutants during this treatment process is, however, largely unknown. Laboratory scale simulations were applied to assess the fate of chlorophenoxy herbicides, chlorophenols, polychlorinated biphenyls, and organochlorine pesticides during the digestion of primary sludge and co-settled waste activated and primary sludge, obtained from full scale works. Incubation was carried out under non-sterile and sterile conditions. The use of a batch technique to study the anaerobic degradation of the chlorinated organic micropollutants permits observations on their rates of degradation. Previous studies have demonstrated that when degradation occurs, it is very rapid with micropollutants being completely removed within four days in

primary digested sludge. In the case of the mixed digested sludge which did not have such a high solids concentration and a proportion of whose solids consisted of the less readily degradable wasted mixed liquor solids, the rate of degradation was not as rapid. This lower inherent biodegradability was illustrated by a subsequent continuous digestion study in which gas output was lower from the mixed sludge digester. However, the rate of degradation was still sufficiently rapid to remove the micropollutants within one retention time of a typical sludge digester. (Mertz-PTT)
W91-01319

ANAEROBIC TREATMENT OF BAKER'S YEAST WASTEWATER: II. SULFATE REMOVAL.
British Columbia Univ., Vancouver. Dept. of Bio-Resource Engineering.
K. V. Lo, A. Chen, and P. H. Liao.
Biomass BIOME9, Vol. 23, No. 1, p 25-37, 1990. 3 fig, 3 tab, 14 ref.

Descriptors: *Anaerobic digestion, *Biological treatment, *Contactors, *Wastewater reactors, Sulfates, *Wastewater treatment, Biomass, Chemical oxygen demand, Fixed-film reactor, Hydrogen ion concentration, Methane, Methanogenesis, Molasses, Wastewater, Yeasts.

The effect of sulfate removal from molasses wastewater on anaerobic digestion was studied using two reactors. One was an anaerobic rotating biological contact reactor with an active biomass developed on its support structure before the experiment commenced. The other was a new fixed-film reactor which was started without attached biomass. The experimental results showed that sulfate removal from the wastewater did not improve the gas production and treatment efficiency of the anaerobic rotating biological contact reactor. This observation indicated that sulfate-reducing bacteria could not compete with methane-producing bacteria in a well-established active biomass reactor. However, the fixed-film reactor showed significant improvement in gas production (0.17-0.66 L CH4/L reactor day) and chemical oxygen demand reduction (maximum of 44%) as a result of sulfate removal coupled with pH adjustment. Thus, the initial step of sulfate removal from molasses wastewater would appear to be essential to start up the reactor without well-developed biomass in order to enhance the slow-growing methanogens. (Author's abstract)
W91-01322

PTIC SYSTEM EFFICIENCY: PARALLEL D SERIAL METHODS FOR DISTRIBUTING FLUENT.
nessee Univ., Knoxville. Dept. of Agricultural gineering.
R. Mote, F. A. Mucke, and J. S. Allison.
rnal of Environmental Health JEVHAH, Vol. No. 5, p 283-287, March/April 1990. 3 fig, 5 17 ref.

criptors: *Effluents, *Septic drain fields, ptic tanks, *Soil disposal fields, *Wastewater osal, *Wastewater treatment, Chemical oxygen and, Fecal coliforms, Filtration, Groundwater ution, Nitrogen, Phosphorus, Soil treatment.

llel and serial methods of distributing septic effluent were compared using representative columns. Effluent was applied to each column period of 63 weeks. Weekly samples of ren- ed effluent were evaluated for volume, chemi- oxygen demand, nitrogen, phosphorus, and coliform content. Although both methods of ibution allowed the soil to adequately transmit ffluent, parallel distribution increased renova- efficiency. Discharges of poor quality effluent esponded with periodic high water discharge episodes observed only for serial-loaded col- . These episodes and the associated reduction novation efficiency suggest that filter fields serial distribution have greater potential for ting the groundwater than do filter fields with lel distribution. (Author's abstract)
01381

REMOVAL OF ORGANOHALOGENS AND ORGANOHALOGEN PRECURSORS IN RECLAIMED WASTEWATER--I.
California Univ., Los Angeles. Dept. of Civil Engineering.
L. C. Bauman, and M. K. Stenstrom.
Water Research WATRAG, Vol. 24, No. 8, p 949-955, August 1990. 5 fig, 3 tab, 21 ref. California Department of Water Resources contract no. B56726.

Descriptors: *Disinfection, *Halogenated hydrocarbons, *Municipal wastewater, *Pesticides, *Wastewater renovation, *Wastewater treatment, *Water reuse, Chlorinated hydrocarbons, Chlorination, Drinking water, Organic matter, Tertiary wastewater treatment, Trihalomethanes.

A high level of treatment will be required if municipal wastewater effluents are to meet drinking water standards. Reclaimed wastewaters contain significant levels of potentially hazardous organohalogens derived from surface pollution. These compounds can be measured as instantaneous total organic halogens. In addition to background contaminant removal, disinfection would be of prime importance for providing a safe product for consumption. Aqueous chlorine, a cost effective and efficient disinfectant, has come under scrutiny following the discovery of trihalomethanes in drinking water. Fractionation, using synthetic resins of dissolved organic material in filtered secondary effluent from an advanced wastewater reclamation facility and unpolluted source water (based upon acidity, solubility and adsorbability), indicated a strong correlation between organohalogen formation potential and organic carbon. Background organohalogens were quantified as total organic halogens. In addition to humic substances, the classic trihalomethane precursors, hydrophilic substances that comprised the largest fraction of the dissolved material, were implicated because of their tendency to form organic halogens upon chlorination. Evaluation of an existing comprehensive advanced treatment process for reclamation of municipal wastewaters indicated that it provides a high level of treatment with respect to removal of organohalogens and precursor organics. (See also W91-01416) (Mertz-PTT)
W91-01415

REMOVAL OF ORGANOHALOGENS AND ORGANOHALOGEN PRECURSORS IN RECLAIMED WASTEWATER--II.
California Univ., Los Angeles. Dept. of Civil Engineering.
L. C. Bauman, and M. K. Stenstrom.
Water Research WATRAG, Vol. 24, No. 8, p 957-964, August 1990. 7 fig, 2 tab, 33 ref. California Department of Water Resources contract no. B56726.

Descriptors: *California, *Halogenated hydrocarbons, *Municipal wastewater, *Pesticides, *Wastewater renovation, *Wastewater treatment, *Water reuse, Air stripping, Carbon adsorption, Chlorinated hydrocarbons, Coagulation, Disinfection, Drinking water, Flocculation, Hydrogen ion concentration, Reverse osmosis, San Diego, Ultraviolet treatment.

The city of San Diego, CA has proposed to utilize reclaimed wastewater as a potential drinking water source. The proposal requires disinfecting and recycling effluent by mixing and storing the treated effluent with natural source waters in a reservoir for one year. The existing wastewater facility consists of primary treatment, secondary treatment, coagulation, flocculation, ultraviolet disinfection, reverse osmosis, air stripping and carbon adsorption. Treatment would potentially be followed with disinfection by chlorination. Treatment, at bench scale, of filtered secondary effluent from an advanced wastewater reclamation facility indicated that carbon adsorption and advanced oxidation each provide significant reductions in concentrations of both total organic halogens and organic halogens precursors. Equilibria and batch dynamic data suggested that multicomponent adsorption of total organic halogens and precursors was favorable and pH dependent. In addition to contact time, oxidation of total organic halogens and precursors by ozone peroxide was highly dependent upon hydrogen peroxide dosages. (See also W91-01415) (Mertz-PTT)
W91-01416

BIODEGRADATION AND SECONDARY EFFLUENT TOXICITY OF ETHOXYLATED SURFACTANTS.
Eckenfelder, Inc., Nashville, TN.
J. Patoczka, and G. W. Pulliam.
Water Research WATRAG, Vol. 24, No. 8, p 965-972, August 1990. 5 fig, 5 tab, 25 ref, append.

Descriptors: *Activated sludge process, *Biodegradation, *Surfactants, *Wastewater treatment, Aliphatic surfactants, Aromatic surfactants, Carbon, Chemical oxygen demand, Ethylene oxide, Sludge, Toxicity.

Several aromatic and aliphatic-based, ethoxylated surfactants were tested for their biodegradability and aquatic toxicity reduction. For all the tested surfactants, almost complete primary biodegradation by the activated sludge process was achieved as measured by the cobalt thiocyanate active substances test. Aliphatic-based products demonstrated better biodegradability in terms of total organic carbon and chemical oxygen demand reduction efficiency than aromatic-based products. Toxicities of individual surfactants, their mixtures, and effluents from biological reactors treating surfactant mixtures were determined using Mysidopsis bahia. For aromatic-based surfactants with the same ethylene oxide molar ratio, the toxicity of the non-biodegraded, aliphatic-based product was highest for the non-ionic (unsubstituted) surfactant. Toxicities of the non-biodegraded, aliphatic-based surfactants were in the same range as those of the non-biodegraded aromatic-based products. Increasing ethylene oxide molar ratios resulted in an exponential decrease in surfactant toxicities. Biological treatment of the aliphatic-based surfactants resulted in non-toxic effluents even at high (600 ml/L) influent concentrations. Effluents from reactors treating aromatic-based surfactants demonstrated markedly higher toxicities than those from treatment of aliphatic-based products. The presence of an active group appeared to have less effect on biological effluent toxicity than did the product base structure. (Author's abstract)
W91-01417

OXIDATION OF PHENOLS IN WATER BY HYDROGEN PEROXIDE ON ALUMINE SUPPORTED IRON (OXYDATION DES PHENOLS PAR LE PEROXYDE D'HYDROGENE EN MILIEU AQUEUX EN PRESENCE DE FER SUPPORTE SUR ALUMINE).
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 2K.
W91-01418

MODIFIED HARDWICKIA BINATA BARK FOR ADSORPTION OF MERCURY (II) FROM WATER.
National Environmental Engineering Research Inst., Nagpur (India).
A. M. Deshkar, S. S. Bokade, and S. S. Dara.
Water Research WATRAG, Vol. 24, No. 8, p 1011-1016, August 1990. 11 fig, 3 tab, 17 ref.

Descriptors: *Mercury, *Trees, *Wastewater treatment, Acetates, Bark, Chemical reactions, Coagulation, Formaldehyde, Hardwickia, Heavy metals, Hydrogen ion concentration, Nitrates, Waste treatment.

Mercury is commonly removed from wastewaters by chemical precipitation, conventional coagulation, lime softening, adsorption, ion exchange, and reverse osmosis. The use of modified tree barks was investigated for removal of heavy metals as early as 1941. Hardwickia binata bark was found to have a good sorption capacity for mercury (II), and color leaching was prevented and the physical characteristics of the bark improved by treatment with formaldehyde in an acidic medium. Studies indicated that the sorption of Hg(II) increases as

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the pH increases and a contact time of 2 hours was found to be optimum. Modified bark can remove most of the Hg(II) from water if its concentration is below 20 mg/L and sorption of mercury conformed to the Freundlich adsorption isotherm. The presence of light metal ions interferes with the sorption of mercury. Mg(II) at a concentration of 200 mg/L interferes with sorption to a maximum extent. Column studies showed that the capacity of the bark was 0.34 mequiv/g. In the presence of metal cations such as Pb(2+), Cd(2+), Zn(2+), and Cu(2+) the sorption of Hg(2+) was the lowest compared to other cations showing that other cations compete with Hg(2+) for sorption by the bark. Among the different anions, it was observed that sorption of mercury was maximum for acetate and nitrate (97%). The break-through sorption capacity determined by conducting a column experiment was observed to be 21 mg/g. (Mertz-PTT)
W91-01422

TRACER STUDY OF THE HYDRAULICS OF FACULTATIVE STABILIZATION PONDS.
AGAMIT S.A., Madrid (Spain). Environmental Engineering Dept.
M. D. Moreno.
Water Research WATRAG, Vol. 24, No. 8, p 1025-1030, August 1990. 10 fig, 2 tab, 11 ref.

Descriptors: *Retention time, *Stabilization ponds, *Tracers, *Wastewater treatment, Heavy water, Hydraulics, Model studies, Spain, Stirred tank reactor model, Water circulation.

Low-cost wastewater treatment methods have become increasingly popular in Spain in recent years, due in part to a surge in the demand for water sanitation and environmental concern in the general population. Among these methods, the most widely employed are wastewater stabilization ponds. This technique is simple, reliable and economical. It provides good-quality effluent, with a high degree of disinfection and a low content in organic matter. The hydraulic behavior of wastewater stabilization ponds operating in different regions in Spain was investigated using a stimulus-response technique. A tracer, tritiated water, was injected at the entrance of each one of the facultative ponds at five facilities. The resulting time distribution functions were used to calculate the mean hydraulic residence time and the extent of short-circuiting inside the ponds. The percentage of dead volume ranged from 10 to 42%. Treatment efficiency would thus be substantially improved by correcting these large dead volumes. The inlets and outlets of the ponds have been redesigned and are being rebuilt as remedial measures to this problem. The statistical analysis of the results indicates that the completely stirred tank reactor model can be used to represent the hydraulic behavior of all the ponds studied, at a 99% confidence level. (Mertz-PTT)
W91-01424

EFFECT OF FEED COMPOSITION, AEROBIC VOLUME FRACTION AND RECYCLE RATE ON NITROGEN REMOVAL IN THE SINGLE-SLUDGE SYSTEM.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
A. Brenner, and Y. Argaman.
Water Research WATRAG, Vol. 24, No. 8, p 1041-1049, August 1990. 6 fig, 3 tab, 10 ref, append.

Descriptors: *Mathematical models, *Nitrogen, *Nitrogen removal, *Sludge treatment, *Wastewater treatment, Ammonia, Biomass, Chemical oxygen demand, Municipal wastes, Simulation, Waste treatment.

A recently developed and experimentally validated model was used to delineate the effects of various design and operation parameters on the performance of single-sludge systems. Model simulation resulted in charts which illustrate the mutual effects of raw feed chemical oxygen demand/ammonia ratio, aerobic volume fraction and recycle rate. The most significant phenomenon, observed experimentally and supported by the simulation, is that increasing recycle may lead to increased effluent nitrate. This situation may occur under low raw chemical oxygen demand/ammonia ratios, whereas for high chemical oxygen demand/ammonia ratios, as in most domestic wastes, an opposite phenomenon occurs. This means that the recycle has an optimum value that depends on feed composition and on aerobic/anoxic fraction of the system. The presence of viable cells in the feed in significant numbers affects the composition of biomass in the system and the removal of nitrogen compounds. (Author's abstract)
W91-01426

CONTROL OF SLUDGE SETTLING CHARACTERISTICS IN THE SINGLE-SLUDGE SYSTEM, A HYPOTHESIS.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
A. Brenner, and Y. Argaman.
Water Research WATRAG, Vol. 24, No. 8, p 1051-1054, August 1990. 2 fig, 14 ref.

Descriptors: *Activated sludge process, *Bulking sludge, *Flocculation, *Nitrogen, *Sludge treatment, *Wastewater treatment, Ammonia, Chemical oxygen demand, Denitrification, Denitrifying bacteria, Filamentous bacteria, Microorganisms, Sludge.

Many studies have been carried out and many models proposed in order to understand and explain the mechanisms of bulking and bioflucculation. All of these studies related sludge bulking to the different substrate utilization rates and different growth rates of the flocculent and filamentous microbes under different operational conditions. However, denitrifying ability may affect population dynamics in activated sludge processes. Operation of activated-sludge in the single-sludge mode is suggested as an operational device for the prevention of filamentous bulking. It is hypothesized that the most filamentous microbes do not possess denitrifying ability and that the denitrifying microbes possess good steeling characteristics. It is therefore concluded that nitrogen transformations within the single-sludge system play an important role in the selection of microbial population by affecting the fractionation of organic carbon removal between the aerobic and the anoxic zones. In order to improve sludge settling characteristics, the aerobic volume fraction and the recycle rate should be carefully selected, based on the influent chemical oxygen demand/ammonia ratio. (Mertz-PTT)
W91-01427

SIPHONING SLUDGE.
Houston Dept. of Public Works, TX. Wastewater Div.
V. Bahl, and J. L. Geibel.
Civil Engineering (ASCE) CEWRA9, Vol. 60, No. 9, p 70-71, September 1990.

Descriptors: *Civil engineering, *Siphons, *Sludge, *Wastewater facilities, *Wastewater management, Ammonia, Biological oxygen demand, Clarification, Clarifiers, Nitrogen, Scum, Suspended solids, Texas, Water quality standards.

A massive wastewater treatment expansion using automatic sludge collection systems is helping Houston grow again. Amid the boom years of the early 1970s, the city had to curtail development because of: insufficient growth of wastewater treatment systems. Numerous small wastewater treatment plants became overloaded as service areas grew. Beginning in 1974, Houston set out to enlarge or upgrade 30 treatment plants, as well as to construct several new facilities for a 700 sq mi catchment area. Efficient removal of scum and floating debris became a major consideration when planning and designing new and upgraded facilities. Floating siphon sludge collection systems met the need. Floating siphon clarifiers were used at the Keegans Bayou Wastewater Treatment plant and at an addition to the Sims Bayou Wastewater Treatment plant. At the Metro Central Wastewater Treatment plant, floating siphon systems were installed in two final clarifiers as part of an expansion project. Keegans Bayou, Sims Bayou, and Metro Central plants now typically treat wastewater that averages 200 mg/L of biological oxygen demand (BOD) and has similar levels of total suspended solids (TSS). Ammonia as nitrogen averages 15 mg/L and organic nitrogen averages 9 mg/L. Aided by the automatic sludge collection systems the three plants consistently produce treated effluent that falls well below the permissible 30-day average of 10 mg/L BOD and 15 mg/L TSS. Ammonia nitrogen levels also fall below the permissible average of 3 mg/L in summer and 5 mg/L in winter. Houston abandoned many small wastewater treatment plants. Several lift stations were built to direct flows to the new regional facilities. (Fish-PTT)
W91-01485

GROUTING SLIP LINERS: THE NEW INSIDE STORY.
Halliburton Services, Houston, TX.
L. Lee.
Civil Engineering (ASCE) CEWRA9, Vol. 60, No. 9, p 78-80, September 1990. 1 fig.

Descriptors: *Civil engineering, *Grouting, *Liners, *Maintenance, *Pipes, *Sewer systems, *Sewers, Bulkheads, Collapse, Corrosion, Design standards, Flotation, Flow system, Industrial wastewater, Materials engineering, Pipe flow, Storm drains.

One cost-effective method of repairing storm drains, industrial drains, and sanitary sewers is slip lining: slipping a new pipe inside an old one and grouting it into place. It saves time and money, and lessens repair work. Large-diameter pipe is usually slip lined with jointed pipe pushed into the old pipe; small-diameter pipe is usually slip lined with continuous pipe pushed or pulled into place. Grouting prevents a failed installation in four ways: providing support for the pipe, slowing corrosion of the existing pipe, blocking the flow of water through the annular space, and preventing long-term damage or collapse of the new liner pipe. Factors affecting the grouting operation include water in the annular space, pipeline access, profile of the existing pipe, flotation effects, the volume of grout required, and the initial cause for pipe failure. The safest method for horizontal pipe is circulation grouting, which consists of pouring grout into one end of the system and tapping off the water and air at the opposite end. Stage grouting with controlled flotation is the best method for large-diameter thin-walled pipe. The best grouting material should have low viscosity, a clean interface with water, low specific gravity, low heat of hydration, and must not segregate when poured through water. Pumping time should be long and the grout should be impermeable and continuously-mixed. The planning and design stages should include a safe external pressure limit for the pipe; bulkhead design, venting requirements, placement and number of stages; profile and map of existing line showing all surface obstructions, elevations, and pipe-run footages; and number of stages for the grouting operation. (Fish-PTT)
W91-01486

BALANCING THE SCADA EQUATION FOR THE FIRST-TIME USER.
Control Mfg. Co., Belmont, CA.
For primary bibliographic entry see Field 7B.
W91-01564

INDUSTRIAL PRETREATMENT: COOPERATION--TO A POINT...
Metropolitan Waste Control Commission, St. Paul, MN.
L. H. Hermes, and J. D. Syme.
Water Engineering and Management WENMD2, Vol. 137, No. 8, p 40-41, August 1990. 3 fig.

Descriptors: *Compliance, *Industrial wastewater, *Metropolitan water management, *Pretreatment of wastewater, *Wastewater facilities, *Wastewater management, Industrial plants, Industrial wastes, Legal aspects, Metal-finishing wastes, Minnesota, Waste recovery, Water quality standards.

A major goal of industrial waste management is to discharge cleaner water. At the very least that means strict monitoring and enforcement. Strict enforcement of pretreatment requirements has proven to be the most effective route to a cleaner waste stream for the Industrial Waste Division of the Metropolitan Waste Control Commission, St. Paul, Minnesota, the regional wastewater treatment authority for the St. Paul-Minneapolis metropolitan area. The Commission has never been in court to battle an industrial waste violator. The use of stipulation agreements has proven to be a more effective and quicker remedy. A stipulation agreement is a legal contract entered into by the Commission and the violating industrial user, specifying the actions which will be taken to achieve compliance, and including a compliance schedule. Part of the success of industrial pretreatment efforts in the Twin Cities is due to the success of a privately-owned centralized treatment and recovery facility. Wastes handled at the facility are generated mainly by metal-plating shops and electronics manufacturing. Industrial waste control is a major issue for the 1990s. The Commission is currently preparing revisions to its waste discharge rules, and additional limits for toxic organics may be added in the future. (Fish-PTT)
W91-01565

START-UP OF LOW TEMPERATURE ANAEROBIC REACTORS USING FRESHWATER METHANOGENIC SEDIMENTS.
Universidad Autonoma de Barcelona (Spain). Unidad de Ingenieria Quimica.
A. Bardulet, J. Cairo, and J. M. Paris.
Environmental Technology ETLEDB, Vol. 11, No. 7, p 619-624, 1990. 3 fig, 1 tab, 19 ref. Commission of the European Communities Contract Nr. EN3B-0050-E(B).

Descriptors: *Anaerobic digestion, *Biogas, *Methanogenesis, *Sludge, *Wastewater treatment, Biological wastewater treatment, Fluvial sediments, Sludge digestion, Spain, Substrates.

Currently anaerobic digestion processes are mainly operated at the mesophilic range of temperatures. However, recently attention has been paid to the study of low temperature anaerobic digestion, which might serve as a method for energy recovery from organic wastes. Biogas production has been observed in lake sediments, wetlands, and marshes at temperatures between 4 and 15 C. Some methanogenic species, with low optimal temperatures have been isolated from sea and lake sediments. There is ongoing research to identify and characterize methanogenic flora which develops in low-temperature environments that might be utilized as inocula. The objective of this project was to start up anaerobic digesters, at 20 C, with non-conventional inocula (fresh water sediments) to assess the feasibility of utilizing such inocula to aerobically treat different wastewaters. This process appeared to be stable for the three substrates studied; pig manure, distillery waste and sewage sludge. The total solids concentrations for the three substrates were 40, 25, and 32 kg/cubic m respectively. The range of organic load applied was 0.1-1.3 kg COD/cubic m/day. Biogas production ranged from 0.195 to 0.257 cubic m biogas/kg substrate/day, and the percentage of methane ranged from 66 to 76%. The results of this work indicate that fresh water sediments are a promising alternative to conventional anaerobic sludge for inoculating low temperature anaerobic digesters. (Korn-PTT)
W91-01637

HYDRAULIC SHOCK LOADINGS OF WASTEWATER TREATMENT SYSTEM TO URBAN RAINFALL-RUNOFF (EFFETS CHOCS HYDRAULIQUES DES EAUX USEES DE RUISSELLEMAENT PLUVIAL URBAIN SUR UN SYSTEME DE TRAITEMENT DES EAUX).
Institut National de là Recherche Scientifique, Riviere-du-Loup (Quebec).
Y. Couillard, and R. D. Tyagi.
Environmental Technology ETLEDB, Vol. 11, No. 7, p 635-650, 1990. 5 fig, 1 tab, 30 ref. English summary.

Descriptors: *Nutrient concentrations, *Rainfall-runoff relationships, *Urban runoff, *Wastewater treatment facilities, Biological wastewater treatment, Canada, Flow characteristics, Literature review, Rainfall, Runoff, Wastewater, Wastewater treatment.

During rain events, run-off waters from urban areas are carried by combined sewer systems toward wastewater treatment facilities. The characteristics of these waters are different from those of usual wastewaters especially concerning flow. A sampling program and knowledge found in literature review lead to the conclusion that variations in flow and concentrations of nutrients measured during the sampling period did not cause any important changes in the operation of a biological wastewater treatment system. (Author's abstract)
W91-01638

GLUCOSE INDUCED BREAKDOWN OF ENHANCED BIOLOGICAL PHOSPHATE REMOVAL.
Ceskoslovenska Akademie Ved, Ceske Budejovice. Inst. of Landscape Ecology.
J. S. Cech, and P. Hartman.
Environmental Technology ETLEDB, Vol. 11, No. 7, p 651-656, 1990. 3 fig, 2 tab, 7 ref.

Descriptors: *Activated sludge, *Anaerobic digestion, *Phosphorus removal, *Tertiary wastewater treatment, *Wastewater treatment, Activated sludge process, Aerobic conditions, Anaerobic conditions, Bacteria, Bacterial physiology, Biological wastewater treatment, Czechoslovakia, Substrates.

Extensive research has been conducted on anaerobic-aerobic activated sludge systems in recent years in an attempt to increase their capacity for phosphate removal from wastewater. The enhanced phosphate removal is possibly attributable to the presence of certain bacteria capable of polyphosphate accumulation under aerobic conditions. Polyphosphate stored in bacterial cells is then hydrolyzed under anaerobic conditions to provide bacteria with the energy needed for an anaerobic substrate uptake. Two laboratory anaerobic-aerobic activated sludge reactors were operated to study enhanced biological phosphate removal. They differed only in organic substrate composition. Reactor F was fed with acetate, reactor G with an acetate-glucose mixture. Both reactors were started with identical activated sludge which had an enhanced biological phosphate removal ability. During the adaptation period, this ability increased several fold in reactor F but it was completely lost in reactor G. In spite of this fact, organic substrate also disappeared from the solution during the anaerobic stage in reactor G. Interferences due to electron acceptors such as dissolved oxygen, nitrates, nitrites, and sulfates were too low to explain this phenomenon. (Author's abstract)
W91-01639

REDUCTION OF TOXIC CHROMATE IN AN INDUSTRIAL EFFLUENT BY USE OF A CHROMATE-REDUCING STRAIN OF ENTEROBACTER CLOACAE.
Tokyo Univ. (Japan). Inst. of Applied Microbiology.
H. Ohtake, E. Fujii, and K. Toda.
Environmental Technology ETLEDB, Vol. 11, No. 7, p 663-668, 1990. 5 fig, 15 ref.

Descriptors: *Anaerobic bacteria, *Chromates, *Chromium, *Detoxification, *Enterobacter, *Industrial wastes, *Wastewater treatment, Anaerobic conditions, Effluents, Heavy metals, Japan, Mutagenicity, Toxicity.

Chromate is one of the toxic heavy metals which are common pollutants and has been shown to be mutagenic in a number of bacterial systems. Wastewaters containing toxic chromate are generated in many industrial processes. Hexavalent chromium is very soluble in water and forms the divalent anions chromate and dichromate. Detoxification and removal of hexavalent chromium in an industrial effluent was investigated using Enterobacter cloacae. This bacterium could completely reduce chromate to less toxic trivalent chromium when appropriate nutrients were supplied to the effluent. The reduction rate was strongly dependent on the amount of added carbon and energy sources, and also on cell density. Since the reduced chromium readily formed insoluble chromium hydroxides, about 40% of the reduced chromium could be removed from the treated water by centrifugation. The important features of the bacterial reduction of toxic chromate were as follows: (1) the reduction occurred only under anaerobic conditions, (2) carbon and energy sources were required not only for the bacterial growth, but also for the reduction of chromate, (3) the reduction occurred at a neutral pH and at normal temperatures of 20-40 C, (4) the rates of reduction were proportional to cell number, and (5) the chromate reduction was inhibited to some extent by metal ions including Cu(2+), Mn(2+), and Zn(2+). (Korn-PTT)
W91-01641

DESIGN CONSIDERATIONS FOR WASTE WATER TREATMENT WITH WATER HYACINTH E. CRASSIPES.
Universidad Autonoma Metropolitana, Mexico City. Dept. de Biotecnologia.
O. M. Hermosillo, and S. Sarquis.
Environmental Technology ETLEDB, Vol. 11, No. 7, p 669-674, 1990. 5 fig, 3 tab, 15 ref.

Descriptors: *Wastewater treatment, *Wastewater treatment facilities, *Water hyacinth, Biochemical oxygen demand, Design criteria, Maturation ponds, Mexico, Nutrients, Toxic wastes.

The use of the water hyacinth for the removal of nutrients, biochemical oxygen demand (BOD) and toxic substances has been practiced at pilot and full scale levels by many researchers. This study was conducted to provide a design methodology for wastewater treatment in water hyacinth ponds. In order to efficiently use water hyacinth ponds for nutrient removal they must be designed as maturation ponds according to the existing local conditions, which implies that secondary treatment is needed prior to the water hyacinth pond. Satisfactory removal efficiencies can be obtained by decreasing the nitrogen load input to the system. This requires a larger pond area that causes increased biomass harvesting and disposal problems. The water-hyacinth density also plays an important role. The plant must be harvested periodically to keep the population between 80 and 120 T/Ha/d which results in the optimum growth rate. Literature data was compiled with growth rate and yield measurements to develop a performance equation with two dimensionless groups indicating the system capacity for nutrient removal. It was concluded that organic loads up to 10 Kg BOD/Ha/d are critical to obtain nitrogen removal efficiencies greater than 80%. (Korn-PTT)
W91-01642

MICROBIOLOGY OF FOAMING IN ACTIVATED SLUDGE PLANTS.
Bendigo Coll. of Advanced Education (Australia). Dept. of Biological and Chemical Sciences.
J. A. Soddell, and R. J. Seviour.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 2, p 145-176, August 1990. 8 fig, 2 tab, 227 ref.

Descriptors: *Activated sludge, *Activated sludge process, *Bacteria, *Bulking sludge, *Flocculation, *Foaming, *Fungi, *Microbiology, *Microorganisms, *Wastewater treatment, Actinomyces, Australia, Bacterial analysis, Bacterial biochemistry, Bacterial ecology, Bacterial physiology, Biological treatment, Microthrix, Nostoc, Sphaerotilus, Wastewater facilities.

One of the most common forms of biological treatment of sewage is the activated sludge process which is a two stage process consisting of initial aeration followed by sedimentation. An essential requirement for successful operation of a sewage treatment plant is the formation of a suitable microbe-containing floc in the aeration tank, that

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produces a clear supernatant. Foaming involves filamentous bacteria and manifests itself as a persistent viscous brown foam or scum on the surface of the mixed liquor in the aeration vessel and sometimes on the secondary clarifier. The formation of this foam prevents the proper settling of solids that is essential to the activated-sludge process. Microscopic examination of foam usually reveals a large number of branching filamentous of actinomycetes, although filamentous bacteria and even non-filamentous bacteria have been reported. Other filamentous bacteria include Microthrix parvicella which selectively accumulates in the foam. Other organisms reported as major constituents of foam include Eikelboom Type 1851, Type 0581, Type 0914, Sphaerotilus and Nostocoida limicola. This review indicates that more studies to understand the ecology, physiology and biochemistry of the organisms in the foam are needed, and micromanipulation techniques must be used to isolate them. New specific identification techniques like DNA probes need to be developed and routinely applied to follow populations of foam causing organisms in selected treatment plants before, during, and after foaming episodes, so that changes in their levels can be detected and followed. Finally, a more complete understanding of the biological basis of foaming in activated sludge is needed. (Korn-PTT)
W91-01654

PREVIEW ANALYSIS OF NATIONAL SLUDGE SURVEY.
Residuals Management Technology, Inc., Madison, WI.
For primary bibliographic entry see Field 5E.
W91-01661

COMPOST ODOR CONTROL THROUGH PROCESS OPTIMIZATION.
Claremont City Water/Sewer Div., NH.
M. E. Lang, B. M. Bennett, and R. A. Jager.
Biocycle BCYCDK, Vol. 31, No. 7, p 76-78, July 1990. 1 fig, 4 ref.

Descriptors: *Composting, *Odor control, *Sludge disposal, *Wastewater treatment.

The Claremont, New Hampshire Wastewater Treatment Facility is a four million gallon per day conventional activated sludge facility, using aerated static pile composting of raw sludge and distribution as the method of sludge management. Numerous odor complaints were received from neighbors of the composting facility. The sludge contained high total and volatile solids, partially due to waste generated from paper processing industries. In aerated static pile composting, a minimum total solids concentration of 40% is important to provide porosity and structural integrity. At the Claremont Facility, the amendment to sludge ratio was approximately 2.7 to 1 and 0.8 to 1 on a volumetric and weight basis respectively. The aeration system was designed so that each blower operated in a positive and negative mode. It was recommended that the system run in the negative mode until the temperature within the compost pile was between 55 and 65 C. Then the air flow was reversed to control temperature while optimizing stabilization and drying. The dewatering schedule and pile construction sequence were modified to insure that aeration was provided to the same day's mix. The active piles were broken down and restacked to stimulate further stabilization. No odor complaints were received in the two months following these modifications. Further planned improvements include the construction of a collection duct and biofilter to treat process air from blowers operating in the negative mode, and the use of bio-ash as an amendment within the composting process. (Miller-PTT)
W91-01662

BOROUGH OF HUNTINGDON UPGRADES ITS WASTEWATER TREATMENT FACILITIES.
Commonwealth Engineering and Technology, Inc., Harrisburg, PA.
R. H. Myers, and J. H. Parks.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 23, No. 4, p 23-27, July/August 1990. 2 fig, 3 tab.

Descriptors: *Filtration, *Wastewater facilities, *Wastewater treatment, Clarigestion, Compliance, Filters, Huntingdon, Juniata River, Pennsylvania, Wetlands.

The Borough of Huntingdon, PA's population growth required increased public service facilities. A 3.75 MGD wastewater treatment facility was recommended. The facility consists of preliminary treatment in the form of screening and grit removal, raw wastewater pumping and distribution, primary treatment by existing clarigestion, trickling filtration, final clarification and disinfection by chlorination prior to discharge. Sludge processing consists of anaerobic digestion of primary sludge by clarigestion, gravity thickening of trickling filter sludge, lime stabilization of thickened sludge and sludge storage. Liquid sludge was hauled to approved farmland for disposal. The Borough successfully handled a design problem involving an adjacent wetlands area with the aid of the U.S. Army Corp of Engineers. Start-up commenced in June, 1988 and final effluent compliance was achieved in less than five days. The Borough was able to meet the compliance schedule and provide facilities which contribute to improving the quality of the Juniata River. (Miller-PTT)
W91-01677

EXPANSION AND UPGRADING OF THE CHALFONT-NEW BRITAIN TOWNSHIP JOINT SEWAGE AUTHORITY/BUCKS COUNTY WATER AND SEWER AUTHORITY WASTEWATER TREATMENT PLANT.
Chalfont-New Britian Township Joint Sewage Authority, PA.
R. L. Truman, and L. E. Ritter.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 23, No. 4, p 31-40, July/August 1990. 4 tab.

Descriptors: *Secondary wastewater treatment, *Wastewater facilities, *Wastewater treatment, Chalfont, Compliance, New Britain, Pennsylvania, Phosphate removal, Sludge treatment, Storm wastewater.

The secondary treatment plant of the Chalfont-New Britain Township Joint Sewage Authority became a regional plant when its capacity was doubled to 1.4 MGD in 1969. A 201 Facility Plan was prepared for the Authorities in 1981. Construction began in April, 1987. The Department of Environmental Resources required that secondary treatment remain in full operation during construction. The system was ready for operation by October, 1988. Sludge handling facilities included two-stage anaerobic digestion, dissolved air flotation thickening of excess activated sludge and dewatering by two belt filter presses. Biological phosphorus removal occurs in the system as the wastewater passes alternately through aerobic and anaerobic zones of the outer channel through 'luxury' phosphorus uptake. A very important special feature of the concentric channel system has been its ability to accept peak flows well beyond capacity during storm events while maintaining a high degree of operating efficiency. The Authority looks forward to producing a high quality effluent with relative ease after struggling to achieve permit compliance during the startup period. (Miller-PTT)
W91-01678

MEASUREMENT OF SURFACE TENSION IN AGRICULTURAL WASTE SLURRIES.
Cambridge Univ. (England). Dept. of Chemical Engineering.
K. W. Hester, K. Niranjan, and J. F. Davidson.
Journal of Agricultural Engineering Research JAERA2, Vol. 46, No. 2, p 147-152, June 1990. 3 fig, 7 ref.

Descriptors: *Data interpretation, *Farm wastes, *Surface tension, *Waste treatment, *Wastewater treatment, Mathematical equations, Slurries, Solids, Viscosity, Wastewater.

An experimental method to determine the equilibrium surface tension of cattle and pig slurries are described. The surface tension was determined by using a published modification of the 'maximum bubble pressure method': the pressure inside a spherical bubble in excess of its surrounding is measured just prior to its release into a slurry through a capillary; the surface tension is calculated using $P = 2$ (surface tension)/radius of the curvature, where P is the maximum pressure. The method was found to be valid only at slurry solid concentrations of $< 6\%$ by weight, where measurement errors due to slurry viscosity and the influence of solids were insignificant. Slurry surface tension was found to be 0.06 to 0.07 N/m, only slightly lower than water. This method may be applied to other agricultural waste slurries, fermentation broths and domestic sewage. (Author's abstract)
W91-01702

GROWTH AND VALUE OF CHLORELLA SALINA GROWN ON HIGHLY SALINE SEWAGE EFFLUENT.
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
P. K. Wong, and K. Y. Chan.
Agriculture, Ecosystems and Environment AEENDO, Vol. 30, No. 3/4, p 235-250, April 1990. 10 tab, 46 ref.

Descriptors: *Chlorella, *Chlorophyta, *Effluents, *Fish food, *Nutrient removal, *Saline water, *Tertiary wastewater treatment, *Wastewater, *Wastewater treatment, Algae, Amino acids, Biomass, Fish, Nitrogen, Phosphorus, Phosphorus removal, Secondary wastewater treatment.

Chlorella salina was successfully cultivated in secondarily treated domestic sewage effluent of high salinity (14 ppt) in an outdoor cultivation tank. Removal efficiencies of NH4(+)-N, NO3(-)-N, and PO4(3-)-P by this alga from secondarily treated sewage effluent were 89-100%, 35-66% and 100% respectively. The high removal efficiencies of inorganic N and P means that this process can be used as a tertiary treatment. The yield of the sewage grown algae was 5.1 g/sq m/day for a retention time of six days. The high protein content (46.8%), relatively good amino-acid profile and low metal content enabled the use of algal biomass as feed supplement for the silver carp (Hypophthalmichthys molitrix). The food conversion ratio (FCR) of 5% and 10% sewage-grown algae supplemented fish food were better than on the control diet (i.e. artificial fish food alone), while the FCR of 20% sewage-grown algae supplemented fish food and live sewage-grown algae alone were inferior to that on the control diet. These results indicate that cultivation of C. salina in secondarily treated sewage effluent of high salinity can be used as a tertiary sewage treatment to remove inorganic N and P from secondarily treated sewage effluent to reduce pollution problems and to produce algal protein suitable as a supplement for fish feed in aquaculture. (Author's abstract)
W91-01708

CONVERSION OF FAT INTO YEAST BIOMASS IN PROTEIN-CONTAINING WASTE WATER.
Lund Univ. (Sweden). Dept. of Applied Microbiology.
S. Rydin, G. Molin, and I. Nilsson.
Applied Microbiology and Biotechnology AMBIDG, Vol. 33, No. 4, p 473-476, July 1990. 1 fig, 3 tab, 15 ref.

Descriptors: *Biomass, *Fats, *Proteins, *Wastewater treatment, *Yeasts, Culture techniques, Fungi, Lipids, Methane, Methanogenesis, Sedimentation, Wastewater utilization.

Candida tropicalis S001 was grown on the lipid fraction of a protein-containing wastewater in order to (i) remove fat from the water, and (ii) produce yeast biomass for feed. The yeast cells were separated from the wastewater by sedimentation. Defatted wastewater was used for methane production and gave a yield of 0.3 cubic meter methane/kg reduced chemical oxygen demand. The maximum specific growth rate of C. tropicali

growing on wastewater fat at pH 4.0 was 0.35/h; the fat content was decreased from 8 g/L to about 0.1 g/L within 24 h. In continuous culture a corresponding reduction was maintained at dilution rates up to 0.36/h. The effect on growth of pH, temperature, and CO2 concentration was studied with triolein as the major carbon source. The maximum specific growth rate was nearly constant (0.16/h) in the pH and temperature range of 3.2-4.0 and 20-38 C, respectively; 10% CO2 was optimal for growth. Growth on triolein resulted in a biomass yield of 0.70 g dry weight/g fat. (Author's abstract)
W91-01717

ORMATION OF PCDDS AND PCDFS BY THE CHLORINATION OF WATER.
Umea Univ. (Sweden). Inst. of Environmental Chemistry.
For primary bibliographic entry see Field 5F.
W91-01725

ITY TACKLES MAJOR SANITARY SEWER EHABILITATION WITH NEW PROCESS.
. K. Murzyn.
ublic Works PUWOAH Vol. 21, No. 9, p 62-63, ugust 1990.

escriptors: *Engineering, *Rehabilitation, Sewer systems, Cost analysis, Illinois, Polyethylne, Swagelining.

he rehabilitation of the sanitary sewer system, me portions of which were in excess of 75 years d, of the city of Wheaton, Illinois is described. rge sections of the pipelines has deteriorated ructurally, and inflow and infiltration problems ere common in older, more established sewer erals and mains. To find a long term solution to e problem, the city considered three basic alterives: open cut excavation and replacement of teriorating pipe sections; a felt lining and epoxy in system; and Swagelining, the polyethylene er pipe process. The process ultimately selected s Swagelining, which is new and unproven for itary sewer applications. The process involves e insertion of polyethylene pipe inside existing ver pipe to provide a tight fitting structural ng. While the costs for using Swagelining were ver than those of other methods, there were er advantages to the process, among them: (1) use of polyethylene pipe is accepted by the nois EPA, (2) the pipe meets ASTM standards, ich means that it has known, predictable engiring properties, (3) the insertion of the liner e actually increases the flow capacity of the tem (by 20%), because the coefficient of friction he polyethylene pipe is much lower than that of original clay and concrete sections. Swagelinaccounted for rehabilitating 15,000 lineal feet ewer lines at a cost estimated at 40 percent less n traditional open cut methods in roughly half time (5 months). Although the process had n previously untried in sanitary sewer applicas, it has proven highly effective in Wheaton. ostine-PTT)
1-01755

GRADATION OF PHENOL BY A BACTEL CONSORTIUM UNDER METHANONIC CONDITIONS.
itut Armand-Frappier, Laval (Quebec). Centre Recherche en Microbiologie Appliquee.
Bechard, J. G. Bisaillon, R. Beaudet, and M. estre.
adian Journal of Microbiology CJMIAZ, Vol. No. 8, p 573-578, August 1990. 4 fig, 3 tab, 27 Natural Sciences and Engineering Research ncil of Canada Grant OGPGP002.

criptors: *Bacteria, *Biodegradation, *Carboxon, *Fate of pollutants, *Microbial degrada- *Phenols, *Wastewater treatment, Anaerobic litions, Bacillus, Benzoates, Degradation prod-

anaerobic bacterial consortium was shown to oxylate phenol to benzoate under methano- conditions. Benzoate accumulated in the cul- medium and was completely degraded when the incubation period was prolonged. Two potential intermediates of phenol metabolism, namely cyclohexanol and cyclohexanone, were not accumulated or transformed by the consortium. Proteose peptone must be added to the culture medium for the carboxylation of phenol to occur and glucose could not replace proteose peptone. Inhibition of methanogenesis did not affect the carboxylation of phenol and the presence or absence of hydrogen in the gaseous atmosphere did not prevent the accumulation of benzoate. The consortium was composed of various microbiological forms dominated by Gram-negative rods. Phenol-carboxylating microorganisms were evaluated to about > or = 100 million cells/ml by using diluted inocula. These results suggest that the carboxylation of phenol is accomplished by co-metabolism and that proteose peptone or some degradation products serve as carbon and energy sources for the growth of the carboxylating bacteria, which appear to be present in large numbers in the consortium. (Author's abstract)
W91-01773

TENTATIVE IDENTIFICATION OF ORGANIC COMPOUNDS AT THE WESTSIDE WASTEWATER TREATMENT PLANT (HIGH POINT, NC) AND IMPLICATIONS FOR AQUATIC TOXICITY.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
F. A. DiGiano, R. F. Christman, and J. F. Storm.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-185869/AS. Price codes: A06 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No. 245, (UNC-WRRI-89-245), July 1989. 103p, 3 fig, 21 tab, 75 ref, 8 append. State Project 70062.

Descriptors: *Organic compounds, *Pollutant identification, *Wastewater treatment, Biomonitoring, North Carolina, Toxicity.

After identifying an acute toxicity problem, the North Carolina Division of Environmental Management required the High Point Westside Wastewater Treatment Plant (Westside WWTP) to institute periodic biomonitoring and reduce whole effluent toxicity. This research was undertaken to provide additional information through a broad spectrum, chemical-specific approach to toxicity reduction in which potential toxicants are identified. Westside WWTP samples determined as acutely 'toxic' or 'non-toxic' by Daphnia pulex bioassay, effluents from six categories of industrial dischargers, and a domestic wastewater sample were analyzed for organic chemicals using continuous solvent extraction of wastewater samples and broad spectrum GC/MS analysis. An extensive data base was developed which includes aquatic toxicity data for 60 compounds and tentatively identified compounds in WWTP samples (82 out 123 peaks were identified) and industrial effluents (about 50 for each) ranked according to their potential for contribution to toxicity. The study suggests that many compounds found in Westside WWTP influent and effluent are of industrial origin because they occur in both industrial samples and Westside WWTP samples. (USGS)
W91-01826

EVALUATION OF THE INSTALLATION OF A SEWAGE COLLECTION SYSTEM ON WATER QUALITY IN A PRAIRIE LAKE.
Dakota State Univ., Madison, SD. Coll. of Natural Sciences.
C. K. Brashier, J. A. Janke, and J. Halbritter.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-217241/AS. Price codes: A03 in papercopy, A01 in microfiche. South Dakota State University, Brookings, Completion Report, October 1989. 38p, 18 fig, 3 tab, 3 ref. USGS Contract No. 14-08-0001-G1590-05. USGS Project No. G1590-05.

Descriptors: *Eutrophication, *Sewer systems, *Wastewater collection, Eutrophic lakes, Glacial lakes, Lake Madison, Nutrients, South Dakota, Water analysis, Water quality.

From 1968-75 extensive studies supported by EPA and OWRR were done to determine the rate and extent of the aging process in Lake Madison, a 300-acre shallow glacial prairie lake surrounded by about 600 homes near Madison, South Dakota. Since then several specific things have been done to try to slow the eutrophication of the lake. In 1970 a Sanitary District was established, and this led to most of the homes around the lake installing septic tanks and disposal fields. In 1986 the sewage treatment plant for the City of Madison was totally replaced and an extensive tertiary treatment was implemented. Sewage effluent from the city is now sent to four infiltration, percolation ponds. A sewage collection system for all the homes around Lake Madison was initiated in 1987 and scheduled for completion in 1988. In order to compile a profile of selected water quality parameters in Lake Madison, Dakota State University conducted water analysis studies in Lake Madison in the summer of 1987 and also included extensive studies of Silver Creek, the main feeder stream for Lake Madison. This research was continued and expanded in the summer of 1988 through a WRI grant. The primary objectives of this research were to continue to develop base-line data prior to and during the first year that the sewage collection system is on-line, to compare collected data to the data assembled in 1969-70, and to expand and test the college's capabilities for monitoring selected water quality parameters. (USGS)
W91-01862

TREATMENT OF CHLOROPHENOL-CONTAMINATED WATER AND SOILS USING IMMOBILIZED MICROORGANISMS.
Biotic Consultants, Inc., Carbondale, IL.
R. L. Crawford, and T. J. Chresand.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-222241/AS. Price codes: A03 in paper copy, A01 in microfiche. Final Report, 1990. 38p, 24 fig, 1 tab, 32 ref, append. USGS Contract No. 14-08-0001-G1474.

Descriptors: *Biodegradation, *Biological wastewater treatment, *Pentachlorophenol, *Wastewater treatment, Alginate, Flavobacterium, Microbial degradation, Phenols, Polyurethane.

A pentachlorophenol (PCP)-degrading Flavobacterium, a p-cresol-degrading Pseudomonas, and the lignin-degrading P. chrysosporium were all effectively immobilized in both alginate and polyurethane. The immobilized cells effectively degraded their target compounds, and the systems proved amenable to use in batch or fluidized bed reactors for degrading PCP or cresol contaminated water and soil. Polyurethane appears to be the immobilization matrix of choice for field application as it: (1) is mechanically strong; (2) stabilizes cells for long half-lives; (3) protects cells from pollutant toxicities; and (4) in the case of PCP, acts to adsorb the contaminant and localize it in the support. Electron microscopy showed that cells were likely entrapped in small pores in the foam as opposed to being covalently linked to it. A field laboratory was assembled at a wood treating site and a 40 liter fluidized bed reactor containing foam-immobilized Flavobacterium was operated for a four week trial. The system achieved approximately 75% removal of PCP with a residence time of 0.5 hours, and approximately 90% removal with a residence time of 0.8 hours. It was determined that PCP activity in the field was due to the inoculated Flavobacterium rather than indigenous organisms growing on the outside of the foam particles. (USGS)
W91-01865

MEASURING TECHNIQUES FOR GAS/SOLID FLUIDIZED BED REACTORS (MEBTECHNIKEN FUR GAS/FESTSTOFF-WIRBELSCHICHTREAKTOREN).
Hamburg Univ. (Germany, F.R.).
J. Werther, E. U. Hartge, and D. Renser.
Chemie-Ingenieur-Technik CITEAH, Vol. 62, No. 8, p 605-613, August 1990. 22 fig, 41 ref. English summary.

Descriptors: *Data acquisition, *Fluidized bed process, *Gases, *Measuring instruments, *Sludge

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treatment, *Solids, *Waste disposal, *Waste treatment, Mass spectrometry, Wastewater treatment.

Significant progress has been made in the field of fluidization in recent years due to its application to the combustion of coal, sewage sludges, and other residues. These new applications have created a demand for new measuring techniques. Currently available measuring techniques for fluid mechanical properties are reviewed, ranging from simple measurements for the determination of bed expansion, to more sophisticated techniques for the determination of local solids concentrations, velocities and mass flows. Furthermore, the problem of gas sampling from fluidized bed reactors is discussed. Among others, a measuring technique based on mass spectrometry is presented for the local and instantaneous measurement of gas concentrations. (Author's abstract)
W91-01896

BROAD-RANGE METHODS FOR DETERMINATION OF POLLUTANTS IN WASTEWATER.
Environmental Protection Agency, Washington, DC. Industrial Technology Div.
For primary bibliographic entry see Field 5A.
W91-01914

COMPREHENSIVE HEALTH EFFECTS TESTING PROGRAM FOR DENVER'S POTABLE WATER REUSE DEMONSTRATION PROJECT.
Denver Water Dept., CO.
W. C. Lauer, F. J. Johns, G. W. Wolfe, B. A. Myers, and L. Y. Condie.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 30, No. 4, p 305-321, August 1990. 1 fig, 2 tab, 33 ref. EPA Contract CS-806821.

Descriptors: *Denver, *Drinking water, *Potable water, *Public health, *Wastewater renovation, *Wastewater treatment, *Water reuse, *Water treatment, Biological studies, Clarification, Colorado, Filtration, Performance evaluation, Reverse osmosis, Secondary wastewater, Toxicity, Toxicology.

A project was designed to evaluate the relative health effects of highly treated reclaimed water derived from secondary wastewater compared to Denver's present high-quality drinking water. The 1 million gallon per day (1 mgd) demonstration plant provides water to be evaluated in the studies treating unchlorinated secondary treated wastewater with the following additional processes: high pH lime clarification, recarbonation, filtration, ultraviolet irradiation, activated carbon adsorption, reverse osmosis, air stripping, ozonation and chloramination. An additional sample is obtained from the identical treatment process substituting ultrafiltration for reverse osmosis. The toxicology tests to evaluate the possible long-term health effects are chronic toxicity and oncogenicity studies in Fischer 344 rats and B6C3F1 mice and reproductive/teratology in Sprague-Dawley rats. The results of these evaluations will be correlated with microbiological, chemical, and physical test results to establish the relative quality of reclaimed water compared to all established health standards as well as Denver's pristine drinking water. (Author's abstract)
W91-01920

MINIMIZATION OF CHROMIUM-CONTAMINATED WASTEWATER AT A PLATING FACILITY IN THE EASTERN UNITED STATES.
Oak Ridge National Lab., TN. Chemical Technology Div.
J. F. Walker, J. H. Wilson, and C. H. Brown.
Environmental Progress ENVPDI, Vol. 9, No. 3, p 156-160, August 1990. 8 fig, 3 tab, 1 ref.

Descriptors: *Chromium, *Industrial wastewater, *Metal-finishing wastes, *Reverse osmosis, *Wastewater treatment, *Water pollution control, Pretreatment of wastewater, Water pollution treatment.

The Oak Ridge National Laboratory conducted a hazardous waste minimization program at an industrial plating facility located in the Eastern United States. Investigations at the facility indicated that chromium was the major source of contamination. Several improvements in the operation of the facility were implemented which reduced the quantity of chromium lost from the facility by 85%. The remaining chromium-contaminated wastewater streams were treated by reverse osmosis (RO) followed by evaporation of the RO concentrate for further volume reduction. Pilot-scale RO tests indicated that the gun line rinse waters could be successfully treated by RO using a 1 to 5 micron prefilter. Pretreatment of the bright-dip rinse water proved to be ineffective; however, cleaning the membrane with a 1% solution of EDTA allowed the use of RO treatment of the bright-dip rinse by oversizing the RO unit to take into account the expected loss in permeate flux. In the full-scale tests, the loss of permeate flux was restored by cleaning with a mixture of phosphoric acid. (Geiger-PTT)
W91-01947

BIODEGRADATION OF CHLORINATED HYDROCARBONS IN AN IMMOBILIZED BED REACTOR.
Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
G. P. Miller, R. J. Portier, D. G. Hoover, D. D. Friday, and J. L. Sicand.
Environmental Progress ENVPDI, Vol. 9, No. 3, p 161-164, August 1990. 7 fig, 1 tab, 10 ref.

Descriptors: *Biodegradation, *Biological treatment, *Chlorinated hydrocarbons, *Groundwater pollution, *Immobilized bed reactors, *Wastewater treatment, *Water pollution treatment, Bacteria, Mineralization, Organic solvents.

A 75 liter immobilized microbe biological reactor with a bed retention time of 20.5 hr was used in a continuous flow mode to remediate contaminated groundwater containing ethylene dichloride (EDC), tetrachloroethylene, and trichloroethylene (TCE), with EDC being the predominant contaminant. The reactor was initially seeded with Xanthobacter autotrophicus, a demonstrated halogenated aliphatic substrate utilizer. The reactor was operated for forty-two days. Material balance determinations for primary volatile aliphatics of concern indicated an average of 90.2% mineralization of EDC, 81.7% of the TCE and 64.0% of the tetrachloroethylene. In addition to X. autotrophicus, four indigenous bacterial species from the groundwater had successfully acclimated to the reactor bed. Of the five effluent isolates only two have been identified. These are X. autotrophicus and Comamonas acidovorans. (Author's abstract)
W91-01948

INNOVATIVE MANAGEMENT OF AN AERATED/FACULTATIVE LAGOON SUSPENDED-GROWTH BIOLOGICAL TREATMENT SYSTEM FOR HIGH STRENGTH INDUSTRIAL WASTE STABILIZATION.
Metropolitan Denver Sewage Disposal District No. 1, CO.
T. J. Muirhead.
Environmental Progress ENVPDI, Vol. 9, No. 3, p 174-182, August 1990. 10 fig, 6 tab, 13 ref.

Descriptors: *Biological wastewater treatment, *Industrial wastes, *Stabilization lagoons, *Waste stabilization, *Wastewater treatment, Aerated lagoons, Aeration, Food-processing wastes, Wastewater lagoons.

The performance and kinetics of the Coors Bio-Tech aerated/facultative lagoon suspended-growth biological treatment system were examined for high strength industrial waste stabilization. The lagoon was operated in various treatment modes and over a range of organic loadings and influent wastes to demonstrate its performance capabilities for high strength industrial waste stabilization. Process stream flexibility, large reactor volume, adequate aeration, sufficient nutrients, long mean cell residence time, high buffering capacity, and healthy-recalcitrant microbial biomass significantly contribute to its excellent efficiency in high strength industrial waste stabilization. The stabilization process was described by a dynamic, high-order removal rate mathematical model. The aerated lagoon maintained a continuous mode of readiness to assimilate varying loads of high strength organic wastes and varying loads of biochemical oxygen demand. Lagoon efficiency was highest when anaerobic conditions existed and slightly less under aerobic conditions. Peak performance was established at a continuous daily loading rate of approximately 4.4 kg/cu m. As organic loadings were increased, the process reached an optimum level of removal as seen in the plateau for removal rates above 8.4 kg/cu m. A simulated clarification evaluation through the use of a settleometer showed an average high suspended solids removal rate. Despite lagoon sludge settleability rates characteristic of bulking sludge conditions, excellent solids compaction and filterability properties were observed. Microbiological studies showed a stable, healthy, recalcitrant microbial biomass comprised of a well-balanced population of bacteria, fungi, protozoa, rotifers and filaments. The microbial biomass was resistive to toxicity from acute loadings of highly concentrated wastes of ammonia, sulfides, acids, caustic, and biocides. (Geiger-PTT)
W91-01950

REMOVAL OF ORGANICS FROM OFFSHORE PRODUCED WATERS USING NANOFILTRATION MEMBRANE TECHNOLOGY.
Texaco, Inc., Beacon, NY.
C. A. Dyke, and C. R. Bartels.
Environmental Progress ENVPDI, Vol. 9, No. 3, p 183-186, August 1990. 7 fig, 1 ref.

Descriptors: *Membrane processes, *Offshore platforms, *Organic pollutants, *Ultrafiltration, *Wastewater treatment, Cleanup procedures, Oil industry, Oil pollution, Organic compounds, Pilot plants, Reverse osmosis.

A treatment process for offshore produced water that employs nanofiltration for the removal of organic pollutants was tested on offshore platforms. The membranes yielded a permeate for discharge of less than 48 mg/l freon-extractable organics at 50% recovery, while rejecting less than 20% of the NaCl when fed a produced water of up to 176 mg/L freon-extractable organics. For a standard 6.35 cm diameter by 1 meter long spiral-wound module, initial productivities at 25 C, 14.8 bar, 58,000 mg/L total dissolved solids, and 7% recovery can be expected to be as high as 1.2 cu m/day. Although more development work is needed for this application, nanofiltration membrane systems have the potential to replace flotation cells and/or carbon adsorbers on platforms where these are required. (Geiger-PTT)
W91-01951

PRESSURE SEWERS DESIGN CONSIDERATIONS AND ANTICIPATED MAINTENANCE.
Hill (William F.) and Associates, Inc., Gettysburg PA.
W. F. Hill.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 23, No. 5, p 20-24, September/October 1990.

Descriptors: *Design criteria, *Pressure sewers, *Sewer systems, *Wastewater collection, *Wastewater treatment, Maintenance, Pipelines, Rural areas, Septic tanks.

In rural communities with hilly terrain, pressure sewer collection and conveyance systems may be beneficial for wastewater collection. The Lake Heritage Municipal Authority and the Possum Valley Sewer Authority of Adams County, Pennsylvania are both served by pressure collection systems that are different with respect to operation and maintenance. Lake Heritage Municipal Authority uses grinder pump units and the Possum Valley Sewer Authority uses septic tank effluent pumping. Septic tank effluent pumping allows the basic form of primary treatment on the customer's property in that the solids are removed by flotation and sedimentation in a conventional septic tank then the septic tank effluent flows to a pump p

where the wastewater is pumped by a one horse-power centrifugal pump to the pressurized sewer system. Almost all centrifugal grinder units are two horsepower units. Velocities in the pressure sewer lines should not be less than two feet per second. The submersible pumps, float controls, and discharge piping are housed in a subsurface basin which is secured to mass concrete to prevent flotation. The recommended piping material for the pressure sewers is polyvinyl chloride SDR 21 type pipe with O-ring fittings. The piping system should be frost protected at all locations. Sufficient plug valves should be provided throughout the collection system to facilitate maintenance and system repair. In-line cleanouts should be provided every 600 ft to provide for periodic flushing of the system and specific maintenance procedures. Terminal cleanouts must be provided at ends of the pressure system. Most pumping units will require a 220 volt, single phase service to the pump unit control panel. Grinding units may be either centrifugal grinders or displacement grinders. Grease accumulations within the grinder units require constant maintenance. For septic tank effluent, periodic pumping will be required every three to four years. Corrosion problems are common in the septic tank effluent pump units, and can be reduced with the installation of a nyatron device at the base of the pedestal. Solid wastes that enter the impeller housing can cause pump failure. This problem can be alleviated by a solids retaining device. (Geiger-PTT)
W91-01964

APPLICATIONS OF ADVANCED MEMBRANE FILTRATION TO INDUSTRIAL WASTEWATER TREATMENT AND GROUNDWATER CLEAN-UP.
Resource Technologies Group, Inc., Morgantown, WV.
R. W. Tiepel, and J. Shorr.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 23, No. 5, p 41-47, September/October 1990. 7 fig, 8 tab.

Descriptors: *Industrial wastewater, *Membrane filters, *Wastewater treatment, *Water pollution treatment, Chemical treatment, Fouling, Groundwater, Metal-finishing wastes, Mine wastes, Pretreatment of wastewater, Uranium.

Recent advances in membrane technology combined with innovative pretreatment techniques have enabled certain complex wastewaters to be effectively treated to required effluent standards. The membrane is made of an inert fluorocarbon-based material and is capable of withstanding pH conditions over the entire pH range of 0-14 and can hold up under severe oxidizing or reducing conditions. The advanced membrane system is designed to operate in turbulent flow to reduce fouling. Surface fouling by organics can be controlled with the addition of organic absorbent pretreatment chemicals such as powdered activated carbon or lime in the recirculating feed stream. The membranes can be cleaned with strong acids or bases or strong oxidants. Average pore sizes of 0.1 microns are used to overcome flux rate problems. Due to the relatively large pore size of the membrane, the system cannot reduce total dissolved solids and can be used in applications where only precipitated or sorbed pollutant species are removed. For removal of dissolved species such as chloride, sulfate, and sodium, a reverse osmosis, electrodialysis, or ion exchange system is required. Three key features of the system enable it to achieve successful treatment for a wide variety of applications: chemical pretreatment of the feed, membrane design, and system cleaning. The system has been applied to the treatment of electronics and metal-finishing industrial wastes, industrial laundry wastewater cleanup and recycling, groundwater cleanup and the Uranium Mill Tailings Remedial Action Program at the Canonsburg, Pennsylvania site. (Geiger-PTT)
W91-01965

RECLAIMING REVERSE OSMOSIS BLOWDOWN WITH ELECTRODIALYSIS REVERSAL.
Ionics, Inc., Watertown, MA.
E. R. Reahl.
Desalination DSLNAH, Vol. 78, No. 1, p 77-89, July 1990. 5 fig, 5 tab, 3 ref, append.

Descriptors: *Desalination wastes, *Electrodialysis, *Industrial wastewater, *Reclaimed water, *Reverse osmosis, *Wastewater renovation, Brines, Desalination, Evaporation ponds, Feedwater treatment, Wastewater disposal.

The Electrodialysis Reversal (EDR) process is being used to reclaim waste concentrate from reverse osmosis (RO) systems for reuse as RO feedwater. The largest operating EDR-RO reclaim system is located at a major aerospace and electronics facility in the southwestern US. Design requirements and actual operation of the EDR system are discussed. The installation of EDR for reclaiming RO blowdowns, to reduce feedwater supply requirements to RO in water short areas, and EDR's reduction of waste brine volumes to evaporative ponding has been a success. The data, and the successful performance from this installation, has already generated additional applications for EDR concentration of RO blowdowns, with further inquiries on even newer potential installations. The EDR process has shown itself to be highly reliable. EDR is easy to operate, particularly with modifications made to the system for brine concentration applications. The process has not developed any intrinsic weakness in over 12,000 hours of operation at this site. (Author's abstract)
W91-01984

HIGH RECOVERY REVERSE OSMOSIS.
Stone and Webster Engineering Corp., Fort Lauderdale, FL.
For primary bibliographic entry see Field 3A.
W91-01985

EFFECT OF PULP AND PAPER MILL EFFLUENT IRRIGATION ON CARBON DIOXIDE EVOLUTION IN SOILS.
Tamil Nadu Agricultural Univ., Coimbatore (India). Dept. of Agricultural Microbiology.
For primary bibliographic entry see Field 5E.
W91-01987

MOSQUITO CONTROL IN WASTEWATER: A CONTROLLED AND QUANTITATIVE COMPARISON OF PUPFISH (CYPRINODON NEVADENSIS AMARGOSAE), MOSQUITOFISH (GAMBUSIA AFFINIS) AND GUPPIES (POECILIA RETICULATA) IN SAGO PONDWEED MARSHES.
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
D. T. Castleberry, and J. J. Cech.
Journal of the American Mosquito Control Association JAMAET, Vol. 6, No. 2, p 223-228, June 1990. 2 fig, 2 tab, 25 ref.

Descriptors: *Biological wastewater treatment, *Insect control, *Mosquitoes, *Sago pondweed, *Secondary wastewater treatment, *Wastewater lagoons, *Wastewater treatment, Aquatic insects, Biological treatment, Biomass, Fish food organisms, Guppies, Marsh management, Mosquitofish, Population density, Pupfish, Zooplankton.

Vascular aquatic plants can provide a remarkably efficient and inexpensive means of treating municipal, agricultural and industrial wastewater. Unfortunately, mosquito control is difficult in artificial marsh environments. The abilities of pupfish, mosquitofish and guppies to control mosquitoes in wastewater marshes was compared. Sago pondweed was planted in 210 liter fiberglass tanks through which secondary wastewater was passed at 4 to 6 ml/second. Groups of 10 to 30 fish were placed in each of 15 tanks (plus 5 controls), along with large mosquito egg rafts. All species of fish reduced mosquito emergence ($p < or = 0.05$). When fish population densities were similar, fish reduced emergence to similar levels. As experiments progressed, guppies developed greater population densities and provided better mosquito control than mosquitofish, which developed greater densities and better control than pupfish. Fish also reduced numbers of zooplankton, and guppies increased total plant biomass, suggesting fish may influence the ability of wastewater marshes to treat wastewater. (Author's abstract)
W91-01988

DESIGN AND CONSTRUCTION OF TREATMENT PROCESSES FOR HIGHWAY RUNOFF IN THE FRG.
Ingenieur-Dienst-Nord, Industriestrasse 32, 2806 Oyten, Germany.
G. Lange.
The Science of the Total Environment STENDL, Vol. 93, p 499-506, April 1990. 1 fig, 11 ref.

Descriptors: *Germany, *Highway effects, *Urban runoff, *Wastewater treatment, *Water pollution control, *Watercourses, Drainage systems, Pollutants, Project planning, Runoff, Surface runoff, Water pollution.

Highway runoff systems used to be designed on the basis of functional and economic considerations. Due to the introduction of the Guidelines for Street Construction (RAS-Ew) drainage guidelines in 1987 by the Transport Minister of the Federal Republic of Germany (FRG), these systems are now chosen on the basis of their effects on watercourses, groundwater and the environment. The different systems for collecting and draining highway runoff are evaluated on the basis of current knowledge. These systems include infiltration basins; footings and slopes; and infiltration ditches, shafts, and wells. The natural infiltration of road surface water over a wide area is a fundamental aim. Only when this proves impossible should runoff be discharged into watercourses. This solution includes retention systems and treatment plants. The discharge of highway runoff involves both a blockage-free drainage system and a removal system which does not harm the ground below. This latter protection must be permanently assured. It is therefore the task of the engineer to plan drainage installations in such a way that road safety requirements are permanently satisfied and no damage is caused at any subsequent stage in the drainage system. (Stoehr-PTT)
W91-02001

DECONTAMINATION OF HIGHWAY SURFACE RUNOFF IN THE FRG.
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
For primary bibliographic entry see Field 5G.
W91-02002

POLLUTANT REMOVAL BY GULLY POTS IN DIFFERENT CATCHMENT AREAS.
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
M. Grottker.
The Science of the Total Environment STENDL, Vol. 93, p 515-522, April 1990. 1 fig, 2 tab, 2 ref.

Descriptors: *Catchment basins, *Decontamination, *Gully pots, *Heavy metals, *Hydraulic design, *Model studies, *Simulation analysis, *Wastewater treatment, *Water pollution control, *Water pollution treatment, Particle size, Suspended solids, Water pollution, Water quality.

Gully pot systems have to fulfill two functions: the efficient discharge of surface water and the removal of pollutants. Since the removal efficiency is limited by the hydraulic loading, these are contrary tasks. In order to produce a more efficient design for a gully pot, about two hundred gully pots in different catchment areas have been examined and the pollutant removal analyzed. A simulation model is calibrated using these data and the model used to predict the pollutant removal and the frequency of gully pot cleansing for different kinds of gully pots. The necessary frequency of maintenance is twice a year for the dry gully pot (DGP) and once a year for the wet gully pot (WGP). Depending on the land use of the paved surface, the removal efficiency is about five to ten percent of the flushed surface pollution load for

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the DGP and about ten to forty percent for the WGP. (Author's abstract)
W91-02003

SLURRY-EXPLOSIVE PLANT WASTE WATERS: ENVIRONMENTAL IMPACT AND TREATMENT.
Ravishankar Univ., Raipur (India). Dept. of Chemistry.
For primary bibliographic entry see Field 5C.
W91-02008

BEHAVIOR OF HEAVY METALS DURING WASTEWATER TREATMENT, I. CADMIUM, CHROMIUM AND COPPER.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. E. Goldstone, P. W. Kirk, and J. N. Lester.
The Science of the Total Environment STENDL, Vol. 95, p 233-252, June 1990. 9 fig, 12 tab, 36 ref.

Descriptors: *Cadmium, *Chromium, *Copper, *Heavy metals, *Sewage, *Wastewater treatment, Activated sludge process, Chemical analysis, Particulate matter, Pollutants, Sedimentation, Sludge, Suspended solids.

Mechanisms of metal removal during sewage treatment were reviewed and the application of these mechanisms to cadmium, chromium and copper removals were discussed. Sampling was performed at Whitlingham sewage treatment works (Anglian Water), Norwich, to assess the removal mechanisms of these metals with reference to partitioning between particulate and soluble phases. Mass balances were performed as a means of quality control. It was concluded that the metals were primarily associated with suspended solids. However, considerable solubilization of cadmium and copper occurred during activated sludge treatment, possibly due to the addition of anaerobic solids in the overflow from a waste activated sludge consolidation tank. Chromium was not affected in a similar manner, possibly due to a change in its valency state. The removals of cadmium, chromium and copper were within the expected range. Final effluent concentrations of copper and chromium were below a value that would ensure compliance with the environmental quality objective for the receiving water, and final effluent cadmium concentrations were within the required standards. (See also W91-02013 and W91-202014) (Author's abstract)
W91-02012

BEHAVIOR OF HEAVY METALS DURING WASTEWATER TREATMENT, II. LEAD, NICKEL, AND ZINC.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. E. Goldstone, P. W. Kirk, and J. N. Lester.
The Science of the Total Environment STENDL, Vol. 95, p 253-270, June 1990. 8 fig, 12 tab, 30 ref.

Descriptors: *Heavy metals, *Lead, *Nickel, *Sewage, *Wastewater treatment, *Zinc, Activated sludge process, Chemical analysis, Particulate matter, Pollutants, Sedimentation, Sludge, Solubility, Suspended solids.

Mechanisms of metal removal during sewage treatment were reviewed and the application of these mechanisms to lead, nickel, and zinc removals were discussed. Sampling was performed at Whitlingham sewage treatment works (Anglian Water), Norwich, to assess the removal mechanisms of these metals with reference to partitioning between particulate and soluble phases. Mass balances were performed as a means of quality control. It was concluded that lead was primarily associated with solids. However, it was solubilized during activated sludge treatment and this was possibly due to the addition of anaerobic solids in the overflow from a waste activiated sludge consolidation tank. The soluble phases of nickel and zinc were not significantly affected by any of the processes in the works. In general, nickel removals during primary sedimentation were lower than the other metals in this study, although they were higher than those reported by other authors. The addition of returned sludge liquors appeared to have a beneficial effect on lead removal during primary sedimentation by adsorbing soluble lead to the increased solids. However, removal of zinc and nickel appeared to have been unaffected by their addition. Final effluent concentrations of the three metals were below a value which would ensure compliance with the environmental quality objective of the receiving waters. (See also W91-02012 and W91-02014) (Author's abstract)
W91-02013

BEHAVIOR OF HEAVY METALS DURING WASTEWATER TREATMENT, III. MERCURY AND ARSENIC.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. E. Goldstone, C. Atkinson, P. W. Kirk, and J. N. Lester.
The Science of the Total Environment STENDL, Vol. 95, p 271-294, June 1990. 11 fig, 11 tab, 44 ref.

Descriptors: *Arsenic, *Heavy metals, *Mercury, *Sewage, *Wastewater treatment, Activated sludge process, Chemical analysis, Particulate matter, Pollutants, Sedimentation, Sludge, Suspended solids.

The removal mechanisms of mercury and arsenic during sewage treatment were reviewed and possible biotransformation of mercury was discussed. Sampling was performed at Whitlingham sewage treatment work (Anglian Water), Norwich. Removal mechanisms were assessed with reference to partitioning between particulate and soluble phases. Further sampling and analysis was performed to determine the importance of mercury methylation. It was concluded that mercury behaved differently in the two studies, possibly due to a change in crude sewage speciation and the introduction of a picket fence thickener in the waste activated sludge consolidation tank. In situ methylation of mercury was found, especially in the presence of bacterial solids. Arsenic removals during primary sedimentation were very high, with soluble and particulate removals on a similar level. Paradoxically arsenic removals during activated sludge treatment were extremely low. (See also W91-02012 and W91-02013) (Author's abstract)
W91-02014

5E. Ultimate Disposal Of Wastes

METAL CONTENT OF FUNGAL SPOROCARPS FROM URBAN, RURAL, AND SLUDGE-TREATED SITES.
Pacific Northwest Forest and Range Experiment Station, Wenatchee, WA. Forestry Sciences Lab.
For primary bibliographic entry see Field 5B.
W91-01005

BATCH LEACHING STUDIES OF RUNDLE OIL SHALE.
Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Coal Technology.
For primary bibliographic entry see Field 5B.
W91-01010

BEHAVIOR OF TOLUENE ADDED TO SLUDGE-AMENDED SOILS.
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
For primary bibliographic entry see Field 5B.
W91-01024

EFFECT OF MUNICIPAL SEWAGE SLUDGE APPLICATION ON GROWTH OF TWO RECLAMATION SHRUB SPECIES IN COPPER MINE SPOILS.
Brigham Young Univ., Provo, UT. Dept. of Agronomy and Horticulture.
For primary bibliographic entry see Field 5B.
W91-01025

ADSORPTION, DEGRADATION, AND PLANT AVAILABILITY OF 2,4-DINITROPHENOL IN SLUDGE-AMENDED CALCAREOUS SOILS.
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
For primary bibliographic entry see Field 5B.
W91-01026

PLANT UPTAKE OF PENTACHLOROPHENOL FROM SLUDGE-AMENDED SOILS.
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
For primary bibliographic entry see Field 5B.
W91-01027

SORPTION AND DEGRADATION OF PENTACHLOROPHENOL IN SLUDGE-AMENDED SOILS.
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
For primary bibliographic entry see Field 5B.
W91-01028

NITRIFICATION IN SLUDGE-AMENDED MICHIGAN FOREST SOILS.
Michigan State Univ., East Lansing. Dept. of Forestry.
A. J. Burton, J. B. Hart, and D. H. Urie.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 609-616, July/September 1990. 9 fig, 3 tab, 27 ref. U.S. EPA Cooperative Agreement S005551-01.

Descriptors: *Fate of pollutants, *Forest soils, *Michigan, *Nitrification, *Sludge, *Sludge utilization, Acidic soils, Digested sludge, Leaching, Nitrates, Soil cores, Soil treatment, Soil types, Waste disposal.

Net nitrification following liquid sludge application to four Michigan forest types was studied by aerobically incubating intact cores containing the forest floor and upper 10 cm of mineral soil. Significant net nitrification occurred in cores receiving surface applications of anaerobically digested municipal sludge (22.3 g N/sq m). Core nitrate N contents at 8 wk were 4.7, 5.3, 4.9, and 2.0 g/sq m for aspen (Populus spp.), northern hardwoods, oak (Quercus spp.), and pine (Pinus spp.) forest types, respectively. Net nitrification did not occur during 8 wk incubations of untreated control cores or cores receiving surface applications of sludge sterilized by freeze-drying (24.5 g N/sq m) or liming (25.7 g N/sq m), suggesting that the nitrifers responsible for net nitrification in cores receiving the anaerobically digested sludge were added with the sludge. Nitrate concentration at 8 wk in cores from an oak field site receiving anaerobically digested sludge (43.0 g N/sq m) 33 mo prior to incubation was 72% of that in oak site soil cores treated immediately prior to incubation (22.3 g N/sq m), indicating that nitrifying populations introduced with sludge 33 mo prior were still viable. Nitrate content at 8 wk in oak cores was 77% lower when sludge was incorporated. Nitrate contents in incubated soil cores could not be used to directly predict nitrate concentrations in soil leachate and groundwater beneath sludge-treated plots at the four field sites. Results indicate that nitrification and potential for nitrate leaching following sludge application to acid forest soils are influenced by sludge type, forest type, and history of prior sludge applications. (Author's abstract)
W91-01029

SOME PHYSICAL PROPERTIES OF STRUCTURAL AGGREGATES SEPARATED FROM ORGANIC WASTE-AMENDED SOILS.
Nigeria Univ., Nsukka. Dept. of Soil Science.
J. S. C. Mbagwu, and A. Piccolo.
Biological Wastes BIWAED, Vol. 33, No. 2, p 107-121,7 tab, 28 ref. 1990.

Descriptors: *Land disposal, *Soil amendments, *Soil properties, *Soil water, Clays, Farm wastes, Loam, Organic carbon, Sludge disposal, Soil aggregates, Soil moisture retention, Waste disposal.

urface (0-20 cm) samples from five soils amended
ith pig slurry, sewage sludge or cattle slurry
ere separated into four macro-, and three micro-
ggregate fractions of drysieving. Relative to the
ontrols, these amendments decreased the apparent
ensity and dispersibility of the aggregates, in-
eased slightly their water-retention capacity at -
33 MPa tension, but had no significant effect on
tra-porosity and particle size distribution of the
:gregates. On average, pig slurry reduced aggre-
te dispersibility by 34% in the sandy loam and
% in the sandy clay loam Modena soils. Sewage
udge and cattle slurry reduced dispersibility by
% and 26%, respectively, in the sandy loam
mporecchio and sandy clay loam Cremona soils.
ne organic carbon contents of the aggregates
counted for 73-98% of variability in their tend-
cy to disperse, whereas their silt plus clay con-
nts accounted for 38-96% of variability in the
oisture they retained at -0.03 MPOa tension. (Au-
or's abstract)
91-01054

FECT OF IRRIGATION WITH SEWAGE EF-
UENT ON DECOMPOSITION OF LITTER
PINUS RADIATA FORESTS.
w Zealand Forest Service, Rotorua. Forest Re-
rch Inst.
r primary bibliographic entry see Field 3C.
91-01067

IOSPHORUS IN WATERS FROM SEWAGE
UDGE AMENDED LYSIMETERS.
nois Univ., Urbana. Dept. of Agronomy.
r primary bibliographic entry see Field 5B.
91-01107

NDAMENTALS AND APPLICATION OF
NDROW COMPOSTING.
ck and Veatch, Irvine, CA.
. Hay, and R. D. Kuchenrither.
rnal of Environmental Engineering (ASCE)
EEDU, Vol. 116, No. 4, p 746-763, July/August
0. 9 fig, 3 tab, 13 ref.

criptors: *Composting, *Sludge disposal,
aste disposal, *Windrow composting, Aeration,
Angeles, Odor control, Sludge, Sludge cake,
lge digestion.

conventional windrow and aerated window
cesses are viable sludge disposal options that
luce marketable end products. Both methods
il constructing long parallel rows containing a
ure of sludge cake and amendment and turning
rows frequently with mobile equipment. The
ventional process relies on natural ventilation
reas the aerated method uses forced mechani-
aeration in addition to natural ventilation.
or drawbacks of the conventional process in-
e excess odor generation and susceptibility to
t from adverse weather. Odor control is a
or advantage of aerated windrow composting;
e systems, however, are more capital intensive
the simpler conventional systems. The Sanita-
Districts of Los Angeles County, CA, operate
te-of-the-art conventional windrow facility at
oint Water Pollution Control Plant in Carson,
The operation uses two composting steps and
different composting machines. Quality con-
monitoring has shown that the two-step
od provides excellent disinfection and pro-
s a dry product during most of the year. Rainy
her and cool air temperatures reduce the
g rate, resulting in the production of a wetter
ost during the winter. (Author's abstract)
-01154

OBILIZATION MECHANISMS IN SO-
FICATION/STABILIZATION OF CD AND
SALTS USING PORTLAND CEMENT
NG AGENTS.
iana State Univ., Baton Rouge. Dept. of
istry.
primary bibliographic entry see Field 5G.
01182

BIOTESTING OF WASTEWATER: A COMPARATIVE STUDY USING THE SALMONELLA AND CHO ASSAY SYSTEMS.
Oak Ridge National Lab., TN. Biology Div.
L. C. Waters, R. L. Schenley, B. A. Owen, P. J. Walsh, and A. W. Hsie.
Environmental and Molecular Mutagenesis EMMUEG, Vol. 14, No. 4, p 254-263, 1989. 1 fig, 9 tab, 22 ref. EPA Interagency Agreement 40-1534-84 and DOE contract DE-AC05-840R21400.

Descriptors: *Bioassay, *Mutagenicity, *Pollutant identification, *Toxicity, *Wastewater analysis, Chinese hamster ovary test, Clean Water Act, Cytotoxicity, Risk assessment, Salmonella.

Reliable procedures for the assessment of the toxicity of wastewaters are essential to implementing the Federal Clean Water Act. Health risk determination is limited to those chemicals for which toxicity data are available. Since long-term whole animal tests on large numbers of wastewater samples are impractical, shorter, cellular-based assays are necessary. The evaluation of two short-term bioassays indicated that the Salmonella test is the more sensitive indicator of mutagenic activity, whereas the Chinese hamster ovary (CHO) test is a sensitive detector of the presence of cytotoxic components in wastewater concentrates. Complementary use of multiple bioassays and concentration methods is necessary for the optimal detection and characterization of toxic components in wastewater. (D'Agostino-PTT)
W91-01184

AUTOTHERMAL FLUID BED FOR SLUDGE INCINERATION.
SEGHERS (N.V.) Engineering, Willebroek (Belgium).
H. A. Masson.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 405-416, 7 fig, 6 tab, 2 ref.

Descriptors: *Fluidized beds, *Incineration, *Sludge disposal, *Waste disposal, *Waste treatment, *Wastewater treatment, Capital costs, Design criteria, Energy costs, Environmental effects, Fly ash, Operating costs.

For large communities, incineration offers an attractive approach to sludge disposal because there is no need to stabilize the sludge, there is no need of nutrients, the waste volume reduction is tremendous, the end product is biologically and chemically inert (ash), the pathogens are completely destroyed, and the transport costs are reduced if not eliminated. Autothermal (without external fuel) incineration of sewage sludge is possible at 850 C if the air is preheated to 650 C and if the dry solid content of the sludge is at least 35% (for an organic fraction in the solids of about 65%). In order to maintain reasonable operating costs, the needed thermal energy supply for drying must be generated in the system itself. In the 'Zerofuel' process a multistage tray dryer does the required sludge drying with heat generated from flue gases. The system offers easy process control for the furnace and dryer and reduces sludge vapors by thermal cracking in the fluidized bed furnace. Flue gas analysis of the Zerofuel process at the Bruges, Belgium, plant showed that only the dust load and the SOx content exceeded the emission standards of 1986. The dust load can be further reduced by installing a third field in the electrostatic precipitator. SOx could easily be removed by introducing limestone in the bed. Washing with amines or a granular filter could be used to control mercury emissions. The system is set up in modular fashion so that various parts of the system can be taken out of operation and used elsewhere. The most sensitive parameters affecting cost of sludge incineration in the Zerofuel system are the nominal capacity, the load factor, the operating hours per year, and the quality of the sludge and its initial dry solids content. (See also W91-01211) (Geiger-PTT)
W91-01244

ANAEROBIC DIGESTION OF INDUSTRIAL AND AGRICULTURAL WASTES.
CLEAR Ltd., Cardiff (Wales).
For primary bibliographic entry see Field 5D.
W91-01245

INDUSTRIAL EFFLUENTS: MINIMIZING ENVIRONMENTAL IMPACT.
Watson Hawksley, High Wycombe (England).
For primary bibliographic entry see Field 5D.
W91-01246

EFFECTS AND BEHAVIOUR OF POLLUTANTS DURING ARTIFICIAL GROUNDWATER RECHARGE.
Institut fuer Wasserforschung G.m.b.H., Dortmund (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-01251

APPRAISAL OF THE POTENTIAL HEALTH IMPACTS OF SEWAGE DISPOSAL TO UK COASTAL WATERS.
Saint David's Univ. Coll., Lampeter (Wales). Centre for Research into Environment and Health.
For primary bibliographic entry see Field 5B.
W91-01278

SITE SEWAGE DISPOSAL: THE IMPORTANCE OF THE WET SEASON WATER TABLE.
Illinois Univ., Urbana. Dept. of Agronomy.
T. J. Bicki, and R. B. Brown.
Journal of Environmental Health JEVHAH, Vol. 52, No. 5, p 277-279, March/April 1990. 28 ref.

Descriptors: *Groundwater pollution, *On-site waste disposal, *Seasonal variation, *Soil disposal fields, *Waste disposal, *Wastewater treatment, *Water level, *Water pollution control, *Water pollution prevention, *Water table, Aeration, Bacteria, Biodegradation, Filtration, Land disposal, On-site wastewater treatment, Viruses.

Effluent entering an on-site disposal system may contain varying combinations and amounts of potential contaminants. A vertical separation distance of 24 inches between the bottom of a soil absorption system and the seasonally high water table has been suggested as a minimum soil depth for the proper treatment of effluent, and the protection of groundwater. The effluent must pass through an unsaturated zone of soil to insure good aeration and slow travel, both of which are needed to: achieve good composition of organic materials, biodegradation of detergents, adsorption of effluent constituents to soil particles, die-off bacteria and viruses, and other processes contributing to the filtration and treatment of effluent. Depth to the wet season water table can be monitored with observation wells or can be estimated from soil morphological characteristics. Caution is advised when evaluating artificial drainage as a method to improve the performance of on-site sewage disposal systems. (Lantz-PTT)
W91-01379

SEPTIC SYSTEM EFFICIENCY: PARALLEL AND SERIAL METHODS FOR DISTRIBUTING EFFLUENT.
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W91-01381

EXAMINATION AND CHEMICAL TREATMENT OF INDUSTRIAL SOLID WASTES FOR SAFE LAND APPLICATION. I. EVALUATION OF TOXIC ELEMENTS PRESENT IN SOLID WASTES FROM A FERTILIZER AND CHEMICAL PLANT.
Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
A. Katzika, and T. Kouimtzis.
Science of the Total Environment STENDL, Vol. 91, p 97-105, February 1990. 6 fig, 2 tab, 8 ref.

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Descriptors: *Chemical analysis, *Chemical treatment, *Chemical wastes, *Fertilizers, *Industrial wastes, *Land disposal, *Solid wastes, *Toxic wastes, *Waste treatment, Arsenic, Chemical industry, Chemical sludge, Greece, Hydrogen ion concentration, Industrial wastewater, Laboratory methods, Pollutant identification, Solubility, Sulfuric acid, Toxicity, Water pollution sources.

Approximately 600,000 tons of solid wastes is generated annually by industries in the Thessaloniki are, of which about 65% is produced by a fertilizer chemical plant. Four solid wastes (sludge from the treatment of sulfuric acid production wastewater, ash from the roasting of iron pyrites, waste from a fertilizer unit, anhydrite produced by hydrofluoric acid and propellants production) from this plant are examined using the U.S. Environmental Protection Agency's (EPA) extraction procedure for toxicity in order to determine their content of toxic elements. Analysis of the extracts indicate that one of the samples generates arsenic at a concentration which exceeds the EPA criterion level for this element by nearly 50 times. Another sample is characterized by pH values that are below the EPA minimum values; however, the toxic element concentration does not exceed EPA limits. The extractability of toxic elements from the solid wastes using various extracting solutions is also examined in order to determine the chemical conditions under which the toxic compounds are soluble. (Author's abstract)
W91-01452

CONSOLIDATION AND CONTAMINANT MIGRATION IN A CAPPED DREDGED MATERIAL DEPOSIT.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
J. M. Brannon, and M. E. Poindexter-Rollings.
Science of the Total Environment STENDL, Vol. 91, p 115-126, February 1990. 6 fig, 3 tab, 14 ref.

Descriptors: *Dredging wastes, *Ocean dumping, *Path of pollutants, *Solid waste disposal, *Spoil disposal, *Waste containment, *Water pollution sources, Aroclors, Diffusion, Lead, Marine sediments, Polychlorinated biphenyls, Sediment contamination, Solute transport, Washington.

The effectiveness of capping contaminated dredged material was investigated in a subaqueous depression in the Duwamish Waterway in Seattle, Washington. The disposal site consisted of a previously dredged depression located in approximately 22 m of water. Field studies were conducted to evaluate the consolidation of the capped material as well as the movement of contaminants from the dredged material into the uncontaminated cap material. Results showed that most of the dredged material consolidation at this site occurred during the first 2 weeks following capping. Monitoring of contaminant concentrations in the capped deposit for 18 months showed no movement of contaminants from the dredged material into the capping material. Data for Pb and Aroclor 1242 indicate that the dredged and cap materials formed a sharp, relatively unmixed interface over the 18 months of the study. (Author's abstract)
W91-01453

BASIC MODEL OF WATER- AND GAS-FLOW THROUGH SMECTITE CLAY BUFFERS.
Clay Technology A.B., Lund (Sweden). Ideon Research Center.
For primary bibliographic entry see Field 2G.
W91-01458

SUSTAINABLE RATES OF SEWAGE SLUDGE FOR DRYLAND WINTER WHEAT PRODUCTION: I. SOIL NITROGEN AND HEAVY METALS.
Colorado State Univ., Fort Collins. Dept. of Agronomy.
R. N. Lerch, K. A. Barbarick, D. G. Westfall, R. H. Follett, and T. M. McBride.
Journal of Production Agriculture, Vol. 3, No. 1, p 60-65, January/March 1990. 2 fig, 7 tab, 23 ref.

Descriptors: *Agricultural engineering, *Colorado, *Heavy metals, *Nitrogen, *Sludge disposal, *Sludge utilization, *Wheat, Cadmium, Copper, Cycling nutrients, Fertilization, Groundwater pollution, Lead, Nickel, Nitrates, Organic loading, Root zone, Zinc.

The application of sewage sludge to agricultural land has become the major method of sludge disposal in the US. Therefore, the long-term impact of sludge application to the soil environment must be investigated in order for proper loading rates to be employed. Thus, a field study was initiated in 1982 in Colorado, with the goal of evaluating the effects of sewage sludge on soil N, Zn, Cu, Cd, Ni, and Pb levels in a dryland wheat-fallow management system compared to commercial NH4NO3 fertilizer. Sewage sludge application resulted in increased soil NO3-N levels at harvest compared with the N fertilizer for all depths sampled and each year reported. The soil NO3-N in the root zone data showed that three sludge applications of 12 ton/acre resulted in significantly higher NO3-N levels throughout the root zone compared with the control of 50 lb N/acre. A loading rate of 3 ton/acre resulted in significantly greater NO3-N than the control at the 0 to 8-inch and 24 to 35-inch depths. Sludge application, at all loading rates tested, resulted in significantly increased NH4HCO3-diethylenetriaminepentaacetic acid extractable concentrations of Zn, Cu, Cd, Ni, and Pb compared to the control in the surface 8 inches of the soil. Because of the potential for NO3 contamination of groundwater (and metal buildup in the soil) by the higher sludge loading rates, a loading rate of 3 ton/acre is recommended as the maximum safe loading rate for this dryland wheat system. (See also W91-01504) (Author's abstract)
W91-01503

SUSTAINABLE RATES OF SEWAGE SLUDGE FOR DRYLAND WINTER WHEAT PRODUCTION: II. PRODUCTION AND INCOME.
Colorado State Univ., Fort Collins. Dept. of Agronomy.
R. N. Lerch, K. A. Barbarick, D. G. Westfall, R. H. Follett, and T. M. McBride.
Journal of Production Agriculture, Vol. 3, No. 1, p 66-71, January/March 1990. 4 tab, 23 ref.

Descriptors: *Agricultural engineering, *Colorado, *Cost analysis, *Cycling nutrients, *Fertilizers, *Grain crops, *Sludge disposal, *Sludge utilization, *Wheat, Cadmium, Crop production, Farm income, Fertilization, Groundwater pollution, Lead, Nickel, Nitrates, Nitrogen, Nutrients, Phosphorus, Zinc.

The increased production of sewage sludge in the US has led to many municipalities to consider the application of sludge to agricultural land as a feasible means of sludge disposal and nutrient recycling. A long-term field study was initiated in 1982 in Colorado, with the objective of evaluating the effects of sewage on gross income, yields, grain protein, and elemental content of dryland winter wheat compared to commercial NH4NO3 fertilizer. Sludge application has produced greater gross income than N fertilizer treatments primarily due to the premiums paid for high protein grain. Application of the 3 ton/acre sludge rate resulted in an average of $45/acre/year increase in income compared to the commonly used N rates of 50 to 60 lb N/acre. In two of the three years, neither the sludge nor the N fertilizer treatments resulted in significant yield responses. Sludge application has resulted in greater soil NH4-N and NO3-N compared to the N fertilizer treatments at boot stage over the last three years. However, because of the potential for NO(-3) contamination of groundwater due to oversupply of N (and the potential for metal buildup in the soil) by the 12 and 18 ton/acre rates, the lower sludge rate of 3 ton/acre is recommended for this dryland wheat production system. Grain levels of P and Zn have been increased by sludge application while the concentrations of Cd, Ni, and Pb have remained very low. (See also W91-01503) (Author's abstract)
W91-01504

BIOFILM GROWTH AND THE RELATED CHANGES IN THE PHYSICAL PROPERTIES OF A POROUS MEDIUM. 1. EXPERIMENTAL INVESTIGATION.
Princeton Univ., NJ. Dept. of Computer Science.
For primary bibliographic entry see Field 2F.
W91-01531

BIOFILM GROWTH AND THE RELATED CHANGES IN THE PHYSICAL PROPERTIES OF A POROUS MEDIUM. 2. PERMEABILITY.
Princeton Univ., NJ. Dept. of Civil Engineering and Operations Research.
For primary bibliographic entry see Field 2F.
W91-01532

BIOFILM GROWTH AND THE RELATED CHANGES IN THE PHYSICAL PROPERTIES OF A POROUS MEDIUM. 3. DISPERSIVITY AND MODEL VERIFICATION.
Princeton Univ., NJ. Dept. of Civil Engineering and Operations Research.
For primary bibliographic entry see Field 2F.
W91-01533

SUBSTRATE AND BIOMASS TRANSPORT IN A POROUS MEDIUM.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-01534

SEASONAL VARIATION OF THERMOPHILIC CAMPYLOBACTERS IN SEWAGE SLUDGE.
Lancaster Univ. (England). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W91-01655

PREVIEW ANALYSIS OF NATIONAL SLUDGE SURVEY.
Residuals Management Technology, Inc., Madison, WI.
R. D. Kuchenrither, and S. I. McMillan.
Biocycle BCYCDK, Vol. 31, No. 7, p 60-62, July 1990. 5 tab.

Descriptors: *Data interpretation, *Regulations, *Sludge analysis, *Wastewater facilities, Cadmium, Chemical analysis, Copper, Detection analysis, Environmental Protection Agency, Fate of pollutants, Heavy metals, Lead, Metals, Surveys, Zinc.

The National Sewage Sludge Survey conducted by the Environmental Protection Agency will be used to develop the agency's sludge regulations. A summary of the survey background and the preliminary results was reported. The survey randomly selected 209 wastewater treatment plants from all regions in the United States. The data, as compared to an earlier 40 city study, showed that most metals have been significantly reduced, except copper and zinc. A national average sludge, which indicates a mean concentration for metals and regulated organic compounds, was analyzed under the draft sludge regulations. Cadmium showed a surprisingly high concentration, but copper,lead and zinc were found at expected levels. Organics were essentially not detected in the survey due to high detection limits. The data should prove useful in developing future regulations, however, the high organic detection limit used for this survey may limit its effectiveness. (Miller-PTT)
W91-01661

COMPOST ODOR CONTROL THROUGH PROCESS OPTIMIZATION.
Claremont City Water/Sewer Div., NH.
For primary bibliographic entry see Field 5D.
W91-01662

PROPOSED EPA SLUDGE DISPOSAL REGULATIONS: PROJECT PURGATORY.
BCM Engineers, Inc., Plymouth Meeting, PA.
D. D. Garvey.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 23, No. 4, p 13-21, July/August 1990. 6 fig, 4 tab.

Descriptors: *Economic aspects, *Legal aspects, *Pennsylvania, *Regulations, *Sludge disposal, Environmental Protection Agency, Heavy metals, Land reclamation, Metals, Risk assessment, Standards.

The EPA regulations Standards for the Disposal of Sewage Sludge are described with emphasis on the aspects that impact Pennsylvania. The initial estimate of the economic impact was that 157 million dollars per year nationwide would be needed to comply with these regulations. This figure was believed to be a gross underestimate. Metals and organics that were not previously a concern, such as arsenic, molybdenum, selenium, and beryllium would now be limiting factors, Congress mandated EPA to adopt a risk assessment approach to developing methodologies and disposal standards, some of which are not cost effective, implementable, or technologically achievable. The proposed regulations could have a significant impact on sludge disposal methods such as distribution and marketing, agricultural use and reclamation. (Miller-PTT)
W91-01676

USE OF LIME-STABILIZED DAIRY-PLANT WASTE FOR FORAGE PRODUCTION.
Missouri Univ.-Columbia. Dept. of Agronomy.
J. R. Brown, W. A. Bough, and C. Hoenshell.
Journal of Production Agriculture, Vol. 3, No. 3, p 340-344, July/September 1990. 11 tab, 12 ref. USDA-CSRS Special Grant No. 85-CRSR-2-2548.

Descriptors: *Lime, *Sludge disposal, *Soil amendments, *Waste disposal, Dairy industry, Fescues, Forages, Grasses, Loam, Nitrogen, Phosphorus, Potassium, Silt.

A lime stabilizing sludge (LSS) from a dairy wastewater treatment plant was evaluated in field studies on a silt loam soil as a source of lime and P for a tall fescue (Festuca arundinacea Shreb.) meadow. An initial treatment of almost 9000 gal/acre significantly increased hay yields and raised the surface soil (0-3 in) above the pH and Bray and Kurtz no. 1 P sufficiency levels for tall fescue. Supplemental N and K were required to achieve maximum yields of the fescue treated with the lime stabilized biomass. There are in sufficient reserve lime in the LSS to offset the acidifying effects of 4 years of NH4NO3 top-dressing. (Author's abstract)
W91-01704

GROWTH AND VALUE OF CHLORELLA SALINA GROWN ON HIGHLY SALINE SEWAGE EFFLUENT.
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
For primary bibliographic entry see Field 5D.
W91-01708

CONVERSION OF FAT INTO YEAST BIOMASS IN PROTEIN-CONTAINING WASTEWATER.
Lund Univ. (Sweden). Dept. of Applied Microbiology.
For primary bibliographic entry see Field 5D.
W91-01717

POLYNUCLEAR AROMATIC HYDROCARBON (PAH) CONTENT OF ARCHIVED SEWAGE SLUDGES.
Lancaster Univ. (England). Inst. of Environmental and Biological Sciences.
For primary bibliographic entry see Field 5A.
W91-01737

LABORATORY STUDIES OF THE FLOW OF SOME ORGANIC SOLVENTS AND THEIR AQUEOUS SOLUTIONS THROUGH BENTONITE AND KAOLIN CLAYS.
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5B.
W91-01781

HILLSLOPE EROSION AT THE MAXEY FLATS RADIOACTIVE WASTE DISPOSAL SITE, NORTHEASTERN KENTUCKY.
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 2J.
W91-01831

SOURCES AND DISTRIBUTION OF NITRATE IN GROUND WATER AT A FARMED FIELD IRRIGATED WITH SEWAGE TREATMENT-PLANT EFFLUENT, TALLAHASSEE, FLORIDA.
Geological Survey, Tallahassee, FL. Water Resources Div.
M. P. Berndt.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4006, 1990. 33p, 23 fig, 8 tab, 31 ref. Project No. FL-459.

Descriptors: *Florida, *Spray irrigation, *Tallahassee, *Wastewater disposal, *Water pollution sources, Nitrates, Surficial aquifer, Treated wastewater, Upper Floridan Aquifer.

The city of Tallahassee, Florida began applying sewage treatment-plant effluent to a sprayfield southeast of the city in 1980. Fertilizers containing inorganic nitrogen were also applied in conjunction with the operation of a commercial farm at this site. Analysis of groundwater in the surficial aquifer and the Upper Floridan aquifer have indicated that nitrate concentrations in some wells exceed the prescribed drinking water maximum contaminant level of 10 mg/L (nitrate as nitrogen). Nitrate concentrations greater than the maximum contaminant level were not detected in samples from monitoring wells outside the sprayfield boundary. Analyses of water from the unsaturated zone indicated that conversion of organic nitrogen and ammonia to nitrate was complete before the nitrogen-enriched water reached the water table. Groundwater samples from wells in the surficial and Upper Floridan aquifers less than 100 ft deep located inside sprayed areas had mean concentrations of nitrate much higher than samples from similar wells located outside sprayed areas at the southeast sprayfield. These shallow wells inside the sprayed areas were the only wells in which the maximum contaminant level for nitrate was exceeded. Analyses of the nitrogen isotope ratios in groundwater were used to determine whether the major source of nitrogen was treated sewage or fertilizers. The nitrogen isotope ratios in contaminated groundwater at the southeast sprayfield were compared to those at another sprayfield southwest of the city, where treated sewage was the sole source of nitrogen. Statistical analyses indicated a significant difference in the nitrogen isotope ratios at the two sites, indicating that both nitrogen sources are significant at the southeast sprayfield. (USGS)
W91-01857

USE OF PUMP-OUT FACILITIES BY RECREATIONAL BOATERS IN MARYLAND.
Maryland Univ., College Park. Dept. of Agricultural and Resource Economics.
I. E. Strand, and G. R. Gibson.
Estuaries ESTUDO, Vol. 13, No. 3, p 282-286, September 1990. 3 tab, 11 ref.

Descriptors: *Boats, *Maryland, *Pumps, *Wastewater facilities, *Water pollution prevention, Marinas, Recreation.

The State of Maryland sponsored a survey of 500 Maryland boaters to determine their use of marina facilities to discharge sewage from portable toilets or holding tanks. Results of the survey are reported as well as an examination of some of the factors that contribute to the use of pump-out facilities. Under 10% of Maryland's marinas have facilities available to pump-out holding tanks or portable toilets. Less than 1 in 20 boaters has ever used such a facility. Using a discrete choice behavior model, it was found that boaters with portable toilets were more likely to use holding tanks, especially if the holding tanks were equipped with macerating devices. The price of using the pump-out facility negatively influenced pump-out use. It was also found that vessels in transition were less likely to use marina facilities. The availability of a pump-out facility at a boater's marina increased the likelihood of pumping by two-fold. In Maryland, reduction of boat-generated pollution will likely require of a policy of both extensive pump-out services and low costs for the services. (Author's abstract)
W91-01904

SUCCESSION OF THE PLANKTON COMMUNITY DURING COASTAL RECLAMATION WITH THE SOLID WASTES.
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
M. Yamada, Y. Hanada, A. Miyazaki, A. Tsuruta, and Y. Yoshida.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 56, No. 5, p 729-734, May 1990. 5 fig, 6 ref.

Descriptors: *Land reclamation, *Landfills, *Plankton, *Succession, *Waste disposal, *Water pollution effects, Japan, Oxidation ponds, Population dynamics, Solid wastes, Water quality.

The plankton community was investigated in a coastal pond at Kitakyushu City, Northern Kyushu, Japan. This pond was on a landfill where various kinds of solid wastes, including soil from land sources, domestic wastes, and industrial wastes, had been dumped from 1980 to 1987. The cell density of phytoplankton in the pond increased gradually and red tides were observed beginning in 1983. The plankton community was dominated by several species of diatoms, dinoflagellates, Cryptophyceae, green algae, filamentous bacteria, ciliates, and rotifers. Some of these occurred continuously, others cyclically during certain periods. Near the end of reclamation, the phototrophic red sulfur bacterium Thiocapsa roseopersicina predominated twice and discolored the water to purple-brown. The first time, phytoplankton almost disappeared from the pond but recovered after a few months; the second time, phytoplankton occurred abundantly with the phototrophic bacterium. In this pond, phytoplankton and zooplankton adapting to the water quality seem to have appeared one after another during most of this investigation. It is suggested that the large quantities of plankton which were observed are important in improving the water quality in the pond, and that the pond acts as an oxidation pond for polluted water from the solid wastes dumped. (Author's abstract)
W91-01943

CHANGE OF WATER QUALITY AND COMPOSITION OF PLANKTON IN THE POND OF RECLAIMED SITE.
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
M. Yamada, Y. Hanada, S. Sueta, A. Tsuruta, and Y. Yoshida.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 56, No. 5, p 735-741, May 1990. 4 fig, 2 tab, 13 ref.

Descriptors: *Land reclamation, *Plankton, *Population dynamics, *Waste disposal, *Water pollution effects, *Water quality trends, Japan, Ponds, Solid wastes, Species composition, Succession.

Changes of plankton populations in relation to changes in water quality were investigated in a coastal pond on reclaimed land at Kitakyushu City, Japan. This site had been used for the disposal of various solid wastes. The pond water became rapidly brackish and polluted during the seven years required for the completion of the reclamation. Agglomerative cluster analysis was used to arrange the water quality in this pond in five clusters. Four water factors--pH, chlorinity, suspended solids, and COD--and four seasons--winter (February), spring (May), summer (August), and autumn (November)--were employed. The occurrence of dominant phytoplankton and the five clusters of water quality were compared; it was found that the change from marine plankton to brackish-water plankton was observed around 10 ppt in chlorinity, and freshwater plankton began to appear below 5

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ppt in chlorinity. The marine plankton's highest COD value was 17 mg/L, but freshwater and brackish-water forms were able to occur at CODs as high as 40 mg/L. One species of phototrophic bacterium was observed in one abnormal cluster which had a COD of 160 mg/L and a pH of 11.2. There was thus an intimate relation between the occurrence of characteristic plankton and the water quality in each of the five clusters. The occurrence of planktonic biota and the variation of water quality were also affected by the climatic conditions, such as increased temperature and heavy rainfall. (Author's abstract)
W91-01944

MUTAGENS, TOXICANTS, AND OTHER CONSTITUENTS IN SMALL CITY SLUDGES IN NEW YORK STATE.
Pennsylvania State Univ., University Park. Pesticide Research Lab.
For primary bibliographic entry see Field 5A.
W91-01974

CHARACTERIZATION OF DESALTING CONCENTRATES.
Rostek Services, Inc., Fort Myers, FL.
For primary bibliographic entry see Field 3A.
W91-01976

HISTORIC DEVELOPMENT OF THE CONCENTRATE REGULATIONS.
Stone and Webster Engineering Corp., Fort Lauderdale, FL.
For primary bibliographic entry see Field 5G.
W91-01977

CURRENT REGULATORY CONCERNS RELATED TO THE DISPOSAL OF RO CONCENTRATES IN FLORIDA.
Florida State Dept. of Environmental Regulation, Tallahassee.
For primary bibliographic entry see Field 5G.
W91-01978

SURFACE WATER DISCHARGE OF REVERSE OSMOSIS CONCENTRATES.
Post, Buckley, Schuh and Jernigan, Inc., Orlando, FL.
P. J. Malaxos, and O. J. Morin.
Desalination DSLNAH, Vol. 78, No. 1, p 27-40, July 1990. 2 fig, 12 tab, 5 ref.

Descriptors: *Desalination wastes, *Florida, *Potable water, *Reverse osmosis, *Surface water, *Wastewater disposal, Desalination, Economic aspects, Membrane processes, Permits, Radioactive wastes, Testing procedures.

On the most recent list available from the Florida Department of Environmental Regulation (FDER), there are 96 membrane plants in Florida treating water for potable consumption. From the cursory studies and surveys conducted to date, some concern has been generated regarding dissolved oxygen, gross alpha radioactivity, fluorides and sulfides normally present in reverse osmosis (RO) concentrates. None of these were produced by RO process itself and it would appear that post-treatment methods can be developed to eliminate any adverse effect on the environment. However, compliance with the radioactivity standards is a difficult problem that is not easily resolved. There is a wide disparity in post-treatment methods being carried out at each facility. This is most probably due to the differences in permitting requirements (i.e., some plants are given potable water permits, some are given industrial waste permits). Finally, there are apparent differences in the types of testing and reporting being carried out. Case histories and economic considerations are also given. (Author's abstract)
W91-01979

DISPOSAL OF CONCENTRATE FROM BRACKISH WATER DESALTING PLANTS BY USE OF DEEP INJECTION WELLS.
A. Muniz, and S. T. Skehan.
Desalination DSLNAH, Vol. 78, No. 1, p 41-47, July 1990. 1 fig.

Descriptors: *Brackish water, *Desalination wastes, *Florida, *Injection wells, *Reverse osmosis, *Wastewater disposal, Desalination, Design standards, Membrane processes, Monitoring wells, Regulations, Wastewater treatment.

The conventional method of disposal of the concentrate from reverse osmosis plants in Florida has been discharge to a brackish surface water body. In Florida, however, the distance to saline water bodies and regulatory constraints can resist this type of disposal. Under the appropriate site-specific conditions, deep injection wells can offer a feasible solution to disposing of concentrates from reverse osmosis plants. Deep injection well systems can be reliable, environmentally safe, and cost-effective. Regulations affecting deep injection wells and typical designs are discussed. The Englewood (Florida) Water District deep injection well is described in detail. Instrumentation for this injection well disposal system includes continuous flow and pressure recorders plus sampling of the monitor well on a weekly, monthly, and quarterly basis. There has been considerable experience with deep injection wells for the disposal of treated wastewater effluents in the state, so that deep injection wells are a proven technology for South Florida. (VerNooy-PTT)
W91-01980

IRRIGATION WITH MEMBRANE PLANT CONCENTRATE: FORT MYERS CASE STUDY.
Boyle Engineering Corp., Fort Myers, FL.
For primary bibliographic entry see Field 3C.
W91-01981

USE OF SOLAR PONDS IN THE DISPOSAL OF DESALTING CONCENTRATE.
California State Dept. of Water Resources, Fresno. Special Investigations Branch.
B. E. Smith.
Desalination DSLNAH, Vol. 78, No. 1, p 59-70, July 1990. 11 fig, 1 tab.

Descriptors: *Agricultural water, *Brines, *California, *Desalination wastes, *San Joaquin Valley, *Solar ponds, *Thermal powerplants, *Waste disposal, *Wastewater renovation, Desalination, Drainage water, Evaporation ponds, Feasibility studies, Reverse osmosis, Saline water, Salinity, Subsurface drainage, Valleys, Wastewater disposal.

A major problem in California's San Joaquin Valley is the disposal of subsurface agricultural drainage water. The valley is 260 miles long and dose not have an acceptable drainage water outlet to the ocean. The feasibility of storing and disposing drainage water desalting plant concentrates in a salt-gradient solar pond was investigated as part of a larger feasibility study on reclaiming agricultural drainage water for beneficial use. As part of the desalting feasibility investigation salt-gradient solar ponds for brine storage are being studied. It is method of storing and using concentrated desalting concentrates to produce power. The Los Banos Demonstration Desalting Facility was constructed to test the feasibility of reclaiming the drainage water. The facility is of the zero-discharge type, minimizing environmental impacts, and uses a three stage reverse osmosis system with thermal evaporation to achieve a 96% recovery of fresh water. Research in the Las Banos system is at the energy production stage and is focused on using a Rankine-cycle turbine for power generation using hot brine from the solar pond system. The cost of a solar pond facility is close to that of a Class I hazardous waste disposal site at from $50,000 (no pond linings) to $250,000 (double linings) per acre. The Solar pond concept shows a great deal of promise for helping manage agricultural drainage in California's San Joaquin Valley. (VerNooy-PTT)
W91-01982

DISPOSAL OF CONCENTRATES FROM BRACKISH WATER DESALTING PLANTS BY MEANS OF EVAPORATION TECHNOLOGY.
Bechtel National, Inc., Washington, DC.
L. Awerbuch, and M. C. Weekes.
Desalination DSLNAH, Vol. 78, No. 1, p 71-76, July 1990. 2 fig, 4 ref.

Descriptors: *Brackish water, *Brines, *Desalination wastes, *Evaporators, *Reverse osmosis, *Waste disposal, *Wastewater disposal, Desalination, Feedwater treatment, Scaling.

Reverse osmosis plants discharge a permeate stream with low dissolved solids (TDS) and a reject stream with high TDS. The use of reverse osmosis (RO) plants to desalt brackish water in South Florida has increased rapidly in the last decade. The concentration of scale forming species such as calcium sulfate and silica usually limits RO recovery in these plants to about 75% of the total feedwater flow. The remaining 25% of the flow is reject brine which presents a serious disposal problem for plants in inland locations. Brine concentrators are being used to reduce the RO reject brine to 2% of the overall flow and so significantly reduce the disposal problem. Two versions of the evaporative brine concentration process known as vapor compression evaporation (VCE) are discussed. Typical operating conditions obtained at successfully operating plants are listed, and projected hybrid plant performance is calculated. Small size VCE system may be installed for $7.50/gal/day. As the sizes increase, the installed price may drop to $6.00/gal/day. (Author's abstract)
W91-01983

HIGH RECOVERY REVERSE OSMOSIS.
Stone and Webster Engineering Corp., Fort Lauderdale, FL.
For primary bibliographic entry see Field 3A.
W91-01985

CHARACTERIZATION OF COMPOST WITH RESPECT TO ITS CONTENT OF HEAVY METALS, PART I: SAMPLE DIGESTION AND ICP-AES ANALYSIS.
Amsterdam Univ. (Netherlands). Vakgroep Milieukunde.
J. W. A. Lustenhouwer, J. A. Hin, F. J. M. J. Maessen, and G. den Boef.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 39, No. 3, p 209-222, 1990. 3 fig, 11 tab, 18 ref.

Descriptors: *Analytical techniques, *Chemical analysis, *Compost, *Emission spectroscopy, *Heavy metals, *Sample preparation, *Sludge disposal, Composting, Digestion, Domestic wastes, Elements, Monitoring, Soil amendments, Testing procedures, The Netherlands, Waste identification.

In recent years the Dutch policy on management of household waste has been increasingly directed towards recycling. Composting might be a solution for about one half of household waste; however, there is a growing concern on the quality of compost, especially with regard to its content of heavy metals. A study was conducted to develop a procedure for the determination of heavy metals in compost. An unambiguous analytical procedure must be available to enable supervision of the legal regulations on maximum tolerable content of heavy metals. The element determination stage, including the digestion of a test portion and element determination in the test solution, is reported. Analysis was studied for a variety of types of composts as well as for a sewage sludge amended soil. Aqua regia digestion was examined using conventional as well as microwave heating. The performance of both procedures is similar with respect to accuracy and precision. Microwave heating was preferred because that procedure is less time-consuming. Simultaneous determination of the elements chromium, copper, nickel, lead, and zinc by inductively coupled plasma-atomic emission spectroscopy was feasible. However, due to the occurrence of severe spectral interferences, cadmium had to be determined separately. (Vernooy-PTT)
W91-01986

EFFECT OF PULP AND PAPER MILL EFFLUENT IRRIGATION ON CARBON DIOXIDE EVOLUTION IN SOILS.
Tamil Nadu Agricultural Univ., Coimbatore (India). Dept. of Agricultural Microbiology.
K. Kannan, and G. Oblisami.
Journal of Agronomy and Crop Science ZAPFAR, Vol. 164, No. 2, p 116-119, 1990. 1 fig, 2 tab, 13 ref.

Descriptors: *Carbon dioxide, *Effluents, *Industrial wastewater, *Pulp and paper industry, *Soil gases, *Wastewater irrigation, Conductivity, Decomposing organic matter, Field tests, India, Microorganisms, Soil bacteria, Soil contamination, Soil organic matter, Wastewater farming.

Soil samples were collected from the field under paper mill effluent irrigation for the past 1, 2, 3, and 15 years. Pulp and paper mill wastewater irrigation increased pH, electrical conductivity (EC), organic carbon, and exchangeable sodium content of soils. The combined effluent irrigation over a period of 15 years resulted in the increased accumulation of sodium and other soluble salts. Soils under effluent irrigation for the past 15 years showed the maximum EC which might be due to accumulation of salts over a long period of time. The increase in organic matter content of soils accelerated microbial activity and hence accelerated substrate decomposition with the release of carbon dioxide. There was a peak followed by a steady decline in the rate of carbon dioxide evolution in effluent irrigated soils. The total amount of carbon dioxide evolved in the control was 5.039 mg/50 g soil (dry weight basis over 15 days), while combined effluent irrigation over a period of 15 years increased the carbon dioxide evolution rate by a factor of five. The carbon dioxide evolution results of the present investigation suggest that pulp and paper mill effluent irrigation to soil was not harmful to the soil microbial activity. (Verhooy-PTT)
W91-01987

F. Water Treatment and Quality Alteration

TREATMENT OF EUTROPHIC WATERS IN SOUTH AFRICA.
Water Research Commission, Pretoria (South Africa).
J. Offringa.
South African Journal of Science SAJSAR, Vol. 86, No. 1, p 6-8, January 1990. 2 fig, 8 ref.

Descriptors: *Eutrophic lakes, *South Africa, *Water quality, *Water treatment, Chlorination, Filtration, Flocculation, Potable water, Settling, Surface water, Water quality control.

Eutrophication of surface waters has caused increased concern in South Africa and elsewhere regarding the supply of potable water of good quality from these sources. Sedimentation and filtration alone are not adequate to treat enriched waters anymore. Pre-chlorination improves the sedimentation of flocculated algae but results in taste and order problems and the excessive formation of halogenated hydrocarbons. The Division of Water Technology of CSIR has developed considerable expertise in the application of Dissolved Air Flotation (DAF) alone, and in combination with filtration (DAFF), resulting in the construction of a number of plants for the treatment of a variety of enriched waters. Whereas the traditional water treatment by sedimentation relied on the settlement of solids in the water, the lighter nature of algae and other suspended organics found in eutrophic waters rendered the DAF process more suitable for solids removal and so it is increasingly being used in South Africa and abroad. The need to incorporate the sedimentation into the DAFF process to treat surface waters of variable quality, and to remove tastes, odors and other micropollutants has been identified, and further research has been directed accordingly. (Lantz-PTT)
W91-01074

HYDROGEOLOGY AND HISTORICAL ASSESSMENT OF A CLASSIC SEQUENTIAL-LAND USE LANDFILL SITE, ILLINOIS, USA.
Northern Illinois Univ., De Kalb. Dept. of Geology.
C. J. Booth, and P. J. Vagt.
Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 3, p 165-178, May/June 1990. 6 fig, 5 tab, 19 ref, 3 append.

Descriptors: *Geohydrology, *Groundwater pollution, *Illinois, *Landfills, *Path of pollutants, *Water pollution sources, Clay liners, Contamination, Groundwater quality, History, Land use, Leachates, Resource management.

The Blackwell site in northeastern Illinois was a classic sequential-use project combining land reclamation, a sanitary landfill, and a recreational park. A recent assessment of leachate generation and groundwater contamination to the site's unfinished record is presented. Hydrogeological studies show that: (1) the landfill sits astride an outwash aquifer and a till mound, which are separated from an underlying dolomite aquifer by a thin, silty till; (2) leachate leaks from the landfill at an estimated average rate between 48 and 78 cubic m/day; (3) the resultant contaminant plume is virtually stagnant in the till but rapidly diluted in the outwash aquifer, so that no off-site contamination is detected; and (4) trace volatile organic carbon VOC levels in the dolomite probably indicate that contaminants have migrated there from the landfill-derived plume in the outwash. Deviations from the original landfill concepts included elimination of a leachate collection system, increased landfill size, local absence of a clay liner, and partial use of nonclay cover. The hydrogeological setting was unsuitable for the landfill as constructed, indicating the importance of detailed geological consideration in landfill and land-use planning. (Author's abstract)
W91-01097

FIXED BED ADSORPTION FOR THE REMOVAL OF POLLUTANTS FROM WATER.
Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
G. McKay, and M. J. Bino.
Environmental Pollution ENPOEK, Vol. 66, No. 1, p 33-53, 1990. 17 fig, 4 tab, 7 ref.

Descriptors: *Activated carbon, *Adsorption, *Mercury, *Phenols, *Water treatment, Chlorophenols, Design criteria, Fixed bed columns, Flow rates, Operating costs.

The adsorption of phenol, p-chlorophenol and mercuric ions from aqueous solution onto activated carbon has been studied in fixed bed columns. The influence of varying parameters such as bed depth, solution flowrate and pollutant concentration has been studied. The Bed Depth Service Time (BDST), using the break point of the effluent concentration, has been used to analyze the experimental data and identify design correlations. The BDST model can predict service time versus bed depth according to the desired percentage breakthrough value. The breakthrough curve represents the shape of the pollutant concentration curve as the solution leaves the bed. The general observation is that no significant increase in throughput is achieved by varying the percentage breakthrough because the breakthrough curves are rather steep and, consequently, the mass transfer zone is very short. Two types of variables are recognized as important in optimizing water treatment processes: primary process variables which are mainly determined by carbon exhaustion rates; and process variables which affect the operating costs as a result of changes in the required level of effluent purity, influent liquid purity, temperature, and viscosity, as well as carbon particle size. Optimization procedures based on the Empty Bed Residence Time have been applied to the data, showing that the carbon exhaustion rate is higher for lower percentage breakthrough required. (Brunone-PTT)
W91-01110

REVIEW OF OZONE GENERATING FACILITIES IN SOME U.S. WATER AND WASTEWATER TREATMENT PLANTS.
Northeast Ohio Regional Sewer District, Cleveland, OH.
L. Debevec.
Ozone: Science and Engineering OZSEDS, Vol. 12, No. 2, p 95-105, 1990. 13 tab, 6 ref.

Descriptors: *Ozonation, *Wastewater facilities, *Water treatment facilities, Feedwater treatment, Municipal wastewater, Municipal water, Ozone, Water quality management.

In previous years, the start-up and operation of ozone systems at U.S. municipal water and wastewater treatment plants has resulted in numerous problems. Some of these problems were of such a magnitude that the operating agency decided to abandon the ozone system. In other cases the systems are operating with the problems resolved. Many of the problems were not unique to any one system. A summary includes the following responses: (1) at least three installations had problems with fires in the ozone destructor; (2) five of the installations experienced problems with the discharge valves; (3) foaming problems are prevalent in almost every contractor; (4) six of the installations use oxygen to generate ozone, four of the installations use air, only one uses both air or a mixture of air and oxygen; (5) of the 11 plants, 9 installations have blowers to remove the ozone contractor off-gas, one installation used the system pressure to force the off-gas through the ozone destructor, while the last facility did not know how the off-gas was removed form the contactor; and (6) of the 5 air-to-ozone generation installations, 4 were a gas-to-gas (freon) refrigeration system, and the other uses a liquid-to-gas (freon) system. (King-PTT)
W91-01165

EVALUATION OF EMPIRICAL PROCESS DESIGN RELATIONSHIPS FOR OZONE DISINFECTION OF WATER AND WASTEWATER.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-01167

REMOVAL OF ATRAZINE BY OZONE AND OZONE-HYDROGEN PEROXIDE COMBINATIONS IN SURFACE WATER.
Laboratoire Central de la Lyonnaise des Eaux 38, rue de la President Wilson, 78230 le Pecq, France.
J. P. Duguet, F. Bernazeau, and J. Mallevialle.
Ozone: Science and Engineering OZSEDS, Vol. 12, No. 2, p 195-197, 1990. 2 tab, 4 ref.

Descriptors: *Atrazine, *Hydrogen peroxide, *Ozonation, *Ozone, *Water treatment, Adsorption, Filtration, Maximum contaminant level, Pesticides, Water quality.

Atrazine is one of the most frequently identified pesticides in Europe. Current European standards stipulate that the maximum contaminant level (MCL) for an individual pesticide is 100 ng/L. This regulation stresses the need for a low-cost and effective treatment system. Adsorption is one promising solution, but in general, breakthrough of the granular activated carbon filter occurs rapidly. Recent research has shown that ozonation alone, utilized according the usual practical conditions, removes atrazine poorly, 15-25%. High oxidation reaction rates of the hydroxyl free radical suggest that combinations of O3/H2O2 is a better removal method. This study indicates that application of an ozone dose of 5.1 mg/L without hydrogen peroxide allows a 46% reduction in atrazine concentration, but the MCL was not reached. The coupling of ozone and hydrogen peroxide increases the removal of atrazine. The removal efficiency increases as the applied oxidant dose increases. It is therefore possible to reach the atrazine MCL by applying in this case, a 3 mg/l dose. (Author's abstract)
W91-01168

OZONATION AT BELLE GLADE, FLORIDA: A CASE HISTORY.
North Carolina Univ. at Charlotte. Dept. of Envi-

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ronmental Sciences and Engineering.
P. C. Singer, K. Robinson, and R. A. Elefritz.
Ozone: Science and Engineering OZSEDS, Vol. 12, No. 2, p 199-215, 1990. 11 fig, 4 tab, 4 ref.

Descriptors: *Color removal, *Ozonation, *Water treatment, Ammonia, Belle Glade, *Florida, Chlorine, Chloroform, Color, Florida, Nitrification, Organic matter, Ozone, Trihalomethanes, Turbidity, Water quality control.

A two-stage ozonation process for the treatment of lake water high in organics, color and thrihalomethanes (THM) concentration was installed at the city of Belle Glade, FL in October of 1984. The average TOC was 30 mg/l with values of up to 755 mg/L The color averaged 100 color units up to 500 color units. The THM level reached nearly 1,000 mg/L. The new treatment process applied 3 mg/l of ozone to the raw water ahead of the flash mix basin, lime softening, alum and polymer coagulation, clarification, recarbonation, and addition of 3 mg/l ozone prior to filtration. Post-chlorination then produced distribution system THM concentrations averaging 124 microgm/L Distribution of THM's shifted from 85% chloroform by the original process to 40% after adoption of ozonation, the balance comprising brominated species, but not bromoform. In 1987, the treatment process was modified by adding chlorine and ammonia at the outlets of the pre-, and intermediate stages of ozonation and abandoning free chlorination. This has further reduced the distribution system THm levels to 20-30 microgm/L. Filtered water turbidity and color have been improved. The use of chloramines after ozonation controls the nuisance aquatic growth in the clarifiers and recarbonation basins, produces a combined chlorine residual which can be maintained throughout the distribution system. Periodic use of free chlorine in the distribution system is required to prevent elevated heterotrophic plate counts and the formation of excessive concentrations of nitrite ion due to biological regrowth and nitrification. (Author's abstract)
W91-01169

ULTRAVIOLET DISINFECTION OF POTABLE WATER.
Southern California Metropolitan Water District, Los Angeles.
R. L. Wolfe.
Environmental Science and Technology ESTHAG, Vol. 24, No. 6, p 768-772, June 1990. 1 fig, 3 tab, 38 ref.

Descriptors: *Disinfection, *Drinking water, *Potable water, *Ultraviolet radiation, *Water treatment, Bacteria, Groundwater, Protozoa, Surface water, Viruses.

Pending regulations by the Environmental Protection Agency regarding control of microbial and chemical contaminants in drinking water has prompted the evaluation of ultraviolet (UV) radiation for primary disinfection of surface and groundwater supplies. Excellent results for inactivation of both bacteria and viruses have been obtained with the combined advantages of short contact times, low relative cost, few undesirable disinfection by-products, and enhanced breakdown of taste and odor contaminants. The drawbacks include inaccuracy of current systems for UV dose measurement, limitations on practical size of cost-effective treatment plants, the necessity of postdisinfection for surface waters, and the requirement of much higher UV doses for the inactivation of protozoan cysts. To date only a limited number of microorganisms have been examined and no actual field information has been obtained. In addition, complete information on the resistance of enteric viruses is not yet available. (D'Agostino-PTT)
W91-01179

RECOVERY OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE FROM WATER SAMPLES ON XAD RESINS AND THE EFFECT OF CHLORINE ON ITS MUTAGENICITY.
Health Effects Research Lab., Research Triangle Park, NC. Genetic Toxicology Div.
For primary bibliographic entry see Field 5A.
W91-01181

CONTAMINATION OF POTABLE WATER BY CORROSION OF TIN-LEAD SOLDERED JOINTS.
Surrey Univ., Guildford (England). Dept. of Materials Science and Engineering.
For primary bibliographic entry see Field 5B.
W91-01222

INTERFACE OF HEALTH EFFECTS AND CHEMISTRY AT WATER TREATMENT PLANTS.
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
L. Cognet, J. P. Duguet, and J. Mallevialle.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 255-264, 4 fig, 22 ref.

Descriptors: *Chlorination, *Disinfection, *Drinking water, *Mutagenicity, *Public health, *Water quality, *Water treatment, Activated carbon, Chlorine, Filtration, Organic matter, Oxidation, Ozonation, Raw water.

Data on raw water quality, oxidation treatment practices, and the resulting mutagenic properties of the treated water were compiled from pilot-and full-scale treatment experiments to evaluate which parameter might produce variability in the results of a mutagenic study. Analysis of the data and comparison of treatment practices indicated that the measured mutagenic activity is strongly related to the characteristics of the organic matrix in the raw water; the methodology used to sample and detect mutagens; the scale of the study both in terms of treatment flow and period of study; and the point at which and the conditions under which oxidants are added during treatment. In disinfection systems in full-scale water treatment plants, when raw water is pretreated, and high concentrations of organics are present in the raw water, both ozonation and chlorination increase mutagenic activity. However, no significant difference in mutagenicity was found between the two oxidants. Also, both in the case of a nitrified groundwater and a clarified surface water, the mutagenic activity of the water after ozonation was related to its mutagenic activity before ozonation. Also, in both of these cases, mutagenic activity decreased after granular activated carbon (GAC) filtration. When GAC filtration follows ozone disinfection, early addition of oxidants may not be deleterious to the finished water quality. When chlorine or chlorine dioxide is added after GAC filtration, chlorine dioxide was found to produce a less mutagenic water. Although these conclusions suggest means of controlling mutagenic activity during treatment, it must be stressed that the measurement of mutagenicity is a presumptive index of contamination level. (See also W91-01211) (Author's abstract)
W91-01226

MICROPOLLUTANTS IN WATER USED FOR RENAL DIALYSIS: AN INTERNATIONAL PERSPECTIVE.
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
For primary bibliographic entry see Field 5C.
W91-01227

CLINICAL AND ENVIRONMENTAL EFFECTS OF A MAJOR EMERGENCY INVOLVING PUBLIC WATER SUPPLY.
Robens Inst. of Industrial and Environmental Health and Safety, Guildford (England). Trace Element Lab.
For primary bibliographic entry see Field 5G.
W91-01228

BIOFILMS: DETECTION, IMPLICATIONS AND SOLUTIONS.
Centre for Applied Microbiology Research, Salisbury (England).
C. W. Keevil, A. A. West, J. T. Walker, J. V. Lee, and P. J. L. Dennis.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 367-374, 37 ref.

Descriptors: *Biofilms, *Biofouling, *Domestic water, *Drinking water, *Fouling, *Plumbing, *Public health, *Water distribution, *Water treatment, Aeromonas, Aromatic compounds, Biocides, Copper, Corrosion, Disinfection, Legionella, Path of pollutants, Pseudomonas, Scotland.

Water treated and supplied for drinking and domestic purposes is not sterile and biofilms are normally found on the materials used in distribution and plumbing systems. The growth of low numbers of microorganisms in the planktonic and sessile phases is usually considered only in terms of aesthetic or operational problems. However, biofilms have been linked to a unique corrosion of copper pipework in institutional buildings in Scotland and biofouling of recirculating water systems is believed to contribute to the proliferation of opportunistic pathogens such as Pseudomonas aeruginosa, Aeromonas hydrophila and Legionella pneumophila. These organisms are occasionally present in treated water and all have been identified in plumbing systems biofilms. While planktonic microorganisms are relatively easily killed by biocides, organisms in the biofilms are more refractory due to poor penetration rates. A continuous culture laboratory model has been developed to investigate the factors responsible for biofilm formation on the surfaces of plumbing materials. It has already proved valuable to assess the implications and design solutions to control copper corrosion and legionellae colonization. The same approach is now being used to address issues related to potable supplies such as nitrite formation, residual disinfection, degradation of coal tar linings releasing polyaromatic hydrocarbons and the control of indicator organisms. (See also W91-01211) (Author's abstract)
W91-01239

ADVANCED NITROGEN REMOVAL PROCESSES FOR DRINKING AND WASTE WATER TREATMENT.
Biwater Ltd., Heywood (England).
For primary bibliographic entry see Field 5D.
W91-01247

CONTROL OF NITROGENOUS POLLUTION.
Surrey Univ., Guildford (England). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W91-01250

WATER TREATMENT TECHNOLOGY FOR REMOVING PESTICIDES FROM WATER.
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
A. Bruchet, J. P. Duguet, J. Mallevialle, and F. Fiessinger.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 487-496, 7 fig, 5 tab, 24 ref.

Descriptors: *Coagulation, *Flocculation, *Ozonation, *Pesticides, *Water treatment, Activated carbon, Chlorination, Chlorine, Drinking water, Fungicides, Groundwater pollution, Herbicides, Insecticides.

The effectiveness of various procedures or coupled procedures used in treatment works to eliminate pesticides from drinking water are examined. At the mg/L concentration level using surface water enriched in pesticides of different chemical origins, laboratory coagulation-flocculation tests using iron and aluminum salts revealed that, of all the pesticides, only methoxychlor and DDT are more than 90% eliminated. For concentrations ranging from the nanogram/L level to 100 micrograms/L, in the

laboratory or at pilot level, DDT was eliminated up to 98%. For lindane, aldrin, dieldrin, parathion, 2,4-D, and endosulfan, the degree of elimination varied between 10% and 60%. Coagulation-flocculation removal of pesticides was enhanced at optimal rates with various coagulants for different pesticides at different pH. Ozonation is extremely effective for the removal of triazine pesticides. When activated charcoal is used for pesticide removal the dose of powder added must be in accord with the level of pesticide to be removed requiring continual monitoring of pesticide levels. Filtering through activated charcoal reduces the peak level of pesticides in treated water. However, it is difficult to predict the effectiveness of this peak-lowering and consequently to guarantee that the maximum acceptable concentration of 100 nanograms/L will not be exceeded. (See also W91-01211) (Geiger-PTT)
W91-01252

REMOVAL OF PESTICIDES BY ADSORPTION ONTO POWDERED ACTIVATED CARBON: THE EFFECT OF HUMIC SUBSTANCES.
Limoges Univ. (France). Lab. de Genie Chimique, Traitement des Eaux.
J. Ayele, B. Fabre, and M. Mazet.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 497-504, 5 fig, 3 tab, 24 ref.

Descriptors: *Activated carbon, *Adsorption, *Humic substances, *Pesticides, *Water treatment, Atrazine, Fulvic acids, Humic acids, Hydrogen ion concentration, Insecticides, Lindane, Pentachlorophenol, Solubility.

Factors affecting the adsorption of lindane, atrazine, and pentachlorophenol (PCP) and humic substances onto activated carbon were examined. The concentrations of pesticides and humic substances (humic and fulvic acids) in solutions were measured before and after shaking in the presence of the activated carbon at 25 C by UV absorbance, high pressure liquid chromatography, or scintillation counting. Results showed that dependence of solubility on pH is strong for PCP but not very important for atrazine or lindane. PCP water solubility increased with increasing pH. Adsorption of PCP was decreased when solubility was increased. The extent of binding of pesticides increased as water solubility decreased, and depended on the source and concentration of the humic substances. Humic substances improved the removal efficiency of pesticides, while the presence of pesticides slightly enhanced the removal of the humic substances by activated carbon. Adsorption onto activated carbon was more rapid for PCP than for atrazine or lindane. The pesticide-humic substances complex was more easily adsorbed than pesticides or humic substances alone. (See also W91-01211) (Geiger-PTT)
W91-01253

WATER QUALITY MANAGEMENT IN ISTANBUL: CREATING A CLEANER ENVIRONMENT.
Istanbul Water and Sewerage Administration, Turkey.
For primary bibliographic entry see Field 5G.
W91-01254

ROLE OF ASSET MANAGEMENT.
Water Research Centre, Swindon (England). Asset Management.
For primary bibliographic entry see Field 6A.
W91-01272

NEW TECHNOLOGY IN A WATER COMPANY.
South Staffordshire Waterworks Co., Walsall (England).
J. Carter.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 3, p 256-2264, June 1990. 3 fig, 1 tab.

Descriptors: *Automation, *Data processing, *Water conveyance, *Water treatment, Chemical analysis, Computer-aided design, Computers, Data storage and retrieval, Excavation, Inspection, Leakage, Monitoring, Remote sensing, Technology, Telemetry, Water management.

The South Staffordshire Water Company serves a population of 1.25 million within an area of 1502 sq km, and has employed new technology across a broad spectrum of its operational, scientific and administrative activities. Applications of this technology include electronic remittance processing, a mail room multimailer, a computerized customer service system, automation of chemical analysis, automatic fuel issue and recording equipment, computer-aided drawing (CAD) in the design office, telemetry and electronic leak detection, fiberoptic inspection methods, and location sensors for excavation. Available technologies have been investigated, adapted and developed to meet the Company's particular requirements for improved efficiency, new regulations and standards, and cost savings. The Company is a leading innovator in the use of new technology; this success has been achieved through the encouragement and development of new ideas and the careful control and monitoring of new projects. (VerNooy-PTT)
W91-01273

TRIAZINE AND CHLOROACETAMIDE HERBICIDES IN SYDENHAM RIVER WATER AND MUNICIPAL DRINKING WATER, DRESDEN, ONTARIO, CANADA, 1981-1987.
Ontario Ministry of Agriculture and Food, Guelph. Agricultural Lab. Services Branch.
For primary bibliographic entry see Field 5B.
W91-01306

ALUMINUM IN DOMESTIC WATER: OVERLOAD MAY BE HAZARDOUS TO DIALYSIS PATIENTS.
Louisiana State Univ. Medical Center, Shreveport.
For primary bibliographic entry see Field 5C.
W91-01382

SURFACE IONIZATION OF POLYNUCLEAR SPECIES IN AL(III) HYDROLYSIS--I. TITRATION RESULTS.
Syracuse Univ., NY. Dept. of Civil and Environmental Engineering.
R. D. Letterman, and S. R. Asolekar.
Water Research WATRAG, Vol. 24, No. 8, p 931-939, August 1990. 14 fig, 2 tab, 29 ref. National Science Foundation grant no. CEE-8315971.

Descriptors: *Aluminum, *Chemical reactions, *Coagulants, *Hydrolysis, *Ionization, *Metals, *Water chemistry, *Water treatment, Aqueous solutions, Chemical interactions, Hydrogen ion concentration.

The formation of polynuclear hydrolysis products of aluminum(III) involves reactions with two consecutive stages, a relatively rapid reaction followed by a slow reaction in which the hydrolysis products undergo subtle changes in chemical and physical form. The rapid part of the hydrolysis reaction was examined because it is this part of the process that is most important in understanding the action of aluminum salt coagulants in engineered systems. Successive titrations with base and acid using one solution yielded evidence that the relatively sharp transition to higher OH/Al values at a pH of about 6 may be caused, in part, by the formation of a relatively stable dispersion of a polynuclear species with OH/Al in the range of 2.5 +/-3. Surface or edge site deprotonation of this species can be used to explain the OH/Al versus pH curve above pH 6. Destabilization of a polynuclear species by charge reduction through surface site deprotonation may control the formation of the visible aluminum hydroxide precipitate at pH > 6.5. The species/precipitate with OH/Al > 2.5 dissolves very slowly with acid addition. Dissolution occurred at a pH (4.9) which was significantly lower than the pH at which the species was formed and lower than the pH at which it apparently had aggregated to form the precipitate. (See also W91-01414) (Mertz-PTT)
W91-01413

SURFACE IONIZATION OF POLYNUCLEAR SPECIES IN AL(III) HYDROLYSIS--II. A CONDITIONAL EQUILIBRIUM MODEL.
Syracuse Univ., NY. Dept. of Civil and Environmental Engineering.
R. D. Letterman, and S. R. Asolekar.
Water Research WATRAG, Vol. 24, No. 8, p 941-948, August 1990. 8 fig, 2 tab, 15 ref. National Science Foundation grant no. CEE-8315971.

Descriptors: *Aluminum, *Chemical reactions, *Coagulants, *Hydrolysis, *Metals, *Model studies, *Water chemistry, *Water treatment, Aqueous solutions, Chemical interactions, Equilibrium models, Hydrogen ion concentration, Kinetics.

The inclusion of reactions for the titration of edge or surface sites on polynuclear Al species can be used to improve the ability of a conditional equilibrium model of Al hydrolysis to predict the molar ratio of metal bound hydroxide ion to total metal concentration as a function of pH. Base and acid titrations of aluminum salt solutions were modeled by including in the reaction scheme the titration of protons from ionizable surface (or edge) sites on polynuclear species and the charged precipitate. It was assumed that the OH/Al ratio of the polynuclear species consists of a structural part, the hydroxide ions that link the Al ions, and a more labile surface site titration part. The hydrolysis products included in the best-fit reaction scheme are two monomeric species, Al(OH)(2+) and Al(OH)4(-), and two polynuclear species Al14(OH)32(10+) and Alp(OH)q(3p-q)(+) where (q/p) = 2.7 (q/p is the molar ratio of the structural hydroxide ion to aluminium in the polynuclear species). The precipitate is assumed to consist of aggregates of the larger polynuclear species destablized by surface site deprotonation. The fitted solubility product (pKsp) for acid titration was -9.8, suggesting a significant kinetic difference between precipitate formation and dissolution. (See also W91-01413) (Mertz-PTT)
W91-01414

OXIDATION OF PHENOLS IN WATER BY HYDROGEN PEROXIDE ON ALUMINE SUPPORTED IRON (OXYDATION DES PHENOLS PAR LE PEROXYDE D'HYDROGENE EN MILIEU AQUEUX EN PRESENCE DE FER SUPPORTE SUR ALUMINE).
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 2K.
W91-01418

GENESIS OF FREE HYDRAULIC JUMPS FOR BETTER MIXING.
Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava, and C. S. P. Ojha.
Water Research WATRAG, Vol. 24, No. 8, p 1003-1010, August 1990. 4 fig, 3 tab, 5 ref, append.

Descriptors: *Hydraulic jump, *Hydraulics, *Mixing, *Water treatment, Channels, Coagulants, Model studies.

Free hydraulic jumps are frequently used in water treatment for mixing processes. Additions of coagulant doses in such a jump would result in a very thorough mixing of the chemical and in efficient dispersion in the entire body of the water to be treated. Such a mode of mixing is most desirable in situations where there is a power shortage or the supply is unreliable, as is currently the case in India. Analysis of the hydraulic jumps was carried out to determine the factors that are responsible for a very thorough and efficient mixing and dispersion of the coagulants. A free hydraulic jump design (which is considered to provide greater energy loss and thus a better mixing in comparison to the submerged jump) was examined for various discharge rates in the 0.1 to 5 cubic m/second range maintaining the desired depth to width ratio in the downstream channel. The free hydraulic jump was created by regulating the flume gates in a rectangular flume of 0.3 m width, 0.5 m depth

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and 7 m length. Increased mixing length corresponds to a lower standard deviation, which is expected, because at longer distances mixing improves. When the chemical was injected at the corner of the channel, the mixing length was greater than when injected at a central channel site. The addition of chemicals on the upstream side of the jump results in an insignificant saving of the effective mixing length. The effective mixing distance is always more than the jump length. This means that the downstream length of the free hydraulic jump channel should be about the length of the free hydraulic jump. When the discharge decreases by a factor of three, the effective mixing distance decreases only 1.25 times. This ensures a shorter effective mixing distance at the minimum flow for a designed channel. (Mertz-PTT)
W91-01421

LITHIUM IN DRINKING WATER AND THE INCIDENCES OF CRIMES, SUICIDES, AND ARRESTS RELATED TO DRUG ADDICTIONS.
California Univ., San Diego, La Jolla. Dept. of Chemistry.
G. N. Schrauzer, and K. P. Shrestha.
Biological Trace Element Research BTERDG, Vol. 25, No. 2, p 105-113, May 1990. 3 tab, 20 ref.

Descriptors: *Behavior, *Drinking water, *Lithium, *Public health, *Trace elements, Biochemistry, Environmental effects, Water quality control, Water quality management, Water quality standards.

Lithium is a trace element that is widely used in the treatment of various mental disorders. Previous studies have compared the lithium concentrations in the regional drinking water supplies with the incidence of mental disorders and homicide rates in Texas and found a statistically significant inverse relationship. Since incidence data for only two years (1967-1969) were used in the studies, the relationships between drinking water lithium with homicide and suicide rates were reinvestigated for 10 years (1978-1987) and extended to other crimes, arrests for possession of opium, cocaine, and their derivatives, and possession of marijuana, as well as arrests for drunkenness (1981-1986). Using data for 27 Texas counties it was shown that the incidence rates of suicide, homicide, rape, robbery, burglary, and theft are significantly higher in counties whose drinking water supplies contain little or no lithium than in counties with water lithium levels ranging from 70-170 micrograms/L. These results suggest that lithium has moderating effects on suicidal and violent criminal behavior at levels that may be encountered in municipal water supplies. Comparisons of drinking water lithium levels with the incidences of arrests for possession of opium, cocaine, and their derivatives also produced statistically significant inverse associations, whereas no significant or consistent associations were observed with possession of marijuana and drunkenness. These results suggest that lithium at low dosage levels has a beneficial effect on human behavior. Lithiation of drinking water is suggested as a possible means of crime, suicide, and drug-dependency reduction at the individual and community level. (Author's abstract)
W91-01483

MODEL FOR WATER DISTRIBUTION SYSTEM RELIABILITY.
Texas Univ. at Austin. Dept. of Civil Engineering.
Y. Bao, and L. W. Mays.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 9, p 1119-1137, September 1990. 11 fig, 4 tab, 23 ref. National Science Foundation Project Assessment of Aging Water Distribution Systems Grant No. ECE-8511399.

Descriptors: *Model studies, *Simulation analysis, *Water conveyance, *Water distribution, Flow rates, Monte Carlo method, Pipelines, Pipes, Pressure head, Uncertainty, Water demand.

The hydraulic reliability of a water distribution system can be defined as the probability that the system can provide the demanded flow rate at the required pressure head. Due to the random nature of future water demands, required pressure heads, and pipe roughness, the estimation of water distribution system reliability for the future is subject to uncertainty. A methodology has been developed to estimate the nodal and system hydraulic reliabilities of water distribution systems that accounts for these uncertainties. The framework for the methodology is based upon a Monte Carlo simulation consisting of three major components: random number generation, hydraulic network simulation, and computation of reliability. This method was applied successfully to an example water distribution system consisting of 17 pipes and 12 demand nodes. It was determined that this new methodology can be used in the analysis or expansion of existing systems, or the design of new systems. (Author's abstract)
W91-01495

OPTIMIZATION OF HYDROPOWER PLANT INTEGRATION IN WATER SUPPLY SYSTEM.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 8C.
W91-01556

IMPLEMENTATION OF ON-LINE CONTROL SCHEME FOR CITY WATER SYSTEM.
Leicester Polytechnic (England). Water Control Unit.
C.-H. Orr, M. A. Parkar, and S. T. Tennant.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 5, p 708-726, September/October 1990. 5 fig, 11 ref.

Descriptors: *Computer models, *Control systems, *Data acquisition, *Metropolitan water management, *Water resources management, Cost-benefit analysis, Data transmission, England, Monitoring, Pumping, Urban planning, Water demand, Water distribution, Water resources data, Water supply.

The provision of on-line computer-based control schemes for water supply and distribution systems has for many years eluded the water industry because of the unavailability of reliable applications modules, as well as the limitations on computing power. Recent technological advances, however, have enabled the development and implementation of one such scheme for a major city (Severn-Trent Water) network in the United Kingdom. Specific objectives for such an on-line control implementation include demand prediction based upon predicted demand consumption, management of all the on-line data, coordination of the real-time activities, monitoring of all major system data, generation of appropriate alarm messages and signals, and advice on regulatory decisions during the control period. Preliminary results from the implementation are encouraging. Confidence has increased about the reliability of predicted demand; under normal operation, accuracy is about 5% for the daily average and 10% for the instantaneous values. This has led in turn to increased confidence in the optimality of pump schedules, which on application have led to reduced operational costs. A typical 15% cost saving has been reported, with occasional savings of up to 27%. System monitoring has proved to be of vital importance, giving early warnings of unexpectedly high and low demands, reservoir levels, pump failures, and other unpredictable events. Major improvements through savings in operational costs and provision of system monitoring and regulation facilities have resulted. The cost benefits and improved efficiency have greatly offset the costs of development of such a scheme. (Fish-PTT)
W91-01559

INACTIVATION OF LEGIONELLA PNEUMOPHILA BY POTASSIUM PERMANGANATE.
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
M. T. Yahya, L. K. Landeen, and C. P. Gerba.
Environmental Technology ETLEDB, Vol. 11, No. 7, p 657-662, 1990. 3 tab, 3 fig, 11 ref.

Descriptors: *Disinfection, *Legionella, *Pathogenic bacteria, *Potassium permanganate, *Water treatment, Chlorination, Hydrogen ion concentration, Microorganisms, Water quality standards.

Effective disinfection of water is essential in order to limit disease transmission. Chlorine, the most popular water disinfectant since the turn of the century, has been found to be effective and economical. However, in the early 1970's, chlorination was found to contribute to the formation of numerous chlorinated organic compounds in water. Potassium permanganate (KMnO4), another oxidant, has been used to treat drinking water for almost 100 years. Although potassium permanganate is not currently being used as a primary disinfectant, water systems that use it in the pre-treatment stages of disinfection might benefit from its broad antimicrobial properties and thereby reduce the amount of chlorine needed in the final treatment. Potassium permanganate was investigated for its ability to inactivate cultures of agar-grown Legionella pneumophila in a phosphate buffer (pH 6.0 and pH 8.0) at 7 C. The results of these experiments demonstrate that the efficacy of potassium permanganate is pH-dependent. Greater bacterial rates of inactivation were achieved at the lower pH values. At pH 6.0, significantly higher inactivation rates, k values, (0.300 log 10 reduction/min) of L. pneumophila were observed compared to those at pH 8.0 (0.032 log 10 reduction/min). By exposure to 5.0 mg/L KMnO4, more than a 99% (2 log 10 cfu/mL) reduction in the bacterial numbers was achieved within 10 minutes at a pH of 6.0. However, at pH 8.0, at least 60 minutes was required for a 99% reduction. KMnO4 was significantly more effective at 5.0 mg/L compared to 2.5 and 1.0 mg/L. Water systems with KMnO4 may gain disinfection credits as proposed by the EPA. (Korn-PTT)
W91-01640

OCCURRENCE OF THE MUTAGENIC COMPOUND MX IN DRINKING WATER AND ITS REMOVAL BY ACTIVATED CARBON.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
R. C. Andrews, S. A. Daignault, C. Laverdure, D. T. Williams, and P. M. Huck.
Environmental Technology ETLEDB, Vol. 11, No. 7, p 685-694, 1990. 6 fig, 3 tab, 21 ref. Health and Welfare Canada (Supply and Services) Contract Nr. H4001-8-N001/01-SS.

Descriptors: *Activated carbon, *Drinking water, *Halogenated compounds, *Mutagenicity, *Water treatment, *Water treatment facilities, Canada, Chlorination, Comparison studies, Organic carbon.

Within the last several years the compound MX (3-chloro-4-dichloromethyl-5-hydroxy-2(5H)-furanone) has been shown to be responsible for up to 57% of the acid fraction mutagenicity observed in chlorinated drinking waters. In aqueous solution, MX can undergo isomerization to an open form known as EMX (E-2-chloro-3-dichloromethyl-4-oxobutenoic acid) which is a weaker mutagen. The use of granular activated carbon (GAC) has been demonstrated to be an effective means of removing mutagenic compounds produced during chlorination of drinking water and as such could be a useful treatment to remove MX. To examine the extent to which MX and EMX are formed in conventional water treatment employing chlorination, and to quantify the removal capacity of GAC for MX, samples were collected from six Canadian water treatment plants. Laboratory investigations showed the strongly mutagenic compound MX to be very well removed by activated carbon over a wide concentration range. Samples obtained from two water treatment plants following pre-chlorination showed MX to be present in the range of 38 to 60 ng/L. MX concentrations were not always correlated with total organic carbon (TOC) levels, suggesting that the type of organic matter present may play a role in MX formation. Granulated activated (GAC) appeared to be capable of removing MX precursors. (Korn-PTT)
W91-01643

INHIBITION OF GROWTH OF LEGIONELLA SPECIES BY HETEROTROPHIC PLATE COUNT BACTERIA ISOLATED FROM CHLORINATED DRINKING WATER.
Queensland Univ., Brisbane (Australia). Dept. of Microbiology.

S. Toze, L. I. Sly, I. C. MacRae, and J. A. Fuerst.
Current Microbiology CUMIDD, Vol. 21, No. 2, p 139-143, August 1990. 3 tab, 23 ref.

Descriptors: *Domestic water, *Legionella, *Water quality control, *Water treatment, Amino acids, Bacteria, Chlorination, Drinking water, Growth rates, Heterotrophic bacteria.

Legionella is a nutritionally fastidious bacterium requiring amino acids as the source of energy. A suggested mode of survival in the environment is by the interaction of the Legionella cells with non-Legionella bacteria. The ability of heterotrophic plate count bacterial strains isolated from chlorinated drinking water on low-nutrient media to inhibit the growth of Legionella species was examined. Between 16% and 32% of these strains were able to inhibit the growth of Legionella species when tested on buffered charcoal yeast extract agar. The exact proportion of inhibiting strains varied with the individual Legionella species. Two strains that inhibited the growth of several Legionella species could also stimulate the growth of the same species when both the test strain and the Legionella species were grown on buffered charcoal yeast extract agar that lacked the essential amino acid L-cysteine. (Author's abstract)
W91-01665

LACK OF EFFECT OF DRINKING WATER BARIUM ON CARDIOVASCULAR RISK FACTORS.
Cincinnati Univ., OH. Coll. of Medicine.
R. G. Wones, B. L. Stadler, and L. A. Frohman.
Environmental Health Perspectives EVHPAZ, Vol. 85, p 355-359, April 1990. 1 fig, 1 tab, 24 ref. PHS Grant No. RR00068 and EPA Cooperative Agreement No. CR-812560.

Descriptors: *Barium, *Cardiovascular disease, *Drinking water, *Human diseases, *Water pollution effects, Epidemiology, Standards.

Higher cardiovascular mortality has been associated in a single epidemiological study with higher levels of barium in drinking water. Drinking water barium at levels found in some U.S. communities was studied to determine the effect on known risk factors for cardiovascular disease. Eleven healthy men completed a 10-week-dose-response protocol in which diet was controlled (600 mg cholesterol; 40% fat, 40% carbohydrate, 20% protein; sodium and potassium controlled at the subject's pre-protocol estimated intake). Other aspects of the subjects' lifestyles known to affect cardiac risk factors were controlled, and the barium content (as barium chloride) of the drinking water (1.5 L/day) was varied from 0 (first 2 weeks), to 5 ppm (next 4 weeks), to 10 ppm (last 4 weeks). Multiple blood and urine samples, morning and evening blood pressure measurements, and 48-hr electrocardiograph monitoring were performed at each dose of barium. There were no changes in morning or evening systolic or diastolic blood pressures, plasma cholesterol or lipoprotein or apolipoprotein levels, serum potassium or glucose levels, or urine catecholamine levels. There were no arrhythmias related to barium exposure detected on continuous electrocardiographic monitoring. A trend was seen toward increased total serum calcium levels with exposure to barium, which was of borderline statistical significance and of doubtful clinical significance. Drinking water barium at levels of 5 and 10 ppm did not appear to affect any of the known modifiable cardiovascular risk factors. (Author's abstract)
W91-01666

ANALYSIS OF 228RA AND 226RA IN PUBLIC WATER SUPPLIES BY A GAMMA-RAY SPECTROMETER.
Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
For primary bibliographic entry see Field 5A.
W91-01667

FORMATION OF PCDDS AND PCDFS BY THE CHLORINATION OF WATER.
Umea Univ. (Sweden). Inst. of Environmental Chemistry.
C. Rappe, S. E. Swanson, B. Glas, K. P. Kringstad, and P. deSousa.
Chemosphere CMSHAF, Vol. 19, No. 12, p 1875-1880, 1989. 2 fig, 1 tab, 11 ref.

Descriptors: *Chlorination, *Dioxins, *Disinfection, *Polychlorinated biphenyls, *Wastewater treatment, *Water pollution sources, *Water treatment, Analytical methods, Drinking water, Pollutant identification, Pulp and paper industry.

Two samples of tap water and double distilled water were chlorinated using chlorine gas. A series of polychlorinated dibenzofurans (PCDFs) could be identified from these experiments, however no dibenzo-p-dioxins (PCDDs) could be found. Differences were found in the congener profiles between the two water samples that could not be explained. The two water samples gave very similar isomeric patterns (e.g. tetra-CDFs). The three dominating isomers among the tetra-CDFs are the 2,3,7,8-, 1,2,7,8-, and 1,2,8,9-isomers; the same isomers that are found in the bleached pulp and paper products, the 'bleaching pattern'. The observation that PCDFs are formed by the reaction of chlorine with double distilled water indicate that the PCDFs or their precursors are present in the chlorine gas. Consequently all the products formed by chlorination reactions are potentially contaminated by PCDFs. The pattern identified in this study is called the 'chlorine pattern'. For the tetra-CDFs it consists of the same isomers as the 'pulp bleaching pattern', however, the 'chlorine pattern' also contains higher chlorinated PCDFs, but no PCDDs. (Agostine-PTT)
W91-01725

MEASURING THE PRODUCTIVITY OF CONSTRUCTION MAINTENANCE OPERATIONS.
Rutgers - The State Univ., Piscataway, NJ. Dept. of Industrial Engineering.
J. T. Luxhoj, and P.-C. Tao.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 8, p 35-39, August 1990. 3 fig, 6 tab.

Descriptors: *Construction, *Maintenance, *Metropolitan water management, *Performance evaluation, *Productivity, *Utilities, *Water treatment, Model studies, Personnel management.

A measurement system for evaluating and controlling a water utility's maintenance activities was developed. The system involves the development of models to graphically describe and measure the work content of the various jobs. The first set of models, which focuses on task descriptions, comprises the construction measurement system. The second set of models comprises the performance measurement system and is developed at the department level to measure labor productivity. The construction and performance measurement system is currently in place at Hackensack Water Company. During the first six months of 1989, a 20 percent productivity gain was reported over the same period in 1988. During the first half of 1989, 300 more jobs were completed and 650 fewer worker hours were expended than during the same period in 1988. The backlog index was reduced to 2.4 from 4.0. Although it is not clear at this point how much of the productivity improvement can be directly attributed to the measurement system, it is reasonable to conclude that such a measurement system has significantly increased the productivity consciousness of the organization. (Agostine-PTT)
W91-01749

OPERATOR EVALUATION OF SMALL SYSTEMS.
Chautauqua County Dept. of Health, Mayville, NY. Div. of Environmental Health Services.
W. D. Gollnitz, and B. Kittle.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 8, p 40-45, August 1990. 3 fig, 1 tab, 13 ref.

Descriptors: *Operating policies, *Performance evaluation, *Water treatment, *Water treatment facilities, Case studies, Clarifiers, Evaluation, Particulate matter, Turbidity, Water quality standards.

Many of the small water treatment systems built before 1960 are having difficulty meeting current water quality regulations, especially with respect to particle reduction (measured as finished-water turbidity). Preliminary evaluations of small surface water treatment systems can and should be performed by system managers and operators before a consulting engineer is hired. System evaluations can be aided by conducting literature searches at local libraries and universities to get a better understanding of the potential problem facing the utility, by reviewing and comparing the design of the treatment system in question with those of neighboring systems treating water of similar quality, by performing system simulations using models of varying complexity, and by conducting evaluations in the treatment plant using different coagulants and coagulant aids. A case study of a water treatment plant in Westfield, N.Y. is described in which the simulation techniques are demonstrated. For the facility to meet the current and proposed turbidity maximum contaminant levels, the existing clarifier must be modified by adding tube settlers or by adding an additional clarification unit. (Agostine-PTT)
W91-01750

MEASURING AND MODELING VARIATIONS IN DISTRIBUTION SYSTEM WATER QUALITY.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
R. M. Clark, and J. A. Coyle.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 8, p 46-53, August 1990. 6 fig, 36 ref.

Descriptors: *Model studies, *Water distribution, *Water quality management, *Water sampling, *Water treatment, Flow pattern, Hydraulics, Monitoring, Pennsylvania.

The effects of hydraulic mixing on water quality variations in a distribution system were examined. The study, which was conducted at the North Penn Water Authority, Lansdale, Pennsylvania, (average production of 5 mgd and 225 mi of distribution pipe), incorporated a field sampling program that utilized customized automated samplers designed to prevent loss of volatile constituents. As a complement to the field sampling program, computer models that would predict water quality variations in distribution systems were examined and developed. A clear need was shown for obtaining more representative monitoring results than are normally acquired from distribution system sampling. It is concluded that steady-state predictive modeling of water quality can provide insight into overall water quality variations and patterns within a distribution system. Interpretation of predictive modeling results must be made in light of an appreciation of system hydraulics, in particular an understanding of the flow patterns and directions that create the gradients of concentration. (Agostine-PTT)
W91-01751

FLOCCULATION IN TURBULENT FLOW: MEASUREMENT AND MODELING OF PARTICLE SIZE DISTRIBUTIONS.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
L. W. Casson, and D. F. Lawler.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 8, p 54-68, August 1990. 15 fig, 21 ref. NSF Presidential Young Investigator Grant CES 8451135.

Descriptors: *Flocculation, *Model studies, *Particle size, *Turbulent flow, *Water treatment, Eddies, Mixing, Statistical analysis, Suspension, Velocity, Water quality.

Fluid motion in an oscillating-grid flocculator was investigated quantitatively with a laser Doppler velocimeter for two mixing conditions. Batch flocculation experiments were performed for monodisperse, bimodal, and trimodal latex suspensions. The effects of mixing intensity, particle charge, and suspension concentration on the rate of change in particle size distributions were studied. Experimen-

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tal results indicated that large eddies are relatively unimportant for flocculation and that flocculation is induced by eddies of approximately the same size as the particles. A method for estimating the velocity gradients in eddies of different sizes in the flow was developed and incorporated into an existing mathematical model for flocculation. The predictions of the revised flocculation model were compared with the experimental results and indicated that the velocity gradients of the eddies adequately describe the interparticle contacts resulting from mixing during flocculation. (Author's abstract)
W91-01752

INFLUENCE OF OZONATED NATURAL ORGANIC MATTER ON THE BIODEGRADATION OF A MICROPOLLUTANT IN A GAC BED.
Weston (Roy F.), Inc., Valhalla, NY.
J. E. DeWaters, and F. A. DiGiano.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 8, p 69-75, August 1990. 7 fig, 1 tab, 23 ref. NSF Grant ECE-8520483.

Descriptors: *Activated carbon, *Biodegradation, *Granular activated carbon, *Organic matter, *Ozonation, *Water treatment, Biofilms, Industrial wastes, Pollutants, Sorption.

Biological activity on granular activated carbon (GAC) may significantly enhance the treatment process. Shifting the pathway for contaminant removal from adsorption to biodegradation reduces biodegradable organics and increases sorptive capacity for non-degradable or slowly degradable compounds. Biodegradation and adsorption of natural organic matter (NOM) were studied in a laboratory-scale GAC reactor. Investigations were done under controlled laboratory conditions in which feed concentration and empty bed contact time (EBCT) could be varied and a synthetic organic chemical (SOC) could be introduced. Ozonation of the NOM used in this research at a dose of 1 mg O3/mg TOC (total organic carbon) increased biodegradation and encouraged biofilm growth in the GAC bed. Substantial steady-state reductions in TOC were achieved within a relatively short EBCT in the presence of this actively growing biofilm. Significant removal of organic matter within a short EBCT implies that biological activity has the potential for reducing the necessary size of a GAC facility, thereby reducing capital costs. Biofilm grown on ozonated NOM readily degraded trace concentrations of phenol. It is concluded that the biological activity provided by a readily available substrate (ozonated NOM) can effectively remove not only the bulk substrate but trace synthetic organics as well. (Agostine-PTT)
W91-01753

RECOVERY OF MINERAL SALTS AND POTABLE WATER FROM DESALTING PLANT EFFLUENTS BY EVAPORATION: PART I. EVALUATION OF THE PHYSICAL PROPERTIES OF HIGHLY CONCENTRATED BRINES.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 3A.
W91-01757

EFFECTS OF OZONE ON THE INFECTIVITY OF HEPATITIS A VIRUS.
New England Univ., Biddeford, ME. Dept. of Microbiology.
J. M. Vaughn, Y. S. Chen, J. F. Novotny, and D. Strout.
Canadian Journal of Microbiology CJMIAZ, Vol. 36, No. 8, p 557-560, August 1990. 1 fig, 1 tab, 34 ref. EPA Grant R-812140-01.

Descriptors: *Disinfection, *Enteroviruses, *Hydrogen ion concentration, *Infection, *Ozone, Disinfectants, Human pathogens, Immunoassay, Water treatment.

The inactivation of a large-focus-forming variant of hepatitis A virus (HM-175) by ozone was investigated as an alternative to chlorine for the disinfection of water and wastewater. Experiments using mainly single-particle virus preparations suspended in phosphate-carbonate buffer were conducted over a range of pH levels (6-8) at 4 C. Viral enumerations involved the use of a radioimmunofocus assay. While some tolerance to lower (i.e., 0.1-0.5 mg/L) ozone residuals was noted, the exposure of virus particles to ozone concentrations of 1 mg/L or greater at all pH levels resulted in their complete (5 log) inactivation within 60 seconds. The pH-related effects that were observed were not considered to be significant. (Author's abstract)
W91-01771

DETERMINATION OF VOLATILE ORGANICS IN DRINKING WATER WITH USEPA METHOD 524.2 AND THE ION TRAP DETECTOR.
Environmental Monitoring Systems Lab., Cincinnati, OH.
J. W. Eichelberger, T. A. Bellar, J. P. Donnelly, and W. L. Budde.
Journal of Chromatographic Science JCHSBZ, Vol. 28, No. 9, p 460-467, September 1990. 9 fig, 3 tab, 9 ref.

Descriptors: *Drinking water, *Ion trap detector, *Laboratory methods, *Pollutant identification, *Volatile organic compounds, *Water treatment, Chemical analysis, Mass spectrometry, Maximum contaminant levels, Measuring instruments, Monitoring.

New drinking water regulations require the monitoring of eight volatile organic compounds that have established maximum contaminant levels (MCLs), and 51 other volatile organics for which MCLs are not established. A laboratory analytical method (method 524.2) for the determination of 58 of these compounds is investigated which uses: a standard inert gas purge extraction; isolation of the volatile organics on a three stage solid-phase trap; thermal desorption into a gas chromatograph; separation with the fused silica capillary column; and identification and measurement with a relatively low cost, bench-top ion trap detector that functions as a mass spectrometer. At a concentration of 2 micrograms/L (2 ppb), the grand mean measurement accuracy for 54 compounds was 95% of the true value with a mean relative standard deviation (RSD) of 4%. At 0.2 micrograms/L (200 parts per trillion), the grand mean measurement accuracy was 95% of the true value with a mean RSD of 3%. (Author's abstract)
W91-01915

COMPREHENSIVE HEALTH EFFECTS TESTING PROGRAM FOR DENVER'S POTABLE WATER REUSE DEMONSTRATION PROJECT.
Denver Water Dept., CO.
For primary bibliographic entry see Field 5D.
W91-01920

5G. Water Quality Control

MODELING LINKED WATERSHED AND LAKE PROCESSES FOR WATER QUALITY MANAGEMENT DECISIONS.
Agricultural Research Service, Durant, OK.
R. M. Summer, C. V. Alonso, and R. A. Young.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 421-427, July/September 1990. 9 fig, 2 tab, 26 ref.

Descriptors: *Computer models, *Lake management, *Limnology, *Management planning, *Minnesota, *Model studies, *Water quality management, *Watershed management, Decision making, Land use, Physical models, Simulation analysis.

A physically based modeling approach is used to link watershed with lake processes and to simulate their responses to land management and weather conditions. Components of the watershed model, AGNPS (agricultural non-point source model) are hydrology, erosion, sediment transport, transport of nitrogen and phosphorus, and chemical oxygen demand. Runoff, sediment, and chemical variables from the watershed were used to provide input to a lake model with a cellular structure. This one-dimensional model of water bodies simulates temperature stratification, mixing by wind, sedimentation, inflow density current, and algal growth. Unsteady advection-diffusion equations characterize the dynamics of suspended sediment, soluble and sediment-attached N and P, and chlorophyll. This model, AGNPS-LAKE, is driven by random generation of weather conditions on a daily basis. Resulting impacts of alternative management plans were simulated by changing agricultural practices and land use, thereby modifying inflow characteristics to a lake. Modeling capabilities are being tested on eutrophic lakes in Minnesota for the purpose of simulating long-term trends and impacts of best management practices. (Author's abstract)
W91-01012

ASSESSMENT OF MANAGEMENT PRACTICES FOR REDUCING PESTICIDE RUNOFF FROM SLOPING CROPLAND IN ILLINOIS.
Illinois Natural History Survey, Champaign.
A. S. Felsot, J. K. Mitchell, and A. L. Kenimer.
Journal of Environmental Quality JEVQAA, Vol. 19, No. 3, p 539-545, July/September 1990. 2 fig, 7 tab, 49 ref. North Central Regional Pesticide Impact Assessment Program Grant ILLU-12-0214, University of Illinois Water Resources Center Grant G1015-02, Southern Regional Research Project S-218.

Descriptors: *Agricultural practices, *Agricultural runoff, *Illinois, *Path of pollutants, *Pesticides, *Water pollution, *Water pollution control, *Water pollution prevention, Adsorption, Alachlor, Carbofuran, Conservation, Contour terracing, Cultivation, Sediment contamination, Simulated rainfall, Slopes, Soil contamination, Surface runoff, Terbufos, Tillage, Transport.

The influence of tillage system and contouring practice on runoff of soil-applied alachlor, carbofuran, and terbufos from small plots (30 sq m) were studied using a rainfall simulator. Plots were planted in corn (Zea mays L.) in 1983, soybean (Glycine max (L.) Merr.) in 1984, and corn in 1985. Runoff was measured during a 60 min event with a rainfall intensity of 63 mm/h. During 1984, moldboard-plowed and no-till systems were studied with rows oriented on the contour or up-and-down slope (7-11% slope). Compared to moldboard-plow, up-and-down slope no-till and contouring significantly reduced runoff of carbofuran and alachlor. Percentage of applied carbofuran lost in runoff and sediment ranged from 1% (contoured moldboard) to 11% (up-and-down slope moldboard). Percentage of alachlor lost ranged from 1% (contoured no-till) to 2% (contoured moldboard). During 1985, the effects of row orientation were evaluated on moldboard-plow, chisel-plow, ridge-tip, strip-till, and no-till systems. Under up-and-down slope conditions, runoff of alachlor and terbufos plus two metabolites (terbufos sulfoxide and terbufos sulfone) was significantly reduced by strip-till (<1% loss) compared to moldboard-plow (6% loss). With contouring, ridge tillage also was effective in reducing pesticide runoff (<1% of applied pesticide), and strip-till held losses to <0.1%. Alachlor and carbofuran were translocated from plots largely in moving water, but terbufos and metabolites were recovered mainly in eroded sediment. Although no conservation tillage system completely eliminated pesticide runoff, losses were most effectively minimized by contoured strip-till and no-till, which controlled both water and sediment movement. (Author's abstract)
W91-01021

ALDICARB FOOD POISONINGS IN CALIFORNIA, 1985-1988: TOXICITY ESTIMATES FOR HUMANS.
California Dept. of Health Services, Emeryville. Environmental Epidemiology and Toxicology Branch.
For primary bibliographic entry see Field 5C.
W91-01052

BALANCE OF REPRESENTATION IN WATER PLANNING: AN ASSESSMENT OF EXPERIENCE FROM NORTH CAROLINA.

Florida State Univ., Tallahassee. Dept. of Urban nd Regional Planning.
For primary bibliographic entry see Field 6A.
V91-01059

POLYCYCLIC AROMATIC HYDROCARBON EMISSIONS FROM THE COMBUSTION OF RUDE OIL ON WATER.
National Inst. of Standards and Technology NEL), Gaithersburg, MD.
or primary bibliographic entry see Field 5B.
V91-01066

MPORTANCE OF NATURAL PROCESSES IN NDERSTANDING ECOSYSTEM CHANGE: A ASE STUDY OF LIMED LAKES.
linois State Water Survey Div., Champaign.
or primary bibliographic entry see Field 2H.
'91-01073

ERSANI V. EPA: TOWARD A PLAUSIBLE TERPRETATION OF THE 404(B)(1) GUIDE-NES FOR EVALUATING PERMIT APPLICA-ONS FOR WETLAND DEVELOPMENT.
Wendel.
olumbia Journal of Environmental Law ELE8, Vol. 15, No. 1, p 99-119, 1990.

escriptors: *Conservation, *Environmental pro-ction, *Judicial decisions, *Legal aspects, *Mas-chusetts, *Resource management, *Wetlands, rmits, Public rights, Zoning.

e rapid destruction of the wetland wealth of the ited States that began with European settlement ntinues despite the enactment of a federal law to event it. One recent case is Bersani v. EPA, a cond Circuit decision that spared from develop-nt a red maple swamp in Massachusetts. Bersani olved the Environmental Protection Agency's o of a permit to fill a wetland area on the unds that an alternative was available when the veloper entered the market for a site. The devel-er claimed that the relevant time for consider-on of whether alternative sites were available to was when he applied for a permit rather than en he entered the market in search of a site. The ny Corps of Engineers (as apparent enforcer of law) approach to the balance embodied in the delines between the developer's interest and the ial interest in wetland values can be described a private interest approach, characterized by ee elements: treatment of the alternatives analy-as the central provision of the guidelines; char-erization of alternatives as practicable or not cticable based upon the absolute size of the loss prospective profits entailed by the alternative; approval of a permit to develop when no cticable alternative is deemed to exist. The delines are meant to implement Section 404's nt as a wetland protection law. Bersani v. EPA es closer to implementing a social cost-benefit ysis and activating the incentive mechanism essary to perform an alternatives analysis than prior decisions of the Corps and the courts. The ng issue of the alternatives analysis of the b)(1) guidelines fails to focus on any of the ria crucial to determining the availability of ticable alternatives to a developer's proposed and site. It is hoped that the positive move-t taken by the case toward protecting society's ng interests in wetlands will be continued and lerated in future court review of wetland nit determination. (Brunone-PTT)
-01092

MMING THE TIDE OF MARINE DEBRIS LLUTION: PUTTING DOMESTIC AND ERNATIONAL CONTROL AUTHORITIES WORK.
ins Coie, Washington, DC.
. Baur, and S. Iudicello.
ogy Law Quarterly ECLQAR, Vol. 17, No. 1, 142, 1990.

riptors: *International law, *Marine pollution, lic participation, *Solid waste disposal, ter pollution control, Degradation, Jurisdic-Public rights, Recycling.

Oceans and coastal seas have long been used as receptacles for all kinds of waste materials. Once the scope and impacts of persistent marine debris pollution became apparent, political institutions responded quickly. Annex V of the International Convention for the Prevention of Pollution from Ships Protocol entered into force after nine years of delay, and Congress enacted tough marine pollution control laws, including the Marine Plastic Pollution Research and Control Act. Lasting success in reducing marine debris depends primarily on translating current public awareness of the marine debris problem into modifications of the way people conduct their everyday activities. Ways to change this attitude and thus to lessen the impact of commonly pursued waste disposal activities on the marine environment include source reduction, recycling, and the judicious use of environmentally safe degradable material. All three ways call for instillation of public understanding of the problems presented by solid waste disposal practices in the vicinity of the ocean and coastal areas. Public education is central to capitalizing on public concern for the marine environment. Over time, however, institutional mechanisms will be needed to sustain this concern and force action. Incentives can be marshalled to encourage recycling, source reduction, and the use of degradable materials. Command and control authorities can mandate waste restrictions and other useful measures. Prompt and thorough action can keep beaches and waters free of debris long after washups of medical waste and plastic trash have become a distant memory. (Brunone-PTT)
W91-01093

EPA'S PESTICIDES-IN-GROUNDWATER STRATEGY: AGENCY ACTION IN THE FACE OF CONGRESSIONAL INACTION.
R. J. Sater.
Ecology Law Quarterly ECLQAR, Vol. 17, No. 2, p 143-177, 1990.

Descriptors: *Cleanup operations, *Contamination, *Environmental protection, *Groundwater pollution, *Pesticides, Agriculture, Aldicarb, Clean Water Act, Comprehensive Environmental Response Com, Dibromochloropropane, Drinking water, Federal Insecticide Fungicide and Rodent, Regulations, Safe Drinking Water Act, Wells.

Until a decade ago, contamination of groundwater by pesticides was not considered a serious health or environmental threat. This belief was shattered in 1979 when the pesticide dibromochloropropane (DBCP) was found in nearly 2500 wells and municipal drinking water systems in California, and aldicarb was found in wells in New York. In both cases, pesticides had entered the water supply through approved agricultural uses, not accidental spills or leaks. The EPA now considers pesticide contamination of groundwater a serious threat, and has developed its own regulatory program to deal with the problem: Agricultural Chemicals in Groundwater: Proposed Pesticide Strategy. The Pesticide Strategy develops a regulatory system that uses a combination of state pesticide management plans and federal groundwater quality standards (the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the Federal Water Pollution Control Act (Clean Water Act or CWA), the Safe Drinking Water Act (SDWA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA))to control pesticide contamination of groundwater. In theory, the EPA's Pesticide Strategy's pesticide-specific and site-specific approach leads to an exact fit between regulation and regulatory need, minimizing both underregulation and overregulation. In practice, however, the fine-tuned regulation demands state resources and political support for plan development, monitoring, and enforcement. A more sound approach to pesticide contamination of groundwater would be FIFRA's national cancellation for pesticides that pose significant health and environmental risks. National cancellation ensures the protection of groundwater, while compensating for the inefficiency of overregulation by reducing groundwater sites requiring public or private cleanup efforts. Although the Pesticide Strategy may ultimately fail, EPA's experience with it will provide many lessons for policymakers trying to respond to complex environmental problems. (Brunone-PTT)
W91-01094

CLEAN WATER ACT: A GOOD BEGINNING.
L. G. Billings.
Environmental Forum ENVFEN, Vol. 7, No. 2, p 46-48, March/April 1990.

Descriptors: *Clean Water Act, *Public participation, *Water quality standards, *Zero discharge, Chemical wastes, Economic aspects, Federal jurisdiction, Pesticides, Runoff, Water pollution.

Senator Edmund Muskie channelled public outrage into the passage of the landmark 1972 Clean Water Act (CWA), which set a national goal of zero discharge of pollutants. It is brought to public attention the fact that water is not a free good and its supply is extremely limited; public drinking water drawn from wells is often unsafe; and chemical contaminants in the water supply are a basic public health threat. Runoff pollution problems has been created by the establishment of more impervious surfaces like roads and parking lots and the increased use of chemicals and pesticides. Twenty years ago, a group of politicians developed a clean water policy based on three broad goals: the biological integrity of receiving waters, the maximum use of available technology, and the ultimate goal of zero discharge. Achieving these goals depended on state authority, federal mandates, citizen suits, and public funding. The single most contentious CWA issue was whether there would be an opportunity for individual polluters to appeal clean water requirements for their particular category of facilities, and was ultimately resolved in favor of categorical effluent standards based on feasibility and cost. For approximately ten billion dollars per year, nearly three quarters of the nation's surface water now meets the national water quality standard. Significant progress has been made as a result of a federal-state partnership, federal financial aid, and federal enforcement. The Environmental Protection Agency has recently, however, been advocating source-by-source waivers, cost-based appeals, pre-cooked risk assessments, and an impossible array of pollution reduction credits, tax law-type carry-forwards and carry backs, and compliance shields designed to minimize rather than maximize federal responsibility for public health related pollution control. A potential solution to the problem of decreased accessibility of members of Congress is the development of a viable Green Party in the USA, which would refocus public attention upon the problems of pollution control and maintenance of clean water. (Brunone-PTT)
W91-01095

MURKY STANDARDS FOR GROUNDWATER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Hazardous Sites and Superfund Enforcement.
For primary bibliographic entry see Field 2F.
W91-01096

INTEGRATED ANALYSIS OF POLICY OPTIONS FOR PROTECTION OF GROUNDWATER QUALITY.
Economic Research Service, Washington, DC. Resources and Technology Div.
N. D. Uri, and W. Y. Huang.
Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 3, p 233-241, May/June 1990. 1 fig, 1 tab, 33 ref.

Descriptors: *Groundwater quality, *Groundwater resources, *Model studies, *Policy making, *Resource management, *Water pollution control, *Water quality control, Fertilizers, Human diseases, Pesticides, Political aspects, Public participation.

A regional authority should use an integrated framework when assessing the potential impacts of any policy initiative directed at improving groundwater quality. A policy model was therefore developed relying on three decision components (farm-level production decisions model, a household de-

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cisions model, and a regional policy decision model) where the objective is one of identifying the trade-offs that a regional authority will be confronted with as it strives to balance the preferences of farmers and households while endeavoring to maximize net economic welfare. The basic rule developed indicates that the regional authority must choose a policy whereby any increase (decrease) in regional income is just equal to the decrease (increase) in net benefits to households. The model developed does require a fair amount of information on the transport and fate of pesticides and fertilizers used in the agricultural production process, dose-response relationships for computing health risks and costs associated with excessive illnesses (and mortality), costs of remedial action options etc. (Author's abstract)
W91-01101

ENFORCEMENT OF FEDERAL UNDERGROUND STORAGE TANK REGULATIONS.
North Carolina Univ. at Wilmington. Dept. of Philosophy.
C. C. Gauthier.
Environmental Law EVLWA8, Vol. 20, No. 2, p 261-289, 1990.

Descriptors: *Enforcement, *Leakage, *Path of pollutants, *Regulations, *Underground storage tanks, *Water pollution prevention, Biodegradation, Economic aspects, Environmental protection, Federal jurisdiction, Flushing, Groundwater pollution, Hydrocarbons, Liability, Political aspects, Soil contamination, State jurisdiction.

During the 1980s, underground storage tanks (USTs) were leaking petroleum products into the soil and groundwater at an alarming rate. In 1986, the EPA tested 433 tanks for leakage at 218 establishments in the United States and found that 35% of the storage tanks tested were leaking. These releases both damage the environment and pose serious risks to public health and safety. The federal government has recently developed an UST regulatory program that includes operating and financial responsibility requirements. Federal regulation requires UST system owners to notify state environmental agencies of the existence of these systems, and directs the EPA to formulate regulations concerning UST release detection, prevention, and corrective action, as well as for financial responsibility for leaks of regulated substances from USTs. State environmental agencies are required to compile tank inventories and to provide this information to the EPA. The EPA is mandated to establish a federal program for the regulation of USTs that allows state programs to operate in lieu of the federal program is they are no less strict than the federal requirements and can be adequately enforced. When a petroleum product is released from an underground storage tank, there is contamination of the soil, and if the release is significant, there is also contamination of the groundwater. To recover shallow spills, the contaminated soil may be excavated and placed in a landfill. For deeper pollution, the only methods of treatment are flushing and recovery or an in-situ treatment, such as biological degradation using bacteria. Ethical issues include the relationship between the public demand for petroleum products, environmental damage, and the conflicts encountered by environmental consulting firms. Legal issues concern the notification of the public and the sale of property on which storage tanks are located, as well as the increasing involvement of the legal system in enforcement of environmental legislation. (Brunone-PTT)
W91-01103

MARINE RESERVE MANAGEMENT IN DEVELOPING NATIONS: MIDA CREEK--A CASE STUDY FROM EAST AFRICA.
Exeter Univ. (England). Dept. of Biological Sciences.
For primary bibliographic entry see Field 6E.
W91-01121

UNITED STATES V. LARKINS: CONFLICT BETWEEN WETLAND PROTECTION AND AGRICULTURE; EXPLORATION OF THE FARMING EXEMPTION TO THE CLEAN WATER ACT'S SECTION 404 PERMIT REQUIREMENTS.
For primary bibliographic entry see Field 6E.
W91-01123

GROUND-WATER PROTECTION AND RECLAMATION.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 4, p 654-662, July/August 1990. 3 tab, 14 ref.

Descriptors: *Groundwater, *Groundwater availability, *Groundwater management, *Groundwater pollution, *Water pollution prevention, *Water pollution treatment, Aquifers, Groundwater contamination, Groundwater quality, Water management, Water treatment.

A review of the status of the nation's groundwater quality and pollution problems reveals the need to be concerned for its protection and to have cleanup technologies available for existing and future contamination problems. Present U.S. federal laws are more than adequate to protect and clean up the nation's groundwaters; compliance with existing groundwater pollution prevention legislation will be most effective. While national interest in the protection and cleanup of the nation's groundwaters is well justified, panic over the current status of groundwaters quality is not. Research needs to be expanded on how to prevent substances from being released to the environment during handling, treatment, storage, or disposal with specific emphasis, in loss control, along with continued efforts to develop and refine methodologies to clean up contaminated soils and aquifers. (King-PTT)
W91-01152

IMMOBILIZATION MECHANISMS IN SOLIDIFICATION/STABILIZATION OF CD AND PB SALTS USING PORTLAND CEMENT FIXING AGENTS.
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
F. K. Cartledge, L. G. Butler, D. Chalasani, H. C. Eaton, and F. P. Frey.
Environmental Science and Technology ESTHAG, Vol. 24, No. 6, p 867-873, June 1990. 3 fig, 2 tab, 32 ref.

Descriptors: *Cadmium, *Lead, *Portland cements, *Solid waste disposal, *Water pollution prevention, Groundwater pollution, Land disposal, Leaching, Path of pollutants, Sludge stabilization.

Cement is often used in solidification/stabilization (S/S) treatment of hazardous heavy-metal-containing wastes that are in liquid or sludge forms to produce a solid for land disposal. Analysis of the behavior of Cd and Pb salts during cement-based solidification, using the toxicity choroeteristic leaching procedure, conduction calorimetry, and solid-state nuclear magnetic resonance, demonstrated that although the concentration of Cd in leachates is very low, the Pb concentration is much higher and represents a serious threat to groundwater. While cadmium salts, whether initially water soluble or insoluble, are effectively immobilized by the cementitious process, lead hydroxide is not. In addition, particularly with mixed waste streams, other components have been previously shown to impair optimal waste immobilization by adverse effect on strength development of the cement matrix. The combined results suggest cautionary use of cement-based solidification. (D'Agostino-PTT)
W91-01182

PROCEEDINGS OF STORMWATER AND WATER QUALITY MODEL USERS GROUP MEETING.
For primary bibliographic entry see Field 5G.
W91-01188

PROCEEDINGS OF STORMWATER AND WATER QUALITY MODEL USERS GROUP MEETING.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-195002. Price codes: A11 in paper copy, A01 in microfiche. October 3-4, 1988, Denver, Colorado. EPA Report No. EPA/600/9-89/001, January 1989. 233 p. Edited by C. Y. James, Ben R. Urbonas, and Thomas O. Barnwell.

Descriptors: *Management planning, *Model studies, *Storm water, *Storm water management, *Urban hydrology, *Urban runoff, *Water quality management, Computer models, Computer programs, Computers, Conferences, Data interpretation, Field tests, Hydraulic models, Mathematical models, Water quality.

Twenty-two technical papers are presented on topics related to the development and application of computer-based mathematical models for water quality and quantity management. The papers address five subject areas: revisions and modifications to EPA models, administrative concerns, applications and experiences, latest developments, and field observations and related studies. Several of the studies present critical reviews of modeling concepts, numerical approaches, and comparisons with field observations. Revisions and modifications of the EPA SWMM model are helpful in the enhancement of the model's capability and user friendliness. Although the application of computer models is the prime subject area, many other subjects, such as spreadsheet use, statistical sensitivity of measured data, AUTOCAD enhancement in data management, and mapping database application, are addressed. (See W91-01189 thru W91-01210) (Author's abstract)
W91-01188

IMPROVEMENTS TO SURCHARGE CALCULATIONS IN EXTRAN.
Brown and Caldwell, Seattle, WA.
For primary bibliographic entry see Field 7C.
W91-01192

APPLICATION OF QUAL II TO EXPLORE WASTELOAD ALLOCATION ALTERNATIVES.
Rhode Island Dept. of Environmental Management, Providence.
A. S. Liberti, R. M. Wright, and K. Scott.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 81-91, 4 fig, 1 tab, 5 ref.

Descriptors: *Model studies, *Patuxent River, *Urban hydrology, *Urban runoff, *Water quality, *Water quality management, Aeration, Biochemical oxygen demand, Dissolved oxygen, Flow profiles, Management planning, Nitrites, Pollution load, Simulation analysis, Urban watersheds.

The Pawtuxent River flows through heavily urbanized areas, receives effluent from 3 municipal wastewater treatment facilities (WWTFs) and one industrial WWTF, and has summer dissolved oxygen (DO) concentrations well below the 5.0 mg/L standard for much of its length. Data collected during three 48 hour sampling surveys was used to calibrate and validate the QUAL-II model. A review was conducted of the model calibration and validation and it was noted that although biochemical oxygen demand (BOD) decay and nitrification rates were calculated from field data, they varied greatly among surveys for a given reach, and between adjacent reaches. To provide a more defendable wasteload allocation (WLA), the model was recalibrated and revalidated using one set of decay rates which successfully predicted the field data. The data used to revalidate the model was collected during a flow profile very close to the 7Q10 flow and alternative WLA strategies were explored using this model. Flow augmentation, instream aeration, increasing the number of outfalls, and advanced treatment (AT) simulations indicated that discharge limits of BOD 10, NH3 2 mg/L are required to attain the instream DO criteria. Seasonal limits were developed using monthly USGS flow and temperature data. When simulating AT, effluent DO concentrations were set to 6.0 mg/L and instream BOD decay and simulated

gen demand (SOD) rates were reduced. (See W91-01188) (Author's abstract)
1-01197

EQUENCY ANALYSIS OF TRACE LEVEL TER QUALITY DATA WITH A TIME RYING CENSORING LEVEL.
rick and Co., Denver, CO.
primary bibliographic entry see Field 5B.
1-01198

PLICATION OF THE HSPF MODEL TO TER MANAGEMENT IN AFRICA.
versity of the Pacific, Stockton, CA. School of ineering.
primary bibliographic entry see Field 6B.
-01199

LTI-MODEL MICRO-COMPUTER BASED T DETENTION BASIN DESIGN METHOD-OGY.
h Carolina Dept. of Natural Resources and mmunity Development, Raleigh. Div. of Envi-nental Management.
primary bibliographic entry see Field 4C.
-01200

DELING AND FIELD EVALUATIONS OF AN WET DETENTION PONDS.
h Carolina Univ. at Charlotte. Dept. of Civil neering.
primary bibliographic entry see Field 4C.
-01201

ERSHED 89: THE FUTURE FOR WATER LITY IN EUROPE. VOLUME II.
eedings of the IAWPRC Conference held in lford, UK, 17-20 April, 1989. Pergamon New York. 1989. 521p. Edited by D. Wheel-L. Richardson, and J. Bridges.

riptors: *Europe, *Eutrophication, tewater treatment, *Water pollution control, er pollution prevention, *Water quality, al wastes, Enteric bacteria, Groundwater pol-, Models, Path of pollutants, Pesticides, Pol- identification, Potable water, Viruses, Water ion effects.

rshed 89 brought together scientists, engi- environmentalists, industrialists, academia oliticians to provide a forum for a wide range inions concerning water quality in Europe. book contains proceedings from the confer-ponsored by the Commission of the Europe-mmunities, the World Health Organization e International Association on Water Pollu-Research and Control and organized by the s Institute, University of Surrey. A declara-greed upon by conference participants states rofessionals concerned with water quality nade substantial progress since the middle of t century. New problems threatening water have resulted from significant changes in in the last forty years. Problems of mercury olychlorinated biphenyl pollution have been with, but solutions to the other problems, s pesticides, cadmium, eutrophication, enter-ses and parasites will necessitate changing f society's established practices. There is a better anticipate new problems, especially lealing with the extent to which groundwat-ll ultimately become contaminated by sol- metals or other toxic substances, thereby tating the installation of new water treat-echnologies or abandonment of sources. The nce concluded that: (1) water pollution pre- was better than having to rehabilitate pol-vaters, (2) guidelines for water quality must n seriously and enforced, (3) water quality nes must take into account the dissimilar s on human health and the ecology of flora na, (4) research must be coordinated on a l and international level, (5) each citizen of has the right to be adequately informed ning the status and trends of the environ-n relation to human health, (6) all nations ake substantial investments in human re-sources to meet the need for increased monitoring and enforcement of standards and guidelines, and (7) guidelines and regulations are important, but they do not remove the need for political choices. (See W91-01212 thru W90-01255) (Geiger-PTT)
W91-01211

Q2X: AN (EXPERT) SYSTEMS APPROACH TO QUANTITY AND QUALITY MANAGEMENT OF STRATEGIC RESOURCES.
Surrey Univ., Guildford (England). Centre for Information Technology Research.
K. Ahmad.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 129-145, 15 fig, 3 tab, 10 ref.

Descriptors: *Computers, *Expert systems, *Water pollution control, *Water quality, *Water resources management, Computer programs, Management planning, Monitoring, Quality control, Water distribution, Water supply.

Expert systems methods, tools and techniques can help in the acquisition, representation and deployment of knowledge about water quality and quantity, particularly in the design and rehabilitation of sewage systems, control and monitoring of water distribution networks, and in the quality management of water supply systems. The Water Industry Expert Systems Club (WIESC) tackles problems relevant to the United Kingdom water industry. WIESC adopted two expert systems, SERPES and WADNES to handle two water quantity problems, namely the rehabilitation of sewer networks, and water distribution networks, respectively. Face-to-face interviews of the experts were used as the principal knowledge elicitation method. Video-and audio-tape recorders were used to acquire knowledge and subsequently transcribe and analyze the interviews. Prototyping and paper-modelling techniques proved useful in the knowledge acquisition for the expansion and refinement of the implemented systems. The Quantity and Quality Expert System (Q2X) was used to carry out an initial feasibility study for a water utility responsible for supplying quality water to a large town with a time-varying demand profile. The Q2X system comprised six knowledge-bases: monitor quality, reservoir operations, feed-source use, network management, stored water quality management, and financial management. The simulation and modeling programs required for a full-fledged Q2X include: programs to model algal growth, network analysis programs, nitrate transformation programs, optimization programs for efficiently managing pump schedules and costs, and hydraulic performance analysis programs to manage head losses and secondary filter management. The Algae Prediction Expert System (APRES) was developed to demonstrate how expert systems methods and techniques could help to solve algae management problems in reservoirs. (See also W91-01211) (Geiger-PTT)
W91-01213

WATER QUALITY INDEX FOR USE IN THE OPERATIONAL MANAGEMENT OF RIVER WATER QUALITY IN EUROPE.
Middlesex Polytechnic, Enfield (England).
M. A. House.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 159-168.

Descriptors: *Europe, *Pollution index, *Regulations, *Water pollution control, *Water quality, *Water quality management, Biochemical oxygen demand, Monitoring, Nitrates, Public health, Rivers, Toxicity, Water quality standards.

The adoption of a water quality indexing system for the operational management of river water quality provides more detailed information than that of a classification system. The theoretical basis underlying the development of a series of four independent water quality indices involves incorporation of legal water quality standards and criteria and the inclusion of the information on potential water use and toxic determinands directly within their structural format. The General Water Quality Index (WQI) was developed for application within the routine water quality monitoring programs of the United Kingdom water industry. It has a scale of 10-100 and relates changes in water quality to its suitability for use in a range of possible water uses. The Potable Water Supply Index (PWSI) is based on routinely monitored determinands and reflects changes in water quality in terms of its suitability for use in potable water supply. This is similarly the case for the Potable Sapidity Index (PSI) which is based on less frequently monitored toxic determinands such as heavy metals, pesticides and hydrocarbons. The final index, the Aquatic Toxicity Index (ATI), is also based on toxic determinands and reflects water quality in terms of its ability to support healthy fish and wildlife populations. The continuous scale provided by a water quality index allows changes in river water quality to be highlighted. The sub-division of this scale into four water quality and water use categories contains sufficient flexibility to enable information at both government and public levels. (See also W91-01211) (Geiger-PTT)
W91-01215

ECOLOGICAL MONITORING: THE NEED FOR A STANDARD.
Wimpol Ltd., Swindon (England).
R. M. Pagett.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 169-176, 1 fig, 14 ref.

Descriptors: *Benthos, *Bioindicators, *Monitoring, *Water quality standards, Ecology, Mussels, Sampling, Toxicity, Water pollution effects, Water quality.

Studies of benthic organisms as indicators of water quality offer benefits over chemical surveys for determining suitability of bathing water according to EC directives. Monitoring of natural sentinels should give some quantifiable measure of the bioavailability of pollutants and provide a time-integrated value for a given contaminant. When using sentinel organisms such as mussels as bioindicators of pollutants the biological variability of size, age, reproductive condition, gender and seasonality should be considered. Programmable, submersible pump systems incorporating exchange and macroreticular resins (artificial sentinels) may also be used for in situ concentration of contaminants. Sub-lethal techniques may offer insights into toxicity effects that are otherwise difficult to measure by direct toxicity to benthos. The handbooks produced by the International Biological Programme and the Estuarine and Brackish Water Sciences Association provide a useful digest of present approaches and methodologies for benthic survey work and for various ancillary measurements. Legislative measures should be taken to establish a directive for benthic studies to develop standards in using benthos for water quality testing. (See also W91-01211) (Geiger-PTT)
W91-01216

DEVELOPING AN ECONOMIC METHODOLOGY FOR LEGAL PROVISIONS REGULATING GROUNDWATER POLLUTION.
Georgia Univ., Athens. Dept. of Agricultural Economics.
T. J. Centner.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 177-186, 1 fig, 21 ref.

Descriptors: *Groundwater pollution, *Liability, *Pesticides, *Water law, *Water pollution control, Compensation, Legal aspects, Legislation, Model studies, Negligence.

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Liability for groundwater pesticide contamination from the application of pesticides is the focus of debate in recent environmental legislation. Two critical questions accompany the issue of compensation for pollution damage: who should bear losses and how to apportion the losses. To minimize costs, persons may reduce their polluting activities if such is less costly than expected liability costs. The liability models reveal that placement of costs influences the adoption of precautions which in turn affects the amount of a polluting activity. Notwithstanding the fact that it is difficult to delineate a preferred response for all types of pollution, the model and factors concerning groundwater contamination suggest that improvements in efficiency can be achieved through changes in existing liability legislation. In the absence of unilateral precaution, strict liability rules may not offer a very efficient solution. Rather, a liability rule based on negligence may be preferable with private rights of action. Comparative negligence may minimize evidentiary uncertainty and respond to risk aversion, although this depends on the symmetry of precaution. The cheapest cost avoider may impact what type of negligence solution is superior. Alternative suggested solutions involve modifying liability rules or employing property rules to modify entitlements. Legislation has been introduced to change from a strict liability standard to negligence for pesticide application pursuant to label instructions by agricultural producers. Comparative negligence may provide a preferred solution. The second category of response is to modify existing entitlements through new legislation. Special cases involving undeserving victims, small numbers of victims, high victim protection costs, and asymmetrical transaction costs may justify a property rule that shifts an entitlement to agricultural producers who engage in contamination, with victims protected by a liability rule that would allow them to pay the polluter to reduce pollution. However, given the growing concern about groundwater contamination, unknown risks, and externalities, economic incentives such as tradeable permits or pollution charges should be further considered as a component of legislation to respond to problems of nonpoint agricultural pollution. (See also W91-01211) (Geiger-PTT)
W91-01217

WATER QUALITY: THE PUBLIC DIMENSION.
Middlesex Polytechnic, London (England). Flood Hazard Research Centre.
C. H. Green, M. A. House, A. Burrows, and S. M. Tunstall.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 187-195, 1 fig, 2 tab, 18 ref.

Descriptors: *Cost-benefit analysis, *Public opinion, *Public policy, *Rivers, *Water law, *Water pollution control, *Water use, Recreation, Water costs, Water quality.

In the simplest terms, investment to improve river water quality is justified if the value the public puts upon these improvements is less than the cost of the improvements. Indirectly, such improvements may benefit the public by, for example, lowering the treatment costs of abstracted water. However, the major direct uses of river corridors by the public are as recreational resources, as amenities and as a 'psychic' resource. The latter value arises out of any desire by the public to preserve landscapes, flora and fauna. To determine the value that the public places on possible water quality improvements, it is necessary to explore the motives which underlie any public preference for clean rivers; and upon what basis the public perceives water quality, how they judge whether or not a river is polluted. At the same time, a river as a recreational and psychic resource cannot be separated from its context: the river corridor. The value of water quality improvement in part depends upon the value of the river corridor. Studies carried out to date indicate that perceived water quality is judged largely by the presence or absence of obvious signs of pollution, and of fish. Both as a recreational and as a psychic resource river corridors are valued as 'natural' resources: mature landscapes with abundant plants, birds and insect populations and an absence of other visitors are what the people desire of river corridors. (See also W91-01211) (Author's abstract)
W91-01218

IS IT POSSIBLE TO REGAIN AN ECOLOGICAL BALANCE IN A LAKE WITH BLOOMS OF NUISANCE MICROORGANISMS.
National Inst. of Public Health, Oslo (Norway). Dept. of Water and Hygiene.
For primary bibliographic entry see Field 5C.
W91-01220

CLINICAL AND ENVIRONMENTAL EFFECTS OF A MAJOR EMERGENCY INVOLVING PUBLIC WATER SUPPLY.
Robens Inst. of Industrial and Environmental Health and Safety, Guildford (England). Trace Element Lab.
A. Taylor.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 277-282, 2 fig, 6 ref.

Descriptors: *Drinking water, *Emergency planning, *Public health, *Water quality management, *Water treatment, Future planning, Management planning, Networks, Potable water, Water pollution effects, Water supply.

Incidents involving the contamination of drinking water supplies serve to illustrate that arrangements to handle the situation and ensure public health are ineffective or are too limited in scope. Appropriate thought should be given to: (1) dealing with an immediate problem, (2) enlisting the support of those affected, and (3) ensuring that follow-up is properly initiated to benefit all groups involved. Consideration should be given to work before an emergency with prediction of what disasters could take place, how a service would be affected, and the preparation of plans to maintain supplies. Procedures to be adopted in response to an emergency include: the immediate assessments and decisions that need to be made, the announcements and communications with the public, the collection and distribution of information, an assessment of areas of ignorance, and the collection of specimens, measurements, and contact with other interested organizations and institutions. A task force core group composed of water industry representatives, microbiologists, toxicologists, and secretariats should be assembled to meet with advisors and plan a course of action to prevent water pollution incidents and to solve pollution problems in an organized manner should an emergency arise. (See also W91-01211) (Geiger-PTT)
W91-01228

DISINFECTION AND SCREENING OF SEWAGE TO IMPROVE THE QUALITY OF BATHING WATER AT A U.K. SEASIDE RESORT.
Wessex Scientific Services, Bristol (England).Technical Services.
For primary bibliographic entry see Field 5D.
W91-01233

SHORE-BASED MICROBIOLOGICAL SAMPLING OF RECREATIONAL/BATHING WATERS: POSSIBLE PROBLEMS AND SOLUTIONS.
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 5A.
W91-01234

VIROLOGICAL QUALITY OF BATHING WATERS IN ENGLAND.
Severn-Trent Labs., Coventry (England).
For primary bibliographic entry see Field 5B.
W91-01235

WATER QUALITY STANDARDS FOR BACTERIOPHAGES.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
A. H. Havelaar, and M. van Olphen.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 357-366, 2 tab, 16 ref.

Descriptors: *Bacteriophage, *Bioindicators, *Enteroviruses, *Pollutant identification, *Water quality standards, *Water treatment, Chlorination, Coliforms, Disinfection, Ultraviolet radiation, Wastewater treatment.

Waterborne transmission of viruses is now an established fact, and particularly relevant for several viruses causing gastro-enteritis and infectious hepatitis. Water treatment processes must therefore be designed for adequate virus removal. Direct enumeration of relevant viruses is hampered by technical problems, and reliance is based primarily on culturable enteric viruses which can only be assayed in specialized laboratories and in small series. Bacteriophages offer prospects as routinely applicable model organisms. F-specific RNA (FRNA) bacteriophages are proposed as model viruses for process control because effluent chlorination has little effect on these organisms. In addition the FRNA-phages f2 and MS2 are at least as resistant to UV-radiation used in wastewater treatment processes as the human enteric viruses and more resistant than E. coli. FRNA-phages are sewage indicators rather than indicators of pollution by human excreta. In sewage-polluted environments, a relatively constant ratio of FRNA-phages to culturable enteric viruses of 1000:1 is found. More insight in the ecology of the FRNA-phages is needed before general water quality standards can be formulated. (See also W91-01211) (Author's abstract)
W91-01238

INDUSTRIAL EFFLUENTS: MINIMIZING ENVIRONMENTAL IMPACT.
Watson Hawksley, High Wycombe (England).
For primary bibliographic entry see Field 5D.
W91-01246

AGRICULTURE: A POSITIVE CONTRIBUTION TO WATER QUALITY.
Imperial Chemical Industries Ltd., Billingham (England).
A. J. Williams, and B. Livesey.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 455-462, 6 fig, 4 tab, 3 ref.

Descriptors: *Agricultural chemicals, *Crop production, *Fertilizers, *Leaching, *Nitrates, *Nonpoint pollution sources, *Water pollution control, *Water pollution sources, Cereal crops, Cultivation, Manure, Nitrogen, Path of pollutants, Soil contamination, Water quality.

Agricultural land is the major water catchment surface. The intensiveness of the farming practiced influences the nitrate content of both ground and surface water. Recent studies show that the majority of nitrate leached from soil comes not directly from fertilizers but is derived from soil organic matter and the quality of nitrate lost is largely a function of land use. Rotations of crops can be adjusted to give the maximum amount of crop cover. Early sown winter cereals will allow less nitrate loss than spring cereals where the land is likely to be uncropped over the autumn and winter. Crops should be fertilized for a realistic yield so that excess fertilizers are not applied to the soil. Fertilization schedules should be decided upon a field-by-field basis, rather than on a district or whole-farm basis, and the quantity of fertilizer nitrogen should take full account of the quantity of nitrogen available from the soil. A high standard of general crop husbandry should be achieved. Nitrogen fertilizers should not be applied in the autumn

in most situations. Cereal straw should be incorporated wherever possible as the input of carbon helps to mop up nitrates during the critical autumn and winter period. Fertilizers should be applied when the crop is ready to use the nitrogen. Adjusting the timing of cultivations can help to reduce mineralization. Use of ammonium-containing fertilizers combined with a nitrification inhibitor may help to reduce nitrogen release from fertilizers. Problems associated with excessive stocking rates supported by imported feeding stuffs can only be solved by moving manure or by reducing stock rate. There is a need for Pan European research to measure the impact of improved agronomy on the reduction of nitrate losses. (See also W91-01211) (Geiger-PTT)
W91-01249

CONTROL OF NITROGENOUS POLLUTION.
Surrey Univ., Guildford (England). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W91-01250

WATER QUALITY MANAGEMENT IN ISTANBUL: CREATING A CLEANER ENVIRONMENT.
Istanbul Water and Sewerage Administration, Turkey.
A. Damali, H. T. Belek, and D. Orhon.
IN: Watershed 89: The Future for Water Quality in Europe. Volume II. Proceedings of the IAWPRC Conference held in Guildford, UK, 17-20 April, 1989. Pergamon Press, New York. 1989. p 505-514, 6 fig, 4 tab, 7 ref.

Descriptors: *Turkey, *Wastewater treatment, Water pollution control, *Water pollution treatment, *Water quality management, *Water treatment, Estuaries, Monitoring, Sewerage, Wastewater disposal, Water distribution, Water supply.

Efforts to cleanup environmental pollution problems in Istanbul, Turkey are outlined. Under the Istanbul Water and Sewerage Administration Act number 2560, the responsibility for pollution control rests with the Istanbul Water and Sewerage Administration. In 1984, this agency undertook the restoration of the Golden Horn estuary which was polluted from untreated discharges of municipal and industrial wastewater. Together with massive relocation of industries and the environmental rearrangement of the shorelines, a new plan was put into action to collect all wastewater generated in this area away from the Golden Horn and channel them to wastewater treatment plants. In stage 2 of the wastewater management plan, two major biological treatment works and outfalls were designed at Kucukcekmece and Tuzla. To reduce industrial discharges, pretreatment conditions were specified in relation to the characteristics of each wastewater collection zone and set limits were imposed on wastewater discharges. To balance water sapply with water demand, elaborate schemes involving a number of dams and pipelines under the Bosphorus interconnecting the Asian and the European sides of the city were implemented to provide water for a population of nearly 7 million. In 1987, a Regional Supervisory and Data Acquisition system was planned to monitor and control all the water transmission and distribution facilities within the Greater Istanbul Area. Measures were taken to prohibit all industrial activity with polluting potential in the protection areas defined around surface water resources. (See also W91-01211) (Geiger-PTT)
W91-01254

ADSORPTION OF ODOR SUBSTANCES FROM WATER BODIES TO THE ATMOSPHERE.
Fukuoka Prefecture Environmental Science Inst., Chikushino (Japan).
T. Tsuji, T. Nakano, and T. Okuno.
Atmospheric Environment ATENBP, Vol. 24A, No. 8, p 2019-2021, August 1990. 2 fig, 3 tab, 7 ref.

Descriptors: *Desorption, *Odor control, *Pollution identification, *Wastewater treatment, Air pollution, Ammonia, Dimethyl sulfide, Hydrogen sulfide, Japan, Methylmercaptan, Regulations, Trimethylamine, Water treatment.

The Control of Offensive Odor Law of Japan was established in 1971. Five odor substances were stipulated in the Law. The regulatory standards for odor substances consist of the following three items: (1) Regulation applied at the boundary line of the sites; (2) Regulation at the gas emission facilities; and (3) Regulation for the wastewater. The regulation standards for odor substances on the boundary line were decided according to the odor intensity of 2.5 and 3.5 of a five step scale. A method was developed for the evaluation of odor pollution caused by wastewater. Two standard analytical procedures were applied to the determination of odor substances in water: head space analysis and the purge-trap method. Henry's constants for five odor substances (hydrogen sulfide, methylmercaptan, dimethyl sulfide, ammonia and trimethylamine) were measured at several conditions of pH and equilibrium temperature, and were used for the estimation of odor emissions from wastewater. The concentration of odor substances that include partial dissociated compounds in water can be measured by head space analysis or the purge trap method. Concentrations above the effluent are related to the flux of odor substances from the water phase. (Lantz-PTT)
W91-01282

ACID RAIN AND PHOTOCHEMICAL OXIDANTS CONTROL POLICIES IN THE EUROPEAN COMMUNITY: A DECISION ANALYSIS FRAMEWORK.
Environmental Resources Ltd., London (England).
S. Bell, K. Raymond, S. Watson, and P. Wenman.
Atmospheric Environment ATENBP, Vol. 24A, No. 8, p 2253-2262, August 1990. 3 fig, 4 tab, 1 ref.

Descriptors: *Acid rain, *Decision making, *Environmental protection, *Europe, *Public policy, Air pollution, Cost-benefit analysis, Lakes, Model studies, Ozone, Urban areas.

The methodology and key findings are presented of a study to evaluate costs and benefits of alternative acid rain control strategies to be implemented at a European Community level between 1980 and 2000. The methodology adopted was decision analysis, whose key advantage is an explicit consideration of uncertainty. Benefits predicted under some of the control strategies were found to be significantly greater than those predicted for the 'no control' case, particularly for lakes. Urban environmental quality was only expected to improve greatly under the strategy that specifically targeted urban emissions. Predictions for crops and forests were relatively uncertain due to inadequacies in the measurement and modeling of ozone. (Author's abstract)
W91-01290

FIELD EVALUATION OF IN-SITU BIODEGRADATION OF CHLORINATED ETHENES: PART 2, RESULTS OF BIOSTIMULATION AND BIOTRANSFORMATION EXPERIMENTS.
Stanford Univ., CA. Dept. of Civil Engineering.
L. Semprini, P. V. Roberts, G. D. Hopkins, and P. L. McCarty.
Ground Water GRWAAP, Vol. 28, No. 5, p 715-727, September/October 1990. 10 fig, 5 tab, 40 ref. EPA Contract CR-812220.

Descriptors: *Biodegradation, *Biological treatment, *Chlorinated hydrocarbons, *Cleanup, *Fate of pollutants, *Methane bacteria, *Site remediation, *Water pollution treatment, Dichloroethylene, Land disposal, Methane, Oxygen, Trichloroethylene, Vinyl chloride.

Results are presented from a field study that document the in-situ biotransformation of trichlorethylene (TCE), cis-dichlorethylene (cis-DCE), trans-dichloroethylene (trans-DCE), and vinyl chloride (VC) in a saturated, semiconfined aquifer. The enhanced biotransformation was accomplished by stimulating the growth of indigenous methane-oxidizing bacteria (methanotrophs) which transform chlorinated aliphatic compounds by a cometabolic process to stable, nontoxic end products. Experiments were performed in the presence and absence of biostimulation by means of controlled chemical addition, frequent sampling, and quantitative analysis. Biostimulation and biodegradation experiments conducted demonstrated that: (1) A specific class of microorganisms, the methanotrophs which are indigenous to the subsurface environment, can be successfully biostimulated to promote the degradation of certain chlorinated aliphatic compounds; (2) Partial transformation of VC, 90 to 95%; trans DCE, 80 to 90%; cis-DCE, 45 to 55%; and TCE, 20 to 30%, occurred over a relatively short flow path of one to two meters in a field test with fluid residence times of one to two days; (3) The rate of biotransformation was dependent on the structure of the chlorinated organic compounds, with less chlorinated compounds more rapidly transformed; (4) An intermediate transformation product, trans-DCE oxide, was produced and resulted from trans-DCE oxidation, which is consistent with the proposed transformation pathway; and (5) Active utilization of methane in the test zone was required for chlorinated aliphatic biotransformation to occur. Field experiments confirmed the existence of a natural population of methane oxidizers that could be stimulated by introducing methane and oxygen. (Lantz-PTT)
W91-01299

SHORT TERM BIOTIC RESPONSE BEFORE AND DURING THE TREATMENT OF AN ACID MINE DRAINAGE WITH SODIUM CARBONATE.
Q.C. Services, Teton, ID.
W. D. Skinner, and D. E. Arnold.
Hydrobiologia HYDRB8, Vol. 199, No. 3, p 229-235, July 31, 1990. 2 fig, 5 tab, 7 ref.

Descriptors: *Acid mine drainage, *Acid streams, *Pennsylvania, *Sodium carbonate, *Water pollution effects, *Water pollution treatment, Aquatic insects, Colonization, Hydrogen ion concentration, Mayflies, Species distribution, Species diversity, Trout.

The lower portion of Upper Three Runs, a woodland stream in central Pennsylvania, receives acid drainage from a strip mine. In 1974, the effect of this input on pH and benthic invertebrates was studied. The same stations were again sampled in 1986 and the mine drainage was then treated with sodium carbonate for seven days in an effort to evaluate the short term colonization response of brook trout (Salvelinus fontinalis) and invertebrates. No differences in the pattern of pH and invertebrate distribution was found between the 1974 and 1986 results, although pH values and invertebrate densities were higher in 1986. Total number of invertebrates and number of taxa colonizing bricks during three pre-treatment time periods (8, 10, 18 days) did not differ from the single treatment period (7 days). However, two species of Baetis (Ephemeroptera: Baetidae) did increase in the treatment section during sodium carbonate application. The number of brook trout also increased in the treatment section, as compared to one pre-treatment estimate. These results indicate that motile species are able to respond within seven days, whereas, longer treatment may be required to produce community wide responses. (Author's abstract)
W91-01358

WHAT SHOULD BE DONE TO MITIGATE GROUNDWATER CONTAMINATION.
Academy of Natural Sciences of Philadelphia, PA.
R. Patrick.
Environmental Health Perspectives EVHPAZ, Vol. 86, p 239-243, June 1990. 9 ref.

Descriptors: *Environmental protection, *Fate of pollutants, *Groundwater pollution, *Path of pollutants, *Policy making, *Water pollution control, *Water pollution prevention, *Water pollution treatment, Environmental policy, Hazardous wastes, Management planning, Public health, Public policy, Technology, Waste containment.

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Groundwater contamination is a serious problem that is growing in the US, but its true extent is not known and it is difficult to determine because of the complexities of contaminants, their transformation, and fate in groundwater systems. It is also difficult to predict their movement in groundwater. Since it is known that the problem is serious and that the need for groundwater will grow, the mitigation of groundwater contamination, despite its high cost, is necessary. Furthermore, it is difficult to predict effects on human health because they have not been defined for many of the chemicals. Antagonism and synergistic effects of interacting chemicals have not been determined because they are complicated by many factors, such as volatile compounds. The effects of leachates in groundwaters entering streams on the riverine environment and aquatic life have not been determined. Successful mitigation requires: (1) determining which microbial and chemical contaminants are the most serious threat to human health; (2) developing the technology to biologically, chemically and physically transform hazardous waste into nonhazardous materials; (3) developing the technology to properly contain hazardous materials; and (4) developing the technology to remediate contamination and determine the effects of those hazardous materials on soils and water microorganisms and macroorganisms. The challenge is how to immobilize or destroy groundwater contaminants so that they will not enter groundwater, or if they enter groundwater, are confined and destroyed. (Author's abstract)
W91-01374

SOME PUBLIC ATTITUDES ABOUT HEALTH AND THE ENVIRONMENT.
Roper Organization, Inc., New York.
For primary bibliographic entry see Field 6B.
W91-01377

SITE SEWAGE DISPOSAL: THE IMPORTANCE OF THE WET SEASON WATER TABLE.
Illinois Univ., Urbana. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W91-01379

WETLAND IDENTIFICATION: A MEANS TO PREVENT POTENTIAL PUBLIC HEALTH PROBLEMS.
Enviram Environmental Consultants, Middlesex, NJ.
For primary bibliographic entry see Field 2H.
W91-01380

BUFFERING CAPACITY OF COAL MINE SPOILS AND FLY ASH AS A FACTOR IN THE PROTECTION OF THE AQUATIC ENVIRONMENT.
Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.
I. Twardowska.
Science of the Total Environment STENDL, Vol. 91, p 177-189, February 1990. 4 fig, 2 tab, 14 ref.

Descriptors: *Acid mine drainage, *Aquatic environment, *Buffering, *Coal mining effects, *Fly ash, *Mine wastes, *Water pollution control, Alkalinity, Buffer capacity, Calcium carbonate, Chemical analysis, Electric powerplants, Hydrogen ion concentration, Industrial wastes, Leachates, Magnesium carbonate, Path of pollutants, Poland, Thermal powerplants, Waste treatment, Water pollution sources.

Carboniferous rocks and colliery spoil samples representing all the stratigraphic series of the coal-bearing formation of the Upper Silesian coal basin (USCB) in Poland, as well as the drainage from the spoil tips were examined with respect to the contamination potential of colliery spoils as a function of the balance between the buffering and acid generation capacities. The susceptibility of spoils and leachates to acidification was estimated experimentally. Coal mine spoils show different buffering rates and compositions of buffering constituents. In general, for the spoils of the USCB, magnesium carbonate concentrations exceed calcium carbonate content in terms of equivalent units. The system is low-buffered and may produce strongly acidic, high sulfate, total dissolved solids and heavy metal drainage if its buffering rate is < 1.5. The buffering rate of freshly-produced spoils is > 2.4 and guarantees the permanent alkaline or neutral reaction of spoils and leachates. Fly ash from coal-fired thermal power stations contains considerable amounts of buffering calcium constituents, which minimize the solubility of neutralization products. Data obtained for representative samples of such fly ash indicate that an effective increase of buffering capacity of low-buffered colliery spoil, and hence a significant abatement of water contamination, could be achieved by means of controlled placing of fly ash layers in the colliery tip during its construction. This has been confirmed by a successful joint deposition of colliery spoil and fly ash over a 16-year period at Przezchlebie in the USCB. (Hoskin-PTT)
W91-01455

WILLINGNESS TO PAY FOR GROUNDWATER PROTECTION.
New Hampshire Univ., Durham. Dept. of Resource Economics and Community Development.
S. D. Shultz, and B. E. Lindsay.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 1869-1875, September 1990. 3 tab, 34 ref. New Hampshire Agricultural Experiment Station Project H-337, Scientific 1643.

Descriptors: *Benefits, *Groundwater quality, *Public opinion, *Water pollution prevention, *Water quality control, Cost allocation, Economic aspects, New Hampshire, Payment, Public policy, Water policy, Water resources management.

To determine the willingness to pay (WTP) for a hypothetical groundwater protection plan in Dover, New Hampshire, a mail contingent valuation survey was conducted. The median WTP value among Dover residents was estimated to be $40 per household, and the community WTP value was estimated to be at least $100,000 annually for a groundwater protection plan. The assessed land values of respondents as well as their incomes were shown to positively influence their WTP values, while their ages had a negative influence on WTP. A variety of other socioeconomic variables, such as respondents assessed house values, the number of years they lived in the community, their knowledge of past groundwater problems and causes, their education, sex, and whether they had children living at home, were shown to have no influence on individuals WTP for groundwater protection. This research illustrates a methodology that other researchers, and water resource managers can use to estimate the value which people place on various water resources and can help to predict whether water policies and projects will be accepted by the public. (Peters-PTT)
W91-01507

MULTIDIMENSIONAL SIMULATION APPLIED TO WATER RESOURCES MANAGEMENT.
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
For primary bibliographic entry see Field 6B.
W91-01508

EXPERIENCE IN OPERATING ECOLOGICALLY CLEAN TURBINES.
For primary bibliographic entry see Field 8C.
W91-01543

COASTAL ZONE MANAGEMENT IN BRITISH COLUMBIA: AN INSTITUTIONAL COMPARISON WITH WASHINGTON, OREGON, AND CALIFORNIA.
Simon Fraser Univ., Burnaby (British Columbia). Natural Reource Management Program.
For primary bihliographic entry see Field 6E.
W91-01618

POISON RUNOFF: NEW ANSWERS TO A PERVASIVE PROBLEM.
Natural Resources Defense Council, Inc., Washington, DC.
P. Thompson.
Environmental Forum ENVFEN, Vol. 6, No. 4, p 5-11, July/August 1989. 3 fig.

Descriptors: *Nonpoint pollution sources, *Path of pollutants, *Pollution load, *Runoff, *Waste load allocation, *Water pollution control, *Water quality management, Administrative regulations, Agricultural runoff, Environmental protection, Management planning, Regulatory agencies, Sediments, United States, Urban runoff, Water quality, Watershed management.

Known for years by the 1972 Clean Water Act title 'nonpoint source pollution', contaminated runoff from farms and urban areas is a dominant source of water pollution. Studies have shown that 65% of river water impairment and 75% of lake water impairment is caused by poisoned runoff form a variety of sources. Sediment is the single largest type of nonpoint source pollution. The barriers to controlling poison runoff include insufficient technical capabilities, the public's failure to perceive the problem, and lack of political resolve to pursue the problem. Recommendations for solving the poison runoff problem require improvement of technical knowledge, increasing public awareness, and implementation of a water quality based approach at the state level. Establishment of total maximum daily load standards for key pollutants provides a goal-oriented framework for implementing best management practices. Model land use and watershed management programs have been initiated by some state and local governments, including 'Load Allocations' for polluted rivers and waterbodies developed by Oregon. It is suggested that the role of the EPA be expanded beyond its present one of technical assistance to enforce a set of minimum criteria by which to judge the adequacy of state programs. (MacKeen-PTT)
W91-01623

FEDERAL AND STATE ROLES IN ENVIRONMENTAL ENFORCEMENT: A PROPOSAL FOR A MORE EFFECTIVE AND MORE EFFICIENT RELATIONSHIP.
Minnesota State Government, St. Paul.
H. H. Humphrey, and L. C. Paddock.
Harvard Environmental Law Review HELRDC, Vol. 14, No. 1, p 7-45, 1990. 186 ref.

Descriptors: *Environmental protection, *Federal jurisdiction, *Legal aspects, *State jurisdiction, *Water pollution control, *Water quality management, Administrative agencies, Enforcement, Institutions, United States.

The allocation of environmental enforcement responsibility between the state and federal government has varied dramatically in different statutory programs enacted over the past twenty years. A significant expansion of the federal role in water pollution control occurred with the passage of the Clean Water Act in 1972. The Safe Drinking Water Act (1982), which regulates the quality of public drinking water systems and the underground injection of contaminants, further expanded federal enforcement authority. Beginning in the mid-1980s, the trend toward federalizing environmental enforcement began to change. The three newest federal environmental programs, the Hazardous and Solid Waste Amendments of 1984 to the Solid Waste Disposal Act, the Emergency Planning and Community Right-to-Know Act of 1986, and the Medical Waste Tracking Act of 1988, all provide for a much stronger state enforcement role. It was recommended that a set of principles for allocating enforcement responsibilities to states and the federal government include the following: (1) States should adopt their own regulatory and enforcement authority to support federal regulatory programs that a state chooses to manage; (2) EPA should ensure a state has developed and has authority to implement a reasonable enforcement strategy before authorizing a state to enforce a federal program; (3) Once a state has been authorized to carry out a federal program, most cases should be handled without EPA inter-

vention; (4) EPA should retain authority to bring enforcement actions in cases involving significant interstate pollution; (5) States should be able to refer certain enforcement cases to EPA; (6) Systems used to account for progress in enforcement should be based on state strategies and designed to encourage innovation by states; and (7) EPA should maintain a credible threat to withdraw authority from states whose implementation of federal programs is consistently inadequate. (MacKeen-PTT)
W91-01624

LIABILITY FOR DAMAGES ARISING FROM AN OIL SPILL.
Exxon Co. USA, Houston, TX.
L. D. Schenke.
Natural Resources & Environment NRENEL, Vol. 4, No. 4, p 14-16/52-54, Spring 1990.

Descriptors: *Judicial decisions, *Legal aspects, *Liability, *Oil pollution, *Oil spills, Administrative agencies, Clean Water Act, Damage, Federal jurisdiction, Legislation, Natural resources, United States.

The Federal Water Pollution Control Act, also known as the Clean Water Act (CWA), provides for the recovery of damages to natural resources in behalf of the public arising from the release of oil. CWA creates liability for certain costs resulting from an oil spill, including damages to natural resources. The natural resource damage provisions of CWA lay dormant until the passage of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), commonly known as superfund. The recent appellate court decision in Ohio v. Department of Interior (DOI) further complicates a clear definition of liability, but brings the focus back to the statutory language of CWA. Several principles are apparent from that decision itself and earlier cases: restoration must take into account the elements of natural recovery and the restoration must be technically feasible and cost-effective. The government is limited in its recovery to resources that are owned by the public at large, and by the long-standing common law prohibiting double counting. Moreover, the statutory goal is of a compensatory rather than a punitive nature. These are the guidelines, together with the holdings in Ohio v. DOI, that will shape future considerations of this issue by DOI and the courts. (MacKeen-PTT)
W91-01627

COMPARATIVE ANALYSIS OF STATE ENVIRONMENTAL POLICY.
Colorado State Univ., Fort Collins. Dept. of Political Science.
For primary bibliographic entry see Field 6G.
W91-01630

CITIZEN ENFORCEMENT OF CLEAN WATER ACT VIOLATIONS; THE SUPREME COURT STEERS A NEW COURSE OVER MUDDIED WATERS; GWALTNEY OF SMITHFIELD, LTD. V. CHESAPEAKE BAY FOUNDATION, INC.
For primary bibliographic entry see Field 6E.
W91-01634

INTEGRATION OF LONG-TERM FISH KILL DATA WITH AMBIENT WATER QUALITY MONITORING DATA AND APPLICATION TO WATER QUALITY MANAGEMENT.
Gast, Buckley, Schuh and Jernigan, Inc., Columbia, SC.
For primary bibliographic entry see Field 5C.
W91-01635

PROPOSED EPA SLUDGE DISPOSAL REGULATIONS: PROJECT PURGATORY.
CDM Engineers, Inc., Plymouth Meeting, PA.
For primary bibliographic entry see Field 5E.
W91-01676

REGIONAL OVERVIEW OF WATER QUALITY MONITORING.
For primary bibliographic entry see Field 6B.
W91-01680

NITRATES IN GROUND WATER.
For primary bibliographic entry see Field 5B.
W91-01681

EFFECT OF ENVIRONMENTAL STORAGE CONDITIONS ON THE ORGANIC CONTENT OF SIMULATED COAL LEACHATES.
Maryland Univ., Solomons. Chesapeake Biological Lab.
N. J. Fendinger, J. C. Radway, and J. H. Tuttle.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 19, No. 2, p 249-256, March/April 1990. 3 fig, 4 tab, 16 ref. Maryland Department of Natural Resources Grant P97-84-04.

Descriptors: *Biodegradation, *Coal mines, *Coal storage, *Leachates, *Mine drainage, *Path of pollutants, *Water pollution control, *Water pollution sources, Bacteria, Hydrocarbons, Lime, Organic carbon, Oxygen, Temperature.

Simulated coal leaching experiments were conducted at 25 C and 7 C, after lime treatment, and under reduced oxygen tension. Leachate from coal stored at lower temperatures, reduced oxygen, and higher pH values with lime, had lower conductivities, and lower concentrations of dissolved organic carbon (DOC) and total organic carbon (TOC) than leachates from coal stored at higher temperatures and/or oxygen rich conditions. The leaching of DOC was found to be related to acid production by chemoautotrophic bacteria. Lower concentrations of DOC in leachates from coal treated with lime can be attributed to neutralization, subsequent decreased production of acidity by autotrophic bacteria, and the utilization of DOC by heterotrophic bacteria. Concentrations of aliphatic and aromatic hydrocarbons associated with the liquid fraction of leachates were not influenced by temperature or reduced oxygen concentration. Changes in the aliphatic hydrocarbon content of the coal leachates are related to metabolism by heterotrophic bacteria and/or to decreased acidity. (Author's abstract)
W91-01689

GEOTEXTILES AS SEALING LINERS FOR EARTHEN MANURE RESERVOIRS: PART 1, GEOTEXTILE POROSITY.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
S. F. Barrington, S. O. Prasher, and R. J. Raimondo.
Journal of Agricultural Engineering Research JAERA2, Vol. 46, No. 2, p 93-103, June 1990. 5 fig, 8 tab, 9 ref.

Descriptors: *Geotextiles, *Liners, *Manure, *Materials testing, *Porosity, *Waste storage, *Water pollution control, Infiltration, Performance evaluation, Permeability, Pressure head.

The development of an inexpensive but durable sealing liner is required for earthen manure storage facilities built of coarse sand or gravel. Fine porosity geotextiles can be used for this purpose, because manures seal media of small pore size. Non-woven geotextiles of 20, 30 and 40 micrometers in equivalent porosity were subjected to pressure heads of 0.9, 1.8, and 2.7 m of swine slurry for 1800 h. Infiltration rates decreased from 0.05 mm/sec to <0.1 and 0.02 microm/s within 150 and 1000 h, respectively. Although some of the experimental combinations gave significantly higher infiltration rates, all geotextiles demonstrated minimum seepage rates ranging from 1.3 m/s to 1.8 Nm/s after 100 to 1400 h. In all cases, seepages were highly contaminated. Highest chemical oxygen demand levels were observed for the 2.7 m heads as well as the 20 micrometer fabric. This 20 micrometer fabric produced significantly higher infiltration rates, probably because of its lower permeability which encourages a less compact manure seal at its surface. (See also W91-01701) (Author's abstract)
W91-01700

Water Quality Control—Group 5G

GEOTEXTILES AS SEALING LINERS FOR EARTHEN MANURE RESERVOIRS: PART 2, SEALING MECHANISMS.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
S. F. Barrington, S. O. Prasher, and R. J. Raimondo.
Journal of Agricultural Engineering Research JAERA2, Vol. 46, No. 2, p 105-112, June 1990. 2 fig, 6 tab, 13 ref.

Descriptors: *Geotextiles, *Liners, *Manure, *Materials testing, *Waste storage, *Water pollution control, Canada, Infiltration, Permeability, Porosity, Solids, Temperature.

Field sealing of geotextile liners for earthen manure reservoirs was verified in the laboratory. A fabric of 20 micrometers in equivalent porosity was subjected to swine slurries of various total solid (TS) levels as well as sterilized and natural 5% TS swine slurries. The infiltration tests indicated that satisfactory clogging of the fine porosity geotextile requires swine slurries of minimum TS content of 4%. Furthermore, higher TS levels guarantee a longer lasting manure seal at the fabric surface. Sterilized manure was used to produce the cool field conditions found in Canada, where manure remains at temperatures of 5-10 C throughout most of the year. Under such conditions biological sealing mechanisms are almost nonexistent. The manure mat retained its impermeability under conditions of sterilization while the natural manure mat demonstrated an increase in infiltration after 1000 h. This gain in manure mat permeability can be attributed to the microbial degradation of manure solids. (See also W91-01700) (Author's abstract)
W91-01701

RESPONSES OF PLANKTON AND NUTRIENTS TO METHYLENE BLUE-PHOTOSENSITIZED LAKE RESTORATION.
Nevada Univ., Reno. Dept. of Civil Engineering.
R. J. Watts, and R. H. French.
Chemosphere CMSHAF, Vol. 20, No. 6, p 663-671, 1990. 9 fig, 13 ref. U.S. EPA Assistance Agreement R811124-01.

Descriptors: *Lake restoration, *Methylene blue, *Nutrients, *Photolysis, *Plankton, *Water pollution treatment, Algae, Algal blooms, Bacteria, Chlorophyta, Cyanophyta, Diatoms, Eutrophic lakes, Lakes, Nitrogen, Phosphorus, Trophic level, Viruses.

The use of sensitized photolysis has been proposed as an improved lake restoration method. Methylene blue is a sensitizer; in the presence of 500 to 700 nm light it is excited to a triplet state. A primary target of the triplet energy is molecular oxygen, which is excited to singlet oxygen. Singlet oxygen is toxic to bacteria, viruses, and algae, and serves as the basis for treating algal blooms. Sections of eutrophic Lahontan Reservoir, Nevada were isolated using in situ microcosms and treated with 1.0 mg/L methylene blue to assess its effectiveness for lake restoration. Green algae (Chlorophyta) and diatom (Bacillariophyceae) levels decreased significantly with one day of treatment; however, blue-green algae (Cyanophyta) levels did not decline. Nitrogen and phosphorus concentrations did not increase after photochemical treatment over the 10-day study period. It is concluded that the use of methylene blue for lake restoration may therefore be ineffective in treating blue-green algae, the group which often causes the most problems in eutrophic systems. (Agostine-PTT)
W91-01736

SOIL CLEAN UP BY IN-SITU AERATION: V. VAPOR STRIPPING FROM FRACTURED BEDROCK.
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
D. J. Wilson.
Separation Science and Technology SSTEDS, Vol. 25, No. 3, p 243-262, 1990. 11 fig, 4 tab, 23 ref.

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Descriptors: *Aeration, *Bedrock, *Cleanup operations, *Mathematical models, *Soil contamination, *Vapor stripping, *Water pollution treatment, Diffusion, Model studies, Transport, Ventilation.

A mathematical model for soil vapor stripping is presented which permits one to model vapor stripping from porous fractured bedrock, where one cannot make the assumption of local equilibrium between the stationary condensed phase and the moving vapor phase with respect to contaminant transport. Models for lab column operation and field operation of a vapor stripping well are presented. A lumped parameter approach is used to handle the kinetics of diffusion of the volatile contaminant from the interiors of the bedrock out to the moving soil gas. A method for estimating the time constant for this diffusion transport is presented and the effects of the time constant on the performance of vapor stripping operations are assessed. Increasing the diffusion time constant results in reduced removal rates. The effects of impermeable circular caps on vapor stripping wells with and without passive vent wells are examined. A moderate improvement in contaminant removal rate with increasing cap radius is seen in systems without passive vent wells. In the absence of a cap the presence of passive wells decreases the contaminant removal rate. In the presence of a cap the presence of passive wells increases the removal rate by 20%. These results suggest that the use of passive wells when one is vapor stripping underneath impermeable surfaces may be moderately advantageous. (See also W90-11832) (Agostine-PTT)
W91-01756

WELL LOCATION IN CAPTURE ZONE DESIGN USING SIMULATION AND OPTIMIZATION TECHNIQUES.
Connecticut Univ., Storrs. Environmental Research Inst.
D. P. Ahlfeld, and C. S. Sawyer.
Ground Water GRWAAP, Vol. 28, No. 4, p 507-512, July/August 1990. 6 fig, 1 tab, 12 ref.

Descriptors: *Flow models, *Groundwater pollution, *Model studies, *Site remediation, *Water pollution treatment, Aquifers, Cleanup, Costs, Economic aspects, Linear programming, Pump wells.

The utility of a groundwater simulation model in combination with numerical optimization to provide guidance for proper siting of extraction wells for aquifer remediation was examined. By mathematically defining design criteria, the analyst can directly determine the pump locations and pumping rates which minimize the operational cost of the remediation system. By varying the parameters of the optimization model and comparing the resulting solutions, inferences can be drawn about aspects of remediation. For an example problem, providing greater choice of the location of the wells produced a 37% reduction in pumping cost. Careful selection of well position in an aquifer cleanup can make a major difference in the total pumping cost when considering containment of the contaminant and subsequent cleanup. (Author's abstract)
W91-01778

NATURAL BIOREMEDIATION OF ORGANIC CONTAMINANTS IN GROUND WATER: CLIFFS-DOW SUPERFUND SITE.
Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab.
For primary bibliographic entry see Field 5B.
W91-01782

GROUND-SURFACE DELINEATION OF FRACTURES OVER MINED-OUT OPENINGS USING CARBON DIOXIDE EMISSIONS.
Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
F. E. Kirschner, R. E. Williams, and D. R. Ralston.
Ground Water GRWAAP, Vol. 28, No. 4, p 576-583, July/August 1990. 7 fig, 1 tab, 35 ref. Bureau of Mines Cooperative Agreement No. CO278001.

Descriptors: *Acid mine drainage, *Carbon dioxide, *Geologic fractures, *Groundwater flow, *Groundwater recharge, *Grouting, *Water pollution control, *Water pollution sources, Path of pollutants, Soil gases.

Subsurface conduits or zones of hydrogeologic discontinuities that connect mined-out areas in the subsurface through the unsaturated zone to the ground surface of the study area of the Bunker Hill Mine located in Kellogg, Idaho, are amenable to detection by the probe extracted static grab sample/onsite analysis method when the appropriate conditions exist. The method is: cost effective; time-efficient; noninvasive; relatively precise; and relatively easy to use. Four discrete CO(2) anomalies are interpreted to identify four structurally created pathways for groundwater recharge. The high CO(2) concentration zone that is associated with the mappable fault appears to be discrete even though the hanging wall of this fault is a fracture zone, not an absolute plane. The area must be capped or otherwise treated and selective grouting is not justifiable for infiltration control. (Miller-PTT)
W91-01787

FIELD EVALUATION OF IN-SITU BIODEGRADATION OF CHLORINATED ETHENES: PART I, METHODOLOGY AND FIELD SITE CHARACTERIZATION.
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, G. D. Hopkins, D. M. Mackay, and L. Semprini.
Ground Water GRWAAP, Vol. 28, No. 4, p 591-604, July/August 1990. 12 fig, 6 tab, 29 ref. EPA Cooperative Agreement No. CR-812220.

Descriptors: *Biodegradation, *Chlorinated hydrocarbons, *Field tests, *Groundwater pollution, *In situ treatment, *Site remediation, *Tracers, *Water pollution treatment, Aquifers, Automation, California, Chlorinated ethenes, Data acquisition, Military reservations, Mountainview, On-site data collections, Organic solvents, Water pollution abatement.

The conditions at the Moffet Naval Air Station, Mountainview, California site proved to be favorable for a quantitative evaluation of in-situ aquifer restoration by enhanced biodegration. Bromide tracer tests revealed travel times of 8 to 27 hours from the injection well to the various monitoring wells and 20 to 42 hours from the injection well to the extraction well. Complete breakthrough of the tracer at the monitoring wells was facilitated by choosing a line of wells aligned with the regional flow and selecting injection and extraction flow rates of approximately 1.5 and 10 liters/min. Transport studies were conducted with selected halogenated organic compounds. The retardation factors ranged from 2 to 12. The breakthrough responses for the more strongly absorbing compounds, e.g. trichloroethylene, exhibited pronounced tailing, such that a minimum period of several weeks was required to achieve complete saturation of the aquifer. The microcomputer-driven sampling, analysis and data management system provided automated data acquisition at sample intervals of 40 minutes with coefficients of variation smaller than 20% and allowed for real-time surveillance of the dynamic responses. (Author's abstract)
W91-01789

DECREASING CHLORIDE TRENDS OBSERVED AT LAKE ERIE MUNICIPAL WATER INTAKES.
Lake County Dept. of Health, Waukegan, IL.
R. S. Whyte, J. H. Hartig, and G. J. Hopkins.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 2, p 233-240, 1990. 2 fig, 3 tab, 22 ref.

Descriptors: *Chlorides, *Lake Erie, *Pollution load, *Statistical analysis, *Water pollution control, Time series analysis.

Using available chloride data collected from seven municipal intakes drawing water from Lake Erie, linear trend analyses were performed to elucidate trends between the late 1960's and the early 1980's. Both seasonality and autocorrelation of the data were considered. Seasonality did not appear to significantly affect the trend. By removing the effects of autocorrelation more efficient estimates of the regression parameters were obtained and the achieved level of significance was considered valid. A decreasing chloride trend was found for all municipal intakes examined in the study. The rate of chloride decrease ranged from 0.47 to 0.88 mg/L/yr (mean:0.7 mg/L/yr). This decreasing chloride trend in Lake Erie is believed to be the result of reduced loadings resulting from point source controls and the cessation of certain industrial operations which historically discharged high chloride loadings. (Author's abstract)
W91-01793

EXPERIMENTAL USE OF DIALYSIS CHAMBER ARRAYS TO STUDY P-FLUXES IN THE BAY OF QUINTE, 1987.
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W91-01796

VOLATILIZATION OF SELENIUM FROM AGRICULTURAL EVAPORATION POND SEDIMENTS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
U. Karlson, and W. T. Frankenberger.
Science of the Total Environment STENDL, Vol. 92, p 41-54, March 1990. 3 fig, 4 tab, 27 ref.

Descriptors: *Biodegradation, *Decontamination, *Farm wastes, *Fate of pollutants, *Microbial degradation, *Sediment contamination, *Selenium, *Volatility, Agricultural chemicals, Agricultural runoff, Agricultural watersheds, Chitin, Evaporation ponds, Farm ponds, Manure, Microorganisms, Organic carbon, Organic nitrogen, Sediment analysis.

Microbial volatilization of Se was evaluated as a means of detoxifying Se-contaminated sediments. Sediment samples containing 60.7 mg Se/kg (Kesterson Reservoir) and 9.0 mg Se/kg (Peck ponds) were incubated for 273 days in closed systems located in the greenhouse. Various organic and inorganic amendments were tested for their capacity to enhance the microbial process, including Citrus (orange) peel, Vitis (grape) pomace, feedlot manure, barley straw, chitin, pectin, ZnSO4, (NH4)2SO4, and an inoculum of Acremonium falciforme (an active Se methylating fungus). With the Kesterson sediment, the highest Se removal resulted from the combined application of citrus peel and ZnSO4, followed by the citrus peel alone, and citrus peel combined with ZnSO4, (NH4)2SO4 and A. falciforme. Manure, pectin, chitin, and straw plus N had less pronounced effects. Without the amendments, cumulative Se volatilization was 6.1% of the initial inventory. Grape pomace inhibited the process. With the Peck sediment, the highest amount of Se removed was observed with chitin, manure, and citrus peel alone. Without amendments, 14% of the native Se was volatilized in 273 days. Pectin, straw plus N, and grape pomace were among the less effective amendments for the Peck sediments. The differences in the effectiveness of each treatment between the two seleniferous soils may be a result of the residual N content of the sediments. With the Kesterson sediment, which was high in organic C and N, added N inhibited volatilization of Se, while with Peck sediments (low in organic C and N), N-rich materials tended to accelerate Se volatilization. Inoculation with A. falciforme did not enhance Se evolution from either sediment, indicating that there was a sufficient population of microflora capable of producing gaseous Se. (Author's abstract)
W91-01814

EVALUATION OF DETENTION BASIN PERFORMANCE IN THE PIEDMONT REGION OF NORTH CAROLINA.
North Carolina Univ. at Charlotte. Dept. of Civil Engineering.
J. S. Wu.
Available from National Technical Information

Service, Springfield, VA 22161 as PB90-186768/AS. Price codes: A04 in paper copy; A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No. 248, (UNC-WRRI-89-248), July 1989. 45p, 18 fig, 15 tab, 18 ref. State Project 70077.

Descriptors: *Detention ponds, *North Carolina, *Pollutant identification, *Storm water, *Urban runoff, *Water quality control, Ammonia nitrogen, Copper, Iron, Lead, Metals, Phosphorus compounds, Piedmont region, Sampling, Storm runoff, Suspended solids, Zinc.

Results are summarized of a stormwater sampling program conducted on three existing urban wet detention ponds in the Piedmont region of North Carolina in the city of Charlotte. These ponds were not originally designed for water quality control. A total of eleven storm events was monitored. Runoff samples were analyzed for total suspended solids, total and ortho phosphorus, total Kjeldahl and ammonia nitrogen, and metals of iron, zinc, copper, and lead. The removal efficiency of pollutants for each detention pond was computed as the percent difference of the total pollutant mass entering and leaving the detention pond. An U.S.EPA model was employed to derive a relationship for estimating the size of detention ponds to achieve targeted levels of water quality improvement. It is estimated that about 1.0% to 2.0% of watershed area would be needed for siting of wet detention ponds to accomplish a sediment removal efficiency of 70% or better. The quality of storm runoff from the Piedmont North Carolina urban areas was found to be generally better than that reported by the National Urban Runoff Program. The research findings are consistent with the North Carolina State Government guidelines for sizing wet detention ponds for water quality considerations. Results of this study are based on Piedmont watershed characteristics and should not be applied to other regions without consideration of site specific information. (USGS)
W91-01824

EVALUATION OF THE INSTALLATION OF A SEWAGE COLLECTION SYSTEM ON WATER QUALITY IN A PRAIRIE LAKE.
Dakota State Univ., Madison, SD. Coll. of Natural Sciences.
For primary bibliographic entry see Field 5D.
W91-01862

SAMPLING STRATEGIES FOR PARAMETER ESTIMATION IN GROUNDWATER QUALITY MANAGEMENT: THEORY AND FIELD VALIDATION.
California Univ., Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W91-01866

ACID PRECIPITATION MONITORING AND RESEARCH. REVIEW OF CURRENT NORWEGIAN ACTIVITIES.
Oslo Univ. (Norway). Dept. of Chemistry.
G. Taugbol.
Science of the Total Environment STENDL, Vol. 96, No. 1/2, p 23-43, July 1990. 5 fig, 20 ref.

Descriptors: *Acid rain, *Acid rain effects, *Air pollution, *Monitoring, *Norway, *Reviews, Water pollution prevention, *Water pollution sources, Acid soils, Aluminum, Aquatic animals, Chemical analysis, Ecosystems, Fish populations, Forests, Groundwater pollution, Metals, Nitrogen compounds, Precipitation, Rainfall, Soil contamination.

Acid precipitation is a major threat to Norwegian ecosystems. Politically and administratively, the issue has been given top priority among environmental issues for nearly 20 years. Hence, fairly large resources are spent on monitoring, research activities, reduction measures and local ameliorating countermeasures. During the seventies, a joint interdisciplinary research and monitoring project was carried out to establish basic knowledge of the cause and effect relationships and extent of problems caused by acid rain. From 1980 onwards the activities were continued within a separate monitoring program which was divided into four major categories: air processes, water, aquatic fauna, and forest and vegetation. The main purpose of the program was to reveal the temporal trends and to assess the geographical distribution of effects. Presently, high priority acid rain projects in Norway include: photo-oxidants and nitrogen compounds, transformation processes and effects, mechanisms for acidification recovery of soils and waters, effects on forest and vegetation, effects of aluminum, and restoration of fish stocks. Norwegian scientists cooperate extensively with groups in other countries and participate in international monitoring networks and research programs. (Author's abstract)
W91-01888

ENVIRONMENTAL TESTING-ISSUES AND DIRECTIONS.
D. Friedman, and J. Poppiti.
Journal of Chromatographic Science JCHSBZ, Vol. 28, No. 9, p 450-452, September 1990. 2 tab.

Descriptors: *Environmental protection, *Monitoring, *Regulations, *Sampling, *Testing procedures, Data acquisition, Data interpretation, Laboratory methods, Standards.

The industry of environmental testing is expanding faster than the revisions to the EPA methods manuals are being developed. Changes are occurring in both directions of the testing itself and in the goals of public policy. Environmental decision making rests on the ability to monitor the environment, establish goals, and monitor for compliance with these goals. Because of the complexity of the analytical problems encountered in the hazardous waste program, it has become apparent to the EPA that the system needs to have greater flexibility. Often the analyst encounters matrix or interference problems when trying to measure an analyte of interest. Analysts need to have the flexibility to select the method that is most appropriate to the sample and problem. The lab also needs the freedom to modify methods when standard protocols do not yield data that meets the Data Quality Objective (DQO). (Lantz-PTT)
W91-01913

UTILIZATION OF HYDROCARBON SUBSTRATES BY HEAVY OIL-DEGRADING BACTERIA ISOLATED FROM THE SEA WATER OF OIL-POLLUTED BISAN SETO.
Shimonoseki Univ. of Fisheries (Japan). Lab. of Microbiology.
B. Kimura, M. Murakami, and H. Fujisawa.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 56, No. 5, p 771-776, May 1990. 3 fig, 5 tab, 15 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Hydrocarbons, *Marine bacteria, *Oil pollution, *Water pollution treatment, Bisan Seto, Carbon, Japan, Oil spills, Seawater.

Eighty-one strains of oil-degrading bacteria were isolated from the seawater of Bisan Seto, a polluted Japanese coastal area which had been the site of an oil spill. These bacteria were tested for their ability to grow on four major groups of hydrocarbons--normal alkanes, branched alkanes, cycloalkanes and aromatic hydrocarbons--all known to be present in heavy oils. The hydrocarbon substrates tested were n-hexadecane (as a representative normal alkane), pristane (2, 6, 10, 14-tetramethylpentadecane, as a representative branched alkane), cyclododecane (as a representative cycloalkane), and low molecular weight polyaromatic hydrocarbon mixtures (fluorene plus anthracene plus pyrene). All the bacteria were able to utilize n-hexadecane and pristane, but not cyclododecane and the aromatic hydrocarbons, as a sole carbon source for growth. Using two representative strains of the bacteria, further degradation characteristics were also studied on normal alkanes of different chain length, pristane, and the aromatics. Results suggest that the degradation potential of normal alkanes and branched alkanes is quite high in Bisan Seto, and also that cyclo-alkanes and polyaromatic hydrocarbons are much more resistant to microbial attack in this area. (Author's abstract)
W91-01945

GROUNDWATER TREATMENT WITH ZERO AIR EMISSIONS.
Peroxidation Systems, Inc., Gardena, CA.
D. A. Cheuvront, C. L. Giggy, C. G. Loven, and G. H. Swett.
Environmental Progress ENVPDI, Vol. 9, No. 3, p 143-148, August 1990. 3 fig, 13 tab, 11 ref.

Descriptors: *Air pollution, *Cleanup operations, *Groundwater pollution, *Path of pollutants, *Volatile organic compounds, *Water pollution treatment, Activated carbon, Organic pollutants, Ultraviolet radiation.

Air emissions from the treatment of volatile organic compound (VOC)-contaminated groundwater are a growing problem in the United States. When air stripping is used to remove VOCs from contaminated groundwater, contaminants are released into the air causing air pollution problems. Several treatment processes with zero air emissions are available for the decontamination of groundwater. In the liquid phase carbon process, organic contaminated water is percolated through beds of granular activated carbon. The carbon is later regenerated in a fired furnace or is disposed of in a hazardous waste landfill. In air stripping/vapor phase carbon, the organic pollutants are scavenged in the vapor phase usually onto activated carbon which is regenerated either on-site by steam stripping or off-site by furnace. In ultraviolet (UV) chemical oxidation, hydrogen peroxide is used in conjunction with UV light to catalyze the chemical oxidation of organic contaminants in water. This system requires little operator attention and does not produce air emissions. Five case studies relate how the air pollution regulation factors affected the decision for groundwater remediation programs. A southern California aerospace manufacturer chose UV/peroxidation for emissions control in its air stripping operations because of the economic attractiveness of this process and the waiver of permit requirements for UV/peroxidation units. For similar reasons, a northern California fleet refueling facility chose UV peroxidation to cleanup a subsurface spill of leaded gasoline. A northern California industrial facility chose a UV/peroxidation system to handle air stripping discharge from the cleanup of a trichloroethylene plume that was migrating towards a residential area. A New York industry chose UV/peroxidation to help cleanup efforts for a groundwater contaminated with trichloroethylene, vinyl chloride and numerous other industrial solvents. A California industrial facility selected UV peroxidation to comply with regulations to reduce toxicity, mobility and volume of hazardous chemicals at Superfund sites. (Geiger-PTT)
W91-01946

MINIMIZATION OF CHROMIUM-CONTAMINATED WASTEWATER AT A PLATING FACILITY IN THE EASTERN UNITED STATES.
Oak Ridge National Lab., TN. Chemical Technology Div.
For primary bibliographic entry see Field 5D.
W91-01947

BIODEGRADATION OF CHLORINATED HYDROCARBONS IN AN IMMOBILIZED BED REACTOR.
Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5D.
W91-01948

PERFORMANCE OF SELECTED IN SITU SOIL DECONTAMINATION TECHNOLOGIES: AN AIR FORCE PERSPECTIVE.
Air Force Engineering and Services Center, Tyndall AFB, FL.
D. C. Downey, and M. G. Elliott.
Environmental Progress ENVPDI, Vol. 9, No. 3,

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p 169-173, August 1990. 19 ref.

Descriptors: *Biodegradation, *Cleanup operations, *Decontamination, *Groundwater pollution, *In situ treatment, *Site remediation, *Soil contamination, Aeration zone, Monitoring wells, Performance evaluation, Radio waves, Vadose zone.

Soil structure, fuel composition, and the depth at which the release of fuels occurs can affect accessibility of treatment chemicals on hydrocarbon contaminants. When hydrocarbons are released in water-saturated or near-saturated conditions, they form large blobs which are trapped in larger pore spaces with little displacement of water from micropores. Fuels released in drier soils above the water table tend to migrate into micropores and form thin films over soil particles. These residuals may have more limited contact with treatment fluids. Enhanced in situ biodegradation attempts to create favorable aerobic conditions in an environment of heterogeneous soils and delicate geochemical balances. Air Force pilot studies using enhanced in situ biodegradation were conducted at jet fuel spill sites at Kelly and Elgin Air Force Bases. A nutrient and hydrogen peroxide delivery system was designed to test the relative effectiveness of three delivery methods in stimulating biodegradation in the vadose zone and in the groundwater. Two shallow injection wells, infiltration galleries, and a spray irrigation system were installed for a side-by-side comparison. After 18 months of peroxide and nutrient additions, aromatic concentrations in groundwater monitoring wells had decreased from 8 ppm to 200 ppb. However, intense sampling of soils above and beneath the water table did not show a significant removal of soil-bound fuel residuals suggesting that enhanced biodegradation cannot be applied at sites with poor permeability. Results of in situ soil venting tests at Hill Air Force Base showed that venting is very effective in removing large amounts of jet fuel from the soil in a relatively short period of time. Laboratory and field tests using radio-frequency (RF) heating of soil contaminated with jet fuel showed high rates of removal of volatile aliphatic and aromatic compounds from the soil. Use of a state-of-the-art RF generator for full-scale applications could reduce the power input to less than 500 kilowatt-hr/cu yard. Two enhancements to the soil venting process that will be tested in the future are the combination of soil venting and RF heating and the optimization of biodegradation of fuels that occurs during the venting process. (Geiger-PTT)
W91-01949

DESIGN CONSIDERATIONS FOR SOIL CLEANUP BY SOIL VAPOR EXTRACTION.
ENSR, Acton, MA.
R. Ball, and S. Wolf.
Environmental Progress ENVPDI, Vol. 9, No. 3, p 187-189, August 1990. 4 fig, 4 tab, 3 ref.

Descriptors: *Cleanup operations, *Decontamination, *In situ treatment, *Organic pollutants, *Site remediation, *Soil contamination, *Volatile organic compounds, *Water pollution prevention, Aeration zone, Bioremediation, Design criteria, Groundwater pollution, Oil pollution, Oil spills, Volatility.

A state-of-the-art approach for design and implementation of a soil vapor extraction system to remediate soil at a federal site in the Midwest contaminated with tetrachloroethylene is presented. Soil vapor extraction is performed by applying a vacuum to the soils to induce volatilization of soil contaminants. The extracted air is usually treated for volatile organic compounds (VOC) removal prior to discharge to ambient air. Typical data requirements needed for site characterization and soil vapor extraction system design depend on the size and complexity of the contaminated site. The contaminants must have sufficient volatility, and the soil must have sufficient air permeability for soil vapor extraction to be feasible. In a soil containing both volatile and nonvolatile contaminants, if the nonvolatile fraction is biodegradable and the soil has sufficient air permeability, bioremediation of the nonvolatile fraction may be feasible by inducing subsurface air flow with soil vapor extraction and by adding nutrients. An integrated systems approach must be taken to remediate a site with contaminated soil and groundwater. The groundwater table is lowered during groundwater pumping and treatment thereby increasing the depth of the unsaturated zone and improving volatilization and capture efficiency of VOCs by soil vapor extraction. At the Midwest site a conceptual model of the subsurface contamination of the soil by tetrachloroethylene (PCE) was developed to design the air extraction and injection well for vapor extraction. In addition, computer analyses of the subsurface airflow induced by the soil vapor extraction process were performed to select optimal locations for the wells. To estimate the remediation time required to achieve the desired cleanup criteria of 1 ppm in the soil, a laboratory column study was performed. The modeled tetrachloroethylene emission rate curve from the laboratory column study was scaled-up to predict the emission rate for a full scale soil vapor extraction system. Actual PCE concentrations in the six monitoring wells agreed well with predicted PCE concentrations from the laboratory model. (Geiger-PTT)
W91-01952

IN SITU BIODEGRADATION OF TCE CONTAMINATED GROUNDWATER.
ECOVA Corp., Redmond, WA.
M. J. Nelson, J. V. Kinsella, and T. Montoya.
Environmental Progress ENVPDI, Vol. 9, No. 3, p 190-196, August 1990. 9 fig, 1 tab, 5 ref.

Descriptors: *Biodegradation, *Bioremediation, *Chlorinated hydrocarbons, *Groundwater pollution, *In situ treatment, *Organic solvents, *Water pollution treatment, Activated carbon, Air stripping, Aquifers, Biological treatment, Fate of pollutants, Microbial degradation, Pseudomonas, Solvents, Trichloroethylene.

Trichloroethylene (TCE)-contaminated groundwater is presently treated by transferring the solvent either to a solid (carbon adsorption) or to the atmosphere (air stripping). Biological treatment of the contaminated water is an alternative that causes complete destruction of the solvent. When performed within the aquifer it is termed in situ biotreatment. A specific strain of bacteria (G4) has been isolated that degrades TCE enzymatically. The process has been extensively tested in the laboratory and confirmed in a field pilot test. The pilot test involved the injection of a clean, oxygenated water stream directly into the TCE plume. Nutrients and G4 were added to the injection stream and TCE and TCE concentrations were measured up-and downgradient of the injection well. A decline in TCE levels was observed eight hr after injection and continued for the following ten days. TCE concentrations were reduced from a high of 3,000 parts per billion to a mean value of 78 parts per billion during a 20 day period. (Author's abstract)
W91-01953

SIMPLE AND RAPID METHOD FOR SCREENING OF HEAVY OIL-DEGRADING BACTERIA FROM MARINE ENVIRONMENT.
Shimonoseki Univ. of Fisheries (Japan). Lab. of Microbiology.
B. Kimura, M. Murakami, and H. Fujisawa.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 56, No. 6, p 1009, June 1990. 1 tab, 6 ref.

Descriptors: *Aquatic bacteria, *Biodegradation, *Culturing techniques, *Microbial degradation, *Water pollution treatment, Fate of pollutants, Membrane processes, Nutrients, Oil spills, Separation techniques.

A rapid method for screening heavy oil-degrading bacteria involves dipping a nitrocellulose membrane filter in a hexane solution containing 2% (weight/volume) desulfurized fuel, evaporating the hexane, and placing the filter at room temperature on the top of 1/5 ZoBell 2216E agar plate on which bacterial colonies are present. After incubation at 25 C for 2 days, the filter is taken out from the agar plate and washed with hot water. Colonies with the ability of oil-degradation make hydrophilic spots on the filter which can be easily recognized by visual inspection or microscopic observation if needed. Results of a screening trial showed that among 23 bacterial strains which were isolated following a previously described procedure, 7 isolates demonstrated positive results with the present method. When these bacterial strains were tested for oil degradation determined by gravimetric analysis, all of the positive isolates degraded desulfurized fuel oil, whereas none of the negative isolates did. Besides being rapid and simple, the present method allows the isolation of oil-degrading bacteria even in the presence of organic nutrients other than hydrocarbons, such as peptone or yeast extract, which have been previously regarded as undesirable additives for isolation of oil-degrading bacteria. (Geiger-PTT)
W91-01961

PREDICTION OF MINE DRAINAGE QUALITY IN PENNSYLVANIA.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Div. of Mine Drainage Control and Reclamation.
For primary bibliographic entry see Field 5B.
W91-01963

APPLICATIONS OF ADVANCED MEMBRANE FILTRATION TO INDUSTRIAL WASTEWATER TREATMENT AND GROUNDWATER CLEAN-UP.
Resource Technologies Group, Inc., Morgantown, WV.
For primary bibliographic entry see Field 5D.
W91-01965

HISTORIC DEVELOPMENT OF THE CONCENTRATE REGULATIONS.
Stone and Webster Engineering Corp., Fort Lauderdale, FL.
W. J. Conlon.
Desalination DSLNAH, Vol. 78, No. 1, p 11-16, July 1990. 1 tab, 4 ref.

Descriptors: *Desalination wastes, *Florida, *Regulations, *Reverse osmosis, *Waste disposal, *Water treatment, Desalination, Environmental protection, Governmental interrelations, History, Injection wells, Land application, Membrane processes, Waste characteristics.

Florida has the highest percentage of membrane process plants in the United States. Membrane processes will play an important role as a treatment technology which will assist the water treatment industry to meet present and future drinking water regulations. Perhaps membrane technology will be the best available technology in terms of the greatest organic and inorganic contaminant removal for the amount of capital invested. However, safe methods of concentrate disposal will be necessary, as well as fair and pragmatic regulations concerning disposal, for the application of membrane processes to continue. Information on the characterization of concentrate discharges and deep well injection economics as they relate to all construction will assist the Florida Department of Environmental Regulation (FDER) in its negotiations with EPA on the creation of a separate class of injection wells solely for process concentrate design. A recent rule change to 17-28, Florida Administrative Code (FAC) allows membrane process plants discharging into Class G-III or Class G-IV groundwater to discharge non-hazardous concentrate through land application to aquifers containing greater than 1500 mg/L total dissolved solids. This demonstrates that regulations can be changed for the better through the cooperation of FDER with consultants, utility owners, and other interested parties. Further cooperation may result in additional rule changes and more uniform interpretation of the existing rules and regulations. (Author's abstract)
W91-01977

CURRENT REGULATORY CONCERNS RELATED TO THE DISPOSAL OF RO CONCENTRATES IN FLORIDA.

Florida State Dept. of Environmental Regulation, Tallahassee.
R. S. Dehan.
Desalination DSLNAH, Vol. 78, No. 1, p 17-26, July 1990. 2 fig, 3 tab.

Descriptors: *Desalination wastes, *Florida, *Regulations, *Reverse osmosis, *Waste disposal, *Water quality standards, *Water treatment, Desalination, Drinking water, Groundwater, Impaired water use, Injection wells, Local governments, Membrane processes.

During adoption of the latest amendments on groundwater regulations affecting reverse osmosis (RO) discharge, the Florida Department of Environment Regulation (FDER) sought to encourage the use of reverse osmosis as a good way of utilizing groundwater of marginal quality. Chapter 387 of the Florida Statutes, which is the State Comprehensive Plan, lists 14 policies, the very first of which is 'to ensure the safety and quality of drinking water supplies and promote the development of reverse osmosis and desalination technologies for developing water supplies. The groundwater regulation codes, which were developed in 1983, classify groundwater into four classes on the basis of water quality as measured by total dissolved solids and geological confinement. These classes are discussed, as well as water quality standards for groundwater and drinking water standards. Last year FDER amended the secondary drinking water standards as they relate to groundwater and exempted existing facilities from compliance with the secondary standards, but they are still applicable to new facilities. Existing sources and new sources of groundwater discharge are dealt with in different ways in the permitting rules. Regulations concerning desalting with discharge of RO concentrates, such as regulations governing deep well injection of concentrates and construction and operation of underground injection wells are outlined. Arguments from FDER are presented for changing current regulations to classify RO concentrate injections wells as municipal rather than industrial, to relieve RO concentrate wells of tubing and packer requirements. (AerNooy-PTT)
W91-01978

S. FEDERAL HIGHWAY ADMINISTRATION'S RECEIVING WATER IMPACT METHODOLOGY.
Woodward-Clyde Consultants, Oakland, CA.
W. Strecker, E. D. Driscoll, P. E. Shelley, D. Gaboury, and J. D. Sartor.
The Science of the Total Environment STENDL, Vol. 93, p 489-498, April 1990. 9 fig, 1 tab, 6 ref.

Descriptors: *Highway effects, *Model studies, Project planning, *Risk assessment, *Storm runoff, Federal jurisdiction, Political aspects, Pollutants, Probabilistic process, Rainfall intensity, Statistical methods, Vollenwieder model, Water pollution, Water quality.

A methodology for assessing the impacts of highway runoff on receiving waters has been developed for Federal Highway Administration (FHWA) for use by state transportation agencies. The methodology is intended to be used as a screening level analysis tool. In cases where there are serious enviornmental risks which cannot be easily mitgated, a more rigorous approach may be necessary. Included in the design procedure is a water impact analysis, which uses the Vollenwieder model. The lake analysis does not currently use a probabilistic approach. The interactive Decision Support program that takes the procedure user through the Federal Highway Administration's highway runoff analysis procedure is described. The procedure requires the input of fixed site data, rainfall and streamflow statistics, highway runoff water quality, and target concentrations. The methodology user is provided guidance in entering required data. Output of the procedure is a run frequency of the exceedances of the target concentration. This methodology is intended for screening level analyses. (Author's abstract)
W91-02000

DESIGN AND CONSTRUCTION OF TREATMENT PROCESSES FOR HIGHWAY RUNOFF IN THE FRG.
Ingenieur-Dienst-Nord, Industriestrasse 32, 2806 Oyten, Germany.
For primary bibliographic entry see Field 5D.
W91-02001

DECONTAMINATION OF HIGHWAY SURFACE RUNOFF IN THE FRG.
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
G. Stotz.
The Science of the Total Environment STENDL, Vol. 93, p 507-514, April 1990. 4 tab, 10 ref.

Descriptors: *Decontamination, *Detention reservoirs, *Highway effects, *Surface runoff, *Water pollution control, *Water pollution treatment, *Water quality management, Effluents, Heavy metals, Suspended solids, Water pollution, Water quality standards.

In order to investigate the possibilities for removing the pollutants originating from motor vehicle trafic that are present in highway surface runoff, the influents and effluents of three detention basins that differed in design and function were analyzed during the years 1978 to 1981. The specific objective of the investigations was to study the elimination of heavy metals and organic substances from the runoff, in order to determine the dimensioning criteria for the construction of treatment facilities. A further objective was to determine the composition of the sludges accumulating in the basins. The investigation of the basins showed that, when properly dimensioned, a detention basin can discharge an effluent in which the concentrations of hazardous substances, originating from motor vehicle traffic, have been reduced by 50 percent to 80 percent through sedimentation and separation processes. Thus, quality requirements for discharges into natural bodies of water can be adhered to. (Author's abstract)
W91-02002

POLLUTANT REMOVAL BY GULLY POTS IN DIFFERENT CATCHMENT AREAS.
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
For primary bibliographic entry see Field 5D.
W91-02003

MACROINVERTEBRATE AND PERIPHYTON RESPONSE TO STREAMBED AGITATION FOR RELEASE OF SUBSTRATE-TRAPPED HYDROCARBONS.
Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
For primary bibliographic entry see Field 5C.
W91-02019

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

BALANCE OF REPRESENTATION IN WATER PLANNING: AN ASSESSMENT OF EXPERIENCE FROM NORTH CAROLINA.
Florida State Univ., Tallahassee. Dept. of Urban and Regional Planning.
B. Stiftel.
Environmental Science and Technology ESTHAG, Vol. 24, No. 9, p 105-120, September 1990. 3 tab, 34 ref.

Descriptors: *North Carolina, *Project planning, *Public participation, *Water resources management, Nonpoint pollution sources, Public policy, Public relations, Water pollution control, Water quality control.

Over-representation of private interests and under-representation of public interests has been endemic in citizen participation in water planning in the USA for many years. Attempts to correct this imbalance in interest representation have not been successful. Such failure is explained by showing that traditional perceptions may not be valid. Empirical evidence from the North Carolina nonpoint pollution control planning program is used. Categories of public and private participants are developed. Agency staff interpretation of representation are reported. Staff believed that private participants were heavily over-represented. The participant categories were tested with staff interpretations tested against participant attitudes. Suprisingly, participant attitudes do not support the staff interpretations. Limitations in traditional categorizations of interests were identified and it was suggested that participants respond to a wide array of incentives and disincentives, not just material rewards. (Author's abstract)
W91-01059

RISK PERCEPTION IN INTERNATIONAL RIVER BASIN MANAGEMENT: THE PLATA BASIN EXAMPLE.
Reid, Collins and Associates Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 6E.
W91-01119

ROLE OF ASSET MANAGEMENT.
Water Research Centre, Swindon (England). Asset Management.
R. J. Britton, and P. B. Rumsey.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 3, p 215-255, June 1990. 3 tab, 1 ref.

Descriptors: *Comprehensive planning, *Management planning, *Water conveyance, *Water treatment facilities, Budgeting, England, Operating policies, Performance evaluation, Projections, Utilities.

Asset management planning has been developed over the last 2 years in response to the needs of the UK water industry as a natural progression from existing engineering planning and accounting practices, to provide more detailed consideration of future investment needs. The six parts of an asset management plan include: procedures for preparing the asset management plan; statement of utility's relevant standards and policies; list of asset systems; information on the performance and condition of principal components of each system; long-term (20-year) investment estimates; and short term (5-year) detailed investment program. In order to achieve and continue to maintain asset management plans, it is necessary to consider the organization and control of the planning functions. Continued re-appraisal of both engineering and accounting objectives is required to ensure a satisfactory result. It is concluded that asset management planning provides an effective method of determining long-term investment needs and is of major benefit in the day-to-day management of a utility. (Author's abstract)
W91-01272

HYDROLOGICAL INFORMATION TRANSFER USING HOMS.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7C.
W91-01274

HYDROGEOLOGICAL DECISION ANALYSIS: 1. A FRAMEWORK.
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
R. A. Freeze, J. Massmann, L. Smith, T. Sperling, and B. James.
Ground Water GRWAAP, Vol. 28, No. 5, p 738-766, September/October 1990. 21 fig, 3 tab, 90 ref, 6 append. NSF Grant CES-8858526.

Descriptors: *Decision making, *Engineering, *Geohydrology, *Geotechnology, *Management planning, Cost-benefit analysis, Design standards, Simulation analysis.

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Group 6A—Techniques Of Planning

The first installment of a four part series describes the application of decision analysis to engineering design for projects in which the geohydrological environment plays an important role. The methodology is well suited to the design of contaminant facilities and new waste management facilities, purge-well networks in contaminant remediation applications, or drainage systems in geotechnical projects. The method is based on a risk-based philosophy of engineering design, and involves the coupling of three separate models: a decision model based on risk-cost-benefit objective function, a simulation model for groundwater flow and transport, and an uncertainty model that encompasses both geological uncertainty and parameter uncertainty. The approach can be used for the comparison of alternative engineered components of a system, for the design of monitoring systems, and for the assessment of data worth in design of site investigation programs. This first paper lays the framework; the subsequent papers describe how the methods can be applied in geotechnical and waste management applications. (Author's abstract)
W91-01301

DEVELOPMENT OF AN EXPERT SYSTEM EMBEDDING PATTERN RECOGNITION TECHNIQUE FOR GROUNDWATER POLLUTION SOURCE IDENTIFICATION.
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-01825

SAMPLING STRATEGIES FOR PARAMETER ESTIMATION IN GROUNDWATER QUALITY MANAGEMENT: THEORY AND FIELD VALIDATION.
California Univ., Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W91-01866

6B. Evaluation Process

ENVIRONMENTAL EVALUATION PROCEDURE FOR COASTAL DEVELOPMENTS IN SOUTH AFRICA.
Cape Town Univ. (South Africa). Environmental Evaluation Unit.
M. R. Sowman.
Ocean & Shoreline Management OSMAE6, Vol. 14, No. 2, p 133-150, 1990. 2 fig, 4 tab, 19 ref.

Descriptors: *Coastal zone management, *Decision making, *Evaluation, *Public participation, *Regional development, *Resources management, *South Africa, Economic aspects, Human population, Legal aspects, Political aspects, Recreation.

The South African coastline represents an area of intense development pressure. Rapid population growth as well as changing political and socio-economic conditions have resulted in increased demands on coastal land, especially for the development of holiday housing and recreation resorts. Until recently, developers and authorities have encouraged and satisfied these demands without rigorous environmental or developmental constraints. Inevitably, this haphazard and unrestrained approach has led to degradation to coastal resources. The root cause of this is the lack of a formal, structured approach for evaluating the environmental implications of development applications. In response to these problems, a systematic procedure for evaluating the environmental suitability and social desirability of development proposals has been developed to ensure that environmental considerations are routinely integrated into the planning, development and decision-making process; the right questions are asked; the developer becomes more involved with, and responsible for, the development proposal; the public are involved in the planning and decision-making process; costly delays are reduced; applications are processed more efficiently; and the process of decision-taking is improved. (Brunone-PTT)
W91-01122

APPLICATION OF THE HSPF MODEL TO WATER MANAGEMENT IN AFRICA.
University of the Pacific, Stockton, CA. School of Engineering.
R. C. Johanson.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 102-109, 13 fig, 5 ref.

Descriptors: *Hydrological Simulation Program-Fortran, *Model studies, *South Africa, *Water management, *Water quality, Computer models, Management planning, Mgeni Basin, Rural areas, Simulation analysis, Water quality management.

The Hydrological Simulation Program-Fortran (HSPF), performs a deterministic simulation of hydrology and water quality, for watersheds of arbitrary complexity. Like any such model, HSPF requires calibration data. Thus, most applications (especially for water quality) have been in North America and Europe. However, HSPF was recently applied to two catchments in S. Africa. One was small (90 ha) and highly urbanized; the other was much larger (300 sq km) and rural. The results of simulations involving hydrology, sediment and phosphorus were very satisfactory. Therefore, this type of modeling will be continued in South Africa, with the goal being to help manage water and constituent cycling in the larger Mgeni basin (approximately 4000 sq/km), which serves as the water supply and effluent conduit for several rapidly expanding urban centers, as well as numerous rural villages. The use of the HSPF model in subcatchments of the Mgeni catchment gave local practitioners some valuable experience in using a comprehensive model; the ease with which time series could be stored and processed and the versatility of the model were readily accepted. However, efficient use of the model requires considerable effort in becoming acquainted with the modeling approach, data management techniques, etc. (See also W91-01188) (Lantz-PTT)
W91-01199

SOME PUBLIC ATTITUDES ABOUT HEALTH AND THE ENVIRONMENT.
Roper Organization, Inc., New York.
R. H. Baxter.
Environmental Health Perspectives EVHPAZ, Vol. 86, p 261-269, June 1990. 13 tab.

Descriptors: *Environmental protection, *Public health, *Public opinion, *Surveys, Data interpretation, Public rights, Regulations.

Public opinion is formed both by long-term developments and by single unanticipated events. This suggests that readers of opinion survey findings should note field interviewing dates and further determine what the news media have been reporting about relevant developments and events. Personal health and the cost of health care are high on the public's agenda; this is an important backdrop for any review of public attitudes and priorities related to health and the environment. Americans increasingly believe that they are not spending enough on environmental protection and improvement. Surveys have shown that the more people perceive an environmental threat to their safety, well being and health, the more they will want regulation or industry action to meet the threat. There is high public concern over hazardous waste disposal and the transport and use of toxic materials in manufacturing and processing, industrial accidents involving release of pollutants, the leakage of chemical waste into the soil, and the pollution of water and air from industrial sources. Data collected supports the assumption that for the foreseeable future these and certain other ecological dangers will be seen as serious by large majorities of Americans. (Lantz-PTT)
W91-01377

MULTIDIMENSIONAL SIMULATION APPLIED TO WATER RESOURCES MANAGEMENT.
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
A. S. Camara, F. C. Ferreira, D. P. Loucks, and M. J. Seixas.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 1877-1886, September 1990. 11 fig, 5 tab, 36 ref.

Descriptors: *Cleanup, *Decision making, *Fate of pollutants, *Model studies, *Oil spills, *Planning, *Project planning, *Water resources management, Mathematical models, Simulation.

A framework for an integrated decision aiding simulations (IDEAS) methodology using numerical, linguistic, and pictorial entities and operations has been developed. IDEAS relies upon traditional numerical formulations, logical rules to handle linguistic entities with linguistic values, and a set of pictorial operations. Pictorial entities are defined by their shape, size, color, and position. Pictorial operators include reproduction (copy of a pictorial entity), mutation (expansion, rotation, translation, change in color), fertile encounters (intersection, reunion), and sterile encounters (absorption). Interaction between numerical, linguistic, and pictorial entities is handled through logical rules or a simplified vector calculus operation. This approach is shown to be applicable to various environmental and water resources management analyses using a model to assess the fate and impacts of an oil spill. Future developments include the implementation of IDEAS implementation on parallel processing machines. (Author's abstract)
W91-01508

DEMAND-BASED BENEFIT-COST MODEL OF PARTICIPATION IN WATER PROJECT.
Arizona Univ., Tucson. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W91-01551

INFRASTRUCTURE--WEATHERING A BOOM-AND-BUST DEVELOPMENT CYCLE.
Austin Water and Wastewater Utility, TX.
T. F. Ellison, and T. M. Walski.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 5, p 652-664, September/October 1990. 2 fig, 3 ref.

Descriptors: *Metropolitan water management, *Nonstructural alternatives, *Public utility districts, *Urban planning, *Wastewater facilities, *Water resources development, *Water resources management, *Water treatment facilities, Environmental effects, Investment, Texas, Water demand, Water rates.

Making wise investments is the goal of every investor. This is certainly true for public utilities as they invest in infrastructure to fulfill their mission of providing safe, reliable, cost-efficient service to their customers. Starting from a capacity deficit condition, the city of Austin, Texas, faced a boom-and-bust development cycle in the 1980s that made sizing and timing decisions for new water and wastewater facilities extremely difficult. Infrastructure and investment decisions were examined for a decade in which Austin experienced a 30% increase in demand, followed by five years of almost no growth. Basic demand-versus-capacity relationships were addressed first. The unusual rates of development activity describe the investment climate. The making of investment decisions was affected by service policies, rate impacts, environmental considerations, and political considerations, including revenue bond voting and the formation of municipal utility districts. Austin's experience calls attention to the importance of certain basic infrastructure planning guidelines, and are lessons learned. (Author's abstract)
W91-01555

EVALUATING GROUND-WATER VULNERABILITY TO PESTICIDES.
Woodward-Clyde Consultants, Oakland, CA.
For primary bibliographic entry see Field 5B.
W91-01558

WATER SUPPLY OR WATER DEFICIENCY.
Dufresne-Henry, Inc., Westford, MA.

For primary bibliographic entry see Field 6D.
W91-01562

AUTOMATING WATER RESOURCE MANAGEMENT.
For primary bibliographic entry see Field 7B.
W91-01563

RESPONSE OF COASTAL ZONE MANAGEMENT PROGRAMS TO SEA LEVEL RISE IN THE UNITED STATES.
Washington Univ., Seattle. Inst. for Marine Studies.
P. Klarin, and M. Hershman.
Coastal Management CZMJBF, Vol. 18, No. 2, p 143-165, 1990. 2 tab, 119 ref.

Descriptors: *Coastal zone management, *Environmental policy, *Global warming, *Sea level, *Sea level rise, *Water resources management, Erosion, Institutions, Land use, Legislation, Management planning, State governments, United States.

State coastal zone management programs are responding to the potential impacts of accelerated sea level rise through a wide range of activities and policies. The federal Coastal Zone Management Act provides a basis for coastal state regulatory activities. State Coastal Zone Management Program (CZMP) responses to concerns about accelerated eustatic sea level rise were classified into four categories: official recognition and assessment of problems and issues; new public and intergovernmental processes; existing adaptable legislation; and new policies responding to sea level rise. Of 24 coastal states, 16 were credited with formal recognition of the problem, while only 3 have implemented new policies addressing the issue. Alternative policy responses to sea level rise included zoning restrictions, economic incentives/disincentives, prohibitions or restrictions on development, nonstructural engineering, and groundwater protection policies. Linking sea level rise to more immediate and tangible issues, such as coastal erosion, storm protection, public recreation, and access, provides an opportunity for CZMPs to increase their role in coastal land use policy. Programs that are able to incorporate sea level rise considerations into their overall program objectives will succeed in broadening the scope and range of the planning process. (MacKeen-PTT)
W91-01619

EYE TO EYE WITH HURRICANE GLORIA ON VIRGINIA'S TANGIER ISLAND.
Old Dominion Univ., Norfolk, VA.
C. Friberg, D. J. Zeigler, and G. K. Fortner.
Coastal Management CZMJBF, Vol. 18, No. 2, p 157-178, 1990. 2 fig, 3 tab, 30 ref.

Descriptors: *Coastal zone management, *Emergency planning, *Hurricanes, *Management planning, Chesapeake Bay, Evacuation, Hurricane Gloria, Natural hazards, Surveys, Tangier Island, Virginia.

A field survey on Tangier Island in the Chesapeake Bay and interviews with emergency management officials in Virginia have provided a base on which to assess and interpret the evacuation response of the resident population when threatened by Hurricane Gloria in 1985. Because of their finely tuned recognition of environmental hazards, most islanders responded to an evacuation advisory by leaving the island. The pattern of evacuation response, including choices of evacuation destinations and transit mode off the island, however, indicated a decision-making process that did not conform to the expectations of emergency officials, but betrayed an understanding of human-environment interaction and insights that needs to be incorporated into the emergency planning process. (Author's abstract)
W91-01620

PERMIT REFORM THROUGH COASTAL CONSISTENCY PREVIEW: AN ANALYSIS OF ALASKA'S COORDINATED PROCESS.
Alaska Univ., Fairbanks.
For primary bibliographic entry see Field 6F.
W91-01621

ENVIRONMENTALISM, POLICY FACTORS AND THE COURTS IN NEW ZEALAND.
Victoria Univ., Wellington (New Zealand).
For primary bibliographic entry see Field 6E.
W91-01622

CALIFORNIAZATION OF ARIZONA WATER POLITICS.
W. Parsons, and D. Mathews.
Natural Resources Journal NRJOAB, Vol. 30, No. 2, p 341-359, 1990. 37 refs.

Descriptors: *Arizona, *California, *Groundwater management, *Policy making, *Resources development, *Water allocation, *Water policy, Decision making, Institutions, Political aspects, Regional development.

An analysis of Western water policy suggested that an elite core of decision makers establishes the values, determines the agenda and controls the conditions under which water policy is made. The core elite are primarily urban business leaders who guide water resources development as a means of promoting urban growth and development. Semicore actors include agriculture, San Diego, and Arizona. The history of Western water policy was seen as being divided into four stages: (1) the foundation of the elites (1880s to 1920s); (2) the rise of the elites (1920s to 1930s); (3) the golden age of concrete (1930s to 1960s); and (4) maintaining elite controls (1970s to present). In the West, a small group of growth and development interests comes to dominate water policy. Furthermore, water policy making in Arizona resembles water policy making as practiced in Southern California, particularly in the continued control of the water agenda. (Author's abstract)
W91-01631

MAR DEL PLATA ACTION PLAN: REVIEW OF PROGRESS OF IMPLEMENTATION IN ASIA AND THE PACIFIC.
Water Resources Journal, No. 163, p 1-35, December 1989. 20 tab.

Descriptors: *Developing countries, *Planning, *Water conservation, *Water quality management, *Water resources development, *Water supply development, Agricultural water, Conservation, Data acquisition, Data interpretation, Economic aspects, Flood control, Governmental interrelations, Legal aspects, Regional planning, Water pollution control.

The Mar del Plata Action Plan was formulated to help participating countries plan and implement efficient programs for the use, management and conservation of water. In May 1988, the U.N. General Assembly issued a questionnaire to review the overall progress in implementing The Plan, to identify measures to improve U.N. support, and to promote exchange of information among member states. Countries and areas responding as of June 1989 were Australia, Bangladesh, Guam, Hong Kong, India, Indonesia, Japan, Maldives, Myanmar, the Philippines, the Republic of Korea, Samoa, Singapore, Sri Lanka, Thailand and Vanuatu. The survey indicated that most of the countries and areas had a national water policy reflecting the priority attached to water resources development within the national development plans. Problems of renovation of major project structures were experienced or anticipated. Most areas had legislation dealing with ownership and use of surface and groundwater, but felt that it was insufficient or incompatible with development plans. Six countries or areas had multilateral/bilateral agreements for the development of shared water resources. All areas reported networks for climatological and hydrological data collection with varying degrees of adequacy and reliability. Floods are a major concern, although most areas do not have adequate structural or non-structural measures. The survey indicated that constraints in the implementation of agricultural water development programs were due to lack of qualified manpower, shortage of financial resources, institutional deficiencies and lack of equipment. Virtually all reporting countries indicated that multilateral and bilateral cooperation would assist in overcoming constraints. Lack of financial resources was considered the major constraint in the area of research. Most reporting countries and areas were willing to participate in establishing joint regional or subregional organizations or institutions. (Miller-PTT)
W91-01679

REGIONAL OVERVIEW OF WATER QUALITY MONITORING.
Water Resources Journal, No. 163, p 95-108, December 1989. 9 tab.

Descriptors: *Developing countries, *Planning, *Regional planning, *Water quality management, *Water resources development, Economic aspects, Legal aspects, Water pollution control.

In a survey conducted by the Economic and Social Council for Asia and the Pacific (ESCAP) (1988-89) on water quality monitoring in the region, a total of 31 countries/areas responded, more than twice as many as in a similar survey conducted in 1980, indicating the growing concern and interest in the subject. Almost all countries/areas reported having some programs for monitoring water quality. The results of the analysis are presented, showing the status of legal, institutional and budgetary allocations for control, monitoring and management of water quality. No less than eight countries still did not have any legal instrument or national legislative policy for water quality monitoring and management. Eight other countries reported that existing legislation was inadequate to deal with the problem of pollution. Almost all countries, including Australia and New Zealand, reported that budgetary allocations were not adequate for effective control of water and environmental pollution in their countries. All regional developing countries reported lack of trained manpower, modern technology and equipment. Interest was expressed by all countries or areas in participating in regional seminars or workshops, and also in exchanging information on up-to-date developments in the field of water quality monitoring. (Miller-PTT)
W91-01680

U. S. FEDERAL HIGHWAY ADMINISTRATION'S RECEIVING WATER IMPACT METHODOLOGY.
Woodward-Clyde Consultants, Oakland, CA.
For primary bibliographic entry see Field 5G.
W91-02000

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

LEAKAGE CONTROL IN A UNIVERSALLY METERED DISTRIBUTION SYSTEM: PINETOWN WATER'S EXPERIENCE.
Pinetown Regional Water Services Corp., Natal (South Africa).
For primary bibliographic entry see Field 3D.
W91-01270

WILLINGNESS TO PAY FOR GROUNDWATER PROTECTION.
New Hampshire Univ., Durham. Dept. of Resource Economics and Community Development.
For primary bibliographic entry see Field 5G.
W91-01507

STRATEGY FOR COST RECOVERY IN THE RURAL WATER SECTOR: A CASE STUDY OF NSUKKA DISTRICT, ANAMBRA STATE, NIGERIA.
North Carolina Univ. at Chapel Hill.
D. Whittington, A. Okorafor, A. Okore, and A. McPhail.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 1899-1913, September 1990. 12 fig, 4 tab, 10 ref.

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Descriptors: *Developing countries, *Domestic water, *Economic aspects, *Nigeria, *Rural areas, *Water costs, *Water use, Cost recovery, Public policy, Social aspects, Water supply development.

In-depth interviews were conducted with 395 households in three rural communities in the Nsukka district of Anambra State, Nigeria, concerning their household water use practices, water expenditures to vendors, willingness to pay for improved water supplies, and household socioeconomic characteristics. Households in Nsukka district do not want to pay for water in advance or commit themselves to a fixed monthly payment for water. They want the freedom to buy water only when they use it, partly due to the seasonal nature of water use and partly because they want control over their cash flow in order to meet other more immediately pressing needs. Equally important, they do not trust government to provide a reliable public water supply. They do not want to pay in advance for a service they are not sure they will ever get. If they are required to pay a fixed fee every month, households are willing to pay only relatively small amounts for improved services, even less than they are currently paying water vendors. Current arrangements for cost recovery, fixed monthly fees for both public taps and unmetered private connections, are inappropriate. Kiosk systems, or kiosk systems with metered private connections for some households, are the most promising way to improve cost recovery and meet consumers' cash flow needs. (Author's abstract)
W91-01510

6D. Water Demand

STEPWISE TIME SERIES REGRESSION PROCEDURE FOR WATER DEMAND MODEL IDENTIFICATION.
Pellissippi International, Inc., Knoxville, TN.
S. P. Miaou.
Water Resources Research WRERAQ, Vol. 26, No. 9, p 1887-1897, September 1990. 1 fig, 8 tab, 22 ref.

Descriptors: *Model studies, *Statistical models, *Water demand, *Water use, Regression analysis, Time series analysis.

Annual time series water demand has traditionally been studied through multiple linear regression analysis. Four associated model specification problems have long been recognized: (1) the length of the available time series data is relatively short, (2) a large set of candidate explanatory or 'input' variables needs to be considered, (3) input variables can be highly correlated with each other (multicollinearity problem), and (4) model error series are often highly autocorrelated or even nonstationary. A stepwise time series regression identification procedure has been proposed to alleviate these problems. The proposed procedure adopts the sequential input variable selection concept of stepwise regression and a previously published 'three-step' time series model building strategy. Autocorrelated model error is assumed to follow an autoregressive integrated moving average (ARIMA) process. The stepwise selection procedure begins with a univariate time series demand model with no input variables. Subsequently, input variables are selected and inserted into the equation one at a time until the last entered variable is found to be statistically insignificant. The order of insertion is determined by a statistical measure called between-variable partial correlation. This correlation measure is free from the contamination of serial autocorrelation. Three data sets from previous studies (Oklahoma City and Tulsa, OK, and Tucson, AZ) were used to illustrate the proposed procedure. (Author's abstract)
W91-01509

STRATEGY FOR COST RECOVERY IN THE RURAL WATER SECTOR: A CASE STUDY OF NSUKKA DISTRICT, ANAMBRA STATE, NIGERIA.
North Carolina Univ. at Chapel Hill.
For primary bibliographic entry see Field 6C.
W91-01510

DEMAND-BASED BENEFIT-COST MODEL OF PARTICIPATION IN WATER PROJECT.
Arizona Univ., Tucson. Dept. of Economics.
R. B. Billings.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 5, p 593-609, September/October 1990. 1 fig, 5 tab, 42 ref.

Descriptors: *Cost-benefit analysis, *Model studies, *Water demand, *Water resources development, *Water use efficiency, Arizona, Rate of return, Regression analysis, Urban planning, Water rates, Water resources management, Water use.

Numerous economists and water resource specialists have advocated the use of demand-based consumer's-surplus measures to determine the benefits of possible new water supplies and other water-related projects. This benefits model was estimated for the projected arrival of Central Arizona Project (CAP) water in Tucson, Arizona, using the parameters of a regression-based demand model. The estimated benefits to water users of the anticipated CAP water are $91 million compared to costs of $175 million at the 8.625% discount rate currently required for federal projects. Thus direct costs exceed direct benefits by $84 million over the 100 year life of the project. To keep current water customers from suffering net losses, a payment of $2,514 in 1985 dollars would be required from each new housing unit over the 100 year life of the project. The internal rate of return for the project is 4.86%, which exceeds the 3.25% rate used in the original analysis of the project. Thus, the practical application has been demonstrated of the frequently-advocated but less frequently-used consumer-surplus model in estimating the benefits of increasing the supply of urban water. (Author's abstract) (Fish-PTT)
W91-01551

MODELING TO GENERATE RECREATIONAL ALTERNATIVES.
Colorado State Univ., Fort Collins. Water Resources Research Inst.
M. Flug, D. G. Fontane, and G. A. Ghoneim.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 5, p 625-638, September/October 1990. 4 fig, 2 tab, 18 ref.

Descriptors: *Model studies, *Recreation demand, *River flow, *Water resources management, *Water use, Boating, Dynamic programming, Fishing, Linear programming, Optimization, Watershed management, West Virginia.

Water resource managers are often faced with the task of balancing recreational activities in an attempt to maximize the overall recreational benefits from a river system. Available recreation-use functions for white-water rafting, boating, and fishing as a function of river flow are used to estimate benefits. Optimization models were used to generate alternatives (MGA) that maximize total recreational activities. Monthly river-flow scenarios that produce different mixes of the three recreational activities, yet ave essentially the same value of total recreational benefits, were sought. Four MGA methods were evaluated with data for the New River Gorge National River in West Virginia. Two of the MGA methods were based on linear programming, and two were based on dynamic programming. It was found that the MGA methods based on dynamic programming were easier to use and modify. The dynamic programming method provides optimal and alternative solutions over the entire flow range of the New River Gorge. (Author's abstract)
W91-01553

INFRASTRUCTURE--WEATHERING A BOOM-AND-BUST DEVELOPMENT CYCLE.
Austin Water and Wastewater Utility, TX.
For primary bibliographic entry see Field 6B.
W91-01555

RECONNAISSANCE-LEVEL ALTERNATIVE OPTIMAL GROUND-WATER USE STRATEGIES.
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
R. C. Peralta, and B. Datta.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 5, p 676-692, September/October 1990. 2 fig, 4 tab, 23 ref.

Descriptors: *Alternative planning, *Aquifer management, *Groundwater use, *Pumping, *Water resources management, Arkansas, Cropland, Flow control, Groundwater movement, Louisiana, Political aspects, Potentiometric surface, Social aspects, State jurisdiction, Water use.

For any large groundwater use area there are an infinite number of feasible sustainable groundwater withdrawal strategies. Also, there are generally several water management objectives. Alternative explicit planning objectives are: (1) maximize total pumping from the underlying aquifer while causing the evolution of a steady potentiometric surface; and (2) maintain a prespecified target potentiometric surface. Implicit objectives involve controlling stream/aquifer interflow and water flow across a state boundary, and attempting to avoid gross disruption of current cropping patterns. Models, bounds, constraints, and data are formulated. Alternative optimal strategies and the rationale for preferring one strategy were developed for a region in Arkansas. The objective of maintaining the relatively unstressed target potentiometric surface yielded politically and socially unacceptable water use strategies. The most acceptable strategy maximized sustainable groundwater extraction, maintained recent groundwater flow to Louisiana, maintained current potentiometric surface heads at the Louisiana-Arkansas border, maintained more than minimally acceptable surface water flow to Louisiana, and approximately maintained current cropping distributions. Developed planning models utilized the embedding approach, over 300 pumping variables, and 700 total variables, indicating the utility of the embedding method for regional sustained yield (steady-state) planning. (Author's abstract)
W91-01557

WATER SUPPLY OR WATER DEFICIENCY.
Dufresne-Henry, Inc., Westford, MA.
M. L. Wetzel.
Water Engineering and Management WENMD2, Vol. 137, No. 8, p 24-26, August 1990. 2 fig.

Descriptors: *Management planning, *Water resources management, *Water supply development.

In the late 1980s, many New England communities experienced water supply shortages that could have been avoided through proper water supply planning and management. While planning will not predict the problems that cause shortages, it will assure that the system is developing new supplies ahead of increased demands and has sufficient capacity to operate in emergency situations. The water supply requirements of a public water system can be predicted by studying past water-use trends in conjunction with detailed planning and zoning data. The two most important trends to evaluate are the maximum day/average day demand ratios and the per service consumption (residential, commercial, industrial, and municipal). Predicting maximum day demand is the most important aspect of water supply planning in order to size groundwater supplies, treatment facilities, pumping equipment, and transmission water mains. The final step in developing water supply projections requires input from the water department, town planning board, and/or local planning agency, to identify potential growth within the existing and future water-system-service areas. Water supply projections should be updated every year, which can be easily performed using a computer. Water supply planning helps provide a safe and adequate supply for both existing and future customers of the water system. Development of new sources requires planning, engineering investigation, regulatory approvals, design, and construction. This process can take several years depending upon the type of supply and treatment facilities required. Therefore, a water department must consider both short-term and long-term solutions for meeting its water supply requirements. (Fish-PTT)

W91-01562

CHANGES IN WEST AFRICAN SAVANNA AGRICULTURE IN RESPONSE TO GROWING POPULATION AND CONTINUING LOW RAINFALL.
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
H. 1. D. Vierich, and W. A. Stoop.
Agriculture, Ecosystems and Environment AEENDO, Vol. 31, No. 2, p 115-132, June 1990. 4 fig, 4 tab, 42 ref.

Descriptors: *Agricultural practices, *Burkina Faso, *Irrigation practices, *Land use, *Rainfall, *Water conservation, *Water use, Fertilizers.

Changes in village farming systems, brought about by population growth and continuing low rainfall, are described for the three main agro-ecological zones in Burkina Faso: the Sahel, Sudanian and Guinean zones.The toposequential land use and cropping patterns were used as the basis for a model, which describes the long-term ecological degradation caused by declining proportions of fallow land and over cropping. Several earlier studies have emphasized the flexibility of traditional African agricultural systems. Increasing population pressure and an extended cycle of low rainfall years starting in 1970, have had impacts on farming in Burkina Faso with serious land degradation, particularly for uplands in the Sahelian and North Sudanian zones as a consequence. The Guinean zone, because of its higher rainfall, was less affected, although the same process of fertility depletion and soil crusting of uplands which have caused the serious situation in the north, have also been set in motion in the south. To offset these trends, farmers in all three zones have been introducing more intensive practices (manure and fertilizer use, irrigated gardens, moisture conservation practices) and earlier maturing cereal cultivars. (Lantz-PTT)
W91-01683

SINGLE-STAGE AND TWO-STAGE DECISION MODELING OF THE RECREATIONAL DEMAND FOR WATER.
Economic Research Service, Washington, DC. Resources and Technology Div.
... T. Hansen, and J. A. Hallam.
Journal of Agricultural Economics Research, Vol. 2, No. 1, p 16-26, Winter 1990. 1 fig, 4 tab, 26 ref.

Descriptors: *Fisheries, *Model studies, *Recreation, *Water demand, Competing use, Decision making, Fishing, Water supply.

Past rivalry over access to water has usually been between the farmers who irrigate, and new agricultural, industrial and municipal demands. Recently, the recreational demand for water has become another consideration in water allocation decisions. The significance of the recreational demand for water as a fishery resource is examined in this study by applying two different frameworks to the decision to fish recreationally. The consistency of the estimated responses to changes in fishery resources across both decision frameworks testifies to the importance of streams as a recreational fishery resource. Modeling behavior within the household production framework allows all downstream effects to be estimated, not just impacts at particular sites. Marginal values of water as a recreational fishery resource are estimated based on daily values of fishing derived in prior research. (Author's abstract)
W91-01699

SIMULATION OF GROUND-WATER FLOW IN AQUIFERS IN CRETACEOUS ROCKS IN THE CENTRAL COASTAL PLAIN, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01843

SUMMARY OF PUBLIC WATER-SUPPLY WITHDRAWALS AND GEOHYDROLOGIC DATA FOR THE LOWER CONNECTICUT RIVER VALLEY FROM WINDSOR TO VERNON, VERMONT.
Geological Survey, Bow, NH. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01845

6E. Water Law and Institutions

EPA'S PESTICIDES-IN-GROUNDWATER STRATEGY: AGENCY ACTION IN THE FACE OF CONGRESSIONAL INACTION.
For primary bibliographic entry see Field 5G.
W91-01094

CLEAN WATER ACT: A GOOD BEGINNING.
For primary bibliographic entry see Field 5G.
W91-01095

INTEGRATED ANALYSIS OF POLICY OPTIONS FOR PROTECTION OF GROUNDWATER QUALITY.
Economic Research Service, Washington, DC. Resources and Technology Div.
For primary bibliographic entry see Field 5G.
W91-01101

FEDERAL-STATE TENSIONS IN AUSTRALIAN ENVIRONMENTAL MANAGEMENT: THE WORLD HERITAGE ISSUE.
Murdoch Univ. (Western Australia). Dept. of Political Science.
For primary bibliographic entry see Field 6G.
W91-01102

QUEENSLAND RAINFOREST AND WETLANDS CONFLICT: AUSTRALIA'S EXTERNAL AFFAIRS POWER--DOMESTIC CONTROL AND INTERNATIONAL CONSERVATION.
Lewis and Clark Coll., Portland, OR. Northwestern School of Law.
T. H. Edmonds.
Environmental Law EVLWA8, Vol. 20, No. 2, p 387-413, 1990. 124 ref.

Descriptors: *Australia, *Conservation, *Environmental protection, *Federal jurisdiction, *International law, *Queensland, *Rain forests, *Resource management, *State jurisdiction, *Wetlands, Legal aspects, Political aspects, Public participation, Tasmanian Dam decision, United Nations, World Heritage sites.

The federal government of Australia exercised environmental protective power by registering a 3500 square mile Queensland rainforest region with UNESCO's World Heritage Committee and legislating to prevent further timber cutting. This exercise of power sparked a fierce battle between the federal and the State of Queensland governments. The protection, however, is legally valid and met with the popular approval of the Australian electorate. Australia's High Court paved the way for the federal government's successful action with its 1983 Tasmanian Dam decision. This decision authorized the same protective federal legislation as a proper implementation of a treaty, the World Heritage Convention, under the Australian Constitution's external affairs power. The government's exercise of power and the Tasmanian Dam decision are unique because they represent the only worldwide legal test of World Heritage protection. Furthermore, Australia's use of external affairs power to protect the environment is different from United States action, which is so heavily reliant on broadened commercial power. Australia's action provokes observance of the potency of World Heritage protection, and thus elicits questions for future expansion of World Heritage protection of endangered natural areas throughout the world. Australia's example also allows portrayal of World Heritage obligations and possibilities. Australia's action is progressive as a globally emerging nation, and sets an example for other nations faced with internal power struggles to protect the environment. (Author's abstract)
W91-01104

RISK PERCEPTION IN INTERNATIONAL RIVER BASIN MANAGEMENT: THE PLATA BASIN EXAMPLE.
Reid, Collins and Associates Ltd., Vancouver (British Columbia).
J. O. Trevin, and J. C. Day.
Natural Resources Journal NRJOAB, Vol. 30, No. 1, p 87-105, Winter 1990. 66 ref.

Descriptors: *International agreements, *International law, *International waters, *Rio de la Plata Basin, *Risk assessment, *Watershed management, Argentina, Bolivia, Brazil, Jurisdiction, Paraguay, Political constraints, Relative rights, Rio de la Plata Basin Treaty, Treaties.

Perception of the risk of multilateral cooperation has affected joint international action for the integrated development of the Plata River Basin. The origins of sovereignty concerns among Argentina, Bolivia, Brazil, Paraguay, and Uruguay are explored in terms of their historical roots, which caused rival nations to interpret certain integrating actions as risky. The Plata Basin Treaty is a result of both the common acceptance by all the Plata nations of the mutual advantages of international cooperation in basin development, and of the particular ways in which the treaty provisions allayed the apprehensions of some states. The role of risk in determining the character of the Plata Basin Treaty, and the ways in which risk was managed in order to reach cooperative agreements, are analyzed. The treaty incorporates a number of risk management devices (nonbinding arrangement, the division of the agreement and inclusion of secondary matters, a provision for unilateral denunciation, the unanimity requirement in collective decision making, and an agreement to agree on the ways of implementing future cooperation) that were necessary to achieve international cooperation. The institutional system implemented under the treaty produced few concrete results for almost two decades. Within the current favorable political environment in the basin, however, the structure already in place reopens the possibility of further rapid integrative steps. (Brunone-PTT)
W91-01119

IN RE WATER OF HALLETT CREEK SYSTEM.
M. Basham.
Natural Resources Journal NRJOAB, Vol. 30, No. 1, p 187-201, Winter 1990.

Descriptors: *California, *Federal jurisdiction, *Judicial decisions, *Riparian rights, *State jurisdiction, *Water law, *Water rights, Land tenure, Land use, Legal aspects, Legislation.

In In re Water of Hallett Creek System (Hallett Creek), the California Supreme Court held that on federal reserved lands, the United States has state riparian water rights to be used for secondary purposes. The Hallett Creek decision re-opens the question of the impact of the Desert Land Act upon the nonnavigable waters of the West, an issue once thought to be settled by the United States Supreme Court's decision in Beaver Portland Cement. In addition, this holding raises the issue of whether the United States may be treated as an ordinary landowner thereby receiving benefits from state law, and, if so, whether subsequent changes in state law can deprive the United States of these benefits. Consequently, the Hallett Creek decision creates more questions than it answers. It remains to be seen how subsequent decisions answer them. (Author's abstract)
W91-01120

MARINE RESERVE MANAGEMENT IN DEVELOPING NATIONS: MIDA CREEK--A CASE STUDY FROM EAST AFRICA.
Exeter Univ. (England). Dept. of Biological Sciences.
A. D. Kennedy.
Ocean & Shoreline Management OSMAE6, Vol. 14, No. 2, p 105-132, 1990. 16 fig, 3 ref, 23 ref.

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Descriptors: *Africa, *Developing countries, *Mida Creek, *Resources management, *Water pollution, Coastal zone management, Conservation, Environmental protection, Recreation, Tourism, Wildlife.

Mida Creek, part of the longest established marine national reserve in Africa, is used to illustrate contemporary problems facing coastal zone managers in developing nations. Activities performed in the creek by tourists, expatriates and indigenous people are having deleterious effects including pollution, over-exploitation, loss of wildlife and the destruction of natural habitat. Despite management policies designed to protect the creek's resources, considerable overexploitation and associated damage is still occurring. Suggestions are made for improved management techniques, and reconciliation of the conflicting needs of conservation, exploitation and recreation. Despite strong economic pressure, the future of the area lies in the conservation of its biotic resources. To attract tourists, and to continue to provide for the needs of the local people, Mida Creek needs first and foremost to be protected as a reserve for wildlife. (Author's abstract)
W91-01121

UNITED STATES V. LARKINS: CONFLICT BETWEEN WETLAND PROTECTION AND AGRICULTURE; EXPLORATION OF THE FARMING EXEMPTION TO THE CLEAN WATER ACT'S SECTION 404 PERMIT REQUIREMENTS.
K. E. Varns.
South Dakota Law Review, Vol. 35, No. 2, p 272-297, 1990. 169 ref.

Descriptors: *Agricultural runoff, *Clean Water Act, *Environmental protection, *Judicial decisions, *Permits, *Water law, *Wetlands, Agricultural practices, Cultivated area, Drainage effects, Federal jurisdiction.

Section 404 of the Clean Water Act requires a dredge and fill permit whenever dredge or fill material is deposited into any of the 'Waters of the United States'. However, the Clean Water Act exempts incidental discharges into 'waters of the United States' resulting from normal, ongoing types of farming activities. United States v. Larkins, presented the Sixth Circuit United States Court of Appeals with the issue of whether the Clean Water Act's farm exemptions applied when the landowners replaced one type of wetland crop with another type of wetland crop, eventually draining and filling the wetland area of his property. The Sixth Circuit held that the farming exemption to section 404's permit requirement is not applicable when a farmer switches from one wetland crop to another thereby causing wetland to be filled. Where an area served primarily wetland functions, even though adjacent to farming activities, the courts have consistently found that if the effect of the change in land use is to convert extensive areas of water into dry land, the conversion is not a 'normal' farming or silviculture activity within the meaning of section 404(f)(1). The court in Larkins followed the same approach in examining the consequences of the landowner's activity. Even though the Larkins used the bottomlands for silviculture and some row crop cultivation prior to draining and filling the land, the court refused to hold that the conversion to dry land fell within the section 404 permit exemption. The holding in Larkins is consistent with the general approach used by other courts and is consonant with Congress' intention that the farming exemption be construed narrowly. (Brunone-PTT)
W91-01123

IS THERE A RESERVED WATER RIGHT FOR WILDLIFE ON THE WIND RIVER INDIAN RESERVATION: A CRITICAL ANALYSIS OF THE BIG HORN RIVER GENERAL ADJUDICATION.
D. M. Stanton.
South Dakota Law Review, Vol. 35, No. 2, p 326-340, 1990. 148 ref.

Descriptors: *Big Horn River, *Federal jurisdiction, *Judicial decisions, *Reservation doctrine, *Water law, *Water rights, *Wildlife, Agriculture, History, Indian reservations, Legal aspects, Wildlife habitats, Wyoming.

In In re the Rights to Use the Water in the Big Horn River the Supreme Court of Wyoming held that Indian tribes occupying the Wind River Indian reservation and the United States were entitled to an award of reserved water rights quantified solely on the basis of an agricultural purpose for the Indian reservation dating from the time the reservation was created. This note contends that the court erred in failing to follow the Special Master's report wherein wildlife uses were included in the quantification of the reserved water rights award. The Wind River Indian Reservation was reserved from the public domain by the United States as the permanent home of the Eastern Shoshone and Bannock Tribes of Indians by the Second Treaty of Fort Bridger in 1868. Implicit in this reservation was a reserved water right in quantities necessary to fulfill the purposes for which the reservation was created. The 1868 Treaty encouraged agricultural development. However, the Treaty also provided for the use of the reservation as a permanent home for the Tribes, and specifically preserved hunting rights. As the Tribes subsisted on the indigenous wildlife at the time the Treaty was signed, and since both parties contemplated this means of subsistence into the indefinite future, the court should have awarded additional reserved water rights in an amount sufficient to maintain wildlife populations at historic levels on the reservation. (Brunone-PTT)
W91-01124

ENVIRONMENTAL IMPACT ASSESSMENT: THE EXAMPLE OF MARINE BIOLOGY AND THE UK POWER INDUSTRY.
Central Electricity Generating Board, Fawley (England). Marine Biological Unit.
R. N. Bamber.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 6, p 270-274, June 1990. 1 fig, 9 ref.

Descriptors: *Electric power production, *Environmental impact statement, *Environmental policy, *Environmental protection, *Europe, *United Kingdom, Ecological effects, Electric powerplants, Regulations, Water resources development.

Environmental impact assessment (EIA) is a process which has been undertaken in some form by the Central Electricity Generating Board in the U.K. for many decades, both as a contribution to public enquiries for consent application and as a natural response to the statutory conditions of the Electricity Act of 1957. The formal title comes from the US originating in the National Environmental Policy Act of 1969. The Commission of the European Communities committed to an official EIA in 1988. The directive became law in July 1988 for any power generating plant with a heat output of 300 MW or more and may be required for smaller plants. The purpose of any single phase of an EIA is to produce the data necessary for the Environmental Statement (ES), which must form a cohesive whole as a procedure of collation, not correction. The ES must make the process of decision easier and meaningful to judges, lawyers, assessors, objectors, and officials. The steps for a biological EIA procedure are: (1) identify the site; (2) determine the fauna and flora, gather the data; (3) identify sensitive or important species or communities; (4) determine the relevant aspects of the development; (5) determine the potential interactions and degree of effect; (6) suggest minimizing or ameliorative procedures; and (7) define post-auditing of monitoring sites. (King-PTT)
W91-01158

DEVELOPING AN ECONOMIC METHODOLOGY FOR LEGAL PROVISIONS REGULATING GROUNDWATER POLLUTION.
Georgia Univ., Athens. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W91-01217

WATER QUALITY: THE PUBLIC DIMENSION.
Middlesex Polytechnic, London (England). Flood Hazard Research Centre.
For primary bibliographic entry see Field 5G.
W91-01218

WASTES FROM ANIMAL BREEDING: WATER QUALITY STANDARDS IN AN INTEGRATED PERSPECTIVE OF TREATMENT AND VALORIZATION FOR PORTUGAL AND SOUTHERN EUROPE.
Universidade Nova de Lisboa (Portugal). Faculdade de Ciencias e Tecnologia.
For primary bibliographic entry see Field 5D.
W91-01248

EXPERT TESTIMONY FOR THE PLAINTIFFS IN THE CASE THAT BROUGHT OHIO GROUND-WATER LAW INTO THE 20TH CENTURY.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
E. S. Blair, and S. E. Norris.
Ground Water GRWAAP, Vol. 28, No. 5, p 767-774, September/October 1990. 8 fig, 13 ref.

Descriptors: *Groundwater management, *Ohio, *Water law, *Water use, Case studies, Competing use, Legal aspects, Water resources management.

The 1984 Ohio Supreme Court ruling on Cline v. American Aggregates changed Ohio's groundwater law from an 1861 ruling based on the English Rule of absolute ownership to a doctrine of reasonable use which recognizes that landowners have the privilege to use the water beneath their land, but can be held liable to others if their use of groundwater causes others unreasonable harm. The Ohio Supreme Court did not define unreasonable harm in the Cline case. As a result, unreasonable harm is being established through case law, the first such case being the relitigation of Cline v. American Aggregates. Depositions and expert testimony presented during the Cline cases, which represent a group of 56 landowners in a single lawsuit, showed the diverse ways in which the quantity and quality of groundwater used for domestic water supplies were affected by operation of a dewatering system at an aggregate mine. The testimony highlighted the complex interaction between regional hydrodynamics, variations in local geohydrologic settings, well construction methods, spatial variations in infiltration and recharge, and vertical leakage with the effects of the regional decline in water levels produced by the dewatering system. The decisions in the Cline cases recognized that groundwater is a common resource which needs to be shared and managed for the common benefit of all. The decisions are consistent with changes in groundwater laws in other midwestern states. (Lantz-PTT)
W91-01302

SUPPORTING WORLD HYDROLOGY: ACTIVITIES OF INTERNATIONAL HYDROLOGICAL PROGRAMS.
World Meteorological Organization, Geneva (Switzerland). Dept. of Hydrology and Water Resources.
J. C. Rodda.
EOS EOSTAJ, Vol. 71, No. 30, p 996-997, July 24, 1990. 2 fig, 12 ref.

Descriptors: *International agreements, *International hydrological decade, *Meteorological data, *Water resources development, Disasters, Forecasting, Foreign research, Hydrologic data, Institutions, Monitoring, Publications.

The 160 member countries of the World Meteorological Organization (WMO) are intimately involved in routinely observing, recording, analyzing, and forecasting the procession of hydrological phenomena (floods, droughts, soil erosion, pollution incidents, landslides, avalanches, river ice formation and breakup) that occur within their territories. These agencies are also involved in water resources assessment. The hydrological services

hat perform these tasks face the painstaking re-
cording of events and the utilization of tried and
ested methods for prediction and forecasting on a
egular basis: standardization of methods, the cre-
tion of archives, and the exchange of data. The
etworks they operate and the data they collect
rovide the essential ingredient of many research
rojects. WMO's activities in support of operation-
l hydrology include reports on flood frequency
nalysis and water quality monitoring; a Guide to
lydrological Practices; Technical Regulations; na-
onal testing of suspended sediment samplers, cur-
ent meters, and water level recorders; an inter-
omparison of 14 models from 11 countries; and 20
r so technical assistance projects in hydrology.
he Commission for Hydrology has agreed upon a
rogram that is being implemented by 32 rappor-
urs and working group members, and includes
ie International Decade for Natural Disaster Re-
uction and the issues of climate change. Impor-
nt to most, if not all, of these endeavors is the
nprovement in the knowledge and understanding
the hydrological cycle. (Fish-PTT)
'91-01457

OASTAL ZONE MANAGEMENT IN BRITISH OLUMBIA: AN INSTITUTIONAL COMPARI-ON WITH WASHINGTON, OREGON, AND ALIFORNIA.
mon Fraser Univ., Burnaby (British Columbia).
atural Reource Management Program.
C. Day, and D. B. Gamble.
oastal Management CZMJBF, Vol. 18, No. 2, p
5-141, 1990. 1 tab, 66 ref.

escriptors: *British Columbia, *California, Canada, *Coastal zone management, *Environ-ental policy, *Oregon, *Washington, *Water re-urces management, Governmental interrelations, stitutions, Legislation, Local governments, Man-ement planning, Resources development.

e basis for coastal zone management in the ited States is established in legislation. In com-rison, Canadian federal and provincial govern-nts have adopted a piecemeal approach for man-ng a variety of concerns examined here: water ality, ecological protection, public access, aes-tics, natural hazards, and water dependency. As esult of this approach, which is characterized by inimum of federal, provincial, and interjurisdic-nal coordination, the British Columbia coastal e is showing signs of stress. For example, major llfish harvesting areas are being lost to water lution; ecologically sensitive habitats are being sumed by urban, commercial, and industrial ansion; recreation and tourism opportunities are g impaired by clear cutting and other inappro-te developments; and infrastructure is allowed flood-prone and erosion-prone areas. Recom-dations to improve the approach to coastal agement in British Columbia include a variety nnovations. New federal and provincial poli-, legislation, institutions, and experimentation n local and regional integrated resource plan-g are required to better govern the coastal zone. reased support for existing agencies, public in-vement, and access to information as well as e common use of environmental impact studies needed to justify proposed coastal develop-ts. (Author's abstract)
1-01618

VIRONMENTALISM, POLICY FACTORS O THE COURTS IN NEW ZEALAND.
oria Univ., Wellington (New Zealand).
E. Fisher.
ironmental and Planning Law Journal JEX, Vol. 6, No. 4, p 316-331, December . 28 ref.

criptors: *Environmental policy, *Jurisdiction, gal aspects, *New Zealand, *Resources man-ent, Administrative agencies, Legislation, cy making.

ronmentalism, it was suggested, is simply an oach to decision making. This analysis is con-ed specifically with the changes that have place within the environmental legal system ew Zealand within the last five years. The Treaty of Waitangi is in form an agreement concluded in 1840 between the Crown and a group of Maori Chiefs guaranteeing the exclusive and undisturbed possession of their lands to the Chiefs and their Tribes. The Treaty of Waitangi is being increasingly recognized as an instrument of legal significance so that at some stage in the future it is likely to be seen as a formal impediment upon the legislative capacity of Parliament. In recent years, Parliament has enacted three major statutes with implications for environmentalism: (1) The Environment Act (1986) establishes the Ministry for the Environment and the Parliamentary Commissioner for the Environment; (2) The State-owned Enterprises Act (1986) provides for the formation, inter alia, of the Coal Corporation of New Zealand Ltd, the Electricity Corporation of New Zealand Ltd, the Land Corporation Ltd, and New Zealand Forestry Corporation Ltd; and (3) The Conservation Act (1987) established the Department of Conservation as a department of government. The New Zealand courts have, either independently of legislation or by the creative use of legislation, treated Maori cultural and spiritual values as matters relevant to environmental management. The significance of environmental perspectives, statutory statements of objective, and policy conflicts between environmental statutes have been practical difficulties faced by the New Zealand environmental legal system. (MacKeen-PTT)
W91-01622

FEDERAL AND STATE ROLES IN ENVIRONMENTAL ENFORCEMENT: A PROPOSAL FOR A MORE EFFECTIVE AND MORE EFFICIENT RELATIONSHIP.
Minnesota State Government, St. Paul.
For primary bibliographic entry see Field 5G.
W91-01624

LIABILITY FOR DAMAGES ARISING FROM AN OIL SPILL.
Exxon Co. USA, Houston, TX.
For primary bibliographic entry see Field 5G.
W91-01627

ACCOMMODATING FISH AND WILDLIFE INTERESTS UNDER THE FPA.
Gordon, Thomas, Honeywell, Malanca, Peterson and Daheim, Seattle, WA.
J. A. Bearzi, and W. R. Wilkerson.
Natural Resources & Environment NRENEL, Vol. 4, No. 4, p 20-22,57-58, Spring 1990.

Descriptors: *Federal jurisdiction, *Fish conservation, *Hydroelectric plants, *Legislation, *Licensing, *Wildlife conservation, Administrative agencies, Legal aspects, Project planning.

The Federal Power Act (FPA), as amended by the Electric Consumers Protection Act of 1986 (ECPA) governs the licencing of hydroelectric projects by the Federal Energy Regulatory Commission (FERC). ECPA has significantly changed the relationships among electric power interests, environmental advocates, fish and wildlife interests, treaty tribes, and state and federal agencies. The new hydroelectric licencing and relicensing process under ECPA illustrates the cycle of Congress responding to pressure by interest groups before judicial solutions fully achieve what these groups seek. The major fish and wildlife provisions of the newly amended FPA require that: (1) the FERC give conservation interests equal consideration with developmental interests in licencing decisions; (2) where the project is within a reservation, the FERC adopt the recommendations of the federal agency managing the reservation; (3) a project must be 'best adapted' to a comprehensive plan for improving or developing a waterway; (4) licence conditions adequately protect, mitigate damages to, and enhance fish and wildlife; and (5) a licensee construct, maintain, and operate at its own expense such fishways as may be prescribed by the Secretary of the Interior or the Secretary of Commerce. The FERC relicensing consultation process consists of three stages: (1) prefiling consultation; (2) applicant identifies its internal licensing team; and (3) public information forums. Affected tribes must be included in the process from the outset and be treated as any other government agency. If policy makers cannot resolve their disputes, the consultation process allows the Director of the FERC Office of Hydropower Licensing to do so. It is recommended that applicants utilize every opportunity to settle fish and wildlife issues in prefiling consultation, in order to avoid the litigation-legislation cycle. (MacKeen-PTT)
W91-01628

CALIFORNIA V. FERC: STATE REGULATION OF FEDERAL HYDROPOWER.
T. J. P. McHenry, and J. D. Echeverria.
Natural Resources & Environment NRENEL, Vol. 4, No. 4, p 26-28,58-59, Spring 1990.

Descriptors: *California, *Federal jurisdiction, *Hydroelectric plants, *Judicial decisions, *State jurisdiction, Administrative agencies, Hydroelectric power, Legal aspects, Legislation, Licensing, Placerville, Project planning, Rock Creek, Water regulation, Water resources development.

On December 4, 1989, the United States Supreme Court granted the state of California's petition for certiorari in a case which will resolve whether the Federal Power Act (FPA) preempts state water regulatory laws or whether Congress intended that hydroelectric projects licensed by the Federal Energy Regulatory Commission (FERC) must comply with the requirements of state water law. The case arises from a hydropower project on Rock Creek, a tributary of the South Fork of the American River located near Placerville, California. The California State Water Resources Control Board (State Board) found that flow rates set by the FERC would greatly reduce the fishery habitat in Rock Creek and adopted permanent higher flow rates. The State of California, acting on behalf of the State Board, has taken the position that federally licensed hydropower projects must comply with state water rights law. The Supreme Court's analysis of the state role in regulating hydropower projects will turn on section 27 of FPA, which has been characterized as an 'antipreemption provision'. A congressional intent to defer to state regulation of water resources is revealed in the Federal Water Power Act, later incorporated into the FPA. In California v. United States (1978), the requirement for water leases for the protection of fish imposed by the State Board was upheld by the Supreme Court. A Ninth Circuit decision cited FERC's 'comprehensive hydropower planning authority' to support the conclusion that FERC is vested with exclusive jurisdiction over hydropower projects. Oral argument in California v. FERC was scheduled for March 20, 1990, and a decision was expected by the end of the term. (MacKeen-PTT)
W91-01629

URBAN CAPACITY SHARING: AN INNOVATIVE PROPERTY RIGHT FOR MATURING WATER ECONOMIES.
University of New England, Armidale (Australia). Centre for Water Policy Research.
N. J. Dudley.
Natural Resources Journal NRJOAB, Vol. 30, No. 2, p 381-402, 1990. 63 refs.

Descriptors: *Water allocation, *Water management, *Water rights, *Water supply, Administration, Economic aspects, Urban capacity sharing, Water demand, Water policy, Water users.

Researchers have previously proposed an innovative property right structure for sharing reservoir catchment water between groups of users and, in the case of irrigation farmers, between individual users. The concept is being implemented for sharing between groups. An urban version for individual consumers, urban capacity sharing, has a number of attractive features as an alternative property rights structure. Its introduction would create decentralized demand management with consumers taking the opportunity cost of water into account. It would be as if each user had his own small reservoir on his own small stream. Urban capacity sharing would provide a sound basis for achieving high levels of short and long

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run economic efficiency of water use. Its introduction into urban water economies would be easier and more beneficial if completed early in the water economy maturation process. (Author's abstract)
W91-01632

IN RE RIGHTS TO USE WATER IN THE BIG HORN RIVER 753P.2D76 (WYO. 1988).
P. Rogers.
Natural Resources Journal NRJOAB, Vol. 30, No. 2, p 439-458, 1990. 118 ref.

Descriptors: *Indian reservations, *Judicial decisions, *Legal aspects, *Water rights, *Water use, *Wyoming, Big Horn River, Federal jurisdiction, State jurisdiction, Water law, Wind River Reservation.

In 1977, the State of Wyoming initiated a suit destined to become the first general stream adjudication involving Indian reserved water rights completed under state jurisdiction. In In re Rights to use Water in the Big Horn River (Big Horn), decided in February 1988, the Wyoming Supreme Court quantified the reserved water rights of the Shoshone and Arapahoe tribes of the Wind River Reservation in northwestern Wyoming. The decision in Big Horn set the stage for future state adjudications of Indian reserved water rights. The court's strict application of the New Mexico primary purpose test in tandem with its narrow interpretation of the Second Treaty of Fort Bridger departed from accepted principles of federal law. Since the Wind River Reservation is the only Indian reservation in Wyoming, the decision may never be followed. However, other states faced for the first time with complex Indian water adjudications previously within the exclusive jurisdiction of the federal courts may find the Big Horn decision persuasive. If so, the decision may herald a shift away from liberal federal treaty interpretation in the Indian water rights context toward a more restrictive state view, unsupported by existing Supreme Court precedent. (MacKeen-PTT)
W91-01633

CITIZEN ENFORCEMENT OF CLEAN WATER ACT VIOLATIONS; THE SUPREME COURT STEERS A NEW COURSE OVER MUDDIED WATERS; GWALTNEY OF SMITHFIELD, LTD. V. CHESAPEAKE BAY FOUNDATION, INC.
S. J. Viscoli.
Natural Resources Journal NRJOAB, Vol. 30, No. 2, p 459-469, 1990. 75 ref.

Descriptors: *Clean Water Act, *Judicial decisions, *Public participation, *Water law, *Water pollution, Federal jurisdiction, Legal aspects, Legislation, Litigation, Water quality standards.

In Gwaltney of Smithfield, Ltd. v. Chesapeake Bay Foundation, Inc. the Supreme Court held that citizens may bring suit under the Federal Water Pollution Control Act (FWPCA) if they can make a good faith allegation of continuous or intermittent violations, but they may not bring suit for wholly past allegations. The Court's decision cleared up a three way conflict in the circuit courts' interpretation of the citizen suit provisions of the FWPCA. Between 1981 and 1984, the petitioner, Gwaltney of Smithfield, Ltd., discharged effluents in excess of its National Pollutant Discharge Elimination System (NPDES) permit. Respondents Chesapeake Bay Foundation and the National Resources Defense Council, both environmental groups, used FWPCA's citizen suit provision after first notifying the federal administrator and giving the state or federal authorities 60 days in which to enforce the NPDES violations. The Court's conclusion was based on an intricate explanation of the procedure Congress expected after the filing of the lawsuit and before the imposition of relief. In future, litigation is likely to focus on the gray area in between a past violation and a continuous violation. (MacKeen-PTT)
W91-01634

MAR DEL PLATA ACTION PLAN: REVIEW OF PROGRESS OF IMPLEMENTATION IN ASIA AND THE PACIFIC.
For primary bibliographic entry see Field 6B.
W91-01679

REGIONAL OVERVIEW OF WATER QUALITY MONITORING.
For primary bibliographic entry see Field 6B.
W91-01680

6F. Nonstructural Alternatives

EYE TO EYE WITH HURRICANE GLORIA ON VIRGINIA'S TANGIER ISLAND.
Old Dominion Univ., Norfolk, VA.
For primary bibliographic entry see Field 6B.
W91-01620

PERMIT REFORM THROUGH COASTAL CONSISTENCY PREVIEW: AN ANALYSIS OF ALASKA'S COORDINATED PROCESS.
Alaska Univ., Fairbanks.
T. J. Gallagher.
Coastal Management CZMJBF, Vol. 18, No. 2, p 179-193, 1990. 2 fig, 3 tab, 13 ref.

Descriptors: *Administrative decisions, *Alaska, *Coastal zone management, *Land development, *Permits, Administration, Coasts, Federal jurisdiction, Legislation, Surveys.

In 1984 the state of Alaska created a process that combined permit review with coastal district review of proposed state and federal projects as provided by the Alaska Coastal Management Act. The process, managed by the Division of Governmental Coordination, incorporates permit reform strategies such as joint reviews, preapplication consultation, time-limiting techniques, and a rapid appeals process. This study examined the success of the process through a survey of 74 people, including permit applicants, both private and public, and representatives of coastal districts and state permitting agencies. Responses support the conclusion that the process achieves its primary goals of coordinating permits, increasing communication among participants, and increasing participation of local communities, as well as other benefits such as saving applicants and agencies time and money. Although all groups suggested changes to the process, all groups felt strongly that the process should be retained. (Author's abstract)
W91-01621

6G. Ecologic Impact Of Water Development

MODIFICATION OF COASTAL CURRENTS BY POWER PLANT INTAKE AND THERMAL DISCHARGE SYSTEMS.
Scripps Institution of Oceanography, La Jolla, CA. Center for Coastal Studies.
For primary bibliographic entry see Field 8B.
W91-01057

UNEXPECTED HYDROLOGIC PERTURBATION IN AN ABANDONED UNDERGROUND COAL MINE: RESPONSE TO SURFACE RECLAMATION.
Indiana Geological Survey, Bloomington.
For primary bibliographic entry see Field 4C.
W91-01098

FEDERAL-STATE TENSIONS IN AUSTRALIAN ENVIRONMENTAL MANAGEMENT: THE WORLD HERITAGE ISSUE.
Murdoch Univ. (Western Australia). Dept. of Political Science.
B. Davis.
Environmental and Planning Law Journal EPLJEX, Vol. 6, No. 2, p 66-78, June 1989. 24 ref.

Descriptors: *Australia, *Conservation, *Environmental protection, *Federal jurisdiction, *Resource management, *State jurisdiction, *World Heritage sites, Legal aspects, Political aspects.

Nowhere is the conflict of values inherent in conservation and resource development more glaringly obvious than in the political and legal battles which have often accompanied proposed World Heritage Listing. From the wilderness of South West Tasmania through tropical rainforests of North Queensland to the open spaces of Kakadu, the struggle between competing interests has mirrored the shifting values of Australian society as a whole. Australia has met its internal obligations and appears willing to fund World Heritage sites and the States have received substantial financial compensation. The Commonwealth has only acted after repeated attempts at negotiation and in instances where mismanagement of resources is clearly evident at State levels. The extent to which State and Territorial decisions can be permitted to infringe upon foreign policy clearly has limits. Some of the unilateral actions taken by the Tasmanian, Queensland and Northern Territory Governments in directly confronting World Heritage Committee members can only be regarded as damaging to Australia's reputation, particularly as the aim is frequently political point-scoring, rather than any deep concern about environmental issues. (Brunone-PTT)
W91-01102

QUEENSLAND RAINFOREST AND WETLANDS CONFLICT: AUSTRALIA'S EXTERNAL AFFAIRS POWER--DOMESTIC CONTROL AND INTERNATIONAL CONSERVATION.
Lewis and Clark Coll., Portland, OR. Northwestern School of Law.
For primary bibliographic entry see Field 6E.
W91-01104

ENVIRONMENTAL IMPACT ASSESSMENT: THE EXAMPLE OF MARINE BIOLOGY AND THE UK POWER INDUSTRY.
Central Electricity Generating Board, Fawley (England). Marine Biological Unit.
For primary bibliographic entry see Field 6E.
W91-01158

DEEP-WELL IN THE NORTH-HOLLAND DUNE AREA.
Waterworks of North-Holland, Bloemendaal (Netherlands).
For primary bibliographic entry see Field 4B.
W91-01304

GLOBAL CLIMATE CHANGE: IMPLICATIONS FOR AIR TEMPERATURE AND WATER SUPPLY IN CANADA.
Canadian Climate Centre, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W91-01388

ENVIRONMENTAL IMPACTS OF DEVELOPMENT ON WETLANDS IN ARID AND SEMI-ARID LANDS.
University Coll., London (England). Dept. of Geography.
G. E. Hollis.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 4, p 411-428, August 1990. 1 fig, 46 ref.

Descriptors: *Ecological effects, *Ecosystems, *Environmental impact, *Land development, *Water resources development, *Wetlands, Agriculture, Arid lands, Greece, New Zealand, Semi-arid lands, United States, Urbanization, Water resources management.

Wetlands, as defined by the Ramsar (Greece) Convention, are productive ecosystems providing goods and services for people. Negative effects from the 'development' of wetlands are exemplified through adverse climatic effects (Aral Sea, USSR), inadvertent environmental changes (Canadian Prairie Potholes), non-sustainable alternative uses (South Chad Irrigation Scheme, Nigeria), exacerbation of problems (Garaet El Haouaria, Tunisia), detrimental effects on rare species (Mikri Prespa, Greece), social disruption (Kissingin Fadama, Nigeria), international obligations (Ich-

keul, Tunisia), and sub-optimal management (Weija-Panbros, Ghana). The functions and values of wetlands are described in the 'Adamus approach,' and are exemplified even for the 'dry' areas of the Hadejia-Nguru wetlands (Nigeria) and Lake Hula (Israel). Wetlands are threatened by agricultural intensification, pollution, engineering schemes, and urban development. Since the societies and institutions that degrade wetlands are themselves complex systems, an understanding of hydrology and ecology is insufficient for a wetland manager. Wetland destruction can be aided by misconceptions, public subsidy, international funds, local-scale planning, sectoral approaches, and narrow disciplinary thinking. National Wetland strategies are needed, on the order of those presently developed in New Zealand and the United States. Hydrologists should be more involved in wetlands and their sustainable utilization. 'Political hydrology' must complement 'scientific hydrology.' (Author's abstract)
W91-01462

OWNSTREAM OF THE NOVOSIBIRSK HYROELECTRIC STATION ON THE OB RIVER.
or primary bibliographic entry see Field 4A.
W91-01544

URRENT PROBLEMS AND PRACTICE OF NGINEERING-GEOLOGICAL SURVEYS HEN DESIGNING LARGE RESERVOIRS.
V. Kayakin.
ydrotechnical Construction HYCOAR, Vol. 23, o. 10, p 592-597, April 1990. 1 fig, 1 tab. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 10, 28-32, October 1989.

escriptors: *Environmental engineering, *Hydraulic design, *Hydraulic engineering, *Hydroctric plants, *Reservoir design, *Soviet Union, sign criteria, Design standards, Ecological effts, Geological surveys, Hydraulic structures.

rrent ecological problems include the negative nsequences of cresting flatland reservoirs in the 0-1950s, when protective measures were not cified, and at that time in the Soviet Union and oad there was no experience in evaluating the eraction of large reservoirs with the environnt. The reasons a negative attitude toward hytechnical construction in the past 20-30 years lude underestimation of the significance of ign and surveys of reservoirs in comparison h the main hydraulic structures, and shirking of ign and surveying organizations from responsiy for errors. There recently occurred a noticee decrease in the extent of engineering-geologi surveys for large reservoirs. The technical eme of these surveys should include the follow elements: construction of engineering-geologi models of the interaction of the reservoir with geologic environment using analogs; organiza of regime observations at the feasibility stage; ting the possible effects of the reservoir on the ogical environment; recommendations on the cture technology and on engineering measures d on a combined model analysis of the interac of the structures with the environment and ing conditions of this interaction; inspection of structures during construction and monitoring ng their operation; and recommendations on nstruction of the reservoir based on an analysis e results of monitoring its interaction with the ronment. A special agency should be created evelop the main directions for creating reser, to coordinate observations and investiga, and to perform protective measures. (Fish-
)
-01545

ORITIZING FLOW ALTERNATIVES FOR IAL OBJECTIVES.
rado State Univ., Fort Collins. Water Reces Research Inst.
lug, and J. Ahmed.
al of Water Resources Planning and Manage- (ASCE) JWRMD5, Vol. 116, No. 5, p 610- September/October 1990. 2 fig, 5 tab, 7 ref.

riptors: *Environmental policy, *Flow ls, *Multireservoir networks, *Social aspects, *Water resources management, Canada, Environmental control, Flow equations, Mathematical models, Minnesota, Numerical analysis, Priorities, Reservoir operation, Simulation analysis, Urban planning.

Most mathematical modeling efforts in water resources fall far short of adequately including social and environmental objectives. Although many modelers have good intentions at the start of their analyses, the objective functions and constraint sets do not provide a good mechanism for addressing these resource issues. Results from a three-reservoir network simulation model were numerically rated for impact upon 22 natural resource attributes associated with seven resource objectives. Priority weighting of individual resource objectives was included, as well as the ranking of importance for each attribute to its respective resource objective. This technique provides a quantitative and objective approach to evaluate flow regulation alternatives. Input from special interest groups, the general public, and concerned individuals, as well as professionals in each resource area, are a part of the overall analysis. The simple technique provides a screening tool to identify good and bad flow alternatives. These methods were successfully applied to a three-reservoir system at Voyageurs National Park on the Minnesota and Canadian border. (Author's abstract)
W91-01552

HYDROELECTRIC DAMS AND THE DECLINE OF CHINOOK SALMON IN THE COLUMBIA RIVER BASIN.
Marquette Univ., Milwaukee, WI. Dept. of Economics.
D. E. Booth.
Marine Resource Economics JMREDD, Vol. 6, No. 3, p 195-211, 1989. 8 tab, 29 ref.

Descriptors: *Chinook, *Columbia River, *Dam effects, *Ecological effects, *Hydroelectric plants, *Salmon, *Water resources management, Environmental impact, Fish harvest, Fish migration, Fish populations, Oregon, Regression analysis, Spawning, Washington, Watershed management.

Chinook salmon runs into the mouth of the Columbia River (Oregon and Washington)--runs that historically were among the largest in the world--have declined significantly since the mid-1920s. The decline is thought to be partly attributable to the construction of hydroelectric dams. The magnitude of losses in chinook salmon runs caused by hydroelectric dams has been estimated using regression analysis. Such estimates are not only of historical interest but also can potentially affect the extent of efforts to mitigate salmon losses from hydropower operations. Congress has mandated that the magnitude of run losses caused by hydroelectric operations be considered in determining the extent of mitigation efforts. The total annual loss of chinook salmon resulting from both mainstem and tributary dams is estimated to be somewhere between 3,543,890 and 4,891,897 fish. In-river runs have recently been less than the weighted and lagged spawner escapement levels for both the spring and summer runs, suggesting that the continued existence of these runs is clearly threatened. The regression equations can be used to calculate the optimum level of spawner escapement and the maximum run level that results given the existence of dams. Unless the ocean harvesting of summer chinook is reduced or extensive mitigation efforts are undertaken, the summer run appears to be doomed. The question is as much ethical as it is economic, given that the destruction of the wild spring and summer runs would be essentially equivalent to the destruction of species. (Fish-PTT)
W91-01560

HETEROTROPHIC MICROPLANKTON IN PLANKTON SUCCESSIONS AND SELF PURIFICATION PROCESSES ALONG THE YENISEI RIVER.
Oceanology Dept, Gelendzhik, Krasnodar, 353470 USSR.
For primary bibliographic entry see Field 2H.
W91-01616

COMPARATIVE ANALYSIS OF STATE ENVIRONMENTAL POLICY.
Colorado State Univ., Fort Collins. Dept. of Political Science.
J. P. Lester, and E. N. Lombard.
Natural Resources Journal NRJOAB, Vol. 30, No. 2, p 301-319, 1990. 1 fig, 4 tab, 39 ref.

Descriptors: *Environmental policy, *Environmental protection, *Governmental interrelations, *Policy making, *State jurisdiction, Administrative agencies, Administrative decisions, Comparison studies, Data interpretation, Model studies, Political aspects.

Since the enactment of the National Environmental Policy Act (NEPA) of 1969, comparative state environmental policy studies have ranged from case studies to systematic input-output analyses. Conditions that promote or inhibit state environmental management have not been clearly identified due to research problems such as lack of theory, a reliance upon cross-sectional (versus longitudinal) analysis, limited measures of environmental effort, and inadequate analytical techniques. Sources of data on state commitment to environmental protection include Department of Commerce, The Council of State Governments, The Conservation Foundation, and the Fund for Renewable Energy and the Environment. Comparative state politics and policy research has been criticized as being atheoretical, endogenic, time-bound and methodologically unsound. An intergovernmental model is presented for future state environmental politics research which conceptualizes the implementation process at the state level. This model adopts a conceptual framework that represents the intergovernmental nature of policy implementation in the 1980s (and presumably in the 1990s). Such a framework would respond to the criticisms that previous research in this area has been too concerned with bivariate relationships (in the absence of a genuine theory) or has adopted a 'mainstream model', which was endogenic (at best) or inaccurate (at worst) by assuming that only state-level variables influenced state policy outputs. Obstacles to the further theoretical advance of the state environmental politics and policy literature can be overcome by: (1) collecting data and analyzing relationships in a diachronic (longitudinal) fashion; (2) measuring state environmental policy with both expenditure and non-expenditure data and testing their relationships with predictor variables separately; (3) using path-analytic techniques whenever possible; and (4) combining quantitative (fifty-state) with qualitative (case studies of individual states) analyses. (MacKeen-PTT)
W91-01630

ABUNDANCE OF SPAWNING PACIFIC SALMON IN TWO LAKE SUPERIOR STREAMS, 1981-1987.
Department of Fisheries and Oceans, Sault Ste. Marie (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
For primary bibliographic entry see Field 8I.
W91-01791

ESTIMATION OF RECRUITMENT FORGONE RESULTING FROM LARVAL FISH ENTRAINMENT.
Michigan Univ., Ann Arbor. School of Natural Resources.
A. L. Jensen.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 2, p 241-244, 1990. 1 tab, 1 fig, 12 ref.

Descriptors: *Electric powerplants, *Entrainment, *Fish populations, *Lake Erie, *Model studies, *Perch, Fish eggs, Larvae, Mathematical analysis.

A method for estimation of recruitment forgone, or lost, as a result of larvae and egg entrainment was developed; it requires parameter estimates only for recruited members of the population, which are more easily estimated than those for younger life stages. It requires no estimates for abundance. The method was applied to assess yellow perch larvae entrainment at the Monroe Power Plant, Monroe, Michigan, located on the

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western basin of Lake Erie. The number of yellow perch larvae entrained was 128 million, which is an enormous number, but larvae mortality is high and the recruitment forgone was 8933 fish. (Author's abstract)
W91-01794

PERSPECTIVE ON AMERICA'S VANISHING STREAMS.
Alabama Univ., University. Dept. of Biology.
A. C. Benke.
Journal of the North American Benthological Society JNASEC, Vol. 9, No. 1, p 77-88, March 1990. 9 fig, 1 tab, 20 ref.

Descriptors: *Dam effects, *Data interpretation, *Environmental impact, *National Rivers Inventory, *Resources management, *Rivers, *Stream classification, *Stream conservation, *Streams, *Water resources management, Conservation, Dams, Stream exploitation, Stream improvement, United States, Water resources.

The free-flowing nature of streams in the U. S. has been dramatically altered over the past century, especially through construction of dams. The Nationwide Rivers Inventory (NRI) estimated a total of 5,2000,000 km of streams in the contiguous 48 states, but only 2% (<100,000 km) have sufficient high quality features to be worthy of federal protection status. The future of this dwindling number of high-quality streams is in doubt as proponents if development compete with conservation interests. Hydropower projects are projected to be built well into the future with a large increase in small projects (55% more than in 1988) even though the total generating capacity of the U. S. would increase only 0.3%. On the other hand, conservation efforts have resulted in increasing levels of federal protection of streams since the 1960s. National River or Wild and Scenic River status now provides protection for almost 16,000 km of streams, but only about 10% are found east of the Mississippi River. Analysis of the NRI database showed that the greatest quantity and density of high-quality streams are found in the south-Atlantic states, where streams have the least protection. The greatest number of NRI streams are found in the Coastal Plain and Central Lowland physiographic provinces. The NRI analysis showed only 42 high-quality, free-flowing (no major dams) rivers > 200 km remaining in the 48 contiguous states. With continuing threats of exploitation, major conservation efforts are required to preserve these last free-flowing streams. (Author's abstract)
W91-01812

7. RESOURCES DATA

7A. Network Design

EVALUATION OF DESIGNS OF PERIODIC COUNT SURVEYS FOR THE ESTIMATION OF ESCAPEMENT AT A FISHWAY.
Department of Fisheries and Oceans, Halifax (Nova Scotia). Biological Sciences Branch.
B. M. Jessop, and C. J. Harvie.
North American Journal of Fisheries Management NAJMDP, Vol. 10, No. 1, p 39-45, Winter 1990. 3 fig, 2 tab, 13 ref.

Descriptors: *Fish migration, *Nova Scotia, *Sampling, Alewife, Fish passages, Fish populations, Quality control, Statistical analysis.

Counts of the number of alewives Alosa pseudoharengus migrating through the fishway on the Gaspereau River, Nova Scotia, were used to evaluate the accuracy and precision of various sampling schemes for estimating the population mean (true mean count/sample unit (15 min)). High variability in counts within day and season required more intensive sampling than suggested by previous studies to estimate the population mean to within a given percent relative error. Stratification in some cases doubled or trebled the precision of the estimated mean relative to the mean obtained from simple random sampling, whereas systematic sampling produced no gain in precision. Stratification to reduce the number of sample units required for a given precision may reduce the power of a test to detect differences between annual estimates of population means, depending on their variances. The importance of these interrelated factors should be determined before a particular scheme and level of effort are chosen for sampling. (Author's abstract)
W91-01384

VARIATIONAL SENSITIVITY ANALYSIS, DATA REQUIREMENTS, AND PARAMETER IDENTIFICATION IN A LEAKY AQUIFER SYSTEM.
California Univ., Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2C.
W91-01512

WATER-RESOURCES DATA-NETWORK EVALUATION FOR MONTEREY COUNTY, CALIFORNIA, PHASE 3: NORTHERN SALINAS RIVER DRAINAGE BASIN.
Geological Survey, Sacramento, CA. Water Resources Div.
W. E. Templin, and R. C. Schluter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4123, 1990. 104p, 9 fig, 12 tab, 76 ref.

Descriptors: *California, *Hydrologic data, *Network design, *Salinas River, *Water resources data, Groundwater, Groundwater level, Groundwater management, Groundwater quality, Land use, Monterey County, Precipitation, Precipitation quality, Surface water, Surface water quality, Surface water records.

This report evaluates existing data collection networks and possible additional data collection to monitor quantity and quality of precipitation, surface water, and groundwater in the northern Salinas River drainage basin, California. Of the 34 precipitation stations identified, 20 were active and are concentrated in the northwestern part of the study area. No precipitation quality networks were identified, but possible data collection efforts include monitoring for acid rain and pesticides. Six of ten stream-gaging stations are active. Two surface water quality sites are sampled for suspended sediment, specific conductance, and chloride; one U.S. Geological Survey NASOAN site and one site operated by California Department of Water Resources make up the four active sampling locations; reactivation of 45 inactive surface water quality sites might help to achieve objectives described in the report. Three local networks measure water levels in 318 wells monthly, during peak irrigation, and at the end of the irrigation season. Water quality conditions are monitored in 379 wells; samples are collected in summer to monitor saltwater intrusion near Castroville and are also collected annually throughout the study area for analysis of chloride, specific conductance, and nitrate. An ideal baseline network would be an evenly spaced grid of index wells with a density of one per section. When baseline conditions are established, representative wells within the network could be monitored periodically according to specific data needs. (USGS)
W91-01836

7B. Data Acquisition

APPLICATION OF A HOLLOW-FIBER, TANGENTIAL-FLOW DEVICE FOR SAMPLING SUSPENDED BACTERIA AND PARTICLES FROM NATURAL WATERS.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W91-01031

VARIATIONS IN SUSPENDED SEDIMENT AND ASSOCIATED TRACE ELEMENT CONCENTRATIONS IN SELECTED RIVERINE CROSS SECTIONS.
Geological Survey, Doraville, GA.
For primary bibliographic entry see Field 2J.
W91-01061

COMPUTED AND OBSERVED CURRENTS, ELEVATIONS, AND SALINITY IN A BRANCHING ESTUARY.
Plymouth Marine Lab. (England).
For primary bibliographic entry see Field 2L.
W91-01129

EVALUATION OF BIOLOGICALLY HARMFUL ULTRAVIOLET RADIATION IN ANTARCTICA WITH A BIOLOGICAL DOSIMETER DESIGNED FOR AQUATIC ENVIRONMENTS.
California Univ., San Francisco. Lab. of Radiobiology.
D. Karentz, and L. H. Lutze.
Limnology and Oceanography LIOCAH, Vol. 35, No. 3, p 549-561, May 1990. 10 fig, 2 tab, 29 ref. NSF Grant No. DPP 87-12533 and DOE Contract No. DE-AC03-76-SF01012.

Descriptors: *Dosimetry, *Instrumentation, *Measuring instruments, *Radiometry, *Ultraviolet radiation, Antarctica, Biological dosimeter, DNA.

A biological dosimeter has been developed for use in aquatic environments. This method is based on the sensitivity of a DNA repair-deficient strain of Escherichia coli (CSR06) to ultraviolet (UV) radiation. The dosimeter permits evaluation of the penetration of biologically active UV radiation within a water column, reflecting the potential effect of exposure over selected time intervals. With the use of various filters, the biological dosimeter can discriminate between the effects of UV-B (280-320 nm) and UV-A (320-400 nm) or other selected portions of the solar UV spectrum. During springtime ozone depletion over the Antarctic in 1988, a general relationship was observed between stratospheric ozone concentration and the contribution of incident solar UV-B radiation to lethality of dosimeter cells. The use of dosimeters within the water column indicated that significant amounts of UV-B can be transmitted to a depth of 10 m and biological effects of UV could be detected to 20 and 30 m. Biological dosimeters may provide a means of standardizing in-water UV measurements across all types of aquatic habitats and at any geographical location. (Author's abstract)
W91-01138

SIMPLE PORE-WATER SAMPLER FOR COARSE, SANDY SEDIMENTS OF LOW POROSITY.
Nederlands Inst. voor Onderzoek der Zee, Texel.
P. M. Saager, J. P. Sweerts, and H. J. Ellermeijer.
Limnology and Oceanography LIOCAH, Vol. 35, No. 3, p 747-751, May 1990. 3 fig, 2 tab, 9 ref.

Descriptors: *Centrifugation, *Interstitial water, *Pore-water samplers, *Samplers, *Water sampling.

A simple, inexpensive, and highly efficient centrifuge tube allows nearly complete extraction of interstitial water from coarse, sandy sediments with porosities as low as 32%. The method is fast (5 min), efficient (55-92% of the available water is obtained), reliable, and can be performed on board ship at only 1,500 x g. The efficiency of the method permits a high sampling resolution (millimeter scale). The centrifuge tube is made of polyethylene and can be used for trace metal determinations after cleaning with acid. Due to a built-in filter, pore waters are clean and need not be filtered afterward, thus reducing the risk of contamination and possible oxidation artifacts. (Author's abstract)
W91-01147

Q2X: AN (EXPERT) SYSTEMS APPROACH TO QUANTITY AND QUALITY MANAGEMENT OF STRATEGIC RESOURCES.
Surrey Univ., Guildford (England). Centre for Information Technology Research.
For primary bibliographic entry see Field 5G.
W91-01213

ULTI-ELEMENT ANALYSIS OF NATURAL
ATER USING INDUCTIVELY COUPLED
LASMA-SOURCE MASS SPECTROMETRY
CP-MS).
rrey Univ., Guildford (England). Dept. of
emistry.
or primary bibliographic entry see Field 5A.
91-01219

CTA-GLUCURONIDASE AS A RAPID COL-
RIMETRIC ASSAY FOR E. COLI IN WATER
ND SEWAGE SAMPLES.
rrey Univ., Guildford (England). Dept. of
crobiology.
r primary bibliographic entry see Field 5A.
91-01242

OTAVIRUS AS A VIRAL INDICATOR IN
ELLFISH.
rrey Univ., Guildford (England). Dept. of
crobiology.
r primary bibliographic entry see Field 5A.
91-01243

MULTANEOUS DUAL COLUMN, DUAL-DE-
CTOR GAS CHROMATOGRAPHIC DETER-
NATION OF CHLORINATED PESTICIDES
D POLYCHLORINATED BIPHENYLS IN
VIRONMENTAL SAMPLES.
celle Ocean Sciences, Duxbury, MA.
primary bibliographic entry see Field 5A.
1-01281

SIGN FOR AN OCCULT PRECIPITATION
LLECTOR.
oria Univ. of Manchester (England). Dept. of
ironmental Biology.
Spink, and A. N. Parsons.
ospheric Environment ATENBP, Vol. 24A,
8, p 2263-2266, August 1990. 2 fig, 16 ref.

criptors: *Acid rain, *Cloud chemistry,
uds, *Measuring instruments, *Mist, *Precipi-
n gages, *Rain gages, *Sampling, Ammonium,
nical analysis, Data acquisition, Hydrogen, Ni-
s, Sulfates.

prototype design for a cloud and mist collec-
s relatively simple and inexpensive design,
des precipitation, making it suitable for long-
collection of chemical data related to occult
sition. Previous passive occult collector de-
suffer from the drawback that the collectors
ct rain and dry deposition as well as cloud and
The design presented here overcomes this
em to a large extent, although there is some
mination from dry deposition. In general, the
t samples collected had a considerably higher
concentration than the bulk samples. The
ge ratio of occult precipitation to bulk pre-
tion was as follows: nitrate, 5.09; sulfate, 3.94;
onium, 6.08; and hydrogen, 2.38. (Lantz-PTT)
01291

CE FOR IN SITU DETERMINATION OF
CHEMICAL TRANSPORT PARAMETERS.
TARDATION.
loo Univ. (Ontario). Dept. of Earth Sciences.
rimary bibliographic entry see Field 5B.
01293

CT OF 3,4-DICHLOROANILINE AND
AVANADATE ON DAPHNIA POPULA-
S.
e for Technology and Policy Studies TNO,
oorn (Netherlands). Dept. of Biology.
imary bibliographic entry see Field 5C.
1326

ING OF SPECIAL HYDROGEOLOGI-
VELLS.
va Univ., Prague (Czechoslovakia). Faculty
nce.
es, and A. el Dunia.
Universitatis Carolinae - Geologica
AY, Vol. 1988, No. 1, p 131-142, 1988. 4
fig, 1 tab, 13 ref.

Descriptors: *Borehole geophysics, *Data acquisition, *Geohydrology, *Logging (Recording), *Well logs, Aquifer characteristics, Aquifers, Boreholes, Geophysics, Groundwater data, Injection wells, Resistivity.

The task of groundwater resources protection represents one of the most difficult tasks of the hydrologist. Geophysical well logging has played an important role in completing geohydrological tasks particularly where boreholes are concerned. A new quantitative method for the evaluation of fluid resistivity logs has been developed which provides information on partial yields of individual inflows. In the wells which penetrate zones of high mineralized waters near their bottoms, it is possible to delineate individual inflows and to determine partial yields of each water producing horizon using only one fluid resistivity log recorded during or after the pumping test. Together with the formation resistivity log it is also possible to distinguish zones yielding fresh and mineral waters. Estimating the run-in characteristics of aquifers during a constant water injection into the well, it is possible to determine the thickness and the hydraulic conductivity of aquifers prepared for artificial recharge. (Lantz-PTT)
W91-01360

CORRESPONDENCE OF THE SCHEME AND METHOD OF CALCULATING THE STABILITY FACTOR.
For primary bibliographic entry see Field 8D.
W91-01436

DETERMINATION FROM SPACE OF ATMOSPHERIC TOTAL WATER VAPOR AMOUNTS BY DIFFERENTIAL ABSORPTION NEAR 940 NM: THEORY AND AIRBORNE VERIFICATION.
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. d'Optique Atmospherique.
R. Frouin, P. Y. Deschamps, and P. Lecomte.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 6, p 448-460, 1990. 8 fig, 3 tab, 29 ref, append.

Descriptors: *Aerosols, *Atmospheric water, *Data acquisition, *Instrumentation, *Measuring instruments, *Meteorological data, *Remote sensing, *Satellite technology, *Spectral analysis, *Water vapor, Climatic data, Marine climates, Microwaves, Optical properties, Reflectance, Solar radiation.

A new technique is proposed to estimate atmospheric total water vapor amounts from space. The technique consists of viewing the Earth's surface in two spectral channels, one narrow, the other wide, centered on the same wavelength at the water vapor absorption maximum near 940 nm. With these characteristics, the ratio of the solar radiance measured in the two channels is independent of the surface reflectance, and yields a direct estimate of the water vapor amount integrated along the optical path. To test the technique, a two-channel radiometer was designed and built based on the above concept. Airborne experiments carried out with the new device demonstrate the technique's feasibility under clear sky conditions over both sea and land. Over the ocean and in the presence of thick aerosol layers, however, total water vapor amounts may be underestimated by as much as 20%. Compared to satellite microwave techniques, which are applicable under most weather conditions, the proposed technique has the advantage of simplicity and constitutes a promising alternative over land, where microwave radiometry is inappropriate. (Author's abstract)
W91-01472

AIRCRAFT-BASED RADIOMETRIC IMAGING OF TROPOSPHERIC TEMPERATURE AND PRECIPITATION USING THE 118.75-GHZ OXYGEN RESONANCE.
Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
A. J. Gasiewski, J. W. Barrett, P. G. Bonanni, and D. H. Staelin.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 7, p 620-632, July 1990. 9 fig, 2 tab, 19 ref.
NASA Grant NAG 5-10.

Descriptors: *Air temperature, *Emission spectrometry, *Meteorology, *Precipitation, *Radiometry, *Remote sensing, *Resonance, Aircraft, Cloud cover, Convective precipitation, Infrared imagery, Oxygen, Spectrometers, Water vapor.

Passive microwave sounding of terrestrial atmospheric temperature profiles was first suggested in 1963. Imaging of O2 emissions using the 118.75-GHz (1-) resonance has been investigated for tropospheric and stratospheric remote sensing of atmospheric temperature and precipitation. An imaging millimeter-wave spectrometer (MTS) was constructed. The MTS collected data during 33 flights of a high-altitude aircraft in 1986, yielding the first high spatial resolution microwave images of atmospheric O2 brightness. The isolated 118-GHz line offers higher spatial resolution and precipitation sensitivity than O2 lines in the 5-mm band near 60 GHz. The brightness temperature perturbations of clouds in nonprecipitating regions are typically twice as large in the 118-GHz channels relative to comparable 60-GHz channels. However, observations over cirrus anvils show that the 118-GHz brightnesses are not adversely sensitive to some optically opaque cloud cover. Thus, these channels are expected to be useful for temperature sounding in the presence of clouds, although retrieval ambiguities can result from variations in the water vapor profile and surface emissivity. Over deep convective precipitation, 118-GHz brightness temperature images are characterized by decreases of up to 200 K due to strong scattering in the storm core. The amplitudes and shape of the 118-GHz spectrum contain information on the cell top by virtue of the various peaking altitudes of the 118-GHz weighting functions. Precipitation cells observed by the MTS sometimes appear in bands or rows, and have been accompanied by periodic radiance structures. (Author's abstract)
W91-01488

EXPERIMENTAL TESTING OF TRANSIENT UNSATURATED FLOW THEORY AT LOW WATER CONTENT IN A CENTRIFUGAL FIELD.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2G.
W91-01514

SOLUTE TRANSPORT WITH MULTISEGMENT, EQUILIBRIUM-CONTROLLED REACTIONS: A FEED FORWARD SIMULATION METHOD.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-01520

MASS ARRIVAL OF SORPTIVE SOLUTE IN HETEROGENEOUS POROUS MEDIA.
Royal Inst. of Tech., Stockholm (Sweden).
For primary bibliographic entry see Field 5B.
W91-01521

AUTOMATING WATER RESOURCE MANAGEMENT.
V. Speed.
Water Engineering and Management WENMD2, Vol. 137, No. 8, p 28-30, August 1990. 4 fig.

Descriptors: *Databases, *Geographic information systems, *Mapping, *Water resource management, *Water resources data, Arid lands, Automation, Benefits, Data interpretation, Government supports, Semiarid lands.

In order to track water resource information and how it relates to independent consumer interests in the irrigable land in the Mid-Pacific Region of the US, the Bureau of Reclamation (Department of the Interior) uses geographic information system (GIS)

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technology--a computerized mapping/database management system that allows users to capture, edit, display, and analyze geographic data. The database allows them to combine information from various sources into a single map displaying areas of concern. The Computer Assisted Cartographic (CAC) document was created to outline functional requirements and allow a more appropriate automation tool. A system was needed that could take data from a variety of different sources, analyze it, and store it in individual layers. When the system requirements were completed, the CAC included such particulars as scale and projection transformations, topological overlays, addition of new layers to existing drawings and the ability to create new layers from existing layers. The Bureau purchased a general-purpose data management package that allows users to bring survey information into the database from many sources. It consists of the ARC system, which stores cartographic data, and the INFO relational database, which stores attribute data. In its efforts to automate the everyday analysis and mapping tasks, the Bureau has expanded its role in water resource management to better provide the districts it serves with accurate and fair water contracts. Their efforts are contributing to the resolution of litigation and water disputes in the arid and semiarid western land. (Fish-PTT)
W91-01563

BALANCING THE SCADA EQUATION FOR THE FIRST-TIME USER.
Control Mfg. Co., Belmont, CA.
T. Meyer.
Water Engineering and Management WENMD2, Vol. 137, No. 8, p 32-33, August 1990. 1 fig.

Descriptors: *Computer models, *Computer programs, *Data acquisition, *Supervisory control, *Wastewater management, *Water management, Cost-benefit analysis, Monitoring, SCADA system, Wastewater facilities.

Over the past five years, supervisory control and data acquisition (SCADA) has evolved from a fledgling tool for the water industry to a reliable, sophisticated means of monitoring, reporting, and controlling the operation of modern water/wastewater plants. A successful installation will reduce manpower requirements by 50% or more, ease future expansion and effortlessly keep pace with the ever-increasing paperwork requirements of regulatory agencies. The benefits of SCADA are not restricted to large plants. SCADA becomes an asset when the costs of installing the system are surpassed by the benefits achieved from the system. System architecture is critical to a successful SCADA system. Over-design and under-design are dangers paid for by high cost, complex maintenance, increased variables, and undertrained operators. Personal computer-platform SCADA systems perform best (most quickly and dependably) when user programs are solved outside of the personal computer. If the system requires only monitoring and direct output of operator commands to the field, remote terminal units can be used. Manual and semi-automatic backups must be designed into the system to maintain all critical processes in the event of malfunction. Today's technology has brought simple SCADA control, financially, within the reach of almost every district. A basic SCADA system can be purchased for less than $30,000. (Fish-PTT)
W91-01564

MEASUREMENT OF EXOENZYMATIC ACTIVITY IN STREAMBED SEDIMENTS USING METHYLUMBELLIFERYL-SUBSTRATES.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
For primary bibliographic entry see Field 2J.
W91-01587

METHOD OF MEASURING THE DEHYDROGENASE ACTIVITY OF SEDIMENTS.
Sofia Univ. (Bulgaria). Dept. of Ecology.
For primary bibliographic entry see Field 2J.
W91-01588

APPLICATION OF THE ISOTOPE DILUTION PRINCIPLE TO THE DETERMINATION OF SUBSTRATE INCORPORATION BY AQUATIC BACTERIA.
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
For primary bibliographic entry see Field 2H.
W91-01599

IMPROVED ASSESSMENT OF BACTERIAL PRODUCTION: COMBINED MEASUREMENTS OF PROTEIN SYNTHESIS VIA LEUCINE AND CELL MULTIPLICATION VIA THYMIDINE INCORPORATION.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2H.
W91-01605

NOTE ON THE MEASUREMENT OF PRODUCTION OF PHOTOTROPHIC BACTERIA IN DEEP LAYERS.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
For primary bibliographic entry see Field 2H.
W91-01614

USE OF POLARIZATION TO CHARACTERIZE PRECIPITATION AND DISCRIMINATE LARGE HAIL.
National Severe Storms Lab., Norman, OK.
For primary bibliographic entry see Field 2B.
W91-01656

COMPARISON OF A GENE PROBE WITH CLASSICAL METHODS FOR DETECTING 2,4-DICHLOROPHENOXYACETIC ACID (2,4-D)-BIODEGRADING BACTERIA IN NATURAL WATERS.
Oregon State Univ., Corvallis. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W91-01664

MEASUREMENT OF SURFACE TENSION IN AGRICULTURAL WASTE SLURRIES.
Cambridge Univ. (England). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W91-01702

SPECIATION OF MERCURY COMPOUNDS IN WASTE WATER BY MICROCOLUMN LIQUID CHROMATOGRAPHY USING A PRECONCENTRATION COLUMN WITH COLD-VAPOR ATOMIC ABSORPTION SPECTROMETRIC DETECTION.
Nagoya Univ. (Japan). Dept. of Applied Chemistry.
For primary bibliographic entry see Field 5A.
W91-01716

SIMPLE METHOD FOR ESTIMATING DERMAL ABSORPTION OF CHEMICALS IN WATER.
ENVIRON Corp., Washington, DC.
For primary bibliographic entry see Field 5B.
W91-01731

BENTHIC MACROPHYTE COMMUNITY CORE SAMPLER.
Wayne State Univ., Detroit, MI. Dept. of Biological Sciences.
M. D. Fornwall, and A. Hough.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 3, p 379-382, June 1990. 1 fig, 10 ref. NSF Grant DEB81-D3528.

Descriptors: *Benthic flora, *Biological samples, *Bottom sampling, *Samplers, *Submerged aquatic plants, Aquatic soils, Cores, Ecosystems, Macrophytes, Sediments.

A coring device for quantitative sampling of benthic submerged macrophyte beds was constructed. The device has a relatively large-diameter barrel to include both above and below ground biomass, a long (variable length) handle for direct control, and a simple sample retaining mechanism to maximize ease of operation and to minimize cost. The sampler is effective in sediments ranging from organic muds to sandy clays, and in water depths of up to four meters. The 30-cm barrel consistently reaches below the maximum depth of plant roots in the sediment. This sampler cuts and retains dense macrophyte growth quite well. Tall shoots are difficult to sample however, requiring careful, vertical lowering of the sampler, and thus the sampler is not well suited for beds of tall plants. The large root systems of the Nymphaceae challenge the sampler also, but at their relatively shallow depths it is possible to achieve the cutting necessary to produce acceptable samples. These types of problems require the direct control provided by the pole-type handle. A short-handled version of this sampler could be adapted for diver use. (Agostine-PTT)
W91-01747

USE OF RESISTIVITY SOUNDINGS TO DETERMINE LANDFILL STRUCTURE.
Northern Illinois Univ., De Kalb. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W91-01786

MEASUREMENT AND INTERPRETATION OF LOW LEVELS OF DISSOLVED OXYGEN IN GROUND WATER.
Geological Survey, Menlo Park, CA.
A. F. White, M. L. Peterson, and R. D. Solbau.
Ground Water GRWAAP, Vol. 28, No. 4, p 584-590, July/August 1990. 6 fig, 1 tab, 22 ref.

Descriptors: *Analytical methods, *Dissolved oxygen, *Groundwater pollution, *Metals, *Path of pollutants, *Radionuclides, *Selenium, Agricultural runoff, Analytical techniques, Aquifers, California, Kesterson Reservoir, Monitoring.

A Rhodazine-D colorimetric technique was adapted to measure low-level dissolved oxygen concentrations in groundwater. Prepared samples containing between 0 and 8.0 micromoles/l dissolved oxygen in equilibrium with known gas mixtures produced linear spectrophotometric absorbance with a lower detection limit of 0.2 micromoles/l. Excellent reproducibility was found for solutions ranging in composition from deionized water to sea water with chemical interferences detected only for easily reduced metal species such as ferric ion, cupric ion and hexavalent chromium. Such effects were correctable based on parallel reaction stoichiometries relative to oxygen. The technique, coupled with a downhole wire line tool, permitted low-level monitoring of dissolved oxygen in wells at the selenium-contaminated Kesterson Reservoir in California. Results indicated a close association between low but measurable dissolved oxygen concentrations and mobility of oxidized forms of selenium in the shallow aquifer which were in general electrochemical disequilibrium. (Author's abstract)
W91-01788

PRIMER ON CLOTHING SYSTEMS FOR COLD-WEATHER FIELD WORK.
Geological Survey, Bow, NH. Water Resources Div.
J. C. Denner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-415, April 1990. 14p, 2 fig, 4 tab, 9 ref.

Descriptors: *Acclimatization, *Clothing, *Cold regions, *Data acquisition, *Hydrologic data, *Hypothermia, *Thermal stress, High-loft insulators, Layering system, Moisture absorption, Thermal conductance, Thin insulators.

Hypothermia in cold environments can be prevented by physiological adaptation and by the proper use of cold weather clothing. The human body adjusts to cold temperature by increasing the rates

' basal metabolism, specific dynamic action, and
ıysical exercise. Heat loss is reduced by vasocon-
riction. Clothing systems for cold weather reduce
ss by providing insulation and protection from
e elements. Satisfactory cold-weather clothing is
ınstructed of wool fabrics or the synthetic fibers
olypropylene and polyester. Outerwear suitable
r cold climates is insulated with down, high-loft
olyester fiberfills, or the new synthetic thin insu-
ors. (USGS)
91-01846

**EASURING TECHNIQUES FOR GAS/SOLID
UIDIZED BED REACTORS (MEBTECHNI-
:N FUR GAS/FESTSTOFF-WIRBELSCHICH-
EAKTOREN).**
mburg Univ. (Germany, F.R.).
r primary bibliographic entry see Field 5D.
91-01896

**OT-SENSOR METHOD OF MEASURING
RRENTS IN SHALLOW ESTUARINE
TERS.**
w Hampshire Univ., Durham. Jackson Estua-
Lab.
E. Anderson.
uaries ESTUDO, Vol. 13, No. 3, p 250-257,
tember 1990. 11 fig, 1 tab, 14 ref. Sea Grant
NA86AA-D-SG-047.

criptors: *Current meters, *Estuaries, *Measur-
instruments, *Shallow water, *Shot-sensor
ice, Currents, Data acquisition, Flow velocity,
formance evaluation, Tides.

urrent measuring device, the Shot-Sensor, was
eloped as a low cost alternative to measuring
er flow speeds and directions using convention-
more expensive instrumentation. The device
ases stainless steel shot, of know size and set-
speed, into a flowing water mass. As the shot
es, it is dispersed by currents and ends up in
ng traps. Mean current speed and direction
be calculated from the patterns of dispersal and
ercentages of shot of various sizes in the traps.
n current speed and direction can be calculat-
om the patterns of dispersal and the percent-
of shot of various sizes in the traps. Determi-
n of precision and accuracy indicate that the
-Sensor can measure within a few cm/sec of
expensive meters and may be suitable for
shallow-water applications. Speed range of
Shot-Sensor is presently limited to between 3
40 cm/sec, but further development could
this range to be extended. (Author's abstract)
-01900

**IRONMENTAL TESTING-ISSUES AND
ECTIONS.**
primary bibliographic entry see Field 5G.
01913

**RACTERIZATION OF COMPOST WITH
PECT TO ITS CONTENT OF HEAVY
ALS, PART I: SAMPLE DIGESTION AND
AES ANALYSIS.**
erdam Univ. (Netherlands). Vakgroep Milieu-
.
rimary bibliographic entry see Field 5E.
01986

**TIRESIDUE METHOD BY HIGH PER-
MANCE LIQUID CHROMATOGRAPHY-
D FRACTIONATION AND GAS CHRO-
OGRAPHIC DETERMINATION OF
E LEVELS OF PESTICIDES IN AIR AND
ER.**
rnia Univ., Davis. Dept. of Environmental
ology.
imary bibliographic entry see Field 5A.
02038

Evaluation, Processing and
ication

**TIFYING FLOW PATHS IN MODELS OF
ACE WATER ACIDIFICATION.**
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-01033

HYDRODYNAMIC MODEL FOR WIND-DRIVEN AND TIDAL CIRCULATION IN THE ARABIAN GULF.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
For primary bibliographic entry see Field 2L.
W91-01077

TEMPORAL VARIABILITY OF SOIL WETNESS AND ITS IMPACT ON CLIMATE.
Princeton Univ., NJ. Geophysical Fluid Dynamics Program.
For primary bibliographic entry see Field 2G.
W91-01090

SALINITY STRATIFICATION IN A RIVER-DOMINATED ESTUARY.
Alabama Marine Resources Lab., Dauphin Island.
For primary bibliographic entry see Field 2L.
W91-01130

TEST OF THE ASSUMPTIONS AND PREDICTIONS OF RECENT MICROALGAL GROWTH MODELS WITH THE MARINE PHYTOPLANKTER PAVLOVA LUTHERI.
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W91-01139

PROCEEDINGS OF STORMWATER AND WATER QUALITY MODEL USERS GROUP MEETING.
For primary bibliographic entry see Field 5G.
W91-01188

USER DEFINED CONDUITS IN THE EXTRAN BLOCK OF SWMM.
Tulane Univ., New Orleans, LA.
For primary bibliographic entry see Field 4C.
W91-01189

IMPROVEMENTS TO SURCHARGE CALCULATIONS IN EXTRAN.
Brown and Caldwell, Seattle, WA.
L. K. Belvin.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 33-42, 6 fig, 4 ref.

Descriptors: *Flow profiles, *Storm Water Management Model, *Storm water management, *Unsteady flow, *Urban hydrology, *Urban runoff, Data interpretation, Flood peak, Fluid dynamics, Mathematical studies, Pipe flow, Storm runoff.

Unsteady non-uniform surcharged flow is a condition frequently found in combined sewer systems. Yet, to date there is no well documented, publicly available sewer model which can accurately simulate such flows. The Extended Transport (EXTRAN) block of the EPA's Stormwater Management Model (SWMM) was designed to model such flows, but it has deficiencies. Continuity is not necessarily preserved in the model, especially under surcharge conditions, which causes errors in flow balance, peak flow time and peak heads. In this paper, modifications have been made to the model to improve the non-uniform surcharge flow calculations. By accounting for fluid volumes in the pipes, the calculations of continuity are improved, especially under surcharge. These modifications were incorporated into the existing model without changing the input or output parameters. The improved model does not require additional user training to operate the model. The result is a publicly available, well-documented hydraulic sewer model that more accurately models unsteady, non-uniform surcharge flows. As demonstrated in a sample application, the modified EXTRAN code preserves continuity and matches computed head values better than the original EXTRAN code. Because the improvements were made without changing the user parameters of the model, this new version of EXTRAN, in conjunction with the available EXTRAN documentation, is the only publically available, well-documented program that accurately models surcharge flow under non-uniform, unsteady conditions. (See also W91-01188) (Lantz-PTT)
W91-01192

URBAN RUNOFF MODELING FOR ADMINISTRATIVE PURPOSES.
Wright Water Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 4C.
W91-01193

MODELING STUDIES FOR THE CITY OF AUSTIN STORMWATER MONITORING PROGRAMS.
Austin Environmental Protection Dept., TX.
For primary bibliographic entry see Field 4C.
W91-01194

HYDROLOGIC DATA AUTOMATION USING AUTOCAD.
Kiowa Engineering Corp., Denver, CO.
J. Y. Chang, and J. C. Y. Guo.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 142-148, 1 fig, 3 tab, 3 ref.

Descriptors: *Automation, *Computer programs, *Data storage and retrieval, *Urban hydrology, *Urban runoff, *Water resources management, Case studies, Colorado, Computer-aided design, Computers, Denver, Management plannings.

CUHPCAD is a computer program developed for the promotion of hydrological data automation, which serves as a control program to link between AutoCAD and the CUHP program. The program was developed for the purpose of hydrologic data automation, and consists of two parts: (1) the CUHP.LSP program which analyzes and stores the data generated by using AutoCAD; and (2) the CUHPCAD.BAS program which can abstract the data from CUHP.LSP and perform data calculation and preparation of CUHP data input files. The CUHPCAD program has been tested and applied to a major drainage basin planning project for the study of Second, Third, and Box Elder Creeks in Adams County, CO. The study area is approximately 70 sq mi. Total sub-basin number is 390. Soil types include A, B, and C groups based on Soil Conservation Service's soil survey report. Land use for existing conditions are mostly agricultural. Three baseline hydrological conditions for the frequencies of 20, 5-, 10-, and 100-year need to be modeled by using CUHP which includes existing basin conditions, and future basin conditions with or without the proposed New Denver Airport. With the use of CUHPCAD, The hydrology portion of this project was completed within the allowable schedule and budget. After the manual preparation of the basin map, soil map, and the land use map, the input of all maps to the computer was completed. (Lantz-PTT)
W91-01202

DISTRIBUTED RAINFALL-RUNOFF MODELING BASED ON DIGITAL MAP DATABASE.
Colorado Univ. at Denver. Dept. of Civil Engineering.
L. E. Johnson.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 149-160, 10 fig, 7 ref. National Science Foundation Grant No. ECE-8513122.

Descriptors: *Computer models, *Data interpretation, *Maps, *Rainfall-runoff relationships, *Urban hydrology, *Urban runoff, Computer programs, Computers, Databases, Digital analysis, Graphical analysis, Runoff, Simulation analysis, Slopes.

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A cascade-of-reservoirs rainfall-runoff model, called MAPHYD, has been developed which incorporates automatic generation of model input data using geographical information system functions integrated into a user friendly workstation. Digital terrain modeling is conducted to obtain slope and the direction of slope for a user-selectable grid cell resolution. Associated data on soils and infiltration characteristics, land use and percent impervious, antecedent moisture conditions, and rainfall distribution are simulation routines. Output result of the spatial distribution of runoff at each time step are displayed using an interval color scale. Input, retrieval, and editing of the digital database is accomplished by interactive computer graphics techniques. (See also W91-01188) (Author's abstract)
W91-01203

PC-SYNOP, A RAINFALL ANALYSIS TOOL.
Woodward-Clyde Consultants, Oakland, CA.
E. W. Strecker, E. D. Driscoll, and G. E. Palhegyi.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 161-172, 3 fig, 7 tab, 9 ref.

Descriptors: *Computer programs, *Data processing, *Microcomputers, *Rainfall-runoff relationships, *Storm runoff, *Synoptic Rainfall Analysis Program, *Urban hydrology, *Urban runoff, Computers, Runoff, Statistical analysis.

EPA's Synoptic Rainfall Analysis Program (SYNOP) for the personal computer analyzes an hourly rainfall record, that can be obtained on floppy disk from the National Climatic Data Center, for rain gages located throughout the country. It generates a variety of storm event based summary statistics. By specifying a minimum dry period that separates successive storms, SYNOP groups the hourly rainfall record into storm events and analyzes the resulting record. A user friendly interface has been provided for the selection of computational and printout options. Some of the added features include the ability to: (1) select either a water year or calendar year organization, (2) to conduct an analysis on a seasonal basis (useful for dealing with the pronounced wet and dry seasons in some areas of the country), (3) to exclude from the statistical analyses all storm event volumes that are less than some user specified minimum (used to determine the characteristics of only those storm events that will produce runoff), and (4) the ability to write out a separate file containing storm event information on all storm events in the record for downloading to a spreadsheet or statistical analysis program. A cooperative analysis is presented in tabular form that examines the effects and some of the implications of a minimum storm event that generates runoff. (See also W91-01188) (Lantz-PTT)
W91-01204

COMPUTER AIDED PLANNING OF DRAINAGEWAY IMPROVEMENTS MADE EASY WITH LOTUS 1-2-3.
Greenhorne and O'Mara, Inc., Aurora, CO.
M. B. Cooke, and R. P. Gildersleeve.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 173-182, 3 ref.

Descriptors: *Computer programs, *Computer-aided design, *Drainage systems, *Storm water management, *Urban hydrology, *Urban runoff, Channels, Culverts, Data processing, Hydraulic properties, Pipes, Storm runoff, Stormwater Master Plan Model.

A computer program was developed which combines an hydraulics package with a cost-estimating program to allow quick planning level comparisons of alternative planning scenarios. The Stormwater Master Plan Model (SMPM) is a menu-driven program for those involved in the master planning of drainageways. The program computes hydraulic characteristics of existing and planned drainageway improvements and estimates their cost. SMPM models four types of drainageway elements: channels, culverts bridges and detention ponds. Channels can be grasslined, riprap or concrete and can include concrete or riprap drop structures. The program accommodates four types of culverts: corrugated metal pipe, corrugated metal arch, concrete pipe and reinforced concrete box culverts. One of the most powerful features of SMPM is its cost routine. The program computes a planning level cost estimate for each drainageway element included in the model. The cost is based on user defined unit costs for excavation, riprap, pipe right of way and other common capital cost items. Modifications to design flows and any drainageway element can be made quickly and easily via the menu. SMPM is designed for those that are familiar with running LOTUS 1,2,3 Release 2. Each model can contain up to 35 channel, culvert or bridge elements. (See also W91-01188) (Lantz-PTT)
W91-01205

HYETOGRAPH COMPOSITING EFFECTS ON URBAN RUNOFF MODELLING.
Kiowa Engineering Corp., Denver, CO.
M. P. Jansekok, and B. R. Urbonas.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 183-195, 15 fig, 1 tab, 1 ref.

Descriptors: *Data processing, *Hyetographs, *Model studies, *Rainfall-runoff relationships, *Urban hydrology, *Urban runoff, Case studies, Colorado, Computer models, Denver, Flood peak, Runoff, Storm runoff.

Rainfall and runoff data from a 3.08 sq mi urban watershed in Denver, Colorado was used to investigate the effects of compositing several recorded rainstorm hyetographs on urban stormwater runoff modelling results. The watershed in this semi-arid region had data at five rain gages and two flow gages, which provided the basis for calibrating an Urban Drainage and Flood Control District version of the Storm Water Management Model (SWMM). The calibrated model was then used to examine the effects of runoff calculations using a single composite hyetograph for each storm. Compositing of hyetographs was performed using two types of area weighted techniques. The five hyetographs were then composited directly using the recorded rainfall depth at each clock time interval. In addition, the hyetographs were composited using a technique that first shifted the five gage records so the peak rainfall time increments of each hyetograph were aligned. In this study very little difference was found in peak flow and runoff volume simulations between the two types of hyetographs compositing techniques, namely compositing straight across or compositing using peak preservation. However, the author's believe that it is premature to accept this finding as a general finding applicable under all conditions. Both methods tended to underestimate peak flows and volumes when compared against the calibrated multi-rain gage hyetograph runs using a calibrated SWMM model. (See also W91-01188) (Lantz-PTT)
W91-01206

FLOOD HYDROGRAPH FOR UNGAGED WATERSHED.
Stewart Environmental Consultants, Inc., Fort Collins, CO.
W. C. Cunha.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 196-207, 3 fig, 1 tab, 8 ref.

Descriptors: *Data interpretation, *Flood hydrographs, *Model studies, *Rainfall-runoff relationships, *Storm runoff, *Urban hydrology, *Urban runoff, Computer models, Flood routing, Hydrographs, Infiltration.

The flood hydrograph for ungaged watershed can be calculated utilizing the Soil Conservation Service (SCS) data and physically-based soil infiltration equations, and the XSRAIN model. This software utilizes physically-based infiltration equations to calculate the abstraction of rainfall in basins for which there is a minimum of available hydrologic information. The hydraulic soil parameters can be easily calculated from a relationships between the SCS's curve number (CN) and the mentioned parameters. Large heterogeneous watersheds can be partitioned into several smaller homogeneous sub-basins. Routing of excess rainfall is performed with the SCS dimensionless unit hydrograph to produce a runoff hydrograph for each individual sub-basin. The final flood hydrograph is obtained by routing and summing the runoff hydrographs of sub-basins according to the travel time associated with them. Rain data can be supplied by simply providing the depth and duration of rain or the user may input variable rain depths. (See also W91-01188) (Lantz-PTT)
W91-01207

UNIT-HYDROGRAPH PROCEDURES FOR ARID LANDS.
G. V. Sabol, J. M. Rumann, D. Khalili, and T. A. Dominguez.
IN: Proceedings of Stormwater and Water Quality Model Users Group Meeting. October 3-4, 1988, Denver, CO. EPA Report No. EPA/600/9-89/001, January 1989. p 208-216, 2 tab, 6 ref.

Descriptors: *Arid lands, *Arizona, *Data interpretation, *Flood control, *Rainfall-runoff relationships, *Unit hydrographs, Graphical analysis, Hydrographs, Mathematical studies, Storm runoff.

Unit hydrographs are used in most hydrometeorological flood analyses in the arid west and throughout the U.S. Recently, two studies were conducted for the Flood Control District of Maricopa County, Arizona, for the purpose of selecting or developing synthetic unit hydrograph procedures for use in the County. A study was conducted to compile S-graphs from the southwest, and to select S-graphs for use in the various physiographic landforms within Maricopa County. A second study was conducted to collect rainfall-runoff data from the southwest and to analyze this data to develop a synthetic hydrograph procedure for Maricopa County. Rainfall-runoff data was compiled from the Walnut Gulch Experimental Watershed at Tombstone, Arizona, Tucson Experimental Watersheds, urban hydrology programs of the USGS in Denver and Albuquerque, and a USGS data collection program in Wyoming. The procedure to synthesize the Clark unit hydrograph was: (1) Estimate the time of concentration (TC); (2) estimate the storage coefficient (R); and (3) develop the appropriate time-area relation which would be expected to fall within appropriate envelopes to select the default time-area relations. (See also W91-01188) (Lantz-PTT)
W91-01208

DETERMINATION OF DESIGNATED FLOODWAY BOUNDARIES AROUND LONG LANDS IN STREAM CHANNELS.
Oklahoma Univ., Norman. School of Civil Engineering and Environmental Science.
For primary bibliographic entry see Field 2E.
W91-01209

Q2X: AN (EXPERT) SYSTEMS APPROACH TO QUANTITY AND QUALITY MANAGEMENT OF STRATEGIC RESOURCES.
Surrey Univ., Guildford (England). Centre for Information Technology Research.
For primary bibliographic entry see Field 5
W91-01213

USE OF A COMPARTMENTAL MODEL TO DEVELOP RULES FOR THE INTERPRETATION OF WATER QUALITY DATA.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B
W91-01214

WATER QUALITY INDEX FOR USE IN THE OPERATIONAL MANAGEMENT OF RIVER WATER QUALITY IN EUROPE.
Middlesex Polytechnic, Enfield (England).
For primary bibliographic entry see Field 5G.
W91-01215

ASSESSMENT OF THE ONTARIO MINISTRY OF THE ENVIRONMENT PROTOCOLS FOR CONDUCTING DAPHNIA MAGNA ACUTE LETHAL TOXICITY TESTS WITH PULP AND PAPER MILL EFFLUENTS.
Pulp and Paper Research Inst. of Canada, Pointe Claire (Quebec).
For primary bibliographic entry see Field 5C.
W91-01266

HYDROLOGICAL INFORMATION TRANSFER USING HOMS.
nstitute of Hydrology, Wallingford (England).
H. R. Oliver, and J. B. Miller.
ournal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 3, p 65-267, June 1990. 1 fig, 1 tab, 5 ref.

Descriptors: *Cooperatives, *Data storage and retrieval, *Hydrologic data collections, *Information systems, *Information transfer, *International commissions, *Organizations, *Water resources institutes, Case studies, Computer programs, Developing countries, Technology, Water resources development, Water resources management.

n recent decades, hydrological science and its associated technology have made substantial rogress, and significant contributions have been ade in the development and management of ater resources. The Hydrological Operational ultipurpose (HOMS) scheme of the World Meteorological Organization (WMO) consists of an ternational network for the transfer of packages proven hydrological know-how, with particular nphasis on helping developing countries. More an one hundred HOMS centers worldwide oduce and supply information components and ndle requests for components for use in their vn countries. These components can take many rms, e.g. sets of drawings for constructing hydological equipment, reports describing hydrolcal procedures, and computer programs. Details e presented of the organization and operation of OMS, together with example case studies to illusate its successful use. HOMS can be of considerle benefit for water engineers and managers in veloping countries. (VerNooy-PTT)
91-01274

NALYSIS OF RADM GAS CONCENTRATION REDICTIONS USING OSCAR AND NEROS ONITORING DATA.
te Univ. of New York at Albany. Atmospheric iences Research Center.
r primary bibliographic entry see Field 5B.
91-01285

GNORMAL DISTRIBUTION OF RADON NCENTRATION IN GROUND WATER.
ole Polytechnique, Montreal (Quebec).
r primary bibliographic entry see Field 5B.
91-01294

DROGEOLOGIC DATABASE FOR OUND-WATER MODELING.
undwater Services, Inc., Houston, TX.
. Newell, L. P. Hopkins, and P. B. Bedient.
ound Water GRWAAP, Vol. 28, No. 5, p 703-, September/October 1990. 9 ref, 7 tab, 17 ref, end.

scriptors: *Computer programs, *Databases, eohydrology, *Groundwater movement, *Hydlogic data collections, *Model studies, ifers, Classification, Computers, Flow velociGroundwater data, Hydraulic conductivity, draulic gradient, Land disposal, Monte Carlo hod, Saturated flow, Seepage.

ew geohydrologic database, the HGDB, was eloped from a national survey of National Water Well Association (NWWA) members. The database contains general geohydrologic information from 400 field site investigations across the country, and detailed statistical summaries of five groundwater parameters: hydraulic conductivity, seepage velocity, hydraulic gradient, saturated thickness, depth to top of aquifer. The HGDB was developed to verify and expand statistical distributions used in a Monte Carlo groundwater model developed by EPA for land disposal regulation. The database structure is a unique application of the aquifer classification method used in the NWWA's DRASTIC system. Respondents were asked to classify their aquifers as one of 111 different DRASTIC geohydrologic settings, and 12 groupings of settings were analyzed to produce statistical distributions of geohydrologic data based on site geology and geomorphology. Three examples of geohydrologic groupings are: coastal beaches; alluvial basins, valleys and fans; and outwash settings. The HGDB can be used for several purposes. First, the HGDB results indicate that the EPA's distributions of seepage velocity and hydraulic conductivity used in the land disposal model are sound. These are the most important geohydrologic parameters in the model. The HGDB goes a step further and provides a set of statistical distributions that can be used to make the land disposal regulations more site-specific than the national approach now being used. Finally, the HGDB data can be used for general site characterization and for educational purposes. The database is available as a detailed written report and spreadsheet file from the American Petroleum Institute, and is contained in a graphical computerized decision support system for groundwater modeling called OASIS. The HGDB serves as a framework for organizing geohydrologic information from different site investigations and can be expanded easily beyond the 400 sites now in the database. (Author's abstract)
W91-01298

PROGRAM TO CALCULATE HYDRAULIC CONDUCTIVITY USING SLUG TEST DATA.
Idaho National Engineering Lab., Idaho Falls.
A. Wylie, and T. R. Wood.
Ground Water GRWAAP, Vol. 28, No. 5, p 783-786, September/October 1990. 4 fig, 1 tab, 7 ref.

Descriptors: *Aquifer testing, *Hydraulic conductivity, *Pumping tests, *Slug tests, *Well testing, Computer programs, Data interpretation.

SLUGTST is a computer program which calculates hydraulic conductivity from data obtained during a slug test. An on-screen graphical display allows the user to view the data and make a rapid evaluation. During the execution of a slug test, the water level in a well is instantaneously raised or lowered and changes in the water level are monitored as it seeks an equilibrium position. SLUGTST a program written in TURBO BASIC for IBM-PC computers and compatibles, calculates hydraulic conductivity from data obtained during these tests. (Lantz-PTT)
W91-01305

PREDICTING BIOACCUMULATION POTENTIAL: A TEST OF A FUGACITY-BASED MODEL.
Environmental Research Lab.-Narragansett, Newport, OR. Mark O. Hatfield Marine Science Center.
For primary bibliographic entry see Field 5B.
W91-01316

TIME SCALES AND VARIABILITY OF AREA-AVERAGED TROPICAL OCEANIC RAINFALL.
Texas A and M Univ., College Station. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W91-01446

SUPPORTING WORLD HYDROLOGY: ACTIVITIES OF INTERNATIONAL HYDROLOGICAL PROGRAMS.
World Meteorological Organization, Geneva (Switzerland). Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 6E.
W91-01457

STOCHASTIC MODELS OF STREAMFLOW: SOME CASE STUDIES.
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-01461

REGIONALIZATION AND SPATIAL ESTIMATION OF ETHIOPIAN MEAN ANNUAL RAINFALL.
Lund Univ. (Sweden). Dept. of Physical Geography.
For primary bibliographic entry see Field 2B.
W91-01466

PREDICTION MODEL FOR SNOWMELT, SNOW SURFACE TEMPERATURE AND FREEZING DEPTH USING A HEAT BALANCE METHOD.
Tohoku Univ., Sendai (Japan). Geophysical Inst.
For primary bibliographic entry see Field 2C.
W91-01469

FURTHER EXPLORATORY EVALUATIONS OF GROSSVERSUCH IV USING HAILPAD DATA: ANALYSIS OF HAIL PATTERNS AND STRATIFICATION BY STORM TYPE FOR SEEDING EFFECT.
Groupement National d'Etudes des Fleaux Atmospheriques, Aubiere, France.
For primary bibliographic entry see Field 2B.
W91-01471

ALGORITHM FOR RETRIEVING WATER VAPOR PROFILES IN CLEAR AND CLOUDY ATMOSPHERES FROM 183 GHZ RADIOMETRIC MEASUREMENTS: SIMULATION STUDIES.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
T. T. Wilheit.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 6, p 508-515, 1990. 6 fig, 1 tab, 11 ref.

Descriptors: *Algorithms, *Atmospheric water, *Data interpretation, *Radiometry, *Remote sensing, *Simulation analysis, *Water vapor, Atmospheric circulation, Cloud physics, Clouds, Marine climates, Microwaves.

The latent heat represented by atmospheric water vapor is extremely important to the energetics of the Earth system. Future satellites (NOAA and DMSP) will carry microwave radiometers designed to measure the profile of water vapor globally. The problem of retrieving water vapor from the measurements is highly nonlinear even in clear atmospheres, and the addition of clouds only makes it more so. An algorithm has been developed which will retrieve water vapor profiles from microwave radiometric measurements even in the presence of clouds. Simulations with this algorithm show a vertical resolution on the order of 3 km; clouds are well handled in many circumstances. At low altitudes the performance is decidedly better over the ocean than over land backgrounds; above 5 km the background makes little difference. The most surprising result is that clouds can actually improve the vertical resolution of the retrieval. (Author's abstract)
W91-01474

CALIBRATION AND VALIDATION OF A MODEL OF NON-INTERACTIVE SOLUTE LEACHING IN A CLAY-LOAM ARABLE SOIL.
Edinburgh School of Agriculture (Scotland). Dept. of Soil Science.
A. J. A. Vinten, and M. H. Redman.
Journal of Soil Science JSSCAH, Vol. 41, No. 2, p 199-214, June 1990. 9 fig, 6 tab, 18 ref.

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Descriptors: *Agricultural hydrology, *Clays, *Data interpretation, *Fertilizers, *Leaching, *Loam, *Model studies, *Soil water, *Solute transport, Agriculture, Arable soils, Calibrations, Fertilization, Model testing, Nitrogen, Permeability, Scotland, Soil science, Soil texture.

Conditions for arable farming in the southeast of Scotland are very variable because of the wide range of elevation, mean annual temperature, and annual effective precipitation. However, the rate of mineralization of nitrogen (N) during winter is low, and rather low carry-over of mineral N to spring occurs. Early application is vulnerable to leaching; thus the prediction of leaching of early spring fertilizer N is important so that later applications can be adjusted. A capacity-type approximate leaching model with a simple treatment of soil matrix permeability was tested, using field tracer experiments with CaBr2, on hydrologically isolated plots. The model predictions are sensitive to the value of the soil matrix permeability factor, and four methods of estimating this parameter were evaluated: (1) using a calibration based on soil texture; (2) least-squares fitting of the model to successive neutron probe measurements of the water content profile; (3) least-squares fitting to daily drainage outflow; and (4) least-squares fitting to cumulative drainage outflow. The best independent method (method 3) led to a slight (20-30%) under-prediction of leaching losses for two of the four experiments, but in one experiment leaching was much less than predicted. As a management model the approach seems promising but more attention needs to be paid to estimation of the value and variability of the permeability parameter. The convective-dispersion equation, using steady-state assumptions and a fitted dispersion length, gave as good a prediction of cumulative leaching losses as the approximate model. (Fish-PTT)
W91-01477

DEVELOPMENT, CALIBRATION AND FIELD TESTING OF A SOIL LOSS AND A RUNOFF MODEL DERIVED FROM A SMALL-SCALE PHYSICAL SIMULATION OF THE EROSION ENVIRONMENT ON ARABLE LAND IN ZIMBABWE.
Institute of Agricultural Engineering, Harare (Zimbabwe).
For primary bibliographic entry see Field 2J.
W91-01478

MODEL FOR WATER DISTRIBUTION SYSTEM RELIABILITY.
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-01495

SOLVING GROUNDWATER FLOW PROBLEMS BY CONJUGATE-GRADIENT METHODS AND THE STRONGLY IMPLICIT PROCEDURE.
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2F.
W91-01515

INVERSE SOLUTION FOR ONE-DIMENSIONAL INFILTRATION, AND THE RATIO A/K1.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W91-01519

MEAN SQUARE ERROR OF REGRESSION-BASED CONSTITUENT TRANSPORT ESTIMATES.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W91-01522

PRACTICAL ASPECTS OF LOW-FLOW FREQUENCY ANALYSIS.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W91-01529

STOCHASTIC ANALYSIS OF UNSATURATED FLOW: ONE-DIMENSIONAL MONTE CARLO SIMULATIONS AND COMPARISONS WITH SPECTRAL PERTURBATION ANALYSIS AND FIELD OBSERVATIONS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2G.
W91-01536

FOURIER DOMAIN SHAPE ANALYSIS METHODS: A BRIEF REVIEW AND AN ILLUSTRATIVE APPLICATION TO RAINFALL AREA EVOLUTION.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 2B.
W91-01537

DEPRESSIONAL STORAGE FOR MARKOV-GAUSSIAN SURFACES.
National Soil Erosion Lab., West Lafayette, IN.
For primary bibliographic entry see Field 2J.
W91-01539

PRIORITIZING FLOW ALTERNATIVES FOR SOCIAL OBJECTIVES.
Colorado State Univ., Fort Collins. Water Resources Research Inst.
For primary bibliographic entry see Field 6G.
W91-01552

MODELING TO GENERATE RECREATIONAL ALTERNATIVES.
Colorado State Univ., Fort Collins. Water Resources Research Inst.
For primary bibliographic entry see Field 6D.
W91-01553

IMPLEMENTATION OF ON-LINE CONTROL SCHEME FOR CITY WATER SYSTEM.
Leicester Polytechnic (England). Water Control Unit.
For primary bibliographic entry see Field 5F.
W91-01559

CLASSIFICATION OF ESTUARIES IN CHINA (IN CHINESE).
East China Normal Univ., Shanghai.
For primary bibliographic entry see Field 2L.
W91-01570

TWO-DIMENSIONAL NUMERICAL CALCULATION OF RESIDUAL CURRENT AND SALINITY AT THE CHANGJIANG RIVER ESTUARY (IN CHINESE).
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 2L.
W91-01578

NEW EQUATION FOR THE ATMOSPHERIC ENERGY BUDGET (EINE NEUE GLEICHUNG FUER DIE ATMOSPHAERISCHEN ENERGIEHAUSHAELTE).
Vienna Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
For primary bibliographic entry see Field 2B.
W91-01581

CHANGEABLE WEATHER-A CHAOTIC PHENOMENON TRIGGERED OFF BY MESOSCALE PRECIPITATION-EDDIES (WETTERLAUNEN ALS CHAOTISCHE MESO-SKALIGE STRUKTUREN).
Vienna Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
For primary bibliographic entry see Field 2B.
W91-01582

EXTREME, SINGULAR AND COHERENT PRECIPITATION IN THE CATCHMENT BASIN OF THE UPPER INN RIVER (EXTREME, SINGULAERE UND KOHAERENTE NIEDERSCLAEGE IM GEBIET DES APLINEN INN).
For primary bibliographic entry see Field 2B.
W91-01583

DELAYED DEVELOPMENT OF BACTERIOPLANKTON WITH RESPECT TO PHYTOPLANKTON: A CLUE FOR UNDERSTANDING THEIR TROPHIC RELATIONSHIPS.
Universite Libre de Bruxelles (Belgium). Groupe de Microbiologie des Milieux Aquatiques.
For primary bibliographic entry see Field 2L.
W91-01609

MODELLING SEASONAL CHANGES OF EPILIMNETIC BACTERIA ON THE BASIS OF PHYTO- AND ZOOPLANKTON DYNAMICS.
South Bohemian Biological Centre, Ceske Budejovice (Czechoslovakia).
For primary bibliographic entry see Field 2H.
W91-01612

ENTRAINMENT AND MIXING PROCESSES AS RELATED TO DROPLET GROWTH IN WARM MIDLATITUDE AND TROPICAL CLOUDS.
Centre National de la Recherche Scientifique, CRPA, Magny les Hameaux, France.
For primary bibliographic entry see Field 2B.
W91-01657

USE OF DAILY VALUES OF SURFACE PARAMETERS AT DURBAN AND CAPE TOWN TO DETERMINE THE PRECIPITABLE WATER CONTENT OF THE ATMOSPHERE.
Natal Univ., Pietermaritzburg (South Africa). Dept. of Geography.
For primary bibliographic entry see Field 2B.
W91-01660

NONLINEAR SOLUTION OF AGGRADATION AND DEGRADATION IN CHANNELS.
Detroit Water and Sewerage Dept., MI.
For primary bibliographic entry see Field 2J.
W91-01668

MEASURING AND MODELING VARIATIONS IN DISTRIBUTION SYSTEM WATER QUALITY.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5F.
W91-01751

FLOCCULATION IN TURBULENT FLOW: MEASUREMENT AND MODELING OF PARTICLE SIZE DISTRIBUTIONS.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-01752

SOIL CLEAN UP BY IN-SITU AERATION: V. VAPOR STRIPPING FROM FRACTURED BEDROCK.
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
For primary bibliographic entry see Field 5G.
W91-01756

GEOELECTRICAL INVESTIGATION FOR GROUND WATER IN CRYSTALLINE TERRAINS OF CENTRAL BAHIA, BRAZIL.
Universidade Federal do Rio Grande do Norte, Natal (Brazil). Dept. de Fisica.
For primary bibliographic entry see Field 2F.
W91-01780

ELUCIDATING GROUND-WATER FLOW PATHS IN A DESERT TERRANE BY GEOCHEMICAL METHODS.
Purdue Univ., Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 2F.
W91-01784

ESTIMATING THE VARIATION OF BUOY WIND AND WAVE DATA BIASES.
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2H.
W91-01797

EMPIRICAL EVIDENCE FOR DIFFERENCES AMONG METHODS FOR CALCULATING SECONDARY PRODUCTION.
Montreal Univ. (Quebec). Dept. of Biological Sciences.
C. Plante, and J. A. Downing.
Journal of the North American Benthological Society JNASEC, Vol. 9, No. 1, p 9-16, March 1990. 2 fig, 3 tab, 40 ref.

Descriptors: *Aquatic environment, *Secondary productivity, *Statistical analysis, *Statistical methods, *Statistics, Aquatic life, Benthos, Calculation methods, Cohort production interval, Ecosystems, Mathematical studies, Population dynamics, Precision.

The hypothesis that different secondary production estimation methods yield unbiased and equally precise estimates was tested using published data from 66 benthic invertebrate populations from lentic habitats. Tests are performed by Kruskal-Wallis one-way analysis of the residuals of a published empirical equation accounting for the important covariables biomass, body-mass, and water temperature. The data set analyzed came from 22 different ecosystems spanning a range of production from 0.03 to 66.40 g dry mass.sq m/yr, a range of mean annual biomass from 0.002 to 10 g dry mass/sq m, a range of body size from 0.01 milligrams to 60 mg dry mass and were found in environments with average annual surface water temperatures ranging from 4 to 18 deg. Of these estimates, 20 were made with the size-frequency technique, 26 were made with the Allen curve or growth increment summation methods, and 20 were made with the instantaneous growth technique. While no method was found to be significantly biased, the size-frequency method was less precise than the Allen curve, growth increment summation or instantaneous growth methods, yielding estimates about three times farther from the probable production values than other methods. Imprecision of inferred cohort production interval (CPI) is suggested as one source of error. (Author's abstract)
W91-01808

PERSPECTIVE ON AMERICA'S VANISHING STREAMS.
Alabama Univ., University. Dept. of Biology.
For primary bibliographic entry see Field 6G.
W91-01812

DEVELOPMENT OF AN EXPERT SYSTEM EMBEDDING PATTERN RECOGNITION TECHNIQUE FOR GROUNDWATER POLLUTION SOURCE IDENTIFICATION.
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-01825

WATER RESOURCES DATA FOR NEW MEXICO, WATER YEAR 1989.
Geological Survey, Albuquerque, NM. Water Resources Div.
J. Borland, R. K. DeWees, R. L. McCracken, L. Lepp, and D. Ortiz.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-252040. Price codes: A19 in paper copy, A03 in microfiche. USGS-Water Data Report-NM-89-1. USGS/WRD/HD-90/276, April 1990. 426p. Prepared in cooperation with the State of New Mexico and with other agencies.

Descriptors: *Hydrologic data, *New Mexico, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water level, Water temperature.

Water-resources data for the 1989 water year for New Mexico consist of records of discharge and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report contains discharge records for 166 gaging stations; stage and contents for 26 lakes and reservoirs; water quality for 56 gaging stations and 84 wells; and water levels at 104 observation wells. Also included are 108 crest-stage partial-record stations. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. Also, two seepage investigations are published this year. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in New Mexico. (See also W90-06444) (USGS)
W91-01828

WATER RESOURCES DATA FOR NEBRASKA, WATER YEAR 1989.
Geological Survey, Lincoln, NE. Water Resources Div.
J. A. Boohar, C. G. Hoy, and M. J. Ellis.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-251893. Price codes: A19 in paper copy, A03 in microfiche. USGS-Water Data Report-NE-89-1. USGS/WRD/HD-90/268, April 1990. 437p. Prepared in cooperation with the State of Nebraska and with other agencies.

Descriptors: *Groundwater, *Hydrologic data, *Nebraska, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water level, Water temperature.

Water-resources data for the 1989 water year for Nebraska consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality in wells. This report contains discharge records for 160 streamflow gaging stations, 12 partial-record or miscellaneous streamflow stations, and 5 crest-stage, partial-record streamflow stations; stage and content records for 11 lakes and reservoirs; water quality records for 38 streamflow stations, 8 ungaged stream-sites, and 159 wells; and water level records for 55 observation wells. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Nebraska. (See also W90-06429) (USGS)
W91-01829

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1989, VOLUME 1. EASTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
L. E. Hubbard, R. L. Moffatt, T. A. Herrett, R. L. Kraus, and G. P. Ruppert.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-251885. Price codes: A10 in paper copy, A02 in microfiche. USGS-Water Data Report-OR-89-1. USGS/WRD/HD-90/287, May 1990. 197p. Prepared in cooperation with the State of Oregon and with other agencies.

Descriptors: *Hydrologic data, *Oregon, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water level, Water temperature.

Water-resources data for the 1989 water year for Oregon consists of records of stage, discharge, and water quality of streams; and stage, contents, and water quality of lakes and reservoirs. This report, in two volumes, contains discharge records for 251 gaging stations; stage only records for 7 gaging stations; stage and contents for 39 lakes and reservoirs; water quality for 43 stations, and water quality for 3 precipitation stations. Also included are 5 crest-stage, partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (See also W90-07847) (USGS)
W91-01830

EVALUATION OF THREE ELECTRONIC REPORT PROCESSING SYSTEMS FOR PREPARING HYDROLOGIC REPORTS OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 10C.
W91-01832

GROUND-WATER FLOW IN THE GULF COAST AQUIFER SYSTEMS, SOUTH-CENTRAL UNITED STATES--A PRELIMINARY ANALYSIS.
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01838

ASSESSMENT OF HYDROLOGIC AND HYDROGEOLOGIC DATA AT CAMP LEJEUNE MARINE CORPS BASE, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01840

HYDROGEOLOGY OF AQUIFERS IN CRETACEOUS AND YOUNGER ROCKS IN THE VICINITY OF ONSLOW AND SOUTHERN JONES COUNTIES, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01841

HYDROGEOLOGIC, WATER-LEVEL, AND WATER-QUALITY DATA FROM MONITORING WELLS AT THE U.S. MARINE CORPS AIR STATION, CHERRY POINT, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-01844

U.S. GEOLOGICAL SURVEY NATIONAL COMPUTER TECHNOLOGY MEETING: PROGRAM AND ABSTRACTS, MAY 7-11, 1990.
Geological Survey, Nashville, TN. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-161, April 1190. 56p. B. H. Balthrop, E. G. Baker (compilers).

Descriptors: *Computers, *Hydrologic application, *Information systems, *US Geological Survey, Databases, Geographic information systems, National water information systems, System administration.

Computer-related information from all Divisions of the U.S. Geological Survey are discussed in this compilation of abstracts. Some of the topics addressed are system administration; distributed information systems and data bases, both current (1990) and proposed; hydrologic applications; national water information systems; geographic infor-

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mation systems applications and techniques. The report contains some of the abstracts that were presented at the National Computer Technology Meeting that was held in May 1990. The meeting was sponsored by the Water Resources Division and was attended by more than 200 technical and managerial personnel representing all the Divisions of the U.S. Geological Survey. (USGS)
W91-01848

GEOHYDROLOGIC CHARACTERISTICS AND SIMULATED RESPONSE TO PUMPING STRESSES IN THE SPARTA AQUIFER IN EAST-CENTRAL ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-01854

WATER RESOURCES DATA FOR IOWA, WATER YEAR 1989.
Geological Survey, Iowa City, IA. Water Resources Div.
D. J. O'Connell, M. J. Liszewski, R. B. Lambert, and W. J. Matthes.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-222423/AS. Price codes: A18 in paper copy, A03 in microfiches. USGS Water Data Report IA-89-1. USGS/WRD/HD-90/256, 1989. 399p. Prepared in cooperation with the Iowa Department of Natural Resources (Geological Survey Bureau) and other agencies.

Descriptors: *Groundwater, *Hydrologic data, *Iowa, *Surface water, *Water quality, Chemical analysis, Data collections, Flow rates, Gaging stations, Groundwater level, Lakes, Reservoirs, Sampling sites, Sediments, Streamflow, Temperature, Water, Water analysis, Water level.

Water resources data for the 1989 water year for Iowa consist of record of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; groundwater levels and water quality of groundwater wells. This report contains records of water discharge for 117 stream-gaging stations; stage or contents for 8 lakes and reservoirs; water quality for 6 stream-gaging stations; sediment records for 10 stream-gaging stations; water levels for 185 observation wells; and chemical analyses for the 135 municipal wells. Also included are 113 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous discharge measurements and miscellaneous water-quality analyses. (USGS)
W91-01856

WATER RESOURCES DATA FOR WEST VIRGINIA, WATER YEAR 1988.
Geological Survey, Charleston, WV. Water Resources Div.
S. M. Ward, J. A. Macy, F. M. Taylor, and G. M. Ferrell.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-222589. Price codes: A09 in paper copy, A02 in microfiche. USGS Water Data Report WV-88-1. USGS/WRD/HD-90/248, 1990. 185p. Prepared in cooperation with the State of West Virginia and other agencies.

Descriptors: *Groundwater, *Hydrologic data, *Surface water, *Water quality, *West Virginia, Chemical analysis, Flow rates, Gaging stations, Sampling sites, Sediments, Water analysis, Water level, Water temperature.

Water resources data for the 1988 water year for West Virginia consist of records of stage, discharge, and water quality of streams; contents of reservoirs; and water levels of observation wells. This report contains discharge records for 79 streamflow-gaging stations; stage only records for 7 gaging stations, and 2 crest-stage partial-record stations; (2) change in contents for 1 reservoir; (3) water quality records for 15 streamflow-gaging stations; and (4) water level records for 30 observation wells. Locations of these sites are shown. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in West Virginia. (USGS)
W91-01858

WATER RESOURCES DATA FOR MICHIGAN, WATER YEAR 1989.
Geological Survey, Lansing, MI. Water Resources Div.
S. P. Blumer, J. C. Failing, W. W. Larson, C. R. Whited, and R. L. LeuVoy.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-230947/AS. Price codes: A13 in paper copy, A02 in microfiche. USGS Water Data Report MI-89-1. USGS/WRD/HD-90/255, 1990, 283p. Prepared in cooperation with the State of Michigan and with other agencies.

Descriptors: *Groundwater, *Hydrologic data, *Michigan, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Sampling sites, Sediments, Water analysis, Water level, Water temperature.

Water resources data for the 1989 water year for Michigan consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water temperature of groundwater. This report contains discharge records for 145 streamflow-gaging stations; stage only records for 13 lake-gaging stations; stage and contents for 5 lakes and reservoirs; water quality records for 21 streamflow-gaging stations; water level records for 51 observation wells; and water temperature records for 4 observation wells. Also included are 48 crest-stage partial record stations and 8 low-flow partial-record stations. Additional water data were collected at various sites not involved in the systematic data collection program. Miscellaneous data were collected at 62 measuring sites and 10 water quality sampling sites. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State, Local and Federal agencies in Michigan. (See also W90-05242) (USGS)
W91-01864

GROUND-WATER LEVELS, SPRINGS 1985, AND GROUND-WATER LEVEL CHANGES, SPRING 1983 TO SPRING 1985, IN THREE BASALT UNITS UNDERLYING THE COLUMBIA PLATEAU, WASHINGTON AND OREGON.
Geological Survey, Tacoma, WA. Water Resources Div.
R. C. Lane, and K. J. Whiteman.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4018, 1989. 4 sheets, 4 fig, 20 ref.

Descriptors: *Aquifer systems, *Columbia Plateau, *Geohydrology, *Geologic units, *Groundwater movement, *Maps, *Oregon, *Washington, Columbia Basin Irrigation Project, Wanapum Basalt, Water resources data.

Groundwater level contour maps for three basalt units of the Columbia Plateau regional aquifer system were constructed by using water levels measured in 1,105 wells during 1985. These measurements then were compared with similar measurements from spring 1983 to assess the changes in groundwater levels over the 2-year period for each of the basalt units. Configuration of the groundwater contours and water level changes reflect (1) recharge and discharge; (2) hydraulic conductivity; (3) use of imported surface water for irrigation; and (4) pumpage of groundwater. The movement of groundwater within each basalt unit is controlled mainly by the major rivers, streams, and coulees, whereas variations in flow directions between units are related to the occurrence, extent, and hydraulic conductivity of the basalt units and sedimentary interbeds and to differences in the amounts of recharge to each unit. (USGS)
W91-01868

MODELLING SOIL WATER SUPPLY TO CROPS.
Wye Coll., Ashford (England). Dept. of Agriculture, Horticulture and the Environment.
For primary bibliographic entry see Field 2G.
W91-01869

INTERPRETATION OF METAL CONCENTRATIONS IN ESTUARINE SEDIMENTS OF FLORIDA USING ALUMINUM AS A REFERENCE ELEMENT.
Florida State Dept. of Environmental Regulation, Tallahassee.
For primary bibliographic entry see Field 2L.
W91-01898

SIMULATION MODEL OF WATER DEPTH IN MANGROVE BASIN FORESTS.
Collier Mosquito Control District, Naples, FL.
For primary bibliographic entry see Field 2L.
W91-01989

APPLICATION OF MULTIVARIATE ANALYSIS FOR CHARACTERIZATION OF ORGANIC COMPOUNDS FROM URBAN RUNOFF.
Universidad Politecnica de Madrid (Spain). Escuela Tecnica Superior de Ingenieros de Caminos.
For primary bibliographic entry see Field 5A.
W91-02004

8. ENGINEERING WORKS

8A. Structures

INVESTIGATION INTO THE PERFORMANCE CHARACTERISTICS OF BOUNDARY BOXES SUBJECTED TO VERTICAL LOADING.
Loughborough Univ. of Technology (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-01269

DESIGN OF ROCK SLOPES IN SOVIET HYDROPOWER CONSTRUCTION PRACTICE.
V. I. Reznikova, and V. I. Rechitskii.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 12, p 669-674, June 1990. 5 fig, 1 tab, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 4-8, December 1989.

Descriptors: *Construction methods, *Dam construction, *Engineering geology, *Hydroelectric plants, *Rock mechanics, *Slope stability, Blasting, Drilling, Mathematical analysis, Mathematical studies, Shear stress, Structural engineering, USSR.

Since 1970, the All-Union Planning, Surveying, and Scientific Research Institute (Gidroproekt) has been calculating the stability of natural slopes and rock slopes of foundation pits, canals and other structures of hydroelectric stations and pumped-storage stations. In all, the stability of slopes with heights of 15-125 m at 20 Soviet hydropower facilities were analyzed. The most widely-used methods for calculation of rock slope stability were the deficit forces method and the method of shear along a plane surface. The form of the sliding limit surface depended on the fracture character of the mass, topography and the kinematic failure possibility. Stability was calculated mainly as a two-dimensional problem, since long slopes in which the effect of side surfaces could be neglected occurred in most cases. The purpose of these calculations included not only a determination of the slope stability factor for given parameters of fracturing and shear strength, but also an evaluation of the effect of the latter on stability. Analysis of the stability of artificial slopes proceeded as follows: on the basis of a model of rock mass fracturing constructed by engineering geologists, a number of

ossible sliding surfaces were outlined and the ability of the rock slope with an initial steepness ontour) value was calculated. Generally, an it- ative cycle of stability calculations was carried it for different values of the dip angles of the ear-dangerous fractures and for the purpose of ding the rock mass region with a minimum lue of the stability factor K. If K was greater an the standard value Ks, the contour of the ture slope was adjusted steeper, otherwise a re gentle slope was recommended or a variant its stabilization was calculated. Design-related lures of masses were not observed in any of the signed slopes. The conditions for, and the pa- neters of, drilling and blasting operations have a ticeable effect on slope stability and angle, indi- ing the need for thorough development and orous observance of drilling and blasting oper- on plans. At a number of hydropower facilities, ailed stability calculations made it possible to ninate costly engineering measures and reduce ject costs. (Hoskin-PTT)
1-01433

ALYTICAL METHOD OF CALCULATING OPE STABILITY.
primary bibliographic entry see Field 8D.
1-01434

DRAULIC CALCULATION OF OPEN OINS WITH VARIABLE COVERAGE.
primary bibliographic entry see Field 8B.
1-01435

ME PARAMETERS OF A SPREADING OW BEYOND PIPE CONDUITS.
primary bibliographic entry see Field 8B.
1-01437

EGULAR WAVE LOAD ON SLOPES OF UCTURES.
primary bibliographic entry see Field 8B.
-01438

SIBILITIES OF CONSTRUCTING HYDRO- CTRIC STATIONS: PUMPED STORAGE TIONS IN ARMENIA.
primary bibliographic entry see Field 8C.
-01439

NITORING HIGH CONCRETE DAMS ING THEIR CONSTRUCTION AND SERV-

primary bibliographic entry see Field 8F.
-01440

HANISM OF THE OPENING OF THE CRETE-ROCK JOINT IN THE SAYANO- SHENSKOE DAM.
primary bibliographic entry see Field 8F.
01441

FORCEMENT OF IN-SERVICE RETAIN- STRUCTURES.
Rubin, O. B. Lyapin, and V. E. Ni.
otechnical Construction HYCOAR, Vol. 23, 2, p 720-725, June 1990. 4 fig, 1 tab, 6 ref. lated from Gidrotekhnicheskoe Stroitel'stvo, 2, p 42-45, December 1989.

iptors: *Concrete technology, *Construction ods, *Load testing, *Retaining walls, *Struc- engineering, Construction joints, Locks, ematical analysis, Mathematical models, Me- al engineering, Reinforced concrete, Struc- nodels, Waterways.

isting retaining structures, which exhibit de- ns in performance from design premises, an ve reinforcement system should be devel- to reduce active loads with a simultaneous se in bearing capacity and a reduction in ure deformability. Experimental investiga- f lightly reinforced concrete models of walls :8 scale (with respect to the lock walls of the Moscow Canal) were performed. The structural components of the reinforcing system were an additional wall (metallic or reinforced-concrete in the form of sheet piling, wall in the ground) and inclined components (metallic or reinforced-concrete girders or cross pieces), which transmitted the load from the additional wall to the front face of the existing wall. The wall models were tested under a static short-term load applied in increments of 0.05 of the computed failing load, Qc. Crack formation in the experimental wall was characterized by the formation and vigorous development of a crack along the construction joint of the second concrete lift and an inclined crack leading away from the joint under a load of 21.4 kN; the failing load was 25.68 kN; this was more than one and one-half times smaller than the Qc value. The mounting of two planes of inclined yokes led to partial restoration of the wall's bearing capacity as compared with the computed Qc value. Installation of an additional wall from which the external load is transmitted onto the concrete wall using two planes inclined at a 12 degree angle to the horizontal made it possible to reduce somewhat the width of the joint opening of the second concrete lift under a load of $>$ 24.0 kN as compared with tests performed without the additional wall. The data obtained for the increase in limiting load that can be taken up by the reinforced wall suggest a significant reduction in bending moments and an increase in the longitudinal (vertical) compressive forces due to transfer of external forces from the additional wall through the force components onto the concrete wall at an angle of alpha-2 = 38 degrees to the horizontal. (Hoskin-PTT)
W91-01442

PREDICTING WAVE FORMATION IN MOUNTAIN RESERVOIRS DURING LANDFALLS AND LANDSLIDES.
For primary bibliographic entry see Field 8B.
W91-01443

UPGRADING ANTIQUE SEWERS.
Massachusetts Water Resources Authority, Boston.
For primary bibliographic entry see Field 5B.
W91-01484

GROUTING SLIP LINERS: THE NEW INSIDE STORY.
Halliburton Services, Houston, TX.
For primary bibliographic entry see Field 5D.
W91-01486

HYDRODYNAMIC PRESSURE ANALYSIS OF ARCH DAMS WITH T-COMPLETE FUNCTIONS.
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-01489

MONITORING THE STATE OF THE DAM OF THE SAYANO-SHUSHENSKOE HYDROELECTRIC STATION.
A. I. Efimenko, K. K. Kuz'min, and E. K. Aleksandrovskaya.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 10, p 573-577, April 1990. 3 fig, 5 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 10, p 15-18, October 1989.

Descriptors: *Dam foundations, *Hydraulic engineering, *Hydraulic structures, *Hydroelectric plants, *Measuring instruments, *Soviet Union, Dam stability, Foundation rocks, Monitoring, Piezometers, Stress analysis.

The Sayano-Shushenskoe (Soviet Union) dam is a unique hydraulic structure. Because high reliability demands are imposed on it. A considerable number of on-site observations and investigations are performed to monitor the reliable operation of the dam. The monitoring system includes geodetic, piezometric, and flow monitoring and measuring instruments (MMI) that were installed during construction of the dam, its components, and the rock foundation, making it possible to observe the structure and evaluate its state at various stages of construction and filling of the reservoir. During current monitoring on the dam the main parameters characterizing the static behavior of the dam foundation system are evaluated: the total displacements (settlements, tilts, horizontal displacements), state of the rock-concrete contact; state of the horizontal joints between blocks, sections, and columns; cracking in the concrete; and the seepage pressure in the concrete and rock foundation. The results of long-term monitoring of the dam indicate a satisfactory state of the structure at all stages of filling the reservoir and correspondence of the values of the parameters being monitored on site to their design premises, with the exception of stresses near the downstream face. To obtain representative information it is necessary to provide in the design for routine correction of the layouts of the MMI, particularly embedded instruments. (Fish-PTT)
W91-01541

INITIAL PERIOD OF OPERATION OF THE CHANNEL DAM OF THE KUREIKA HYDROELECTRIC STATION.
Y. N. Mznikov, S. I. Panov, and N. A. Shakov.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 10, p 578-583, April 1990. 5 fig, 3 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 10, p 18-22, October 1989.

Descriptors: *Cold weather construction, *Dam construction, *Dams, *Hydraulic structures, *Hydroelectric plants, *Soviet Union, *Stress analysis, Dam design, Deformation, Earth dams, Reservoirs, Rockfill dams, Temperature effects.

The harsh natural and climatic conditions and year-round operation of hydroelectric stations at low negative air temperatures cause substantial changes in temperature and moisture state (TMS) of materials being placed in earth-rock dams in the Far North of the Soviet Union. On-site and experimental investigations of the TMS and stress-strain state of the upstream shoulder during filling of the reservoir were carried out to predict deformations of the earth-rock dam of the Kureika hydroelectric station. The results of the 2-year on-site observations of the behavior of the earth-rock dam being constructed under conditions of the Far North during filling of the reservoir permit the following conclusions: (1) rapid temperature and deformation processes occurred in the frozen upstream shoulder of the dam during its primary subirrigation; (2) under unfavorable deformation conditions, the formation of cracks is possible and in these cases special designs providing static and seepage stability of the structures are necessary; (3) the calculated strength and deformation characteristics should be assigned differentially depending on the working conditions of dams in the initial operation period; (4) special consideration should be devoted to the size and deformability of the transition zones which perform the role of a buffer between the core and shoulders; (5) mined rock should be placed uniformly over the entire area in layers with compaction by heavy vibrating rollers; and (6) on-site observations of the TMS and deformations of the upstream shoulders should be performed during their construction and operation in order to refine the design parameters of dams being constructed in the Far North. (Fish-PTT)
W91-01542

EFFECTIVE DESIGN OF FACINGS OF BLAST-FORMED DAMS.
Y. N. Kasatkin.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 10, p 601-605, April 1990. 4 fig, 1 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 10, p 34-36, October 1989.

Descriptors: *Construction methods, *Dam construction, *Dam design, *Rockfill dams, *Slope stabilization, Asphalt, Hydraulic design, Porosity, Rock fill, USSR.

The slopes of rockfill and blast-formed dams often have unorganized heapings of stone, often in a

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loose state relative to the dam body. To prepare such a slope for a reinforced-concrete facing, it is necessary to carry out considerable crushing, leveling, and compaction of the stone. However, this work often need not be performed if the facing on such a dam is made of poured asphalt. The depth of penetration of asphalt under the effect of its own weight into the pores of the rockfill with one-time pouring is determined by an empirical relation. The larger the size of the rock and the higher its porosity, the deeper the penetration of asphalt into it during pouring. However, the rock must most often be covered several times, counting on its flow into the pores of the fill between pourings. The formation of the given facing is quite simple and consists of: crushing of large rocks on the slope with subsequent grading; washing of the rock distributed over the slope not later than a day before covering it with asphalt by a pressure jet of clean water delivered to the slope through hoses; covering the rock with poured asphalt after its surface dries; holding the formed coating for a time during which the asphalt penetrates into the fill pores to the prescribed depth; a repeated leveling and covering of the rock with poured asphalt. Using empirical relations, for a known fractional composition of the rock a composition of the asphalt mass can be selected such that its penetration into the fill pores will be optimal. Thus facings of rockfill and blast-formed dams of rock covered with poured asphalt are easily designed and easily made, which opens broad opportunities for their use. (Fish-PTT)
W91-01547

CONCERNING THE PROBLEM OF ASSIGNING THE COMPOSITIONS OF STEEL FIBER-REINFORCED CONCRETES.
For primary bibliographic entry see Field 8F.
W91-01549

MECHANICAL EQUIPMENT OF THE TASHLYK PUMPED-STORAGE HYDROELECTRIC STATION AND ALEKSANDROVKA HYDRO DEVELOPMENT OF THE SOUTHERN UKRAINE POWER COMPLEX.
For primary bibliographic entry see Field 8C.
W91-01644

MECHANICAL EQUIPMENT OF THE VILYUI NO. 3 HYDROELECTRIC STATION.
For primary bibliographic entry see Field 8C.
W91-01645

BEHAVIOR OF SOIL UNDER A BRIEF DYNAMIC LOAD.
For primary bibliographic entry see Field 8D.
W91-01649

SEEPAGE IN EARTH DAMS IN TWO- AND THREE-DIMENSIONAL FORMULATIONS OF THE PROBLEM.
For primary bibliographic entry see Field 8D.
W91-01650

GEODETIC PROBLEMS IN THE CONSTRUCTION OF HIGH CONCRETE DAMS.
D. M. Grachev.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 11, p 661-664, 1990. 4 fig. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 11, p 36-38, November 1989.

Descriptors: *Arch dams, *Concrete dams, *Dam construction, *Dam design, *Dams, *Deformation, *Geodesy, *Gravity dams, *Hydraulic structures, *Soviet Union, Dam foundations, Dam stability, Gravity-arch dams, Hydraulic geometry.

A high-head dam under construction undergoes deformation under the water head, its own weight, and other factors. The dam shifts along the foundation, moves vertically, and tilts or bends. The deformations increase with an increase of the dam height and head of water, as a consequence the elements of the structure are noticeably displaced. Other discrepancies are then noted between the constructed part of the dam and its overlying part, which is still to be constructed. Discrepancies are also noted while performing geodetic location work for the overlying concrete levels. In designing high concrete dams of the arch and gravity-arch types it is necessary to provide special measures for geodetic construction provisions. A change to a system that involves location axes that move in space together with the dam under construction is recommended. This approach requires calculated predictions of the magnitude of deformations and data from on-site observations of the structure under construction. This approach was used for constructing the Sayano-Shushenskoe Dam. The points of the geodetic base, metal surface markers, were embedded every other section at a distance of 35 to 50 m from one another along the lower face of the dam around its perimeter (here final construction had to be put off until last). The coordinates of the points were determined by a geodimeter survey from points on the geodetic base of the construction site as of a certain date. The points of the geodetic base, once determined on the structure, are kept until the end of construction. They can then be raised from tier to tier along the plumb line. (Korn-PTT)
W91-01652

HYDRAULIC JUMP IN TRIANGULAR CHANNEL.
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
For primary bibliographic entry see Field 8B.
W91-01669

FLOW INDUCED PIPE VIBRATION DURING ITS SAGGING PROCESS.
East China Technical Univ. of Water Resources, Nanjing.
For primary bibliographic entry see Field 8B.
W91-01670

BEARSPAW DEVELOPMENT: DESIGN AND CONSTRUCTION OF A SIDE-CHANNEL OVERFLOW SPILLWAY.
For primary bibliographic entry see Field 8B.
W91-01721

DAM RENOVATION: FROM INVESTIGATION TO REPAIR.
Bridgeport Hydraulic Co., CT.
For primary bibliographic entry see Field 8F.
W91-01748

CITY TACKLES MAJOR SANITARY SEWER REHABILITATION WITH NEW PROCESS.
For primary bibliographic entry see Field 5D.
W91-01755

8B. Hydraulics

MODIFICATION OF COASTAL CURRENTS BY POWER PLANT INTAKE AND THERMAL DISCHARGE SYSTEMS.
Scripps Institution of Oceanography, La Jolla, CA. Center for Coastal Studies.
M. H. S. Elwany, J. Reitzel, and M. R. Erdman.
Coastal Engineering COENDE, Vol. 14, No. 4, p 359-383, 17 fig, 1 tab, 13 ref. August 1990.

Descriptors: *Electric powerplants, *Environmental effects, *Hydraulic profiles, *Thermal pollution, *Water currents, *Water resources development, Cooling water, Flow profiles, Flow velocity, Hydraulic models, Nuclear powerplants.

Powerplant cooling systems that entrain large volumes of seawater in multiple discharge jets can produce changes in the local field of flow. A case history of observed flow modification is provided by dye studies and records of currents around the diffusers of the San Onofre Nuclear Generating Station (SONGS), which entrain a volume of flow on the order of 1000 cu m/s. Field observations of dilutions and velocities in the discharge plume agree well with the results of hydraulic modelling of the diffuser system. Synoptic observations and long term statistical distributions of current speeds and directions show systematic patterns of altered flow around the diffusers that are more complex than the flow in the model because of interactions with flow modification by local beds of giant kelp. (Author's abstract)
W91-01057

INVESTIGATION INTO THE PERFORMANCE CHARACTERISTICS OF BOUNDARY BOXES SUBJECTED TO VERTICAL LOADING.
Loughborough Univ. of Technology (England). Dept. of Civil Engineering.
J. G. Dickens, and G. H. Mortimer.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 3, p 227-234. 8 fig, 5 ref, June 1990.

Descriptors: *Check structures, *Domestic water, *Hydraulic loading, *Load testing, *Water metering, Backfill, Design criteria, Field tests, Vertical flow, Water boundary.

The results of a series of load tests carried out on a variety of designs of boundary boxes which are intended for use as stopcock/water meter chambers at domestic properties are presented. A test which was developed at Loughborough University to measure the performance, under load, of the complete boundary-box units in simulated site conditions was used. Three broad classifications of different design types were identified, namely rigid, flexible, and sliding; and the load displacement of each type are presented. The effects of rate of loading and different backfill conditions were considered, and conclusions were drawn on suitable performance specifications under load. A wide spread of performance within each design type was found. The units of the rigid design type were the only ones to approach the load-displacement performance of traditional claywire units, and not all rigid types would meet all criteria. Field tests on flexible boxes, which did not meet load criteria, correlated well with observed characteristics in sandbox tests. Sliding units also did not meet load criteria; but their load capacity was increased where quarry waste backfill was used. In conclusion, where vehicle loading is possible, a rigid type unit should be used. (VerNooy-PTT)
W91-01269

ESTIMATION OF MANNING'S ROUGHNESS COEFFICIENT FOR BASIN AND BORDER IRRIGATION.
Bangladesh Agricultural Research Inst., Joydebpur.
For primary bibliographic entry see Field 3F.
W91-01406

GENESIS OF FREE HYDRAULIC JUMPS FOR BETTER MIXING.
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-01421

HYDRAULIC CALCULATION OF OPEN GROINS WITH VARIABLE COVERAGE.
M. R. Bakiev, and N. P. Togunova.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 12, p 684-688, June 1990. 3 fig, 1 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 14-17, December 1989.

Descriptors: *Groins, *Hydraulic design, *Hydraulic models, Flow around objects, Flow models, Flow velocity, Hydraulic engineering, Mathematical analysis, Mathematical equations, Mathematical studies, River flow, Soviet Union.

Open groins are finding wide use in protection and regulation on rivers with a sand and loam channel. To eliminate the possibility of the flow bypassing the groins from the side of the bank being protected (from the root), they are made with variable coverage. The construction of such groins creates at their root in the upper pool a certain 'water cushion' protecting the structure from the flow

ypassing from the root, and the effectiveness of iminishing the velocities is higher than for ordiary open groins with a constant coverage, which an be achieved both with the arrangement of the lements of the groin in one row and several rows. he coverage factor is equal to the ratio of the rea occupied by elements of the groin to the area f the channel being covered by the groin. The otal coverage factor should not exceed 0.65, i.e., ie limit after which the open groin begins to work s a closed one. Assigning the value of the coverge coefficient P < = 0.65, the number of elements necessary for the groin was determined. Experiental and theoretical investigations were conucted to study the work of open groins of the escribed design. An analysis of measurements of e level regime of the flow deformed by the open roin with a variable coverage showed that it udergoes changes mainly in the immediate vicinity of the groin, and on the remaining parts of the ngitudinal and transverse velocity differences are iall. An analysis of the velocity distribution in an revealed the presence of zones with small and rge transverse velocity differences, which was e basis for using certain principles of the theory turbulent jets, in particular, the schemes of vision of the flow into hydraulically homogenes zones. The results of the investigations were ed by the Central Asia Institute for Water Maement in Cotton-Growing Regions when select variations for regulating the Amu Darya River annel in the region of the damless water intake the Karshi main canal. (Hoskin-PTT)
91-01435

ME PARAMETERS OF A SPREADING OW BEYOND PIPE CONDUITS.
D. Kekhtokhyan.
drotechnical Construction HYCOAR, Vol. 23, . 12, p 694-698, June 1990. 2 fig, 1 tab, 18 ref. nslated from Gidrotekhnicheskoe Stroitel'stvo, . 12, p 20-24, December 1989.

scriptors: *Flow characteristics, *Flow models, ydraulic models, *Pipe flow, Flow profiles, Hyulic design, Hydraulic engineering, Laboratory hods, Mathematical analysis, Mathematical ations, Mathematical studies, Open-channel files.

e conduits are widely used as dam spillways, d culverts, diversion tunnels, offtake regulators, A hydraulic analysis of these structures is not iciently accurate without appropriate consider- n of the actual water flow conditions through n. Accordingly, the parameters were deter- ed for a freely spreading rapid flow beyond sure pipe conduits with consideration of the e-dimensional character of the flow. The prob- was solved by an experiment performed on a ratory model of a pipe outlet. During the riment the form factor of the jet, N, was ed in the range 1.52-2.19 and the relative head varied in the range 2.05-11.27. Free spreading investigated in a wide lower pool with a three- nsionality factor indicating unlimitedly-wide r pool. The experimental investigation includ- determination of the coordinates of the bound- of the free spreading, depth, mean pressures ie bottom, and mean velocities over the axis of preading flow. The results of these investiga- demonstrated that existing analytical and exnental methods of calculating the parameters ee spreading of a flow in the lower pool nd pressure pipe conduits do not give acceptaesults for N > 1, since the flow has a proced three-dimensional character. When evalu- the kinetics of the flow in the exit section the use of its integral form, it is possible to nate the substantial effect of N on parameters ee spreading. The empirical relations obtained it possible to calculate more accurately the neters of free spreading of a rapid flow nd pressure pipe outlets. (Hoskin-PTT)
01437

EGULAR WAVE LOAD ON SLOPES OF UCTURES.
Shaitan, and D. V. Morozova.
otechnical Construction HYCOAR, Vol. 23, 2, p 699-703, June 1990. 3 fig, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 24-27, December 1989.

Descriptors: *Hydraulic engineering, *Hydraulic models, *Sloping waves, *Wave action, Hydraulic design, Mathematical analysis, Mathematical equations, Mathematical studies, Storms.

The chaotic characteristics of various irregular wind-wave processes can be reliably determined using functions having scientific and practical applicability. This was demonstrated by examining a non-erodible continuous slope, the most distinct manifestation of the group effect of wind systems on an obstacle. Under conditions of a random combination of complex factors and particular kinetics of breaking of dissimilar waves creating an unsteady hydraulic regime in the water-line region, the load acting on the slope requires a probabilistic interpretation in analogy with that used for wind-wave characteristics in the quasi-storm period. Replacement of the monochromatic principle of determining the wave load on slopes by a differentiated action with respect to probability of the process in a storm or in a representative quasi-steady system makes it possible to increase the technical and economic effectiveness of material expenditures in the construction and operation of objects of various types, purpose, operating conditions, service life, etc., and at the same time to ensure a high reliability of the structures. To study the new probabilistic regularities of the force effect of irregular waves on slopes under real storm conditions, permanent (several year) investigations were set up on several objects, which made it possible to collect numerous on-site data sets. Unlike a regular wave load, an irregular wave load depends explicitly on the steepness of the slope, with a tendency toward an increase of this effect on a more gentle slope than a decrease of the numerical value on the load on a steeper slope. The on-site data on irregular wave pressure and total load on slopes can be used on various water areas, since the integral distribution functions of the wave characteristics in their representative systems had a completely satisfactory convergence with analogous distribution functions characteristic for other water areas, including with the standard values used for a wide range of water bodies. (Hoskin-PTT)
W91-01438

PREDICTING WAVE FORMATION IN MOUNTAIN RESERVOIRS DURING LANDFALLS AND LANDSLIDES.
T. L. Gvelesiani, B. N. Ostroverkh, G. Y. Dzhindzhikhashvili, S. O. Eranosyan, and V. I. Reznikova.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 12, p 725-730, June 1990. 5 fig, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 46-49, December 1989.

Descriptors: *Dam design, *Dam failure, *Hydraulic engineering, *Landslides, *Reservoirs, *Wave formation, Geophysics, Mathematical analysis, Mathematical equations, Mathematical models, USSR, Wave height.

Wave formation as a result of landslides into closed pools, bays and fjords has recently attracted the attention of hydraulic engineers. Prediction of the parameters of landslide-induced waves is broken down into a series of problems, which are related to the different fields of continuum and fracture mechanics: determination of the stress-strain state and slope stability on the sides of the reservoir; the separation, movement and immersion of the separated mass in the water; the formation and propagation of waves on the surface of the water; and, the interaction between the waves and the retaining or shore structures. Analytic analysis of the first group of problems is based primarily on the theory of elasticity and plasticity and lies in the field of geomechanics. For the second group of problems, modification of the hydraulic model of a one-dimensional fluid flow is used to describe the rapid motion of large rubbly masses. The last two groups of problems are investigated on the basis of methods of hydromechanics using computational geometric and kinematic parameters, as determined, respectively, as a result of solution of the previous problems, and as initial data (boundary conditions). These methodologies were applied to the study of wave formation in the reservoir formed by the Getiksk hydraulic facility with a dam built of local materials (53 m high) on the Chichkhan River in the Armenian republic. The rate of wave formation in the reservoir is governed primarily by the volume of the landfall body and by the rate landfall immersion. A frictional model of the motion of a quasideformable landfall block along a plane surface (the shoreline slope and bottom of the reservoir) was used for a characteristic of the kinematic indicators of a landfall with a volume of ca. 1 million cu m. These calculations indicated that a wave that will top the crest of the dam can form during such a collapse. The design therefore specifies a 3-m increase in the dam's crest, and the construction of a wave-protection dike. (Hoskin-PTT)
W91-01443

HYDRODYNAMIC PRESSURE ANALYSIS OF ARCH DAMS WITH T-COMPLETE FUNCTIONS.
Ohio State Univ., Columbus. Dept. of Civil Engineering.
K. Sun, and F. C. Hadipriono.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 116, No. 9, p 2054-2069, September 1990. 10 fig, 10 ref.

Descriptors: *Arch dams, *Hydraulic engineering, *Hydrodynamics, *Model studies, *Water pressure, Boundary conditions, Canyons, Dam design, Numerical analysis, Stream banks.

The analysis of hydrodynamic pressure on arch dams is a practical yet complex engineering topic. To solve this problem numerically with the boundary element method (BEM), a semi-analytical and semi-numerical approach in the fluid domain may be used. The hydrodynamic pressure acting on the upstream face of arch dams has been explored by a special BEM based on the use of a complete and nonsingular set of Trefftz functions. The arch dam, bounded by a limited, arbitrary irregular part and an unlimited regular part of the river valley, was considered to be in an arbitrary shape. using this method, one can accurately model the compressibility of the water and the gravity waves on the water surface. Numerical examples illustrated the effects of the canyon shape and the bank angle from the symmetry axis. The hydrodynamic pressure on an arch dam will be reduced significantly by decreasing the value of the half-width on the dam bottom. The shape of the canyon slope has an important effect on the pressure for cross-canyon excitation, but it has little effect on upstream-downstream excitation. Comparisons with other numerical solutions show complete agreement. (Fish-PTT)
W91-01489

DEVELOPMENT OF BED FEATURES.
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W91-01491

MODELING EROSION OF SAND AND SILT BED RIVER.
Barnett Consultants, Hamilton (New Zealand).
For primary bibliographic entry see Field 2J.
W91-01492

THREE-DIMENSIONAL COMPUTATION OF FLOW AND BED DEFORMATION.
Civil Engineering Research Inst., Sapporo (Japan).
For primary bibliographic entry see Field 2J.
W91-01493

FLOW STABILITY AND FRICTION FACTOR IN ROUGH CHANNELS.
Politecnico di Torino (Italy). Inst. di Idraulica.
M. Rosso, M. Schiara, and J. Berlamont.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 9, p 1109-1118, September 1990. 6 fig, 1 tab, 20 ref, append. NATO Grant

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696/84.

Descriptors: *Channel flow, *Flow friction, *Flow models, *Froude number, *Hydraulic properties, *Model studies, *Waves, Friction loss, Open-channel flow, Reynolds number, Uniform flow.

It is well known that in steep channels, the flow becomes unstable when the Froude number exceeds some critical value. Instead of obtaining uniform flow, a short distance from the channel inlet/ waves of various lengths, amplitudes, and phase velocities appear. These waves, traveling downstream and occasionally overtaking each other, are called roll waves. The value of the friction factor in open channels in unstable flow conditions is affected by the Froude number. Some formulas for the calculation of the friction factor in unstable flow conditions have been suggested previously. After these formulas were checked for smooth channels, the formulas for rough channels were compared with measurements. The critical Froude number, which is presented as a function of the Reynolds number, the channel roughness, the vertical velocity distribution coefficient, and the channel width, is found to be an important parameter. A generalized formula computes the friction factor both in smooth and rough channels in unstable supercritical flow conditions. The experiments carried out confirm the increase of the friction factor in unstable flow in rough channels. (Author's abstract)
W91-01494

ADVECTION SIMULATION BY MINIMAX-CHARACTERISTICS METHOD.
Hong Kong Polytechnic, Kowloon. Dept. of Civil and Structural Engineering.
C. W. Li.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 9, p 1138-1144, September 1990. 3 fig, 10 ref.

Descriptors: *Advection, *Dispersion, *Finite difference methods, *Groundwater movement, *Hydrodynamics, *Model studies, Fourier analysis.

The advective transport of a scalar has been simulated by using the minimax-characteristics method, which is an explicit and efficient finite difference scheme derived from the local minimax approximation of the exact solution of the pure advection equation. Fourier mode analysis shows that the method is unconditionally stable, and produces relatively small celerity error and little amplitude dissipation. The scheme compares favorably with the other commonly used backward characteristics schemes: it is better than the scheme using quadratic interpolation (higher accuracy, approximately equal computational effort), and is better than the schemes using cubic interpolation (approximately equal accuracy, less computational effort); it is less accurate than the scheme using Hermitian cubic interpolation, but requires only one-half the computational effort. By interpreting the scheme as a backward characteristics scheme with quadratic approximation of the exact solution over four nodes, the extension of the method in a split-operator approach for advection-dispersion and hydrodynamics modeling in two or three dimensions is straightforward. (Author's abstract)
W91-01496

CURRENT PROBLEMS AND PRACTICE OF ENGINEERING-GEOLOGICAL SURVEYS WHEN DESIGNING LARGE RESERVOIRS.
For primary bibliographic entry see Field 6G.
W91-01545

EXPERIENCE IN USING DIGITAL VOLTMETERS IN THE SYSTEM MEASURING THE POOL LEVELS AND HEAD AT HYDROELECTRIC STATIONS.
For primary bibliographic entry see Field 8G.
W91-01546

WHAT RESULTS WHEN THE BUILDING CODES ARE NOT OBSERVED.
E. S. Lyubashevskii, and V. Y. Martenson.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 10, p 612-615, April 1990. 1 fig, 2 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 10, p 42-44, October 1989.

Descriptors: *Building codes, *Construction methods, *Hydraulic design, *Hydraulic engineering, *Hydroelectric plants, Design criteria, Hydraulic gates, Installation, Maintenance, Mechanical equipment, Safety, Soviet Union.

In recent years the construction of hydropower plants in the Soviet Union has been carried out increasingly more often where the units are put into operation temporarily, i.e., long before completion of all construction and assembly works on the dam structures. According to the 'Standards for the Technological Design of Hydroelectric Stations,' the mechanical equipment intended for operation in the construction period should be designed according to the standards used for the operating period, which allows for operation of the mechanical equipment according to the temporary scheme with adjustments as the structure 'grows.' Ahead-of-schedule flooding of the pit deprives the operation of proper installation and start-up adjustments. Standards regulating the opening size of gates are often violated by designers of hydraulic structures. Nonsynchronized hoisting operations with cranes is the grossest violation of the 'Rules of the arrangement and safe operation of cranes, in which it is forbidden to raise and move a restrained load. The operating reliability of gates also depends on the installation and quality of concreting the embedded parts, which is not always satisfactory. Start-up and adjustment operations should be formulated and carried out according to requirements in newly developed guides (in place of the abolished sections of the building code). Before publication of the new guide ('Manufacture, installation, and acceptance of mechanical equipment of hydraulic structures'), all requirements of the building codes and standards of the technological design of hydrostations should be fulfilled by all participants in the creation of mechanical equipment and hydraulic structures. (Fish-PTT)
W91-01550

INVESTIGATION OF THE DIVERSION OUTLET OF THE KIRZAN HYDRO DEVELOPMENT.
G. L. Mazhbits, and V. N. Kurdyukov.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 11, p 628-631, 1990. 3 fig. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 11, p 12-14, November 1989.

Descriptors: *Diversion structures, *Hydraulic design, *Hydraulic equipment, *Hydraulic models, *Hydraulic structures, *Outlets, *Soviet Union, Dams, Design criteria, Hydroelectric plants, Model studies, Reservoirs.

The diversion outlet of the Kirzan hydro development was investigated with a hydraulic model on a scale of 1:50. A check of the initial design variant of the outlet showed design imperfections. The originally designed diversion outlet consists of a three-bay intake, a pipe with a section of 8 x 8 m, and expanding outlet portal. The middle opening has a width of 8 m and the extreme ones 4 m each. The low-flow discharges pass through the three openings, and after reaching a reservoir level of 72 m, the extreme openings are covered by stoplogs and no longer operate. After flood waters recede and subsequent partial drawdown of the reservoir, the middle opening is also closed and the division outlet is taken out of further service. As a result of the experimental investigation on a hydraulic model, an improved design of the diversion outlet was obtained, which has practically the same construction volume and elements. When compared with the original variant it has several advantages. It has a higher discharge capacity at low levels and a lower capacity at high reservoir water levels. The new design provides an allowable maximum fall during damming of the river channel and it provides the maximum allowable discharge at the highest water level in the reservoir. The new diversion outlet guarantees a free flow in the pipes in the entire range of discharges and it has a better spreading and dissipation of the energy of the flow in the lower pool. Finally, the new outlet design provides a 25% smaller depth of scouring in the lower pool and prevents local scouring of the tailwater channel in the immediate vicinity of the structure. (Korn-PTT)
W91-01646

EFFECT OF THE RIGA HYDROELECTRIC STATION ON THE CURRENT VELOCITY NEAR WHARVES OF THE RIGA COMMERCIAL SEAPORT.
G. Y. Segal, and E. L. Tsoneva
Hydrotechnical Construction HYCOAR, Vol. 23, No. 11, p 631-633, 1990. 2 fig. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 11, p 15-16, November 1989.

Descriptors: *Channel erosion, *Channel flow, *Channel morphology, *Channel scour, *Dam effects, *Hydroelectric plants, *Hydrologic regime, *Soviet Union, Channel improvement, Economic evaluation, Hydraulic design, Hydraulic equipment, Hydraulic machinery, Hydraulic structures, Hydroelectric power, Velocity.

The Riga commercial sea port (RCSP) is located at the mouth of the Daugava River. The operation of the Riga hydroelectric station (1974) completely changed the hydrological regime in the lower pool of the station, in which the port was located. A prediction of the transformation of the Daugava channel as a consequence of these changes was made by the Latvian Urban Planning Institute. These predictions were based on the technological regime of the planned hydrostation. The more than 10-year period of hydrostation operation showed that although operating as a peak-load station in a daily regulating regime with two releases, there are considerable differences from the design regime. The differences between the design and actual operating regime of the hydrostation led to a considerable deviation of channel deformation downstream from the station when compared with the prediction. The channel of the lower course of the river is composed mainly of medium-grained sands in the size range 0.25-0.50 mm. For these grains, the permissible bottom velocity does not exceed 0.25 m/sec. Actually, the velocities occurring during operation of all units of the Riga hydrostation are considerably higher. These high velocities are the main cause of the channel scouring. Large and costly hydrotechnical works will be required to prevent further dangerous deformations of the Daugava channel near the wharves of the RCSP. (Korn-PTT)
W91-01647

LOCAL ENERGY LOSSES IN TWO-COMPONENT PRESSURE FLOWS.
B. M. Levin, A. N. Lopatin, and V. F. Boiko.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 11, p 634-638, 1990. 1 fig, 1 tab, 17 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 11, p 16-19, November 1989.

Descriptors: *Cavitation, *Flow characteristics, *Flow friction, *Flow resistance, *Head loss, *Hydraulics, Agriculture, Flow equations, Hydraulic friction, Hydraulic transportation, Hydroelectric plants, Land reclamation, Multiphase flow, Slurries.

Systems of hydraulic transport of solid materials have presently become widespread in various areas of agriculture, hydrotechnical construction, industry, and land reclamation. Most developments and investigations of the two-phase flows associated with these hydraulic transport systems pertain mainly to a determination of their transporting capacity. Even less studied is the problem of determining the head losses of slurries due to local hydraulic resistances (in an abbreviated form, local losses). At the same time, local head losses in some cases make a substantial contribution to the calculation of hydraulic transport systems, and sometimes are the factor determining this calculation (e.g., the suction lines of systems, short slurry pipelines). Local losses during movement of slurries representing a mixture of water and solid material (mainly quartz sands) were investigated

Along with this, mixtures of water with polymer additives (mainly polyacrylamide, PAA), which under certain conditions can considerably reduce hydraulic friction in a turbulent pressure flow were also investigated. The presence in two-component flows of a second component in the form of solid inclusions (with a particle size up to 25 nm) or polymer additives (reducing the linear head losses in uniform turbulent flows) does not affect the extent of local hydraulic resistances expressed in fractions of the velocity head of the mixture. This conclusion was indirectly confirmed by the discharge coefficients of contracting devices (flowmeters) and the cavitation characteristics of centrifugal pumps. (Korn-PTT)
W91-01648

HYDRAULIC JUMP IN TRIANGULAR CHANNEL.
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
W. H. Hager, and R. Wanoschek.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 5, p 549-564, 1987. 12 fig, 16 ref.

Descriptors: *Hydraulic geometry, *Hydraulic jump, *Hydraulic properties, *Open-channel flow, *Spillways, *Tailrace, Channel morphology, Energy dissipation, Froude number, Hydraulic structures, Momentum transfer, Tailwater, Turbulent flow.

The main features of hydraulic jumps in trapezoidal channels were analyzed. In particular, the hydraulic jump in channels with triangular cross-sections was examined experimentally. The results were compared with data collected in channels with rectangular cross-sections. Based upon the equality of mass, energy, and momentum transfer in the inflow section, the hydraulic and geometric properties of the two jumps were correlated. The sequent depth ratio in the triangular channel was significantly lower; therefore, the tailwater depth of a rectangular channel must be much higher. As a consequence, the relative energy dissipation of the jump in the triangular channel was much higher (typically 30%). The jump in a triangular channel was almost two times shorter than the corresponding jump in a rectangular channel. However, the volume of the jump was about 30% higher in the triangular channel; the ratio of jump volumes increased almost linearly with the Froude number. The surface width at the end of the jump was larger in a triangular channel; therefore, lateral space limitations may become important. The sensitivity of the hydraulic jump to slight discharge variations was lower in the triangular channel; consequently, the sensitivity of slight tailwater variations was higher. (Miller-PTT)
W91-01669

LOW INDUCED PIPE VIBRATION DURING TS SAGGING PROCESS.
ast China Technical Univ. of Water Resources, anjing.
. Mao.
ournal of Hydraulic Research JHYRAF, Vol. 25, o. 5, p 565-582, 1987. 19 fig, 1 tab, 10 ref.

escriptors: *Hydraulic engineering, *Pipe flow, *ipelines, *Scour, *Vibrations, Damage, Erosion, ow velocity, Hydraulic structures, Sagging.

pelines may be damaged by flow-induced vibran. Fatigue problems caused by pipe vibration ve received much attention, but little consideron has been given to the impact of vibrating pelines on their beds. The interaction between a rating pipe and an erodible bed was studied. pe vibration during sagging was emphasized. d scour below a pipeline is promoted by pipe ration. If the scour hole below a pipeline is ge enough, gravity and the flexibility of the eline can allow the pipe to sag into the scour e. Flow velocity is an important factor in proting vibration, but the eroded bed has a restric- effect on vibration. The distance between the e and the bed is also important. The pipe state be classified as (1) the pre-vibration stage, (2) lock-in stage, or (3) the lock-out stage. For erent pipe states, the amplitude response tendencies during sagging of the pipe are quite different. When the pipe is in the lock-in stage and very close to the bottom of the scour hole, the pipe may vibrate with such an amplitude that it may be damaged due to its impact on the scour hole. (Author's abstract)
W91-01670

COMPARISON BETWEEN MEASURED WAVE PROPERTIES AND SIMPLE WAVE HINDCASTING MODELS IN SHALLOW WATER.
North Carolina Univ. at Morehead City. Inst. of Marine Sciences.
R. A. Luettich, and D. R. F. Harleman.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 4, p 299-308, 1990. 4 fig, 1 tab, 16 ref. U.S./Hungary Cooperative Science Program Grants INT-8112454 and INT-8411545 and NSF Grant ECE-8211525.

Descriptors: *Lakes, *Model studies, *Sediment transport, *Shallow water, *Waves, Comparison studies, Fetch, Hungary, Lake Balaton, Wave height.

The U.S. Army Corps of Engineers has published two versions of a simple shallow-water wave hindcasting model that has the potential for predicting characteristic wave properties. Significant wave heights and wave periods obtained from field measurements in Lake Balaton, Hungary, were compared with the two versions of this model. The earlier version was found to give very good hindcasts of wave height but fell approximately 20% low on wave period. The later model was 15-20% above the earlier version for winds directed along the axis of the lake and therefore having relatively long fetches. For short fetches, results from the two model versions were nearly the same. (Author's abstract)
W91-01671

ANALYTICAL ASYMPTOTIC SOLUTIONS FOR LONGITUDINAL DISPERSION WITH DEAD ZONES.
Contra Costa Water District, Concord, CA.
R. A. Denton.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 4, p 309-329, 1990. 5 fig, 1 tab, 33 ref.

Descriptors: *Dead zones, *Dispersion, *Mathematical analysis, *Path of pollutants, *Streamflow, Aris method of moments, Boundary conditions, Data interpretation, Mathematical studies, Rivers.

Longitudinal dispersion in rivers is the combined effect of the stretching of a dispersant cloud by differential advection and removal of the cross-sectional concentration gradients by cross-sectional mixing. Dispersant material can become temporarily trapped in separation or dead zones along the flow boundaries. Analytical solutions for the asymptotic behavior of two-dimensional flow with dead zones was obtained using the Aris method of moments. The spatial and temporal solutions demonstrated the relative contributions of main flow shear dispersion and dead zone trapping to the total rate of longitudinal dispersion. Steady-state equilibrium profile solutions for the variations in mass, centroid and variance over the flow cross-section were derived. While the centroid, variance and skew all increase linearly during the equilibrium period, the kurtosis increases quadratically, consistent with an eventual asymptote of the kurtosis coefficient to the Gaussian value of 3.0. (Author's abstract)
W91-01672

KINEMATIC CASCADES: DERIVATION OF A GENERALIZED SHOCK FORMATION CRITERION.
Technische Univ., Vienna (Austria). Inst. fuer Hydraulik Gewasserkunde und Wasserwirtschaft.
B. H. Schmid.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 4, p 331-340, 1990. 2 fig, 16 ref.

Descriptors: *Hydraulic engineering, *Kinematic wave theory, *Overland flow, *Rainfall-runoff relationships, *Shock formation, Excess rainfall, Infiltration, Mathematical analysis, Model studies, Ponding.

Practical use of the kinematic-wave concept in engineering applications of the hydraulics and hydrology of overland flow frequently requires an extension termed the 'kinematic cascade', which allows the approximation of natural ground surface by a series of planes. Shock formation may present problems in the course of kinematic cascade modeling. When choosing an adequate algorithm of solution, it is important to know beforehand whether discontinuities are to be expected. A generalized criterion including cases of time-dependent rates of rainfall excess was derived. Kinematic shock formation on a cascade of infiltrating planes was found to be strongly dependent on the ratio of respective ponding times. If a kinematic cascade comprises two planes with overland flow on the upper one starting earlier than on the lower one, a shock will occur as soon as the rate of rainfall excess related to the upper plane becomes nonzero. In all other cases the generalized shock-formation criterion accounting for time-dependent infiltration is more complicated. Three different types of shock were identified, two of which are relevant to the problem considered. Accordingly, the derived criterion consists of two cases, both of which must be checked in the course of practical application. (Miller-PTT)
W91-01673

SCOURHOLE DEVELOPMENTS IN SHALLOW TAILWATER.
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Civil and Systems Engineering.
A. J. Johnston.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 4, p 341-354, 1990. 6 fig, 4 tab, 27 ref.

Descriptors: *Erosion, *Hydraulic structures, *Scour, *Tailwater, Experimental data, Hydraulic processes, Plane jet, Sediment transport, Shallow water.

An understanding of scour processes in areas where loose sediments are located near the foundations of hydraulic structures is normally required during analysis and design. The scourhole development of a plane jet entering shallow tailwater conditions was investigated. Through dimensional considerations and physical reasoning, the appropriate functional groups were identified. Experimental laboratory results were used to evaluate the functional relationships and show that in shallow conditions, the jet can produce three very different scourhole regimes. (1) For fairly small depth values, moderate bed offsets and small densimetric Froude numbers, a surface jet scourhole regime is likely where the jet is attached to the free surface. This scourhole is rarely observed in normal engineering applications. (2) For large depth values up to and beyond large offsets, a bed jet regime is observed where the jet is attached to the bed. This regime is the most commonly observed in engineering practice. (3) With moderate depths and moderate bed offsets, the jet flicks between boundaries. The period of this flicking cycle varies between 2 and 30 min and is dependent on tailwater depth. This transient regime has a number of important characteristics which need assessment in a number of engineering situations; for instance, the rate at which the scourhole depth increases is 40% (surface regime) and 70% (bed-surface regime) that of the bed regime. (Miller-PTT)
W91-01674

MODELLING OF SANDWAVE EVOLUTION RESULTING FROM SUSPENDED AND BED LOAD TRANSPORT OF SEDIMENT.
Reading Univ. (England). Dept. of Meteorology.
B. Johns, R. L. Soulsby, and T. J. Chesher.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 4, p 355-374, 1990. 7 fig, 16 ref. Contract No. GR/E/09436.

Descriptors: *Bed load, *Channel morphology, *Dunes, *Model studies, *Sand, *Sediment transport, Coastal waters, England, Estuaries, Flumes,

Group 8B—Hydraulics

Mathematical models, Sedimentation, Taw Estuary.

Bedforms are a common feature of sand-bedded rivers, estuaries and open sea areas. In addition to small-scale ripples, larger sandwaves (dunes) are found in most areas of strong sediment transport. A numerical model was used to determine changes in the bed morphology resulting from the bed load and suspended transport of sand. The ability of the model to predict mean and turbulent quantities and the suspended transport of sand was assessed by laboratory flume experiments and field observations. The model was then applied to investigate changes that may be expected to occur in an initial bedform corresponding to asymmetrical sandwaves characteristic of those found in the coastal and estuarine environment. It was found that suspended transport may frequently dominate over bed load transport in producing changes in the bedform structure. The predicted evolution of the bedform was consistent with observations made of sediment fluxes and sandwave migration in the Taw Estuary, England. (Author's abstract)
W91-01675

BEARSPAW DEVELOPMENT: DESIGN AND CONSTRUCTION OF A SIDE-CHANNEL OVERFLOW SPILLWAY.
M. Pildysh, R. J. Slopek, J. O. H. Nunn, and R. A. Keys.
Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 3, p 423-430, June 1990. 7 fig, 1 ref.

Descriptors: *Alberta, *Dams, *Flood control, *Overflow channels, *Spillways, *Weirs, Channel improvement, Earth dams, Engineering, Erosion control, Flood-control storage, Heaving, Hydraulic engineering, Model studies, Reinforced concrete, Spillway gates.

An emergency spillway with a capacity of 1840 cu m/s has been built to increase the spillway capacity of the 30-year-old Bearspaw Development so that it can safely pass the probable maximum flood. A unique aspect of the free-overflow, side-channel emergency spillway is the weir. This consists of an earthfill dike with a cap and downstream facing of reinforced concrete. Comprehensive hydraulic model testing was undertaken to provide detailed design data and optimize the design of the emergency spillway. The overflow weir substructure is a zoned earthfill dike with a 2 mm thick polyethylene membrane at the top of the impervious core to prevent frost heave of the concrete lining. The reinforced concrete lining of the spillway is required for erosion protection and is designed to withstand the hydrodynamic drag and uplift forces caused by flowing water as well as piezometric uplift pressures due to seepage. An extensive underdrainage system was installed to reduce uplift pressures under the lining. An unlined return channel excavated through overburden and rock conducts spillway discharges back to the river. The Bearspaw Development side-channel spillway provides an example of design and construction of a major free-overflow spillway founded on a low-cost earthfill substructure. The overflow spillway, which was more economical and reliable than a conventional gated structure, was made technically and economically feasible through detailed engineering and extensive model testing. Conventional construction procedures were utilized to build an unconventional structure. (Agostine-PTT)
W91-01721

RIVER DISCHARGE AND TIDAL CONTROLS ON SALT-WEDGE POSITION AND IMPLICATIONS FOR CHANNEL SHOALING: FRASER RIVER, BRITISH COLUMBIA.
Guelph Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2L.
W91-01722

8C. Hydraulic Machinery

POSSIBILITIES OF CONSTRUCTING HYDROELECTRIC STATIONS: PUMPED STORAGE STATIONS IN ARMENIA.
V. B. Rostomyan, and G. A. Burnachyan.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 12, p 704-706, June 1990. 1 fig, 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 28-29, December 1989.

Descriptors: *Armenia, *Economic evaluation, *Hydroelectric plants, *Pumped storage, Electric power costs, Electric power demand, Electric power production, Hydroelectric power, Pumping head, Reservoir operation, USSR.

Pumped storage stations (PSSs), because of their flexibility in producing electric power at particular times, are necessary to meet the peak loads of modern power systems. The increasing electric power requirements of the Armenian republic, the increasing proportion of thermal electric power plants, the decrease in flexible capacity at existing hydroelectric stations (HESs) and the presence of favorable natural conditions indicated the need to introduce PSSs into the Armenian power system. This can be accomplished successfully and economically by reconstructing certain HESs of the Sevan-Razdan and Vorotan cascades. The Gyumush HES with a head of 285 m, discharge of 90 cu m/s, and installed capacity of 224 MW, the third step of the cascade, is the most powerful HES of the system and the most favorable for conversion to a HES-PSS operating regime. A discharge equal to 41 cu m/s will be used at the HES, which will provide a capacity of 102 MW. A capacity equal to 122 MW remains free. The volume of water required during the off-peak period of the load curve can be delivered by pumps from the lower pool of the existing HES during 7 h. The PSS will be located between the daily storage and the reservoir, with two reversible units: the turbine regime design discharge is 49 cu m/s with a 80 m head and a 38 MW capacity while the pump regime design discharge is 21 cu m/s with a head of 100 m and a capacity of 25 MW. Some 530,000 cubic m of water from the lower pool of the Gyumush HES will be delivered to the daily storage and further to the upper storage reservoir by a pump station constructed next to the HES. The pump station parameters are for a discharge of 21 cu m/s, a 295 m head and a 75 MW capacity. The daily energy for filling and discharging the PSS for a pure storage cycle is 480 MW. According to preliminary calculations, the unit investments in reconstructing the existing HES into a HES-PSS are 95 rubles/kW. The second and fifth steps of the cascade, the Atarbekyan and Kanaker HESs can also be transformed into HES-PSS by creating a daily storage at the end of the diversion canal of the second stage, deepening the daily storage of the fifth step, and constructing pump stations next to the powerhouses of the indicated stations. (Hoskin-PTT)
W91-01439

PECULIARITIES OF THE FORMATION OF BOTTOM DEPOSITS IN A CLOSED-COOLING POND.
B. I. Novikov, and N. A. Chizhmakova.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 12, p 730-733, June 1990. 1 fig, 1 tab, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 49-51, December 1989.

Descriptors: *Bottom sediments, *Cooling ponds, *Electric powerplants, *Sediment distribution, *Sedimentation, Artificial ponds, Bottom sampling, Hydrodynamics, Sediment analysis, Sediment transport, Suspended sediments.

The development of thermal and nuclear powerplants has resulted in an ever-increasing number of cooling ponds. The peculiarities of the process of bottom deposits deformation in a closed cooling pond were examined. The investigations were performed at two cooling ponds with level segments with depths of 5-6 m and closed trenches exceeding 10 m. The studies consisted in removing cores and individual samples from a network of stations uniformly disposed over the pool area. The basic characteristic of the formation of bottom sediments in closed cooling ponds is the predominant participation of indigenous materials in this process, which are products of the scouring of primary soils-submerged soils. It is precisely from these products that the silts of the troughs and the sections protected from hydrodynamic action are formed. Consequently, any substance, including any harmful ones, will ultimately be concentrated on the bottom of the above-indicated sections of the body. This concentration is especially pronounced for substances associated with suspensions. (Hoskin-PTT)
W91-01444

MECHANICAL EQUIPMENT OF THE TIKHOVSK HYDRO DEVELOPMENT ON THE KUBAN RIVER.
A. F. Levashova.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 10, p 569-572, April 1990. 2 fig, 6 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 10, p 12-14, October 1989.

Descriptors: *Fish management, *Fish passages, *Hydraulic equipment, *Hydroelectric plants, *Locks, *Soviet Union, Ecological effects, Fish guiding, Fish populations, Hydraulic gates, Irrigation water, Mechanical equipment.

The Tikhovsk (Soviet Union) hydro development on the Kuban River is located at the confluence of the Protoka River and the Kuban River. The hydro development is intended for irrigation purposes; the interests and requirements of the economy were taken into account when selecting the composition of the structures of the hydro development. Because great attention is being given to ecology and, in particular, to the reproduction and protection of fish, two fish locks are provided for at the Tikhovsk hydro development. In comparison with the navigation locks and overflow dam, the fish locks have the most complex and diverse mechanical equipment. Of the total mass of 2560 tons of mechanical equipment the fish locks accounts for 1130 tons. The upstream and downstream slotted gates form a working chamber in which the pools are isolated and the fish are examined and counted. Directly behind the upstream slotted gate is an icthyological platform. The fish locks in addition to their main function--forceful transport of fish from the lower to the upper pool--can serve as a natural laboratory for developing ways of attracting various fish species. When designing the mechanical equipment of the fish locks, past experience in operating such structures was used. (Fish-PTT)
W91-01540

MONITORING THE STATE OF THE DAM OF THE SAYANO-SHUSHENSKOE HYDROELECTRIC STATION.
For primary bibliographic entry see Field 8A.
W91-01541

INITIAL PERIOD OF OPERATION OF THE CHANNEL DAM OF THE KUREIKA HYDROELECTRIC STATION.
For primary bibliographic entry see Field 8A.
W91-01542

EXPERIENCE IN OPERATING ECOLOGICALLY CLEAN TURBINES.
V. A. Lagutin, and G. P. Nekryachenko.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 10, p 584-586, April 1990. 1 tab. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 10, p 22-24, October 1989.

Descriptors: *Hydraulic engineering, *Hydraulic machinery, *Hydraulic turbines, *Hydroelectric plants, *Soviet Union, *Water pollution control, Ecological effects, Maintenance, Mechanical failure, Oil pollution.

The first turbine of the Cheboksary (Soviet Union) hydroelectric station that was put into operation has an oil-filled runner bushing; therefore, the possibility of oil entering the river in an amount specified by the standards of the manufacturer is possible. The other 17 turbines have water-filled bushings, and are ecologically clean. However, these turbines are mechanically unreliable; complete fai

ure of the crossbeams on six turbines occurred in 1982-1985. Strengthening of the crossbeam, increasing the gaps, and replacing the bushings did not increase the reliability of the turbines. The turbine bearing is distinguished by an extremely low reliability, due to insufficient rigidity of the bearing housing, disturbance of the threading in the supports, difficult self-adjustment of the segment, transmission of tangential alternating forces through the bolt leading to partial or complete separation of the supports, and difficult repairs on the bearing owing to the confined space. At the hydrostation a number of operations to strengthen the bearings had to be carried out. An interdepartmental conference was forced to acknowledge that ecologically clean turbines do not provide the necessary reliability and do not correspond to the requirements of the specifications. Despite the unsuccessful introduction of ecologically clean adjustable-blade turbines into operation, the return to oil-filled runners should be decisively rejected, since the advantages of ecologically clean equipment are too obvious. It is necessary to develop a turbine that satisfies all operating conditions. (Fish-PTT)
W91-01543

DESIGN OF CRANES FOR OPERATING GATES.
I. K. Kaplan.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 10, p 605-607, April 1990. 1 fig, 1 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 10, p 37-38, October 1989.

Descriptors: *Hydraulic design, *Hydraulic gates, *Hydraulic machinery, *Hydroelectric plants, Control systems, Mechanical failure, Safety, USSR.

Operation of hydraulic gates at hydroelectric stations may sometimes become difficult. When lifting a gate, it is possible for it to become wedged in the guideways of the groove, causing both overloading of the hoisting device and transmission of an increased pulling force from the hoisting device to the object being raised. It may also jam during lowering, whereupon the hoisting device continues to operate and sagging of the cable occurs, followed by a sudden drop of the gate with a jerk considerably exceeding the design load. A protection device for both the crane and the restrained load is needed. A device has been developed for controlling the hoisting mechanism for a gantry crane of the water intake and outlets of a hydroelectric station. Tests on a prototype at the hydrostation confirmed the performance of the device. The technical and economic indices are: (1) the possibility of changing the capacity of the hoisting mechanism allows reduction of the number (and weight) of mechanisms needed; (2) the possibility of crane overloading decreases due to the use of electrical and hydraulic apparatus; (3) operating safety on the crane increases, since the control apparatus is backed up in the device; and (4) if necessary, the device can be made as an independent drive of increased capacity with a small stroke for lifting the gate from the sill and with a reduced load lifting or lowering speed. (Fish-PTT)
W91-01548

WHAT RESULTS WHEN THE BUILDING CODES ARE NOT OBSERVED.
For primary bibliographic entry see Field 8B.
W91-01550

OPTIMIZATION OF HYDROPOWER PLANT INTEGRATION IN WATER SUPPLY SYSTEM.
California Univ., Davis. Dept. of Land, Air and Water Resources.
A. Afshar, F. B. Jemaa, and M. A. Marino.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 5, p 665-675, September/October 1990. 2 fig, 7 tab, 5 ref. Agricultural Research Service Cooperative Agreement 4116-H with the University of California, Davis.

Descriptors: *Energy sources, *Hydroelectric plants, *Water delivery, *Water resources management, *Water supply development, Available head, Dynamic programming, Hydraulic turbines, Hydroelectric power, Metropolitan water management, Model testing, Optimization, Pipes.

During the past few years many water districts have discovered that electricity generated by installing suitable hydroelectric power plants in water supply mains may now be cost-effective as an energy source. An optimization model has been developed for determining the optimal design capacities of a water delivery system integrating small hydropower plants. A discrete distance model of the transmission pipeline was solved by employing dynamic programming. The model determines the proper allocation of available pressure head to various potential hydropower sites along the supply main and determines the optimal pipe diameter. The practical value of the model was demonstrated in a supply system to serve four towns. The solution of the model gives the set of turbine capacities, pipe diameters, head allocation resulting in maximum net benefit for a given quantity of available water and demand, and the expected net benefits. (Author's abstract)
W91-01556

HYDROELECTRIC DAMS AND THE DECLINE OF CHINOOK SALMON IN THE COLUMBIA RIVER BASIN.
Marquette Univ., Milwaukee, WI. Dept. of Economics.
For primary bibliographic entry see Field 6G.
W91-01560

ACCOMMODATING FISH AND WILDLIFE INTERESTS UNDER THE FPA.
Gordon, Thomas, Honeywell, Malanca, Peterson and Daheim, Seattle, WA.
For primary bibliographic entry see Field 6E.
W91-01628

CALIFORNIA V. FERC: STATE REGULATION OF FEDERAL HYDROPOWER.
For primary bibliographic entry see Field 6E.
W91-01629

MECHANICAL EQUIPMENT OF THE TASHLYK PUMPED-STORAGE HYDROELECTRIC STATION AND ALEKSANDROVKA HYDRO DEVELOPMENT OF THE SOUTHERN UKRAINE POWER COMPLEX.
Y. V. Maksimenko, and V. S. Nesterenko.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 11, p 617-620, 1990. 4 fig. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 11, p 6-7, November 1989.

Descriptors: *Dams, *Hydraulic gates, *Hydraulic machinery, *Hydroelectric plants, *Nuclear powerplants, *Soviet Union, *Turbines, Gates, Hydraulic design, Hydraulic structures, Hydroelectric power, Slide gates, Ukraine.

The Southern Ukraine power complex includes a nuclear power station and three hydro developments: Tashlyk, Aleksandrovka, and Konstantinovka. The Tashlyk hydro development is being created in a ravine located in the left-bank region of the Southern Bug River valley next to the upstream Konstantinovka hydro development. The Aleksandrovka hydro development will be constructed 15 km downstream. The general layout of the facilities of the power complex was determined mainly by the location of a nuclear power station on the left bank of the Tashlyk reservoir. The Tashlyk pumped-storage hydroelectric station (PSS) provides combined operation of all power complex reservoirs for cooling the circulating waters of the Southern Ukraine nuclear power station. Six reversible units and four turbine units will be installed at the Tashlyk PSS. The water intake of the Tashlyk PSS is equipped with two absolutely identical emergency-guard slide gates 8.0 meters in width, 12.2 meters in height, and 24.0 m in head. The gate consists of four sections interconnected by hooks. The Aleksandrovka hydro development will be used as a buffer in the Southern Ukraine power complex. It will consist of an eight-bay overflow dam and a low-head powerhouse with two units. The overflow dam is equipped with fixed wheel gates 16.0 meters in width, 14.5 meters in height and with a head of 14.1 meters. These gates will serve as the service gates. The gates consist of two sections interconnected by hooks. Slide gates are used as the emergency-guard gates for purposes of economy of the mass of the embedded parts and gates. (Korn-PTT)
W91-01644

MECHANICAL EQUIPMENT OF THE VILYUI NO. 3 HYDROELECTRIC STATION.
V. V. Bychkov, and L. I. Perel'shtein.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 11, p 620-627, 1990. 4 fig, 2 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 11, p 8-12, November 1989.

Descriptors: *Dams, *Hydraulic equipment, *Hydraulic structures, *Hydroelectric plants, *Soviet Union, Bulkhead gates, Economic evaluation, Gates, Hydraulic design, Hydraulic gates, Hydroelectric power, Reservoirs, Slide gates, Turbines.

The Vilyui No. 3 hydroelectric station is the second step of the cascade of Vilyui hydroelectric stations and is located 140 km downstream from the Vilyui Nos. 1 and 2 hydroelectric station sites. The main elements of the Vilyui No. 3 hydrostation structures are the powerhouse combined with the bottom outlets, headwater and tailwater canals, earth-rock dam, and office-production building. The reservoir of the No. 3 hydrostation does not have a seasonal storage and the station will operate on the through-going flow from the Nos. 1 and 2 hydrostations. A thorough study of the project made it possible to unify elements of the set of mechanical equipment, which in turn led to an increase in its reliability, reduction of the time, labor intensity, and cost of manufacturing and installing the equipment. It also resulted in an improvement in the quality of manufacture and assembly as a result of the economically advantageous use of special assembly jigs. Eliminating the use of specially manufactured intake and draft tube bulkhead gates and emergency-guard gates of the bottom outlet saves 420,000 rubles and 450 tons of metal. In addition, a new design for the lining was used thereby reducing the amount of field welding and welding deformations in the structures. This eliminated labor-intensive manual operations on installing anchor rods on the assembled linings and thereby increased the factory readiness of the linings for assembly. In addition, the new lining design reduced the consumption of metal and the presence of cutoffs in the anchor ribs improved the concreting conditions. (Korn-PTT)
W91-01645

INVESTIGATION OF THE DIVERSION OUTLET OF THE KIRZAN HYDRO DEVELOPMENT.
For primary bibliographic entry see Field 8B.
W91-01646

EFFECT OF THE RIGA HYDROELECTRIC STATION ON THE CURRENT VELOCITY NEAR WHARVES OF THE RIGA COMMERCIAL SEAPORT.
For primary bibliographic entry see Field 8B.
W91-01647

8D. Soil Mechanics

ANALYTICAL METHOD OF CALCULATING SLOPE STABILITY.
I. A. Maslov.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 12, p 675-683, June 1990. 5 fig, 1 tab, 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 9-14, December 1989.

Descriptors: *Analytical, *Dam construction, *Engineering geology, *Mathematical analysis, *Slope stability, *Soil mechanics, Mathematical equations, Mathematical studies, Shear stress, Soil engineering, Soil physics, Structural engineering.

Methods of calculating the stability of slopes of earth structures, based on an examination of sliding of a soil mass on a cylindrical surface and proceeding from the fact that the soil in the zone of this surface is in a limit state, are the most widespread in modern engineering practice. However, the conditions of equilibrium of the forces acting on the sliding mass are not fulfilled in most of these methods, reducing the accuracy of the solution obtained, sometimes quite substantially. An analytical method of calculating slope stability which satisfies the conditions of equilibrium and permits calculation without dividing the sliding mass into vertical elements is proposed. In addition to the assumption generally made in such problems concerning the presence on the failure surface of a limit state characterized by the Coulomb criterion , a likelihood law of distribution of normal stresses on the failure surface compatible with the conditions of equilibrium is assumed a priori. This makes the investigated problem definite and not too complex. Methods of calculating slope stability in which the equilibrium conditions are not fulfilled can be used only for preliminary calculations if there are no considerable horizontal loads. In this case, it is recommended to use Terzaghi's method, introducing a proposed correction factor to the frictional forces on the failure surface. In critical calculations it is necessary to use methods in which the equilibrium conditions are fulfilled. They give essentially the same results. (Hoskin-PTT)
W91-01434

CORRESPONDENCE OF THE SCHEME AND METHOD OF CALCULATING THE STABILITY FACTOR.
V. I. Istomin.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 12, p 689-693, June 1990. 3 fig, 5 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 17-20, December 1989.

Descriptors: *Mathematical analysis, *Shear stress, *Slope stability, *Soil physics, Mathematical equations, Mathematical studies, Sliding wedge, Soil engineering, Structural engineering.

Three variants of a problem involving a sliding wedge form for an earth slope were calculated using the inclined forces of interaction (IFI) method, and the methods of Chugaev, Krey and Terzaghi. For the calculation of Kc, the stability factor of the experiment, a calculation accuracy of $0.85\ Kp < Kc < Kp$, (Kp is the stability factor for the prototype) is guaranteed for $x <= 15$ degrees (x is angle between the lines of action of the resultants of the restraining and shearing forces) (the sliding wedge is separated from the slope by the sliding surface not having an ascending branch) for the Terzaghi method and its analoges, the Krey method and its analoges, and the IFI method. The same Kc accuracy is found for the Chugaev method for $x < 90$ degrees (the sliding wedge is separated from the slope by a sliding surface having an ascending branch, on the sliding surface the ratio of the angles of the internal friction should be $>= 1.1$). The ascending branch is the part of the sliding surface where the shear force is directed toward retaining the sliding wedge. (Hoskin-PTT)
W91-01436

BEHAVIOR OF SOIL UNDER A BRIEF DYNAMIC LOAD.
O. A. Orlova.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 11, p 638-648, 1990. 5 fig, 1 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 11, p 20-26, November 1989.

Descriptors: *Load distribution, *Load testing, *Shear stress, *Soil dynamics, *Soil mechanics, Distortional strain, Dynamic load, Elastic properties, Plasticity, Soil engineering, Soil physical properties, Soil strength, Strain measurement, Volumetric strain.

The behavior of an earth structure under a dynamic load is determined by its design and physical and mechanical characteristics of the materials composing it These characteristics in turn depend on the stress-strain state of the structure at the moment of the dynamic load start, as well as on the process of deformation of the soil under this load. An investigation was initiated in which both a cohesive and a noncohesive soil was placed under a combined stress state. The results of the investigation show that the damping coefficients both of cohesive and noncohesive soils do not depend on the soils state relative to the limit state almost up to loss of strength by the soil specimen. An increase of the initial lateral pressure and dry density of the noncohesive soil as well as a decrease of the moisture content of cohesive soil noticeably reduce the value of the damping coefficients. The shear moduli for small values of the initial lateral pressure under conditions of a combined stress state for cohesive soil depend on the level of the initial lateral pressure, while for the noncohesive soil it depends on the change in moisture content. Both volumetric strains and distortional strains under brief dynamic shear load and under conditions of a combined stress state are far less than the strains from an equal static load. The description of the soil deformation process as a result of a brief dynamic load shows the possibility of determining the nonlinear reaction of soil to this load by means of the linear acceleration method, if the system under consideration can be represented as a system with one degree of freedom. (Korn-PTT)
W91-01649

SEEPAGE IN EARTH DAMS IN TWO- AND THREE-DIMENSIONAL FORMULATIONS OF THE PROBLEM.
L. N. Rasskazov, N. A. Aniskin, V. G. Zhelankin, V. V. Melakhanov, and V. F. Korchevskii.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 11, p 648-656, 1990. 8 fig, 8 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 11, p 26-32, November 1989.

Descriptors: *Dams, *Finite element method, *Flow velocity, *Hydraulic models, *Hydraulic structures, *Seepage, *Soil mechanics, *Soviet Union, Fluid mechanics, Hydraulic properties, Permeability coefficient, Rapid excavation, Seepage gradient, Unconfined flow.

At present, problems of unconfined seepage flows are solved by hydraulic methods, since fluid mechanical solutions are complex and applicable to a limited class of problems. Three-dimensional regions do not have direct fluid mechanical solutions. The problem is complicated when dams being constructed by a directed blast are examined, since inhomogeneity and anisotropy of the soil and nonlinearity of the relation between the flow velocity and seepage gradient occurs. A method and program were developed for calculating nonlinear seepage in blast-formed dams, which makes it possible to obtain the solution of a three-dimensional problem for an inhomogeneous, anisotropic region of a complex geometric form under arbitrary boundary conditions. In a dam composed of material having a nonlinear law of seepage, the position of the surface of depression is higher than for the case when a linear (laminar) seepage law is used. Consideration of three-dimensionality when solving the problem of nonlinear seepage in a blast-formed dam with a height of 70 m showed that the seepage discharge was somewhat greater and the position of the surface of depression was higher than for the case of the two-dimensional problem. This eliminates the need for solving three-dimensional seepage problems for this structure class. (Korn-PTT)
W91-01650

CAUSES AND CHARACTER OF MOVEMENTS OF THE LOAMY SAND MORAINE IN THE FOUNDATION OF THE PLYAVINYAS HYDROELECTRIC STATION POWERHOUSE.
M. P. Leonov.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 11, p 657-660, 1990. 4 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 11, p 33-35, November 1989.

Descriptors: *Foundation failure, *Foundation rocks, *Hydroelectric plants, *Loam, *Moraines, *Pipes, *Sand, *Soil erosion, *Soil mechanics, *Soviet Union, Erosion, Piping erosion, Soil dynamics, Soil physical properties, Soil properties, Soil stability.

The Plyavinyas hydroelectric station powerhouse, in operation since 1965, has a foundation composed of moraine loams and loamy sands characteristic of the ancient valley of the Daugava River. In the lower part of the strata weakly cemented sands and sandstones with infrequent thin interlayers of clay belonging to the Amata and Gauya suites occur. The zone of the Amata-Gauya rocks in the valley walls and floor in the immediate vicinity of the boundaries of the erosional incision, which after filling the valley with glacial deposits was in close contact with the moraine, was eroded by piping. Long-term operation of the drainage systems during construction and operation of the hydro development was accompanied by intensified removal of sand, which led to the revival of the process of piping erosion of the rocks under the base of the moraine. Loamy sand moraine movements in the foundation of the right-bank abutment of the powerhouse were most probably due to the caving in of large piping cavities in the underlying rocks. Taking into account the available data on the geological structure of the foundation and physical and geological processes occurring, the possibility of new loamy sand moraine movements in its right-bank is a possibility. Under the established conditions it is necessary to take urgent measures to limit the continuing piping erosion of the Amata-Gauya strata by removing sand through the vertical drain wells in the area near the station. The most radical solution would be maximum dispersal of water withdrawal by transferring the center of the discharge zone a greater distance from the powerhouse and complete cessation of the operation of nearby high-output wells. (Korn-PTT)
W91-01651

8E. Rock Mechanics and Geology

DESIGN OF ROCK SLOPES IN SOVIET HYDROPOWER CONSTRUCTION PRACTICE.
For primary bibliographic entry see Field 8A.
W91-01433

SOLUTION-COLLAPSE DEPRESSIONS AND SUSPENSATES IN THE LIMNOCRENIC LAKE OF BANYOLES (NE SPAIN).
Barcelona Univ. (Spain).
For primary bibliographic entry see Field 2J.
W91-01876

8F. Concrete

MONITORING HIGH CONCRETE DAMS DURING THEIR CONSTRUCTION AND SERVICE.
E. K. Aleksandrovskaya.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 12, p 708-714, June 1990. 2 fig, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 33-37, December 1989.

Descriptors: *Concrete dams, *Dam construction, *Dam inspection, *Dam stability, Construction joints, Dam design, Dam failure, Data analysis, Mathematical analysis, Mathematical models, Model studies, Monitoring, Seepage, Soviet Union.

A comparison was made between observed and computed basic control parameter values in the construction and construction-service periods to evaluate the condition of the high arch-gravity dam at the Sayano-Shushenskoe hydroelectric plant. Measured and computed values were compared for four periods during the rise in the level of the headrace, which occurred in 1983, 1984, 1986 and 1987. An overall assessment of the dam's condition was made on the basis of the comparison between measured parameters and their computed values. The incomplete dam's profile, determined

from concrete elevations and computed for increments of hydrostatic pressure and the weight of concrete masonry, was adopted on the basis of conditions at the outset of the rise in headrace level for each of these periods during filling of the reservoir; temperature effects were disregarded. The comparison between the measured and computed values for three raceway sections indicated that the radial displacement from the computation for the first three ascents of the headrace level exceeded the measured values. In 1987, however, the computed displacements exceeded the measured by 440 m, while the measured values exceeded the computed in the lower portion of the dam. The arch stresses in the concrete at the maximum headrace level were identical with the computed values; several of them however, exceeded the computed values, especially in the keyed section of the dam. Continuous comparison between computed and measured arch stresses indicated that until a certain moment in 1987, the computed values exceeded the measured. Subsequently, the measured stresses exceeded the computed as the headrace level reached maximum (1986) elevations. During the second ascent of the headrace level from 500 to 532 m in 1988, the computed stresses again exceeded the measured. This suggested a more elastic stage of structure performance in 1988 as compared with the previous year. The noncorrespondences between the mathematical model and the prototype were due to the disregard of temperature effects on the dam and the opening of the contact joint, which was not precisely defined in the computations. During continuous service, the monitoring of high concrete dams should be performed by automated, computerized systems capable of determining discrepancies between computed and measured data. (Hoskin-PTT)
W91-01440

MECHANISM OF THE OPENING OF THE CONCRETE-ROCK JOINT IN THE SAYANO-SHUSHENSKOE DAM.
V. A. Ulyashinskii, S. N. Starshinov, and V. V. Tetelmin.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 12, p 714-719, June 1990. 3 fig, 3 tab, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 37-41, December 1989.

Descriptors: *Concrete dams, *Construction joints, *Dam failure, *Dam stability, *Soviet Union, Bed load, Dam design, Dam inspection, Data analysis, Hydrologic properties, Hydrostatic pressure, Mathematical analysis, Mathematical models, Model studies.

The opening of the contact joint between the concrete and rock in the zone of the upstream face of the bed sections of the Sayano-Shushenskoe dam, first noted during the filling of the reservoir, has been continuously increasing. Monolithizing of the dam during its construction was repeated annually after seasonal drawdown of the reservoir in the winter-spring period. This has caused 'bridging' of the dam on the shoreline slopes and the appearance of an additional retaining moment, which prevented the tilting and deflection of the dam's channel sections. Two alternate schemes of computing the stress-strain state of the canyon were performed by the finite-element method, one assuming the dam is a monolithic body and one assuming it nonmonolithic. In the case of the monolithic dam, some of the load due to its own weight, including the channel sections, is taken up by the shoreline slopes. This causes a reduction in normal stresses at the concrete-rock contact in the region of the upstream face, especially in the bed sections adjacent to the shoreline slopes. Since the hydrostatic pressure on the bottom of the canyon causes corresponding bed deformations, conditions were created that contributed to separation of the bed from the dam and to opening of the contact joint. On the whole, seasonal warming apparently exerted a positive influence on the performance of the contact joint in the region of the upstream face. Seepage processes in the bed also exerted a major influence on the formation of the stress-strain state at the concrete-rock contact. Thus, a zone with tensile stresses, which does not completely disappear during seasonal drawdowns of the reservoir, exists at the concrete-rock contact in the region of the upstream face of the Sayano-Shushenskoe Dam. The condition of the dam is currently considered satisfactory, although a rise in the headrace level to the normal operating level, and also subsequent seasonal fillings and drawdowns of the reservoir may cause further opening of the joint and its associated deterioration of the structure's condition. (Hoskin-PTT)
W91-01441

CONCERNING THE PROBLEM OF ASSIGNING THE COMPOSITIONS OF STEEL FIBER-REINFORCED CONCRETES.
L. M. Deryugin.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 10, p 608-611, April 1990. 2 fig, 3 tab. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 10, p 38-41, October 1989.

Descriptors: *Concrete dams, *Concrete technology, *Dam construction, *Dam design, *Hydraulic design, *Hydroelectric plants, Concrete mixes, Materials engineering, Reinforced concrete, Sand, Soviet Union, Spillways.

Passage of the flood discharges of the Enisei River in the Soviet Union through the temporary spillway openings of the second level of the Sayano-Shushenskoe dam in 1980-1982 led to serious erosion of the concrete surfaces. Construction of the permanent spillways was approached from two fundamentally different aspects: the provision of a hydraulic regime safest from cavitation erosion; and the search for a material considerably more resistant to the effect of cavitation in order to create surfaces able to withstand high-velocity flow (55 m/s) on the permanent spillways. Steel fiber-reinforced concrete, which was successfully used for treating damages of the concrete at a hydro development in Pakistan, was examined as one of the possible variants. It was found that a considerable increase of the content of sand in comparison with ordinary concrete mixes is required for preparing workable fiber-reinforced concrete mixes. The optimal content of sand should be selected experimentally in relation to the particular properties of the aggregates and length, cross section, and content of fiber. Fiber can be regarded as a coarse aggregate of acicular form with a developed surface, for binding of which an increased quantity of the mortar component is necessary. When using fiber in the form of wire lengths without additional anchorage on the ends, its length can be taken equal to 60-65 diameters without a substantial decrease of the tensile strength of the fiber-reinforced concrete. A reduction in length of the fiber to these limits considerably decreases clumping of the fiber during mixing. (Fish-PTT)
W91-01549

GEODETIC PROBLEMS IN THE CONSTRUCTION OF HIGH CONCRETE DAMS.
For primary bibliographic entry see Field 8A.
W91-01652

INVESTIGATION OF CONCRETE IN ABSORBING FORMWORK.
R. N. Shmantsar, T. A. Kuznetsova, and L. A. Petrova.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 11, p 665-668, 1990. 2 tab, 4 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 11, p 39-41, November 1989.

Descriptors: *Cements, *Concrete technology, *Concrete testing, *Concretes, *Formwork, Ensonite, Hydraulic structures, Soviet Union, Water to cement ratio.

The face surface of formwork should have an absorbing layer to promote surface hardening of the concrete. A series of investigations were carried out to determine the effectiveness of absorbing formwork on concrete using water to cement ratios (W/C) of 0.365. The results of the investigation indicated that absorbing formwork has a substantial effect on concrete quality for concretes with W/C greater than or equal to 0.365. The concrete surface quality depends on the quality of the absorbing formwork materials used. The possible amount of water removed from the concrete by means of the absorbing (vacuum) formwork was 2.4-3.57 kg/sq m. Before the start of hardening of the concrete, its water content decreases by 20-30% at a depth to 15 cm from the absorbing formwork. During hardening of the concrete, its water content equalizes over the entire length of the specimen (thickness of the block), and under these conditions the W/C ratio of the concrete near the formwork is not more than 1% below the initial ratio. According to the results of concrete testing for cavitation resistance, the best indices were noted for formwork containing ensonite. In this case, the cavitation resistance of the concrete was increased up to 1.4 times. This circumstance permits the use of formwork absorbing material such as fine-porous paperboard of the ensonite type (with pore sizes 20-100 nm), which freely passes water molecules but retains cement particles. (Korn-PTT)
W91-01653

DAM RENOVATION: FROM INVESTIGATION TO REPAIR.
Bridgeport Hydraulic Co., CT.
E. M. Bernard.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 8, p 28-34, August 1990. 2 fig.

Descriptors: *Concrete technology, *Dams, *Maintenance, *Rehabilitation, Concrete dams, Connecticut, Gravity dams, Leakage.

Bridgeport Hydraulic Company (BHC) in southwestern Connecticut has undertaken a comprehensive renovation program to identify and schedule necessary repairs to each of its 21 concrete gravity dams, all of which were built in the early part of this century. Renovation efforts at two BHC dams (Easton Dam and Means Brook Dam) from initial investigatory work to final design and construction are described. Although both projects involved concrete gravity dams that were constructed during the same period and exhibited similar freeze-thaw damage, distinctly different repair approaches were formulated. In the case of Easton Dam, repairs made to control leakage through the dam were undertaken because of the amount of leakage and repairs of the concrete surfaces were split into separate renovation projects for the crest and the downstream surface because of the size of the dam. Cast-in-place concrete was employed for the crest, whereas the method to be used for the downstream surface remains undecided. At Means Brook Dam, leakage control repairs were deemed unnecessary; repairs of the concrete surfaces will be undertaken with cast-in-place concrete for the crest and precast panels for the downstream surface. Factors that affect the renovation approach of any dam are reviewed. (Agostine-PTT)
W91-01748

8G. Materials

MONITORING HIGH CONCRETE DAMS DURING THEIR CONSTRUCTION AND SERVICE.
For primary bibliographic entry see Field 8F.
W91-01440

DIMENSIONLESS STRAIGHT-TYPE LINES FOR AQUIFER TESTS.
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Hydrogeology.
For primary bibliographic entry see Field 2F.
W91-01497

EXPERIENCE IN USING DIGITAL VOLTMETERS IN THE SYSTEM MEASURING THE POOL LEVELS AND HEAD AT HYDROELECTRIC STATIONS.
V. E. Kornev, and M. B. Dolgii.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 10, p 598-600, April 1990. 2 fig. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 10, p 32-34, October 1989.

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Group 8G—Materials

Descriptors: *Hydraulic equipment, *Hydroelectric plants, *Measuring instruments, *Sensors, *Watershed management, Pressure head, Soviet Union, Water depth.

General industrial sensors are presently finding wide use at hydroelectric stations for measuring the pool levels and head. Milliammeters are used as the direct reading instruments. These milliammeters and indicating instruments have a low resolution and do not always meet the accuracy requirements imposed on readings. It is suggested that digital voltmeters be used instead as indicating instruments, however it is necessary to install a matching device at the input of the digital voltmeters for interfacing with the output signal of the sensor. The reference voltage is fed to the voltage divider. A voltage proportional to the minimum or maximum value of the elevation of the pool level is set by potentiometers. The algebraic sum of the voltages is fed to the input of the digital voltmeter for displaying the value of the present parameter. Measuring systems which use digital voltmeters have been operating for several years at a number of hydrostations in the Soviet Union, their operation has been reliable. The introduction of digital voltmeters as indicating instruments in circuits measuring the pool levels and head make it possible to have convenient information providing accurate readings of the parameters of interest. (Fish-PTT)
W91-01546

8H. Rapid Excavation

EFFECTIVE DESIGN OF FACINGS OF BLAST-FORMED DAMS.
For primary bibliographic entry see Field 8A.
W91-01547

8I. Fisheries Engineering

EFFECT OF BODY SIZE ON THE UPTAKE AND BIOCONCENTRATION OF DI-2-ETHYLHEXYL PHTHALATE IN RAINBOW TROUT.
Washington State Univ., Pullman. Coll. of Pharmacy.
For primary bibliographic entry see Field 5B.
W91-01257

EVALUATION OF DESIGNS OF PERIODIC COUNT SURVEYS FOR THE ESTIMATION OF ESCAPEMENT AT A FISHWAY.
Department of Fisheries and Oceans, Halifax (Nova Scotia). Biological Sciences Branch.
For primary bibliographic entry see Field 7A.
W91-01384

TEMPERATURE SELECTION BY STRIPED BASS IN A GULF OF MEXICO COASTAL RIVER SYSTEM.
Georgia Cooperative Wildlife Research Unit, Athens.
M. J. Van Den Avyle, and J. W. Evans.
North American Journal of Fisheries Management NAJMDP, Vol. 10, No. 1, p 58-66, Winter 1990. 3 fig, 3 tab, 21 ref. U.S. Fish and Wildlife Service Project AFS-13.

Descriptors: *Fish behavior, *Gulf of Mexico, *Striped bass, *Temperature effects, Apalachicola River, Fish populations, Monitoring, Seasonal variation, Telemetry.

Behavior of adult striped bass Morone saxatilis in the Flint River-Lake Seminole portion of the Apalachicola River system was evaluated to determine if temperature preferences differed from those of striped bass from Atlantic coast stocks. Radiotelemetry was used to monitor fish distribution and temperature selection from March 1984 to November 1985. Seasonal distribution patterns and influences of water temperature on striped bass behavior were similar to those reported elsewhere for Atlantic striped bass. The fish ranged widely and occurred throughout the 166-km-long study area during fall, winter, and spring. During summer, however, they inhabited spring-fed areas almost exclusively. The fish moved into these sites during May, when surrounding waters averaged 24.3 C, and remained there through late October or early November, when ambient water temperatures declined to an average of 20.1 C. Temperatures selected by the fish averaged 21.6 C during both summers. When the data were separated into subsets of native Gulf and introduced Atlantic striped bass by the use of previously reported meristic characteristics, there were no differences between groups for average temperatures selected during summer or for temperatures at which the fish moved into or out of springs. The results indicated that preferred temperatures of striped bass in the Apalochicola River are not higher than those of other stocks. (Author's abstract)
W91-01385

EFFECT OF HARDNESS AND SALINITY ON SURVIVAL OF STRIPED BASS LARVAE.
Maryland Univ. at Baltimore. Dept. of Pathology.
A. S. Kane, R. O. Bennett, and E. B. May.
North American Journal of Fisheries Management NAJMDP, Vol. 10, No. 1, p 67-71, Winter 1990. 2 fig, 1 tab, 22 ref.

Descriptors: *Bioassay, *Fish hatcheries, *Fish larvae, *Hardness, *Salinity, *Striped bass, *Survival, Calcium carbonate, Chemical properties, Fish physiology, Sodium chloride.

Larval striped bass Morone saxatilis were exposed to three hardness concentrations (40, 100, and 160 mg/L as CaCO3 equivalents) and two NaCl salinities (2.0 and 3.0 ppt) treatments for 10 d in a modified flow-through system. Salinity had a greater effect on larval survival than did hardness over the ranges tested. Elevated NaCl salinity appeared to by detrimental; larvae exposed to 3.0 ppt NaCl had significantly higher mortality than did those exposed to 2.0 ppt NaCl. At 2.0 ppt salinity, hardness does not appear to play an important role in larval survival (probability of survival > 0.70). At 3.0 ppt salinity, mortality was greatest at hardness levels of 40 and 100 mg/L (probability of survival = 0.06 and 0.01, respectively), whereas at 160 mg/L, mortality was reduced (probability of survival = 0.39). The reason for this response is not clear, although there may be an optimal ratio of different ions contributing to total salinity. By comparison, other studies in which diluted seawater was used indicated that salinities of 0.5-10.0 ppt enhance the survival of striped bass larvae. (Author's abstract)
W91-01386

RELATIONS BETWEEN BROOK TROUT STANDING STOCKS AND HABITAT FEATURES IN BEAVER PONDS IN SOUTHEASTERN WYOMING.
Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie.
P. L. Winkle, W. A. Hubert, and F. J. Rahel.
North American Journal of Fisheries Management NAJMDP, Vol. 10, No. 1, p 72-79, Winter 1990. 1 fig, 7 tab, 25 ref.

Descriptors: *Aquatic habitats, *Beaver ponds, *Brook trout, *Fish populations, *Limnology, *Wyoming, Dissolved solids, Elevation, Regression analysis, Standing stock, Water depth.

Relations between abundance of brook trout Salvelinus fontinalis and habitat features of ponds made by beavers Castor canadensis were determined in 1986 and 1987 from observations of 25 southeastern Wyoming ponds. Standing stocks of fish longer than 100 mm in total length ranged from 5 to 313 kg/hectare, and densities ranged from 27 to 9,812 fish/hectare among 0.02-0.51-hectare ponds at elevations from 2,341 to 2,969 m above mean sea level. Of 25 habitat features, 6 were correlated with brook trout standing stock or density; surface area, mean water depth, water volume, discharge into pond, elevation, and morphoedaphic index (total dissolved solids (mg/L)/mean depth (cm)). The presence of young-of-year brook trout in beaver ponds was also related to both standing stock and density of brook trout longer than 100 mm in total length. Two multiple-regression models based on a rating of natural recruitment potential and pond surface area accounted for significant variation in brook trout standing stocks (adjusted R sq = 0.42) and densities (adjusted R sq = 0.50). The models provide a potential tool for assessment of beaver ponds as habitat for brook trout in southeastern Wyoming. (Author's abstract)
W91-01387

POTENTIAL APPLICATION OF MODELS IN FORECASTING THE EFFECTS OF CLIMATE CHANGES ON FISHERIES.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2B.
W91-01392

TEMPERATURE-OXYGEN HABITAT FOR FRESHWATER AND COASTAL STRIPED BASS IN A CHANGING CLIMATE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2B.
W91-01393

POTENTIAL LOSS OF THERMAL HABITAT FOR BROOK TROUT, DUE TO CLIMATIC WARMING, IN TWO SOUTHERN ONTARIO STREAMS.
Toronto Univ. (Ontario). Dept. of Zoology.
J. D. Meisner.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 282-291, March 1990. 3 fig, 3 tab, 28 ref. NSF and Engineering Research Council of Canada Grant OGP0003918.

Descriptors: *Aquatic habitats, *Climatic changes, *Climatology, *Fish populations, *Global warming, *Ontario, *Stream fisheries, *Thermal effects, *Trout, Air temperature, Brook trout, Groundwater, Model studies, Seasonal variation.

A hydrometeorological model of stream temperature was calibrated to two southern Ontario streams the Rouge and Humber Rivers, in the summer to estimate potential reductions, due to climatic warming, of thermal habitat for brook trout Salvelinus fontinalis. Summer habitat for brook trout in both streams, determined from electrofishing surveys during 1987 and 1988, was delimited downstream by a thermal barrier of about 24 C. Tagging data for one stream suggested that brook trout moved upstream to summer habitat as water temperatures in downstream areas increased during spring and summer. To estimate upstream movement of the thermal habitat barriers and concomitant reductions in summer habitat for brook trout due to climatic warming, the calibrated stream models were forced with the changes in mean July and August air temperatures (increase, 4.1 C) projected for the region by the climate warming scenario of the Goddard Institute for Space Studies. The temperature of groundwater discharging to the streams by the projected change in mean annual air temperature (increase, 4.8 C) was also adjusted. Elevated air and groundwater temperatures increased maximum summer stream temperatures and moved the thermal habitat barriers upstream, which reduced summer thermal habitat for brook trout in the two streams by 42 and 30%. However, because groundwater temperatures will always be lower than summer air temperatures, the cooling function of groundwater in streams will be maintained. The fate of a stream population of brook trout in a 'warmer' climate will be determined by the volume of groundwater discharging to the stream and the space available to which the fish can retreat in summer. (Author's abstract)
W91-01397

SIZE-DEPENDENT WINTER MORTALITY OF YOUNG-OF-THE-YEAR WHITE PERCH: CLIMATE WARMING AND INVASION OF THE LAURENTIAN GREAT LAKES.
York Univ., Toronto (Ontario). Dept. of Biology.
T. B. Johnson, and D. O. Evans.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 301-313, March 1990.

7 fig, 4 tab, 58 ref.

Descriptors: *Climatic changes, *Climatology, *Fish populations, *Global warming, *Great Lakes, *Introduced species, *Limnology, *Perch, *Temperature effects, Age classes, Body size, Distribution, Foods, Mortality, Seasonal variation, White perch.

White perch Morone americana invaded Lake Ontario about 1946 and are now found in Lakes Erie, St. Clair, and Huron, and in Green Bay, Lake Michigan. The indigenous marine distribution of white perch along the Atlantic coast of North America and an analysis of climatological data suggest that the northern Gulf of St. Lawrence in the vicinity of the Gaspe Peninsula is too cold to permit white perch to establish local populations or to invade the Great Lakes via the St. Lawrence River. High mortalities of white perch have occurred in Lake Ontario during very cold winters, further suggesting that distribution of white perch is limited by low tolerance of cold temperature. Warmer-than-average summer and winter temperatures during the late 1940s coincided with the invasion of white perch into the Great Lakes via transportation canals in the state of New York. Tolerance of young-of-the-year white perch for low temperature was tested in the laboratory in overwinter experiments at constant temperatures of 2.5 and 4.0 C. Winter mortality was strongly influenced by body size, winter duration, temperature, and food availability. At 4.0 C, mortality was high for the smallest fish when food was withheld, but no mortality occurred under ad libitum feeding. The observed mortality for starved fish held at 4.0 C for 180 d was 40.6%. At 2.5 C, observed mortality was much higher than at 4.0 C and body size and winter duration continued to have strong effects. The results suggest that continued climate warming due to the 'greenhouse effect' would lead to improved recruitment and expansion of the range of white perch in the Great Lakes, because growth and size of young-of-the-year would be enhanced by longer growing seasons and winters would be shorter and less severe. (Author's abstract)
W91-01399

CLIMATE CHANGE AND FISH COMMUNITIES: A CONCEPTUAL FRAMEWORK.
Alberta Univ., Edmonton. Dept. of Zoology.
W. M. Tonn.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 337-352, March 1990. 2 fig, 4 tab, 98 ref, append.

Descriptors: *Climatic changes, *Ecosystems, *Fish populations, *Fisheries management, *Global warming, *Temperature effects, Community structure, Distribution, Habitats, Lakes, Species composition.

Many autecological effects of temperature on fish are known, and fishery biologists have begun to incorporate this knowledge into population-level relations that can be used to assess possible effects of climatic warming on fishes and their habitats. However, the problem of extrapolating these or other relations to multispecies assemblages is not straightforward, given the complexity of community-level phenomena. A conceptual framework that views fish assemblages as products of a series of filters, operating at different spatial and temporal scales, through which an assemblage's component species must pass is presented. This framework can facilitate an understanding of the processes that organize fish assemblages and suggest ways in which the complex problem can be divided into manageable pieces. This framework is applied to an examination of small-lake fish assemblages in three regions on two continents. The procedure reveals local and regional relations of richness and composition and highlights the importance of isolation, extinction, and colonization, as well as temperature, that must be considered in climate change assessments. This community-level framework can organize accumulated knowledge of fish assemblages, identify causal processes behind community-level patterns, and focus research needed for the management of fish assemblages in the face of major anticipated changes in climate. (Author's abstract)
W91-01401

IMPLICATIONS OF CLIMATE CHANGE FOR FISHERIES MANAGEMENT POLICY.
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
M. C. Healey.
Transactions of the American Fisheries Society TAFSAI, Vol. 119, No. 2, p 366-373, March 1990. 3 fig, 37 ref.

Descriptors: *Climatic changes, *Environmental policy, *Fisheries management, *Global warming, *Policy making, Adaptation, Equilibrium models, Prediction, Remedial policies.

It is now generally agreed that world climate will warm significantly over the next half century, but the effects of that warming on fishery resources are uncertain. Unpredictable changes in biological systems that result from perturbations such as climatic warming can be classified into four types: (1) changes that are consistent with current equilibrium models (predictions); (2) high-frequency, short-lived changes that cannot be predicted by current models (noise); (3) low-frequency, short-lived changes that cannot be predicted by current models (anomalies); and (4) low-frequency, long-lived changes that cannot be predicted by current models (catastrophes). Climatic change is a gradual process and the responses of biological systems are generally expected to be of the first type. However, increases in both the frequency and amplitude of the other types of response cannot be ruled out. The typical, incremental, remedial policy adjustment of governments and agencies is unsuited to uncertain changes in fishery resource dynamics of types 2-4, particularly those of type 4. An emphasis on mitigating the effects of climatic change is also likely to be unsuccessful because it focuses on the status quo and ignores opportunities that may be inherent in the changes taking place. Bolder policies that involve adaptation to new climate conditions and experimental probing of system behavior are more likely successful. (Author's abstract)
W91-01402

MECHANICAL EQUIPMENT OF THE TIKHOVSK HYDRO DEVELOPMENT ON THE KUBAN RIVER.
For primary bibliographic entry see Field 8C.
W91-01540

ACCOMMODATING FISH AND WILDLIFE INTERESTS UNDER THE FPA.
Gordon, Thomas, Honeywell, Malanca, Peterson and Daheim, Seattle, WA.
For primary bibliographic entry see Field 6E.
W91-01628

INTEGRATION OF LONG-TERM FISH KILL DATA WITH AMBIENT WATER QUALITY MONITORING DATA AND APPLICATION TO WATER QUALITY MANAGEMENT.
Post, Buckley, Schuh and Jernigan, Inc., Columbia, SC.
For primary bibliographic entry see Field 5C.
W91-01635

REDD SITE SELECTION BY BROWN TROUT IN DOUGLAS CREEK, WYOMING.
Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie.
R. T. Grost, W. A. Hubert, and T. A. Wesche.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 3, p 365-371, June 1990. 3 fig, 2 tab, 13 ref.

Descriptors: *Douglas Creek, *Fish behavior, *Mountain streams, *Trout, *Wyoming, Aquatic habitats, Fish populations, Habitats, Spawning, Water depth.

The surface features of brown trout redds constructed by a resident population in Douglas Creek (a moderate-sized stream in the central Rocky Mountains) were studied and compared to measurements reported in the literature. The specific objectives were to describe spawning habitat used (water depth, water velocity, and substrate type) by brown trout and to assess selection for spawning habitat features. Average redd length was 147 cm, water depth 16 cm, and water velocity 34 cm/s, but variation was substantial. Brown trout selected water depths of 12-18 cm and velocities of 24-37 cm/s and avoided depths less than 6 cm and velocities less than 12 cm/s. Water depths and velocities measures over redds in 1987 and 1988 were similar to those measured in 1975 despite a 50-100% increase in the minimum flow during the 1987 and 1988 spawning periods. (Agostine-PTT)
W91-01745

ABUNDANCE OF SPAWNING PACIFIC SALMON IN TWO LAKE SUPERIOR STREAMS, 1981-1987.
Department of Fisheries and Oceans, Sault Ste. Marie (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
J. R. Kelso, and D. B. Noltie.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 2, p 209-215, 1990. 4 tab, 28 ref.

Descriptors: *Dam effects, *Fish migration, *Fish passages, *Lake Superior, *Salmon, Fish populations, Spawning.

Mark and recapture procedures were used to examine the abundance of Pacific salmon entering two Lake Superior tributaries to spawn between 1981 and 1987. In 1987, abundance of pink salmon in the Carp and Pancake rivers declined to 50 and 25%, respectively, of that observed in 1981. In contrast, abundance estimates and catch records indicated that coho and chinook salmon had increased since 1981. The construction of a lowhead barrier dam on the Carp River in 1983/84 allowed passage of coho and chinook but precluded passage by pink salmon. Construction of the barrier dam did not appear to be the major cause for changes in abundances of pink salmon. Most mature pink salmon (> 50% of total abundance) entered the spawning streams during a two-week period following either onshore wind or a heavy rainfall. It is premature to suggest a lake-wide decline in pink salmon abundance. (Author's abstract)
W91-01791

ESTIMATION OF RECRUITMENT FORGONE RESULTING FROM LARVAL FISH ENTRAINMENT.
Michigan Univ., Ann Arbor. School of Natural Resources.
For primary bibliographic entry see Field 6G.
W91-01794

COMPARISON OF THE DIETS OF GULF KILLIFISH, FUNDULUS GRANDIS BAIRD AND GIRARD, ENTERING AND LEAVING A MISSISSIPPI BRACKISH MARSH.
Louisiana Universities Marine Consortium, Chauvin.
For primary bibliographic entry see Field 2L.
W91-01909

VARIATIONS IN STRUCTURE OF ESTUARINE FISH COMMUNITIES IN RELATION TO ABUNDANCE OF SUBMERSED VASCULAR PLANTS.
Maryland Dept. of Natural Resources, Annapolis.
For primary bibliographic entry see Field 2L.
W91-01926

SPATIAL AND TEMPORAL DISPERSION PATTERNS OF GOLDEN PERCH, MACQUARIA AMBIGUA, LARVAE IN AN ARTIFICIAL FLOODPLAIN ENVIRONMENT.
New South Wales Dept. of Agriculture, Narrandera (Australia). Inland Fisheries Station.
For primary bibliographic entry see Field 2H.
W91-01957

EFFECTS OF LOW PH ON THE CHORION OF RAINBOW TROUT, ONCORHYNCHUS

MYKISS, AND BROWN TROUT, SALMO TRUTTA F. FARIO.
Munich Univ. (Germany, F.R.). Zoologisches Inst.
For primary bibliographic entry see Field 5C.
W91-01959

ACUTE TOXICITIES AND HEMATOLOGICAL EFFECTS OF TWO SUBSTITUTED NAPHTHOQUINONES IN CHANNEL CATFISH.
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5C.
W91-01970

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

PRIMER ON CLOTHING SYSTEMS FOR COLD-WEATHER FIELD WORK.
Geological Survey, Bow, NH. Water Resources Div.
For primary bibliographic entry see Field 7B.
W91-01846

9D. Grants, Contracts, and Research Act Allotments

ANNUAL PROGRAM REPORT - 1989 (FY 1988), (MASSACHUSETTS WATER RESOURCES RESEARCH CENTER).
Massachusetts Univ., Amherst. Water Resources Research Center.
P. J. Godfrey.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-217217/AS. Price codes: A03 in papercopy, A01 in microfiche. Report No. G-1568-01, March 1990. 38p. USGS Contract No. 14-08-0001-G1568. USGS Project no. G1568-01.

Descriptors: *Information transfer, *Massachusetts, *Research, *Training, *Water resources Institutes, Education, Projects.

Research on water related issues was supported by federal, state, and other funds. Projects included Denitrification System for On-Site Wastewater Treatment, Acidity and Chemistry of Clouds and Fog in Central Massachusetts, Development of a Water-Supply Decision-Making Model Incorporating the Long-Run Cost of Water, the Acid Rain Monitoring Project (A.R.M.), Phase II, Stimulation of Mercury Methylation by Acid Deposition, and Surface Water Supplies at Risk to Acid Deposition in Massachusetts--Development of a Geographic Information System Layer. Information transfer, student training, and coordination of research with various academic departments, colleges, and universities, and state, local and federal government agencies and officials continued as part of the Water Resources Institute Program. (USGS)
W91-01860

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

EVALUATION OF THREE ELECTRONIC REPORT PROCESSING SYSTEMS FOR PREPARING HYDROLOGIC REPORTS OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION.
Geological Survey, Reston, VA. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-576, 1990. 66p, 27 fig, 11 tab, 19 ref. G. J. Stiltner, Editor.

Descriptors: *Automation, *Computer programs, *Publications, Page layout, Software.

In 1987, the Water Resources Division of the U.S. Geological Survey undertook three pilot projects to evaluate electronic report processing systems as a means to improve the quality and timeliness of reports pertaining to water resources investigations. The three projects selected for study included the use of the following configuration of software and hardware: Ventura Publisher software on an IBM model AT personal computer, PageMaker software on a Macintosh computer, and FrameMaker software on a Sun Microsystems workstation. The following assessment criteria were to be addressed in the pilot studies: The combined use of text, tables, and graphics; analysis of time; ease of learning; compatibility with the existing minicomputer system; and technical limitations. It was considered essential that the camera-ready copy produced be in a format suitable for publication. Visual improvement alone was not a consideration. This report consolidates and summarizes the findings of the electronic report processing pilot projects. Text and table files originating on the existing minicomputer system were successfully transformed to the electronic report processing systems in American Standard Code for Information Interchange (ASCII) format. Graphics prepared using a proprietary graphics software package were transferred to all the electronic report processing software through the use of Computer Graphic Metafiles. Graphics from other sources were entered into the systems by scanning paper images. Comparative analysis of time needed to process text and tables by the electronic report processing systems and by conventional methods indicated that, although more time is invested in creating the original page composition for an electronically processed report, substantial time is saved in producing subsequent reports because the format can be stored and re-used by electronic means as a template. Because of the more compact page layouts, costs of printing the reports were 15% to 25% less than costs of printing the reports prepared by conventional methods. Because the largest report workload in the offices conducting water resources investigations is preparation of Water-Resources Investigations Reports, Open-File Reports, and annual State Data Reports, the pilot studies only involved these projects. (USGS)
W91-01832

U.S. GEOLOGICAL SURVEY NATIONAL COMPUTER TECHNOLOGY MEETING: PROGRAM AND ABSTRACTS, MAY 7-11, 1990.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-01848

10F. Preparation Of Reviews

EFFECTS OF LAKE ACIDIFICATION ON AQUATIC MACROPHYTES--A REVIEW.
Imperial Coll. at Silwood Park, Sunninghill (England). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-01105

GROUNDWATER: A REVIEW OF THE 1989 LITERATURE.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 2F.
W91-01178

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Mercury, Cadmium and Lead Concentrations in Five Species of Freshwater Fish from Eastern England.
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1991 Price Schedules for the United States, Canada, and Mexico

These prices are for customers in the United States, Canada, and Mexico other customers, write for price list PR-360-4

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Standard Prices		*Exception Prices*	
A01	$8.00	E01	$10.00
A02	11.00	E02	12.00
A03	15.00	E03	14.00
A04–A05	17.00	E04	16.50
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A10–A13	31.00	E06	21.50
A14–A17	39.00	E07	24.00
A18–A21	45.00	E08	27.00
A22–A25	53.00	E09	29.50
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		E11	35.00
"N" Codes		E12	38.50
N01	$60.00	E13	41.00
N02	59.00	E14	45.00
N03	20.00	E15	48.50
		E16	53.00
		E17	57.50
		E18	62.00
		E19	69.00
		E20	80.00
		E99	*

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Diskettes		*Magnetic Tapes*	
D01	$50	T01	$165
D02	80	T02	220
D03	130	T03	340
D04	180	T04	450
D05	230	T05	560
D06	280	T06	670
D07	330	T07	780
D08	380	T08	890
D09	430	T09	1 000
D10	480	T10	1 110
D11	530	T11	1 220
D12	580	T12	1 330
D13	630	T13	1 440
D14	680	T14	1 550
D15	730	T15	1,660
D16	780	T16	1 770
D17	830	T17	1 880
D18	880	T18	1,990
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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

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University Coll., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
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Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
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For primary bibliographic entry see Field 2F.
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Geological Survey, Bow, NH. Water Resources Div.
For primary bibliographic entry see Field 2F.
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Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02283

USE OF OXYGEN-18 AND DEUTERIUM MASS-BALANCE ANALYSIS TO EVALUATE INDUCED RECHARGE TO STRATIFIED-DRIFT AQUIFERS.
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02287

STATE-OF-THE-ART OF HYDROLOGY AND HYDROGEOLOGY IN THE ARID AND SEMI-ARID AREAS OF AFRICA.
Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. 990p. Edited by Misganaw Demissie and Glenn E. Stout.

Descriptors: *Africa, *Arid lands, *Arid-zone hydrology, *Geohydrology, *Hydrology, *Sahel, *Semiarid lands, *Symposium, Developing countries, Drought, Floods, Sudan, Water resources development, Water resources management.

The Sudan-Sahel is the southern expanse of the desert in West Africa that for many centuries has been subject to frequent droughts and flash floods. The situation is little changed today. The countries of Sudan-Sahel continue to try to juggle a precarious supply of water for municipal, industrial, and agricultural uses with their rapidly expanding populations. A significant barrier to water supply planning in this part of Africa is the lack of basic hydrological information. This volume includes presentations from a seminar held in Burkina Faso from 18-23 February 1989. The purpose of the seminar was to assemble knowledge on hydrogeology and hydrogeology in the arid and semiarid areas of Africa and make it available to the countries in this region as they seek long-range solutions to their water management questions. The more than 81 presentations cover various aspects of hydrology, hydrogeology, and water engineering appropriate to these regions, including: general and theoretical hydrology of the area; regional surface water hydrology; soils and runoff; drought and climatic factors in regional hydrology; information systems and computer applications suitable for water resources management in the Sahel; mathematical modeling; irrigation; aquifer characteristics; natural recharge of aquifers; village water supply systems; water exploration methods and instrumentation; groundwater resources; effects of pollution on aquifers and surface water quality; control of water-borne disease; hydrologic education programs; and agricultural water management. (See W91-02289 thru W91-02369) (Rochester-PTT)
W91-02288

DEVELOPMENT OF THEORETICAL HYDROLOGY IN WEST AFRICA (DEVELOPPEMENT DE L'HYDROLOGIE THEORIQUE EN AFRIQUE DE L'OUEST).
Universite Nationale du Benin, Cotonou. Dept. de Mathematiques.
A. Abel.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 1-14, 1 fig, 2 tab, 15 ref. English summary.

Descriptors: *Drought, *Model studies, *Rainfall-runoff relationships, *West Africa, Climates, Mathematical models, Theory.

Theoretical hydrology as it applies to West Africa is analyzed with respect to persistent droughts and rainfall-runoff relationships. Several features are required for proper understanding of hydrologic phenomena, including: continuously operated observation networks, thoroughly controlled basic data, and mathematical models incorporating dynamics, stochastic features, and non-linearity of the natural environment. The development of theoretical models associating direct observations and model concepts can be done within an appropriate working group. Validation of existing observational records and improvement of the acquisition of new data are important. The value of the interaction between theoretical and practical hydrology must be recognized to obtain a complete understanding of the hydrology of West Africa. (See also W91-02288) (Rochester-PTT)
W91-02289

HYDROLOGICAL MODELLING FOR WATER MANAGEMENT IN ARID AND SEMI-ARID AREAS OF AFRICA.
Institute of Hydrology, Wallingford (England).
R. J. Moore.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 35-46, 5 fig, 1 tab, 13 fig.

Descriptors: *Arid lands, *Model studies, *Rainfall-runoff relationships, *Semiarid lands, Decision making, Evaporation, Hydrologic models, Infiltration, Mathematical models, Vegetation, Water resources management.

Rainfall, evaporation, and runoff formation processes operating in arid and semi-arid areas differ from those in humid temperate regions. The special nature of hydrological processes in arid and semi-arid areas are reviewed in relation to the structure, data requirements, and accuracy of hydrological models for water management in such areas. Evaporation in the arid zone, rainfall in the arid zone, hydrologic models and rainfall variability, a conceptual rainfall-runoff model for semi-arid basins, drought management and decision support systems are considered. Recommendations for direction of future efforts in hydrological modeling of surface water resources in the arid and semi-arid areas of Africa are as follows: (1) further research on evaporation estimation in drylands that incorporates water use-vegetation growth models; (2) evaluation of the combined use of radar, satellite, and gauge measurements of rainfall; (3) rainfall-runoff models that explicitly account for spatially varying rainfall, even in a probabilistic way; (4) a field experiment to examine transmission losses in detail, using infiltrometers located along a wadi bed, to provide information to support predictive modeling of basin runoff; (5) give more attention to the decision making framework within which models are used and to the choice of an appropriate model prescription; (6) development of decision support systems for water resource management in semi-arid areas; and (7) seeking opportunities for demand management of water resource systems to sustain essential water supplies throughout a drought. (See also W91-02288) (Rochester-PTT)
W91-02291

CIEH'S CONTRIBUTION TO THE DEVELOPMENT OF HYDROLOGY IN ARID AND SEMI-ARID AREAS IN AFRICA (CONTRIBUTION DU CIEH AU DEVELOPPEMENT DE L'HYDROLOGIE DANS LES ZONES ARIDES ET SEMI-ARIDES D'AFRIQUE).
Comite Interafricain d'Etudes Hydrauliques, Ouagadougou (Burkina Faso). Dept. of Hydrology.
J. P. Triboulet.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 47-67, 12 fig, 29 ref. English summary.

Descriptors: *Africa, *Arid lands, *Data collections, *Hydrologic data collections, *Information systems, *Inter-African Committee for Hydraulic Studies, *Semiarid lands, Developing countries, Floods, Frequency analysis, Hydrologic models, Publications, Storms, Urban hydrology, Water resources development.

For about 30 yr, the Inter-African Committee for Hydraulic Studies (CIEH) has provided important leadership in hydrology of West and Central Africa. The main objective has been making available climatological and hydrological data for engineers of water resources projects. Computerized files of daily rainfall for all 13 member countries have been prepared from the origin of the stations until 1965. Extension of these files to 1980 is under way. Regional frequency analysis of the annual maximum daily rainfall has been carried. Maps showing 10-yr and 100-yr daily precipitation values are available. Monthly evapotranspiration values, calculated by Turc formula and mapped, were published in 1972. Other studies have been carried out on artificial precipitation, reduction of water losses by evaporation, and drought persistence in West Africa. CIEH has supported some national hydrological services in the development of data bank software for use on a microcomputer. CIEH has published hydrological monographs on large river basins prepared by ORSTOM. In hydrology, the main activity has been the development of methodology for studying exceptional floods and annual runoff in small rural catchments. The information collected by ORSTOM on representative catchments was used to draw deterministic relationships between flow (10-yr peak flow and annual flow) and storm event characteristics, geomorphology, and infiltration capacity of the catchment area. Another method based on a statistical approach was developed in 1983. A large program in urban hydrology began in 1976 with measurements on 25 catchment areas in 6 main cities of West Africa. These results will permit the design of a rainfall-runoff model adapted to urbanized areas. CIEH also is involved in training engineers and technicians concerned with water resources assessment and management in rural and urban areas. The Information and Documentation Center of CIEH collects specialized references in

water resources and provides support for bibliography. (See also W91-02288) (Author's abstract)
W91-02292

ADVANCES TOWARDS WATER RESOURCES DEVELOPMENT THROUGH HYDROLOGICAL TRAINING AND EDUCATION.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 6E.
W91-02293

CONTRIBUTION OF CIEH IN THE FIELD OF HYDROGEOLOGY (CONTRIBUTION DU CIEH DANS LE SECTEUR DE L'HYDROLOGIE).
Comite Interafricain d'Etudes Hydrauliques, Ouagadougou (Burkina Faso). Dept. of Hydrology.
C. Di Luca.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 90-115, 1 fig, 6 tab. English summary.

Descriptors: *Africa, *Geohydrology, *Inter-African Committee for Hydraulic Studies, *Mapping, *Water resources management, Aquifers, Developing countries, Recharge, Sampling, Wells.

Since its inception CIEH (le Comite Interafricain d'Etudes Hydrauliques or Inter-African Committee for Hydraulic Studies) has had an important role in hydrogeology. A series of maps for water resources management was drawn for the 13 countries of CIEH during the period 1976-1982. These maps synthesize all acquired knowledge and give the national authorities valuable information on exploitable storages and water quality to support development projects. Development of computer-assisted cartography using the data bases already available in the member states demonstrated the advantages of evolutionary mapping. With the development of air-hammer drilling, CIEH directed an important part of its activity to understanding the water resources in crystalline bedrock and to the methodology of borehole location in these formations. Several areas are appropriate targets for future efforts, including: estimation of aquifer recharge in bedrock using observation of experimental basins and isotope studies to establish mathematical models; understanding of regional faults and adjusting geophysical methods for discontinuous aquifers; improved use of radon prospecting; combatting the problems of 'sanding-up' of wells; use of computer data bases for aquifer management; and national organization of collection and processing of hydrogeological data. (See also W91-02288) (Rochester-PTT)
W91-02294

TOWARDS A REGIONAL WATER RESOURCE STUDY OF ARID AND SEMI-ARID AFRICA.
Institute of Hydrology, Wallingford (England).
A. Bullock, and A. Gustard.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 118-125, 5 fig, 6 ref.

Descriptors: *Africa, *Arid lands, *Discharge capacity, *Rainfall-runoff relationships, *Regional planning, *Semiarid lands, *Water resources development, Catchment areas, Estimating equations, Soils, Ungaged streams, Zimbabwe.

Regionalization techniques generally are poorly developed in the arid and semi-arid regions of Africa compared with temperate regions. This is because of the relative scarcity of hydrological records, difficulties in derivation of appropriate flow statistics, and the absence of established extrapolation procedures. An analysis of data from 49 catchments in central Zimbabwe reveals a pedological control upon the shape of standardized flow duration curves. When combined with a regional rainfall/runoff relationship for southern Africa, a provisional procedure is established for the estimation of ungauged sites of discharges with particular exceedance probabilities. Streams in moderately shallow to moderately deep soils are characterized by a sustained flow regime compared those in shallow to moderately shallow soils, which are ephemeral and experience zero flows for approximately 18-36 days per year on average. A regional rainfall/runoff relationship has been calibrated using data from 171 catchments in four southern African countries. This enables preliminary estimates of the average daily flow at ungauged sites, which may then be used to rescale the standardized flow duration curves. In combination this procedure, although provisional, could prove valuable in enabling estimates of discharges with a given exceedance probability in southern Africa. Several opportunities exist for improving and developing this procedure. (See also W91-02288) (Rochester-PTT)
W91-02295

SURFACE FEATURES: ONE OF THE KEY ELEMENTS OF SAHELIAN HYDROLOGY (LES ETATS DE SURFACE: UNE DES CLEFS DE L'HYDROLOGIE SAHELIENNE).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lome (Togo). Centre ORSTOM du Togo.
A. Casenave, and C. Valentin.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 135-147, 2 fig, 1 tab, 23 ref. English summary.

Descriptors: *Africa, *Arid lands, *Infiltration, *Mapping, *Rainfall-runoff relationships, *Sahel, *Soil properties, Data acquisition, Floods, Remote sensing, Simulation.

Rainfall simulation experiments have been implemented in the Sahelian zone for more than 10 years is related to worsening water management problems. They have led to the assessment and comparison of the various factors influencing infiltration and runoff in this climatic zone. The prevailing role of surface features, including vegetative cover, faunal activity, surface roughness, and surface crust, was evident. The analysis of the process and the factors involved in surface crusting, coupled with the identification of peculiar microlayers, led to the definition of a morphogenetic typology of nine major types of Sahelian crusts. In addition, grass or crop cover, faunal activity, and tillage were taken into account to characterized 11 main unit surfaces. This morphological approach coupled with rainfall experiments enabled specific hydraulic parameters to be associated with each unit surface. At a higher scale level, the concept of 'surface features' was proposed. This refers to the combination of several map unit surfaces and has been used as the basis for an original mapping method. Mapping units were considered as homogeneous both in terms of dynamics and hydraulic behavior. Also, remote sensing was used satisfactorily for mapping remote watersheds. Low-frequency floods were determined with a reasonable accuracy and results could be derived to unstudied watersheds, provided remote sensing had been combined with the rainfall experiments data and a small time step modelling. (See also W91-02288) (Author's abstract)
W91-02297

WATER LOSSES IN THE NILE BASIN.
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
M. M. A. Shahin.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 148-157, 3 fig, 2 tab, 11 ref.

Descriptors: *Africa, *Arid lands, *Drought, *Evapotranspiration, *Hydrologic budget, *Nile River Basin, *Water loss, Agricultural wate Egypt, Irrigation, Lakes, Storage reservoi Sudan, Swamps.

The water shortage in Africa is becoming so acu that it has begun to threaten the entire continer From an annual rainfall of about 20,000 billion m, only some 2,500 billion cu m comprise the lon term annual flow in all African rivers. Only 10 of the stream flow is used for irrigation. Slight less than half the irrigated land in Africa lies with the Nile basin. Permanent and temporary swam in Africa occupy an area estimated at 340,000 km, causing the loss of some 500 billion cu m/ more than 10% of which is lost in swamps of t Nile basin alone. The increase in number and ar of storage reservoirs in the basin is leading to t loss of substantial volumes of water each ye Irrigated agriculture cannot be expanded unl some of the water lost is saved. Proper design conservation schemes must be based on accur estimates of the losses. Water losses for the N basin are reported here for swamps and stora reservoirs. Total water losses via these two f tures are estimated at 105 billion cu m/yr, about billion of which is accounted for storage res voirs, the rest being lost by swamps and lak Adding these losses to the irrigation losses of billion cu m/yr in Egypt and the Sudan yield total of 179 billion cu m/yr, or roughly 11% of rainfall on the Nile basin. (See also W91-022 (Rochester-PTT)
W91-02298

ANALYSIS OF DROUGHT IN ETHIO BASED ON NILE RIVER FLOW RECOR
Illinois State Water Survey Div., Champaign.
M. Demissie.
IN: The State-of-the-Art of Hydrology and drogeology in the Arid and Semi-Arid Area Africa. Proceedings of the Sahel Forum, Ou dougou, Burkina Faso, 18-23 February 1989. In national Water Resources Association, Urbana linois. 1990. p 158-168, 7 fig, 2 ref.

Descriptors: *Arid lands, *Drought, *Ethio *Low flow, *Nile River, Long-term studies, R flow, Time series analysis.

The drought situation in Ethiopia, which has sulted in serious famines in 1972-1973, 1982-1 and 1987-1988, has been attributed to a short-t (7-10 yr) cycle of recurring droughts. Whether is true was assessed by examining available rec of the flow of the Nile River from 1912 until 1 Examination of these records shows a much r serious and long-term trend. The Nile R records show that the most recent three drou are associated with a long-term drying period started in the mid-1960s. With the exceptio four years, the flow of the Nile has been b normal since 1965. Not only has the lowest an flow of the Nile since 1912 been recorded w this dry period, but six of the seven lowest an flows occurring since 1912 occurred since 196 quick recovery from this trend appears unli (See also W91-02288) (Author's abstract)
W91-02299

EVAPORATION FROM FREE WATER S FACES IN THE SUDANO-SAHELIAN MATE (L'EVAPORATION DES NA D'EAU LIBRE EN CLIMAT SOUDANO-SA LIEN).
Institut Francais de Recherche Scientifique po Developpement en Cooperation, Montpe Centre de Montpellier.
For primary bibliographic entry see Field
W91-02300

ELECTRONICS AND INFORMATICS THE ACQUISITION OF HYDROMETEO LOGICAL DATA: A GREAT TOOL WATER RESOURCE MANAGEMENT IN SAHEL (ELECTRONIQUE ET INFORM QUE POUR L'ACQUISITION DES DON HYDROMETEOROLOGIQUES, UN O PRODIGIEUX POUR LA GESTION DES SOURCES EN EAU DANS LE SAHEL).

Laboratoire General de Recherches, Brussels (Belgium).
For primary bibliographic entry see Field 7B.
W91-02303

PREDETERMINATION OF FLOODS IN SMALL SAHELIAN BASINS UNDER 10 SQUARE KILOMETERS (LA PREDETERMINATIONE DES CRUES SUR DES PETITS BASSINS SAHELIENS INFERIEURS A 10 KM2).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Montpellier. Centre de Montpellier.
For primary bibliographic entry see Field 2E.
W91-02305

PROBLEM OF WATER BALANCE MODELLING UNDER SEMI-ARID CONDITIONS.
Oslo Univ. (Norway). Inst. of Geophysics.
For primary bibliographic entry see Field 7C.
W91-02307

SOME EXAMPLES OF IMPORTANT PROBLEMS CONNECTED TO RAINFALL-RUNOFF MODELLING IN SEMI-ARID ZONE.
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 7C.
W91-02308

USE OF A DISTRIBUTED MODEL OF A SMALL SAVANNAH CATCHMENT (BOOROBOROTOU, IVORY COAST) UTILISATION D'UN MODELE DISTRIBUE SUR UN PETIT BASSIN VERSANT DE SAVANE (BOOROBOROTOU, COTE D'IVOIRE).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Montpellier. Centre de Montpellier.
P. Chevallier, and G. Girard.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 280-290, 6 fig, 1 tab, 10 ref. English summary.

Descriptors: *Hydrologic budget, *Hydrologic models, *Ivory Coast, *Model studies, Booro-Borotou catchment, Climatology, Geohydrology, Mathematical models, Performance evaluation, Soils, Vegetation.

The Hyberbav Program is located on a small catchment in the northwest of the Ivory Coast. Fine observations have been made on a 136-ha area from 1984 to 1988 on all the parameters that may affect water balance (hydrology, climatology, soil science, hydrogeology, and botany). The 'coupled model,' developed jointly by ORSTOM and the Ecole Nationale Superieure des Mines de Paris seems to be a good tool for incorporating all these data into a model representing the superficial and internal water exchange transfers. (See also W91-02288) (Author's abstract)
W91-02310

GLOBAL MODELLING OF THE RAIN-RUNOFF RELATIONSHIP: A TOOL FOR EVALUATION OF WATER RESOURCES (MODELISATION GLOBALE DE LA RELATION PLUIE DEBIT: DES OUTILS AU SERVICE DE L'EVALUATION DES RESSOURCES EN EAU).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Abidjan (Ivory Coast). Centre ORSTOM d'Adiopodoume.
For primary bibliographic entry see Field 2E.
W91-02349

SCIENTIFIC AND TECHNICAL EVALUATION OF MATHEMATICAL MODELS IN THE PLANNING DESIGN AND OPERATION OF HYDROSYSTEMS IN AFRICA.
New Tech International Inst., Dar es Salaam (Tanzania).
For primary bibliographic entry see Field 2E.
W91-02350

USE OF PERSONAL COMPUTERS FOR THE ANALYSIS AND MANAGEMENT OF HYDROMETEOROLOGICAL AND GROUNDWATER DATA.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7C.
W91-02351

HYDROLOGICAL NETWORK, DATA BANKS, AND TELETRANSMISSION (RESEAUX HYDROLOGIQUES, BANQUES DE DONNEES INFORMATISEES ET TELETRANSMISSION).
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France).
For primary bibliographic entry see Field 7B.
W91-02352

SYSTEMS ENGINEERING APPROACH TO SOLUTIONS OF DROUGHT IN DEVELOPING COUNTRIES: THE CASE OF TANZANIA.
New Tech International Inst., Dar es Salaam (Tanzania).
A. R. Mfutakamba.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 889-901, 22 ref.

Descriptors: *Developing countries, *Drought, *Model studies, *Political aspects, *Public policy, *Systems engineering, *Tanzania, *Water supply, Economic aspects, Management planning, Nonstructural alternatives, Performance evaluation, Rural areas, Social aspects, Urban areas.

A drought model was developed and applied to Tanzania as an example of the developing world. Factors affecting millions of poor people include climate, politics, economics, and the lack of technological capabilities to offset drought effects. The model critically examines government policy, social and technological constraints in the implementation of rural water supply, sanitation, irrigation, and energy systems based on a United States Agency for International Development (USAID) study. Contrary to the study, there seems to be no contradiction between policy and program implementation. Technological constraints seem to prevail. The model proposes a systems engineering approach to analyze the shortcomings and proposes multi-disciplinary solutions to the water economy sectoral problem. The extent of commitment on the part of the government and its nationals to the rural water supply programs is assessed. Due to the global power structure, the urban water supply and sanitation systems are still more favored than those in the rural areas where the majority live. The lack of participation in the study by women missed key subjects for research work. The focus has never been on the key foreign exchange earners: the rural poor. Even the budget structure continues to favor urban areas, not only in health services, roads, housing, and education, but in water supply and sanitation. The Tanzanian study had numerous methodological shortcomings, including: too many water professionals on the study team, lack of a local economist on the team, lack of a balance between village water supply and agricultural water supply emphasis, lack of participation by the local academic community, and the lack of an overall model to guide study design and execution. (See also W91-02288) (Rochester-PTT)
W91-02361

FREQUENCY-RELATED TEMPORALLY AND SPATIALLY VARIED RAINFALL.
Army Engineer District, Fort Worth, TX.
For primary bibliographic entry see Field 2B.
W91-02524

HYDROGEOCHEMICAL AND ISOTOPICAL INVESTIGATIONS OF GROUND AND SURFACEWATERS AT THE SOUTHWEST EDGE OF THE HARZMOUNTAINS DURING AN ARTIFICIAL INDUCED HIGH WATER (HYDROGEOCHEMISCHE UND ISOTOPENCHEMISCHE UNTERSUCHUNGEN AN GRUND UND OBERFLACHENWASSERN AM SUDWESTRAND DES HARZES WAHREND EINES KUNSTLICH INDUZIERTEN HOCHWASSERS).
Goettingen Univ. (Germany, F.R.). Sedimentpetrographisches Inst.
For primary bibliographic entry see Field 2K.
W91-02545

EFFECT OF FIELD-SCALE SOLUTE INFILTRATION INTO GROUNDWATER ON SURFACE WATER QUALITY.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering.
For primary bibliographic entry see Field 5B.
W91-02683

INFLUENCE OF PRECIPITATION ON THE QUALITY OF KARST GROUNDWATER IN INDUSTRIAL ZONES.
Belgrade Univ. (Yugoslavia). Faculty of Mining and Geology.
For primary bibliographic entry see Field 5B.
W91-02686

BIOSPHERE AND CLIMATE.
Akademiya Nauk SSSR, Leningrad. Inst. for Lake Research.
K. Y. Kondratyev.
Atmosfera ATMSEF, Vol. 3, No. 3, p 165-182, July 1990. 3 tab, 38 ref.

Descriptors: *Atmospheric water, *Climatic changes, *Climatology, *Greenhouse effect, *Hydrologic cycle, Atmospheric circulation, Deserts, Evapotranspiration, Forest hydrology, Geochemistry, Mathematical models, Numerical analysis, Parametric hydrology, Precipitation, Snow cover, Soil water, Solar radiation, Surface water, Vegetation effects.

Atmospheric variations, which determine both the incoming solar radiation and greenhouse effect, are key factors of climate change. A new stage of climate theory development has begun which demonstrates the need to more adequately consider land surface processes as well as the interaction between biogeochemical cycles and climate; the biosphere must be considered as a component of the 'atmosphere-hydrosphere-cryosphere-lithosphere-biosphere' climate system. Analysis of numerical modeling results of the sensitivity of atmospheric general circulation (AGC) to the parameters characterizing the land surface processes has shown that AGC is very sensitive to surface albedo and upper soil layer moisture content. Climate models should take into account the spatial extent and optical properties of snow cover, type and density of vegetation cover, and rate of soil moisture fluctuation. Evapotranspiration is one of the most important climate-forming factors. The transfer of water and energy through the underlying surface depends on the morphological features and vegetation cover physiology. The most adequate model foresees a differentiation of vegetation cover (tropical forests, mid-latitude forests, deserts, grass cover, etc.) and its interactive connection with conditions in the atmosphere and soil. Preliminary calculations show marked effects of tropical deforestation and desertification. Sea ice cover, continental snowcover, and permafrost play important roles in cryosphere component of the climate system. The key role in the formation of climate and biospheric functioning is played by the global water cycle. (Fish-PTT)
W91-02803

SENSITIVITY OF THE SURFACE HYDROLOGY TO THE COMPLEXITY OF THE LAND-SURFACE PARAMETERIZATION SCHEME EMPLOYED.
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
For primary bibliographic entry see Field 7C.
W91-02804

Group 2A—General

RUNOFF GENERATION IN A SANDY AREA--THE NIZZANA SANDS, WESTERN NEGEV, ISRAEL.
Hebrew Univ., Jerusalem (Israel). Inst. of Earth Sciences.
A. Yair.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 7, p 597-609, November 1990. 10 fig, 3 tab, 28 ref.

Descriptors: *Dunes, *Geomorphology, *Israel, *Rainfall-runoff relationships, *Sand, *Storm runoff, Playas, Rainfall.

The study of present-day geomorphic processes in the Nizzana sand field in Western Negev, Israel, is very limited. Sprinkling experiments were conducted over the lower part of vegetated and crusted linear dunes as well as over flat playa surfaces that appear in the interdune corridors. Data obtained show that these two surface units respond quickly to rainstorms. Runoff generation can be expected for any storm exceeding 2-3 mm and runoff coefficients are high. When the topsoil algal crust, I to 2 mm thick, is removed from the surface of the dune, infiltration increases drastically and eliminates any possibility of runoff generation under present-day rainfall conditions. This data may be of great help in the understanding of the geomorphology and sedimentary sequence of the corridors separating linear dunes. (Author's abstract)
W91-02811

RAINFALL AND SURFACE KINEMATIC CONDITIONS OVER CENTRAL AMAZONIA DURING ABLE 2B.
James Madison Univ., Harrisonburg, VA. Dept. of Geology and Geography.
For primary bibliographic entry see Field 2B.
W91-02841

IDENTIFICATION OF LARGE-SCALE SPATIAL TRENDS IN HYDROLOGIC DATA.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 7C.
W91-02870

2B. Precipitation

DROUGHT IN FRANCE IN 1989 (LA SECHERESSE DE 1989).
Y. Merillon, and P. Chaperon.
Houille Blanche HOBLAB, Vol. 1990, No. 5, p 325-339, 1990. 10 fig, 3 tab. English summary.

Descriptors: *Drought effects, *France, *Precipitation, *Rainfall index, *Water resources, Agriculture, Rainfall distribution, Water quality, Water scarcity.

The French drought of 1989 was comparable to the great droughts of the last half century (in 1946, 1976, 1985 and 1986) which had taken place in the southwest of France. The droughts impact many economic sectors--initially agriculture and powerplants. The droughts also caused: widespread eutrophication; the dessication of numerous rivers; increased pollution effects; and a general decline in available water resources. However, the distribution of drinking water was ensured in most cases. From November 1988 to October 1989, the total precipitation which fell on France was 560 mm or 73% of normal. This value represented an average of 31 meteorological stations and is the lowest reading from the last 32 years (1957 to 1989). The precipitation by region was: north, 559 mm (85% of normal); northeast, 663 mm (86%); west, 579 mm (74%); central east, 546 mm (69%); southwest, 631 mm (73%); southeast, 384 mm (56%); and Corsica, 434 mm (67%). (King-PTT)
W91-02048

FLOODS OF 1987 IN THE GLACIAL BASINS SITUATED IN PENNINE ALPS IN SWITZERLAND (LES CRUES DE L'ETE 1987 DANS LES BASSINS VERSANTS GLACIAIRES DES ALPS PENNINES).
Grande Dixence Societe Anonyme, Sion (Switzerland).
For primary bibliographic entry see Field 2E.
W91-02049

STREAM SEDIMENT LOADING AND RAINFALL--A LOOK AT THE ISSUE.
Economic Research Service, Washington, DC.
N. D. Uri, and B. Hyberg.
Water, Air and Soil Pollution WAPLAC, Vol. 51, No. 1/2, p 95-104, May 1990. 3 fig, 1 tab, 16 ref.

Descriptors: *Erosion, *Rainfall intensity, *Sediment load, *Soil erosion, Iowa River, Statistical analysis, Storms, Temporal distribution.

Sediment loadings in a stream measured after an intense storm have frequently led to the conclusion that significant soil erosion is associated only with a few storms, or that they are solely a function of peak storm intensities. The issue of the nature of the relationship between stream loading and storm intensity and whether stream sediment loading can best be explained by storm intensity (rainfall) or whether a more general average rainfall measure is superior was examined. Based on data covering the years 1947 to 1985 for the Iowa River watershed north of Iowa City, a nonlinear relationship between stream sediment loading and rainfall is indicated. Moreover, average monthly rainfall better explains sediment loading than do other measures of storm (rainfall) intensity. Finally, when the structural stability of the estimated relationships between stream loading and storm intensity are estimated, the conclusion is that the relationship between stream loading and rainfall is stable over the sample period. (Author's abstract)
W91-02086

SCHEME FOR PARAMETERIZING ICE-CLOUD WATER CONTENT IN GENERAL CIRCULATION MODELS.
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 2C.
W91-02118

PHYSICS OF SUPERCOOLING OF THIN WATER SKINS COVERING GYRATING HAILSTONES.
Toronto Univ. (Ontario). Dept. of Physics.
For primary bibliographic entry see Field 2C.
W91-02119

PARAMETERIZATION OF THE ACCRETION PROCESS BETWEEN DIFFERENT PRECIPITATION ELEMENTS.
Meteorological Research Inst., Yatabe (Japan).
H. Mizuno.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 68, No. 3, p 395-398, June 1990. 2 fig, 26 ref.

Descriptors: *Accretion, *Clouds, *Mathematical analysis, *Precipitation, Accretion rate, Aggregation, Atmospheric physics, Mathematical equations, Mathematical models, Parameterization, Particulate matter.

Accretion processes in simultaneous different precipitation elements with their related aggregation process play important roles in precipitation formation. These processes produce a large mass transfer between precipitation particles and a broadening of the size distribution. In prior cloud models, a detailed evaluation of the parameterization of the accretion rate has been lacking. An exact accretion rate was obtained by analytically solving an accretion equation without any arbitrary assumptions. It was shown that the accretion rate used previously had a shortcoming, especially in the cases where two different particles become close in mass-weighted mean fall velocity. As an improvement, a more accurate and simpler parameterization for the accretion rate was proposed based on the exact accretion rate. It was demonstrated that this parameterization was valid for various conditions of the accretion process. (MacKeen-PTT)
W91-02120

RANGE PROFILING OF THE RAIN RATE BY AN AIRBORNE WEATHER RADAR.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
R. Meneghini, and K. Nakamura.
Remote Sensing of the Environment RSEEA7, Vol. 31, No. 3, p 193-209, March 1990. 10 fig, 20 ref.

Descriptors: *Radar, *Rain, *Remote sensing, *Weather, Airborne weather radar, Attenuation, Dual-wavelength radar, Liquid water content, Mathematical analysis, Rainfall rate.

One of the quantities of interest in a spaceborne weather radar is the rain rate or liquid water content as a function of height. In the presence of attenuation, however, the reconstruction of the profile is possible with usual methods only if the rain rate is uniform or if the relationships between the radar measurables and the rain characteristics are well known. Even with a dual-wavelength radar, estimates of attenuation between adjacent range gates tend to be noisy. A class of methods that are based on a measure of path attenuation which is used to constrain the Hitschfeld-Bordan solution was investigated. Methods of this type have been investigated for lidar, radar, and combined radar-radiometer applications; their functions can be interpreted as allocating the attenuation in proportion to the strength of the measured reflectivity. Four estimates of rain rate were described and tested using data from a dual-wavelength airborne radar at 10 GHz and 35 GHz. When attenuation was significant, the estimates were generally more accurate than those without attenuation correction. This suggests that such methods can be used to extend the effective dynamic range of the radar to higher rain rates. Comparisons between the estimates also provide some diagnostic capability for the detection of radar calibration errors. Instabilities in the estimates can occur, however, in cases of low signal to noise ratios and in situations where partially melted hydrometeors contribute to the attenuation. (Author's abstract)
W91-02128

SEPTIC TANK AND AGRICULTURAL NON-POINT SOURCE POLLUTION WITHIN A RURAL WATERSHED.
Texas Christian Univ., Fort Worth. Environmental Sciences Program.
For primary bibliographic entry see Field 5B.
W91-02177

DEVELOPMENT OF THEORETICAL HYDROLOGY IN WEST AFRICA (DEVELOPPEMENT DE L'HYDROLOGIE THEORIQUE EN AFRIQUE DE L'OUEST).
Universite Nationale du Benin, Cotonou. Dept. de Mathematiques.
For primary bibliographic entry see Field 2A.
W91-02289

GENERAL CHARACTERISTICS OF SURFACE HYDROLOGY IN ARID AND SEMI-ARID AREAS OF AFRICA AND THEIR CONSEQUENCES FOR DEVELOPMENT (CARACTERES GENERAUX DE L'HYDROLOGIE SUPERFICIELLE DES ZONES ARIDES ET SEMI-ARIDES EN AFRIQUE: LEURS CONSEQUENCES SUR LES ETUDES DES INGENIEURS).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Paris. Service Hydrologique.
For primary bibliographic entry see Field 2E.
W91-02290

FRACTAL APPROACH TO SPATIAL VARIABILITY OF WEST AFRICAN RAINFALL EVENTS (APPROCHE FRACTALE DE LA VARIABILITE SPATIALE DES EPISODES PLUVIEUX DE L'AFRIQUE DE L'OUEST).
Ecole Nationale Superieure des Mines de Par

(France).
P. Hubert, and J. P. Carbonnel.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 181-190, 5 fig, 2 tab, 11 ref. English summary.

Descriptors: *Arid lands, *Fractals, *Mathematical models, *Meteorology, *Model studies, *Rainfall distribution, *West Africa, Albedo, Burkina Faso, Network design, Random processes, Spatial distribution, Topography.

The main characteristic of West African rainfall is its great variability in time and space. This variability is difficult to study and to explain. As the influence of topography is admitted and that of albedo unconfirmed, this variability is often considered as a random process. During the rainy season of 1986, a field experiment in Burkina Faso (100 rain gauges spread over 10,000 sq km) permitted the study of the spatial variability of rainfall events by fractal geometry. A downpour observed on June 12-13, 1986 in the region was subjected to an in-depth study using fractal techniques. This permitted an evaluation of the influence of the geometric structure of the measuring network on the perception of the phenomenon under study. The technique also permitted the recognition and quantification of certain structural elements of the precipitation field, especially its anisotropy. (Rochester-PTT)
W91-02301

ANALYSIS OF NON-STATIONARITY OF WEST AFRICAN RAINFALL AND HYDROLOGICAL SERIES (ANALYSE DE LA NON STATIONNARITE DES SERIES PLUVIOMETRIQUES ET HYDROLOGIQUES D'AFRIQUE DE L'OUEST).
Paris-6 Univ. (France). Dept. de Geologie Dynamique.
J. P. Carbonnel, and P. Hubert.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 191-201, 4 fig, 26 ref. English summary.

Descriptors: *Arid lands, *Meteorology, *Rainfall distribution, *Statistical analysis, *West Africa, Climates, Frequency distribution, Time series analysis.

The Lee and Heghinian statistical procedure was employed to demonstrate the non-stationarity of the West African hydrometeorological series. This non-stationarity of series led to the development of an original segmentation procedure. Since the beginning of the century the climatic evolution has experienced shifts of stationarity that are synchronous in the whole West African series. The following sequences are distinguishable: before 1906, 1907-1921, 1922-1936, 1937-1949, 1950-1968, and from 1969 to the present. The last shift, in 1968, seems a major event with the general fall in pluviometric heights. The length of these sequences varies from 13 to 20 yr and they are not cyclic. These results yield a climatic evolution with successive stages on a general downward trend toward more and more extensive aridity. Furthermore, these results challenge the hydrological standards and limit, in particular, the use of the notion of climatic means and 'normals' used to describe the years of low and abundant rainfall. (See also W91-02288) (Author's abstract)
W91-02302

ELECTRONICS AND INFORMATICS FOR THE ACQUISITION OF HYDROMETEOROLOGICAL DATA: A GREAT TOOL FOR WATER RESOURCE MANAGEMENT IN THE SAHEL (ELECTRONIQUE ET INFORMATIQUE POUR L'ACQUISITION DES DONNEES HYDROMETEOROLOGIQUES, UN OUTIL PRODIGIEUX POUR LA GESTION DES RESSOURCES EN EAU DANS LE SAHEL).
Laboratoire General de Recherches, Brussels (Belgium).
For primary bibliographic entry see Field 7B.
W91-02303

USE OF A DISTRIBUTED MODEL OF A SMALL SAVANNAH CATCHMENT (BOORO-BOROTOU, IVORY COAST) UTILISATION D'UN MODELE DISTRIBUE SUR UN PETIT BASSIN VERSANT DE SAVANE (BOORO-BOROTOU, COTE D'IVOIRE).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Montpellier. Centre de Montpellier.
For primary bibliographic entry see Field 2A.
W91-02310

UTILIZATION OF THE LAW OF GAPS FOR THE DESCRIPTION OF THE PLUVIOMETRIC REGIME (L'UTILISATION DE LA LOI DES FUITES POUR LA DESCRIPTION DES REGIMES PLUVIOMETRIQUES).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Niamey (Niger). Mission ORSTOM au Niger.
L. Le Barbe, G. Ale, and L. Seguis.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 686-700, 6 fig, 3 ref. English summary.

Descriptors: *Rainfall distribution, *Risk assessment, *Semiarid lands, *Statistical analysis, Agriculture, Drought, France, Hydrologic mapping, Mapping, Prediction, Temporal distribution.

Information on the risks from variation in the rainfall distribution in time is indispensable for establishing the agricultural calendar. Risk definition also serves to determine which crop varieties should be cultivated. If a long dry period is expected during the usual rainy season, resistant plants should be preferred. If the risk is small, one could select plants with a growth cycle corresponding to this duration. The classical solution has been to determine empirically the distribution of pluviometric totals within short time spans (10-day or 5-day intervals). Among the problems with this method are its laboriousness and the need to work with short intervals where the errors may be great and the results cannot be mapped easily. The use of the law of gaps permits solutions to the problem without these difficulties. The law of gaps is simple because there are only two parameters: (1) distribution of time spans between two heavy rainfalls and (2) the amount of heavy rain. After the monthly adjustments, one can deduct the distribution of totals for periods shorter than 1 month and for the time separating two successive rainfalls. The results can be mapped and interpolation is feasible. It is possible to make a synthesis of all the pluviometric information from 24 maps with monthly values of each of the parameters of the law. Examples are given of the use of the method at sites in France, including mapping of the results. (See also W91-02288) (Author's abstract)
W91-02345

CLIMATE AND CLIMATIC RESOURCES OF RESERVOIRS.
Limnologicheskii Inst., Irkutsk (USSR).
For primary bibliographic entry see Field 2H.
W91-02373

LONG-TERM TRENDS IN THE SESTON CONTENT OF A SHALLOW EUTROPHIC LAKE AND SOME RELATIONS TO CLIMATIC ELEMENTS.
Institute of Geography and Geoecology, Berlin (German D.R.). Dept. of Hydrology.
For primary bibliographic entry see Field 2H.
W91-02374

USE OF CLUSTER ANALYSIS TO DEFINE PERIODS OF SIMILAR METEOROLOGY AND PRECIPITATION CHEMISTRY IN EASTERN NORTH AMERICA: PART I. TRANSPORT PATTERNS.
Michigan Univ., Ann Arbor. Dept. of Atmospheric, Oceanic and Space Sciences.
For primary bibliographic entry see Field 5B.
W91-02409

USE OF CLUSTER ANALYSIS TO DEFINE PERIODS OF SIMILAR METEOROLOGY AND PRECIPITATION CHEMISTRY IN EASTERN NORTH AMERICA: PART II. PRECIPITATION PATTERNS AND POLLUTION DEPOSITION.
Michigan Univ., Ann Arbor. Dept. of Atmospheric, Oceanic and Space Sciences.
For primary bibliographic entry see Field 5B.
W91-02410

HYDROLOGICAL ASPECTS OF THE DEVELOPMENT AND RAPID DECAY OF THE 1989 DROUGHT.
Institute of Hydrology, Wallingford (England).
T. Marsh, and R. Monkhouse.
Weather WTHRAL, Vol. 45, No. 8, p 290-299, August 1990. 3 fig, 4 tab, 11 ref.

Descriptors: *Climatology, *Drought, *Great Britain, *Groundwater recharge, *Hydrologic aspects, *Hydrology, *Precipitation excess, *Runoff, *Weather, Evaporation, Groundwater level, Hydrologic budget, Local precipitation, Precipitation, Rainfall, Soil water, Water resources.

In all but a few of Great Britain's eastern districts the persistent and widespread rainfall over a 10-week period beginning in mid-December 1989 served to terminate, in dramatic fashion, a sustained drought which by the late autumn had constituted a significant threat to water resources. The notable recent variations in water resources with particular emphasis on the extraordinary transformation in hydrological conditions were examined over the 1989/1990 winter. The transformation reached a climax in February when unprecedented rates of river runoff and aquifer recharge were recorded over large areas. Exceptionally wet spells have succeeded sustained dry periods in Britain on a number of occasions, notably following the droughts of 1959, 1976, and 1984. When, as in the last two cases, the drought broke at the end of the summer, the hydrological effectiveness of the heavy rainfall was, initially, reduced by high soil moisture deficits and continuing evaporative losses. The singular nature of the water resources recovery in February 1990 owes as much to the insignificance of these factors throughout most of Britain as the abundant rainfall itself. A very dry winter, followed by an exceptionally wet one in 1989/90 resulted in monthly runoff totals and a rise and fall of groundwater levels that extended the range of recorded variations in a number of regions. Both winters were also notably mild. In water resources terms this implied an increase in evaporation losses throughout the winter--especially if the climate becomes windier--partly counteracting the benefit that a trend towards, or clustering of, wetter winters would confer. The challenge for climatologists and hydrologists is to determine whether the exceptional conditions recently experienced represent the extreme range of normal variability or are indications of a trend towards less familiar climatic territory. (Mertz-PTT)
W91-02428

PRECIPITATION FLUCTUATION OVER SEMIARID REGIONS IN NORTHERN CHINA AND THE RELATIONSHIP WITH EL NINO/SOUTHERN OSCILLATION.
Atmospheric and Environmental Research, Inc., Cambridge, MA.
W. Wang, and K. Li.
Journal of Climate JLCLEL, Vol. 3, No. 17, p 769-783, July 1990. 9 fig, 4 tab, 30 ref. US DOE Grant No. DE-FG02-86-ER60422.

Descriptors: *China, *Climatic changes, *Climatology, *Desertification, *El Nino/Southern Oscillation, *Meteorological data, *Meteorology, *Precipitation, *Rainfall, *Semiarid climates, *Weather

patterns, Atmosphere-ocean interactions, Climates, Correlation analysis, Meteorological data collection, Monsoons.

Many observational studies in recent years suggest that interannual variations in rainfall at low latitudes, sometimes even at middle and high latitudes, are related to the El Nino (EN) and Southern Oscillation (SO) events in the tropics. The interaction between atmosphere and ocean caused by such exchange will have a profound effect on the global climate. In recent years the semiarid region of northern China, which has total annual precipitation between 200 and 500 mm, has shown signs of severe desertification. In this study, the 1951-86 monthly precipitation measurements in this region were used to study their fluctuations and relationships with the El Nino/Southern Oscillation (ENSO). Three main features were identified as a result of the study: (1) a 2-3 year quasi-periodic fluctuation, (2) a tendency for rainfall deficiency for the whole region during ENSO years, and (3) a significant correlation between the precipitation fluctuations in the southern part of this region and Southern Oscillation index, with the former lagging the latter by 2-5 months. These features are also evident from analysis of the proxy data during the last hundred years. (Korn-PTT)
W91-02446

FREQUENCY-RELATED TEMPORALLY AND SPATIALLY VARIED RAINFALL.
Army Engineer District, Fort Worth, TX.
G. R. Perry, and K. L. Shafer.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 10, p 1215-1231, October 1990. 11 fig, 1 tab, 11 ref.

Descriptors: *Design storms, *Flood discharge, *Model studies, *Rainfall, *Rainfall distribution, *Rainfall-runoff relationships, *Storm runoff, Catchment areas, Drainage patterns, Flood control, Spatial distribution, Temporal distribution, Texas, Watersheds.

A frequency-related design storm with spatial and temporal variation was derived from basic statistical properties. An analysis was performed to determine the impact of the spatially varied (proposed) rainfall pattern on a watershed on Tenmile Creek in Dallas County, Texas. The results of the experiment were as follows: (1) If a large subbasin is suddenly encountered, a peak for that subbasin may produce a secondary area of critical storm centers; (2) The critical storm center path will coincide with locations along the stream path; (3) Compared to a spatially uniform rainfall model, a spatially varied synthetic rainfall model is less efficient in the total volume of rainfall delivered to a drainage basin and more efficient in placing the volume of rainfall to achieve best effect; (4) Drainage area discontinuities appear to be an important consideration in modeling a drainage basin, as does the drainage network; and (5) The storm pattern does not affect the critical storm center for small drainage areas, but for larger basins it is presumed that the storm pattern will be a critical element. The frequency-related temporally and spatially varied rainfall analysis produces a graphical illustration of the ideal locations to construct flood control facilities. (MacKeen-PTT)
W91-02524

SOME CHARACTERISTICS OF POINT DISCHARGE CURRENT DURING TWO PRE-MONSOON SEASON THUNDERSTORMS AT PUNE.
Indian Inst. of Tropical Meteorology, Poona.
G. K. Manohar, S. S. Kandalgaonkar, and S. M. Sholapurkar.
Current Science CUSCAM, Vol. 59, No. 7, p 367-370, April 10, 1990. 4 tab, 18 ref.

Descriptors: *Electric currents, *Meteorology, *Monsoons, *Point discharge current, *Thunderstorms, *Weather data collections, Distribution patterns, Electric fields, Electrical studies, Frequency distribution, India.

During the periods of thunderstorms when strong electric fields exist, transfer of negative/positive charge to the earth through point discharges from surface irregularities takes place. Measurements of point discharge current were made at Pune during two pre-monsoon season thunderstorms of 1987 and 1988. The point discharging element consisted of a platinum/10% iridium needle 0.5 mm in diameter and about 2 cm long erected at a height of 14 m above the ground level. Continuous record of point discharge current was obtained. The monthly distribution of the number of days of thunderstorms in the pre-monsoon months (April, May and June) of 1987 was seen to vary from that of 1988 (0/7, 6/1, and 5/2 days, respectively), though the total number of seasonal thunderstorm days on both occasions were equal. The daily features of point discharge current on the days of thunderstorm during 1987 and 1988 are as follows. The seasonal positive charge received by the earth was +31.51 mC in 1987 and +16.14 mC in 1988. Similarly the seasonal negative charge received was -19.09 mC in 1987 and -21.79 mC in 1988. Normalized frequency distribution of spells and diurnal time duration of point discharge current and the values of charge received by the earth are also presented. Results suggest that thunderstorms in May through June contributed for excess positive charge rather than negative charge, and thunderstorms in April contributed for excess negative charge. In 1987 longer durations of positive current prevailed than those of negative and in 1988 the reverse was noticed. During 1987 an appreciable duration of point discharge current persisted even beyond mid-night hours, which was unlike that in 1988. However, since the above results are based on limited observations, these inferences should be taken with sufficient reservation and detailed verification is necessary from future works. (VerNooy-PTT)
W91-02553

CHARACTERIZATION OF YEAR-ROUND SENSITIVITY OF CALIFORNIA'S MONTANE LAKES TO ACIDIC DEPOSITION.
California Univ., Santa Barbara. Marine Science Inst.
For primary bibliographic entry see Field 5B.
W91-02619

INFLUENCE OF ACID ATMOSPHERIC INPUTS ON SURFACE WATER CHEMISTRY AND MINERAL FLUXES IN A DECLINING SPRUCE STAND WITHIN A SMALL CATCHMENT (VOSGES MASSIF, FRANCE).
Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
For primary bibliographic entry see Field 5B.
W91-02741

STORMFLOW HYDROCHEMISTRY OF A SMALL WELSH UPLAND CATCHMENT.
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 2K.
W91-02748

DOPPLER-RADAR ANALYSIS OF A LOW-PRECIPITATION SEVERE STORM.
Oklahoma Univ., Norman. School of Meteorology.
H. B. Bluestein, and G. R. Woodall.
Monthly Weather Review MWREAB, Vol. 118, No. 8, p 1640-1664, August 1990. 26 fig, 61 ref, append.

Descriptors: *Convective precipitation, *Meteorology, *Radar, *Remote sensing, *Storms, Hail, Meteorological data, Oklahoma, Rain, Weather patterns, Wind.

The structure and evolution of a convective storm that formed along the dryline in Oklahoma on 26 April 1984 and developed into a supercell was studied in detail. Dual-Doppler wind analyses, analyses of surface-mesonetwork and instrumented-tower data, storm-intercept photographs, analyses of raingage data from a dense network, and storm reports were used. The storm exhibited the following low-precipitation (LP) characteristics: the absence of any strong, evaporatively cooled, storm-scale downdraft near the surface; a paucity of rain reaching the ground; large hail; long-lived rotating updrafts; and a strong, relatively small in areal extent, unicellular radar echo. The storm split, and its right-moving member developed into an isolated, high-precipitation supercell. It is suggested that the region under cloud base was associated with strong radar echo caused by widely spaced, large water droplets and hailstones. Separate cyclonically and anticyclonically rotating updrafts were found on the southern and northern flanks of the storm, respectively. The high correlation between vorticity and vertical motion is circumstantial evidence that they are dynamically related. The storm split as the updrafts on the northern and southern flanks of the LP storm developed precipitation cores, and each propagated away from the original echo. (Author's abstract)
W91-02760

TROPICAL SQUALL LINE OBSERVED DURING THE COPT 81 EXPERIMENT IN WEST AFRICA. PART III: HEAT AND MOISTURE BUDGETS.
Centre National de Recherches Meteorologiques, Toulouse (France).
M. Chong, and D. Hauser.
Monthly Weather Review MWREAB, Vol. 118, No. 8, p 1696-1706, August 1990. 10 fig, 32 ref.

Descriptors: *Atmospheric physics, *Atmospheric water, *Heat budget, *Meteorology, *Moisture content, *Squalls, *Storms, *Tropical region, *West Africa, Condensation, Convection, Cooling, Drying, Evaporation, Heat flow, Melting, Meteorological data collection, Radar, Remote sensing.

The role of moist convective processes in the heat and moisture budgets of a June 1981 tropical squall line, observed in West Africa during the cooperative experiment COPT 81 (COnvection Profonde Tropicale), was investigated using Doppler radar observations. Condensation and evaporation through the release of latent heat, were the dominant terms in the total apparent heating profile although the melting process was also important. The total apparent moisture sink was also dominated by condensation and evaporation. However, the eddy moisture flux had an important influence on the vertical structure. The total apparent heat source was marked by a deeper layer of cooling while the total apparent moisture sink had a single peak observed in the middle troposphere. The convective-scale heating profile indicated a net cooling in the lower troposphere, mainly due to the evaporation of precipitation. This cooling could be explained by a deep subsaturated layer where convective precipitation was evaporated. The convective-region moisture sink profile exhibited drying through the full depth of the troposphere, but with a peak at middle levels. It was found that the relatively high position of the drying peak resulted from the specific contribution of the eddy moisture transport in the convective region, which was concentrated in the low-to-middle troposphere and which tended to raise the drying peak due to condensation in convective updrafts. From the particular impact of convective eddies the occurrence of a double-peaked structure in the total apparent moisture sink is proposed. It was also found that ambient air entering the system at mid levels strongly modified the vertical exchange from convective updrafts by limiting it to the lower part of the troposphere. (Author's abstract)
W91-02761

BIOSPHERE AND CLIMATE.
Akademiya Nauk SSSR, Leningrad. Inst. for Lake Research.
For primary bibliographic entry see Field 2A.
W91-02803

SENSITIVITY OF THE SURFACE HYDROLOGY TO THE COMPLEXITY OF THE LAND SURFACE PARAMETERIZATION SCHEME EMPLOYED.
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.

For primary bibliographic entry see Field 7C.
W91-02804

GEOGRAPHIC DISTRIBUTION AND CLIMATIC VARIATION OF THE PLUVIAL REGIMES IN BAJA CALIFORNIA SUR, MEXICO (DISTRIBUCION GEOGRAFICA Y VARIABILIDAD CLIMATICA DE LOS REGIMENES PLUVIOMETRICOS EN BAJA CALIFORNIA SUR, MEXICO).
Centro de Investigaciones Biologicas de Baja California Sur, La Paz (Mexico).
C. A. SalinasZavala, A. LeyvaContreras, D. LluchBelda, and E. Diaz-Rivera.
Atmosfera ATMSEF, Vol. 3, No. 3, p 217-237, July 1990. 7 fig, 5 tab, 23 ref. (English summary).

Descriptors: *Baja California, *Climatic zones, *Climatology, *Precipitation mapping, *Weather data collections, Mexico, Physiographic provinces, Rainfall distribution, Weather patterns.

Annual pluvial precipitation patterns obtained from 57 weather stations in the southern part of the Baja California Peninsula, Mexico, during more than 20 years were analyzed. Three distinct periods are readily recognizable from the annual mean pattern: Period I corresponding to the dry season from March to June; Period II corresponding to the rainy season from July to October; Period III corresponding to the rainy season from November to February. A regionalization was obtained from the rainy regime based on the relative weight of both rainy periods, marked along the mean physiographic climatological zonal features, that in general terms correspond to the climatic zonation obtained by several authors based on different data sets. Notwithstanding the geographic distribution in accord with the mean physiographical and climatological characteristics of the study zone, a transitional climatic index is proposed which, seems to indicate that the tropical and temperate influences go beyond the regions of predominance. The variability of some casual phenomena associated with the zonal weather tendencies also were analyzed by means of an original interpretation of harmonic analysis. (Author's abstract)
W91-02805

ACID DEPOSITIONS, SUMMER DROUGHTS, FOREST DECLINE: DEVELOPMENT OF THE NITROUS ACID HYPOTHESIS.
Association pour la Prevention de la Pollution Atmospherique, Bordeaux (France).
For primary bibliographic entry see Field 5C.
W91-02828

LIQUID WATER CONTENT AND PRECIPITATION CHARACTERISTICS OF STRATIFORM CLOUDS AS INFERRED FROM SATELLITE MICROWAVE MEASUREMENTS.
Pennsylvania State Univ., University Park. Dept. of Meteorology.
J. A. Curry, C. D. Ardeel, and L. Tian.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 95, No. 10, p 16,659-16,671, September 20, 1990. 13 fig, 3 tab, 55 ref.

Descriptors: *Cloud liquid water, *Meteorology, *Microwaves, *Precipitation, *Remote sensing, *Satellite technology, Atmospheric water, Cloud physics, Clouds, Data acquisition, Radiometry.

An analysis of the integrated liquid water content and precipitation characteristics of stratiform clouds using data from Nimbus 7 Scanning Multichannel Microwave Radiometer (SMMR) for January 1979, over the North Atlantic Ocean is presented. Concurrent analysis of the SMMR data with the US Air Force 3-Dimensional Nephanalysis (3DNEPH) allows the interpretation of the SMMR-derived liquid water paths and precipitation characteristics in terms of cloud type, cloud fraction, and cloud height. Combining the initialized analyses from the European Center for Medium Range Weather Forecasting (ECMWF) with the 3DNEPH enables vertical temperature and humidity profiles to be incorporated into the retrievals. The average liquid water paths for middle and low clouds were determined to be 115 and 102 g/sq m, respectively, with a maximum value of 1070 g/sq m. Analysis showed that the clouds were substantially diluted by a combination of precipitation, freezing and entrainment. Analysis of the liquid water path as a function of temperature showed that clouds with average temperatures below 246 K had very little liquid water, and were inferred to be predominantly crystalline. There was little evidence that the cloud liquid water path increases with temperature for cloudiness on a large scale, suggesting that cloud thickness plays the dominant role in determining cloud liquid water path. A total of 8.5% and 4.4% of the total middle and low clouds, respectively, were determined to be raining. Liquid water paths of 350 g/sq m and 55 g/sq m for middle and low clouds, were determined to be average thresholds for the onset of precipitation. Maximum rain rates for these clouds were determined to be 7 mm/h. The autoconversion of cloud water to rain water was determined to occur at a rate of 0.001/s. (Lantz-PTT)
W91-02835

PASSIVE MICROWAVE REMOTE SENSING OF CLOUD LIQUID WATER OVER LAND REGIONS.
Cooperative Inst. for Research in the Atmosphere, Fort Collins, CO.
A. S. Jones, and T. H. Vonder Harr.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 95, No. 10, p 16,673-16,683, September 20, 1990. 5 fig, 5 tab, 40 ref. ARO Grant No. DAAL03-86-G-0190.

Descriptors: *Cloud liquid water, *Meteorology, *Microwaves, *Remote sensing, Atmospheric water, Data acquisition, Radiation, Radiometry, Satellite technology, Temperature.

Techniques for cloud liquid water retrieval over land are developed using data from the Special Sensory Microwave/Imagery 85.5 GHz (3.5 mm) channels. To minimize the effect of surface emittance variability on the calculations, the surface emittance was estimated with the aid of surface skin temperature retrievals from the Visible Infrared Spin Scan Radiometer in geosynchronous orbit. The high sensitivity of the 85.5 GHz channels to cloud liquid water allows for the estimation of integrated cloud liquid water based on the microwave brightness temperature depression caused by attenuation and emission of microwave radiation at the colder ambient temperature of the cloud. The method assumes non-scattering radioactive processes are dominant; therefore, only non-precipitating cloud liquid water is considered. Integrated cloud liquid water retrievals show good qualitative agreement with other available data sources. Numerical error sensitivity analysis showed integrated cloud liquid water error estimates of 0.05-0.50 kg/sq m depending on the contrast of cloud over background. (Author's abstract)
W91-02836

PRECIPITATION CHEMISTRY IN CENTRAL AMAZONIA.
Florida State Univ., Tallahassee. Dept. of Oceanography.
M. O. Andreae, R. W. Talbot, H. Berresheim, and K. M. Beecher.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 95, No. 10, p 16,987-16,999, September 20, 1990. 12 fig, 4 tab, 57 ref. NASA Tropospheric Chemistry Program Grant No. NAG-1-588.

Descriptors: *Acid rain, *Amazon River Basin, *Chemistry of precipitation, *Path of pollutants, *Water pollution sources, Aerosols, Chlorides, Fluctuations, Nitrates, Organic acids, Potassium, Precipitation, Seasonal variation, Sodium, Statistical analysis, Sulfates, Tropical regions.

Rain samples from three sites in central Amazonia were collected over a period of 6 weeks during the 1987 wet season and analyzed for ionic species and dissolved organic carbon. A continuous record of precipitation chemistry and amount was obtained at two of these sites, which were free from local or regional pollution, for a period of over one month. The volume weighted mean concentrations of most species were about a factor of 5 lower during the wet season. Only Na, K, and Cl2 showed similar concentrations in both seasons. When the seasonal difference in rainfall amount is taken into consideration, the deposition fluxes are only slightly lower for most species during the wet season than during the dry season, again with the exception of Cl2, Na, and K. Na and Cl2 are present in the same ratio as in sea salt; rapid advection of air masses of marine origin to the central Amazon Basin during the wet season may be responsible for the observed higher deposition flux of these species. Statistical analysis suggests that sulfate is, to a large extent, of marine (sea salt and biogenic) origin, but that long range transport of combustion derived aerosols also makes a significant contribution to sulfate and nitrate in Amazonian rain. Organic acid concentrations in rain were responsible for a large fraction of the observed precipitation acidity; their concentration was strongly influenced by gas/liquid interactions. (Author's abstract)
W91-02840

RAINFALL AND SURFACE KINEMATIC CONDITIONS OVER CENTRAL AMAZONIA DURING ABLE 2B.
James Madison Univ., Harrisonburg, VA. Dept. of Geology and Geography.
S. Greco, R. Swap, M. Garstang, S. Ulanski, and M. Shipham.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 95, No. 10, p 17,001-17,014, September 20, 1990. 16 fig, 5 tab, 32 ref. NSF Grant No. ATM85-18826.

Descriptors: *Amazon River Basin, *Chemistry of precipitation, *Climatology, *Data interpretation, *Hydrologic budget, *Meteorology, *Rainfall, *Satellite technology, Acetates, Acid rain, Aerosols, Formates, Meteorological data collection, Pyruvates, Rainfall intensity, Remote sensing, Sulfates, Tropical regions.

Meteorological and chemical data collected during the wet season Amazon Boundary Layer Experiment near Manaus, Brazil, were used to investigate the rainfall, rainfall systems, and surface kinematics of the south central Amazon basin wet season. Analysis of the Geostationary Operational Environmental Satellite (GOES-West) imagery indicated that, based on location of initial development, there are three main types of convective systems which influence a mesoscale network near Manaus. Coastal Occurring Systems (COS) are mesoscale to synoptic scale sized systems of generally linear orientation which form along the northern coast of Brazil and propagate across the Amazon Basin. The Basin Occurring Systems (BOS) form in the basin east and north of Manaus and also propagate toward the network. Locally Occurring Systems (LOS) form in and around the mesoscale network and rarely are larger than 1000 cu km. Composites of hourly rainfall totals and satellite derived cloud cover show that rainfall and cloudiness associated with COS occurred in the network between 1000 and 1400 UT. Little rain or cloud cover was seen before 1600 UT during days influenced by LOS. Chemical analysis of the rain water delivered by these systems also shows significant differences in the concentrations of formate, acetate, pyruvate, sulfate, and hydrogen ion. In addition, aerosol concentrations measured near Manaus indicate large influxes of aerosols (Na, Cl, and Si) into central Amazonia after the passage of BOS and COS. During April 11-20, BOS occurred on 8 days and produced 98% of the rainfall. Eight COS occurred during April 21 to May 3 and accounted for 89% of the rainfall. The final part of the experiment, May 4-14, was influenced solely by LOS. Harmonic analysis of surface divergence during this period exhibits a peak at 24 hours. This peak, representing the diurnal heating cycle, does not exist earlier in the experiment when BOS and COS are more frequent. (Author's abstract)
W91-02841

ESTIMATES OF DAILY RAINFALL OVER THE AMAZON BASIN.

Wisconsin Univ.-Madison. Space Science and Engineering Center.
D. W. Martin, B. Goodman, T. J. Schmit, and E. C. Cutrim.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 95, No. 10, p 17,043-17,050, September 20, 1990. 6 fig, 5 tab, 20 ref. NSF Grant No. ATM-8703966.

Descriptors: *Amazon River Basin, *Data acquisition, *Rainfall, *Remote sensing, Mapping, Maps, Meteorology, Rain gages, Rainfall distribution, Satellite technology, Surveys, Temperature, Tropical regions.

Five geostationary satellite rain estimation techniques were tested over Amazonia. Individually, the techniques explained 1/4 to 1/3 of the variance of daily gage rainfall. Based on large part on cost, one technique which involves a nonlinear relation in temperature, was selected to provide a mapping of daily Amazonia rainfall between May 6 and 12, 1987. Accumulated over seven days, rainfall by this technique averaged 40 mm. It varied from zero in the southeast to more than 150 mm in the northwest. To the southwest the predominantly convective pattern of the rain image was overlaid by a streakiness, implying some baroclinic influence. In maps combining gage observations with satellite estimates, rainfall varied significantly from day to day. Only over the largest scale did a trend emerge--a tendency for rain to withdraw from south to north. (Author's abstract)
W91-02842

INCORPORATING HILLSLOPE EFFECTS INTO THE GEOMORPHOLOGIC INSTANTANEOUS UNIT HYDROGRAPH.
CH2M/Hill, Reston, VA.
For primary bibliographic entry see Field 2E.
W91-02868

CLIMATIC INFLUENCES ON STREAMFLOW VARIABILITY: A COMPARISON BETWEEN SOUTHEASTERN AUSTRALIA AND SOUTHEASTERN UNITED STATES OF AMERICA.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
I. Kuhnel, T. A. McMahon, B. L. Finlayson, A. Haines, and P. H. Whetton.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2483-2496, October 1990. 9 fig, 3 tab, 42 ref.

Descriptors: *Australia, *Climates, *Climatology, *Rainfall, *Rainfall-runoff relationships, *Runoff, *Stream discharge, *Streamflow forecasting, Atmospheric circulation, Comparison studies, Flow rates, Seasonal distribution, Southern oscillation.

Differences in runoff and rainfall variability between southeastern Australia and southeastern United States have been examined, using various standard techniques such as principal component and spectral analyses, and examination of the quick and base flow components of runoff. The higher runoff variability in Australia can be explained, in part, by the large-scale circulation and rainfall patterns associated with the Southern Oscillation which are unlike those in the southeastern United States. Whereas the Southern Oscillation signal is easily detectable in the southeast Australian rainfall and runoff data, it is, with the exception of several small areas, absent in the southeastern United States data. In the case of this particular comparison, the differences in runoff variability between the two selected regions were found to be largest in winter and spring months and smallest in summer. Among the continents, Australia shows the strongest impact of the Southern Oscillation, and the different rainfall and runoff variability in the two specific regions is likely to be similar when comparing Australia with any other part of the world. (Author's abstract)
W91-02877

PERIODIC-STOCHASTIC MODELING OF SEPARATION OF PRECIPITATION INTO RAINFALL AND SNOWFALL.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
V. Yevjevich, and N. B. Harmancioglu.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2613-2623, October 1990. 17 fig, 1 tab, 23 ref. National Science Foundation Grant CEE-8405289/8541631.

Descriptors: *Model studies, *Precipitation, *Rainfall, *Runoff, *Snowfall, *Stochastic models, Distribution, Fourier analysis, Markov process, Mathematical models, Probability distribution, Statistical analysis.

Modelers must separate precipitation into rainfall and snowfall because the two processes have significant differences as input to runoff. The purpose of the present study is to model this separation, provided that available data permit the coding of observed precipitation as rainfall, snowfall, and/or mixed rainfall-snowfall. Modeling of precipitation is realized by a simple approach such as the periodic-stochastic Markov chain description of occurrence and nonoccurrence of time interval precipitation. The exponential probability distribution based function, with periodic parameters, are is for modeling the nonzero values of precipitation. The generated series are then separated into rainfall and snowfall components by means of the rainfall-precipitation ratio. This ratio is modeled as a periodic-stochastic process in the range zero to one. The bounded (0,1)-beta distribution function is selected as the appropriate distribution function to describe the ratio when it can also assume values between zero and unity. Most parameters in modeling precipitation and the ratio show periodicity, often fitted well by one-harmonic and two-harmonic Fourier functions. Two sets of daily precipitation series, each ten years long, are used to demonstrate the results of modeling daily precipitation and daily rainfall-precipitation ratio: the Bansanson precipitation gauging station in the Durance River basin, France (as a point process), and the W-3 watershed area, near Danville, Vermont (as a daily average areal precipitation process). The investigation shows the feasibility of modeling the separation when observed precipitation is coded for rainfall, snowfall, or mixed rainfall-snowfall. (Brunone-PTT)
W91-02886

COMPUTER-CONTROLLED AUTOMATED RAIN SAMPLER (CCARS) FOR RAINFALL MEASUREMENT AND SEQUENTIAL SAMPLING.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 7B.
W91-02914

2C. Snow, Ice, and Frost

REMOTE SENSING APPLIED TO GLACIER SUPERVISION IN THE FRENCH ALPS (YEARS 1986, 1987 AND 1988)(TELEDETECTION APPLIQUEE AU SUIVI DES GLACIERS DES ALPES FRANCAISES (ANNEES 1986, 1987 ET 1988)).
Grenoble-1 Univ. (France). Lab. de la Montagne Alpine.
For primary bibliographic entry see Field 7B.
W91-02051

GLACIAL MASS BALANCE DETERMINATION IN THE ACCUMULATION ZONE BY IN SITU MEASUREMENTS OF TCHERNOBYL RADIOACTIVITY (DETERMINATION DU BILAN GLACIAIRE EN ZONE D'ACCUMULATION PAR MESURE IN SITU DE LA RADIOACTIVITE DUE A TCHERNOBYL).
Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France).
J. F. Pinglot, and M. Pourchet.
Houille Blanche HOBLAB, Vol. 1990, No. 5, p 359-361, 1990. 3 fig, 7 ref. English summary.

Descriptors: *Chernobyl, *Data acquisition, *Fallout, *Glacier mass balance, *New snow, *Radioactivity, *Tracers, Glaciers, Snow accumulation, Snow sampling.

Glacial mass balance determination in the accumulation zone is accomplished by the determination of the water equivalent of the fresh snow cover. Radioactive fallout due to the Chernobyl accident on April 26th, 1986, has already been identified in Northern hemisphere glaciers, where it has provided a new reference level. An in situ gamma ray spectrometer was developed in order to detect the radiation from Chernobyl directly in the field. Therefore the depth of the Chernobyl layer can be determined. (Author's abstract)
W91-02052

SCHEME FOR PARAMETERIZING ICE-CLOUD WATER CONTENT IN GENERAL CIRCULATION MODELS.
National Center for Atmospheric Research, Boulder, CO.
A. J. Heymsfield, and L. J. Donner.
Journal of the Atmospheric Sciences JAHSAK, Vol. 47, No. 15, p 1865-1877, August 1990. 8 fig, 3 tab, 39 ref, 2 append. NASA Contract L98100B, NASA Grant NAG-1056, NSF Grant ATM-85 13975.

Descriptors: *Clouds, *Data interpretation, *Ice clouds, *Model studies, *Moisture content, Climatic changes, Cloud liquid water, Cloud physics, Mathematical models, Meteorological data, Meteorology, Optical properties, Three-dimensional model.

The optical properties of ice clouds are a primary issue for climate and climate change. Evaluating these optical properties in three-dimensional models for studying climate will require a method to calculate the ice water content of such clouds. A procedure is developed to parameterize ice water content as a function of large-scale meteorological characteristics for use in circulation models, in which the ice water content is not calculated by means of a three-dimensional prognostic equation for condensed water. The technique identifies large-scale flows in which ice clouds exist and calculates their ice water content by reconstructing the trajectory associated with cloud formation. As the cloud forms, its ice content changes both by deposition of ice from water vapor and by ice removal by sedimentation. The sedimentation process is found to significantly modify the ice water content expected from deposition alone. Ice water contents predicted by the parameterization were compared with aircraft observations collected in the middle latitudes and the tropics, and show reasonable agreement over four orders of magnitude of ice and water content. A parameterization for the sublimation of ice crystals settling into ice-subsaturated environments has also been developed. (Author's abstract)
W91-02118

PHYSICS OF SUPERCOOLING OF THIN WATER SKINS COVERING GYRATING HAILSTONES.
Toronto Univ. (Ontario). Dept. of Physics.
R. List.
Journal of the Atmospheric Sciences JAHSAK, Vol. 47, No. 15, p 1919-1925, August 1990. 7 fig, 10 ref.

Descriptors: *Atmospheric physics, *Freezing, *Hail, *Precipitation, *Supercooling, Air-water interfaces, Heat transfer, Ice formation, Ice-water interfaces, Physical analysis.

Liquid water skins on spongy deposits of hailstones that grow while gyrating in a wind tunnel environment, have been routinely observed to be supercooled at the water skin-air interface to as low as -5 C. The average water skin thickness (up to 1 mm) in the main growth region was calculated on the basis of the molecular conduction of the latent heat of freezing from the spongy substrate at the base of the water skin to its surface. This heat transfer is gradient-driven and relates directly to the speed of ice accretion on the hailstone. Extrapolation of an equation for the ice growth speed in supercooled bulk water suggested a supercooling of the ice-water interface on the order of -0.3 C. The physical picture which emerged, was that

of an ice sponge from which a fragile dendrite mesh grows into the water skin with a very homogeneous front, and an advance speed that is controlled by the diffusion of heat (heat conduction) away from the ice front. Combining all results, it can be categorically stated that all surface points of growing hailstones have temperatures below the freezing point of water. (Author's abstract)
W91-02119

FIELD FROST HEAVE MEASUREMENT AND PREDICTION DURING PERIODS OF SEASONAL FROST.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
H. N. Hayhoe, and D. Balchin.
Canadian Geotechnical Journal CGJOAH, Vol. 27, No. 3, p 393-397, June 1990. 8 fig, 1 tab, 12 ref.

Descriptors: *Data acquisition, *Electrical equipment, *Freezing, *Frost heaving, *Instrumentation, *Thermocouples, Canada, Cultivation, Loam, Soil properties, Soil temperature, Temperature gradient.

Frost heave measurements were taken over two winter seasons on a clay loam soil located near Ottawa, Canada. Heaving was measured using linear displacement transducers attached to a metal frame that was anchored in the soil below the depth of frost penetration. The output of the displacement transducer was recorded hourly using a microcomputer based data logger. The system functioned reliably and the observed data compared well with published measurements. Soil temperature was recorded simultaneously using thermocouples placed at various depths up to 1 m. Time-domain reflectometry was used to measure the unfrozen water content at approximately two week intervals. The study shows that soil temperature measurements can be used to estimate the temperature gradient at the freezing front for determining the cumulative frost heave, as suggested by the Konrad-Morgenstern theory of ice segregation processes. The results also support the observation that tilled soils are more susceptible to heave than undisturbed soils. (Author's abstract)
W91-02150

RECONSTRUCTION AND DYNAMICS OF THE LATE WISCONSIN 'ONTARIO' ICE DOME IN THE FINGER LAKES REGION, NEW YORK.
Maryland Univ., College Park. Dept. of Geology.
R. W. Ridky, and R. A. Bindschadler.
Geological Society of America Bulletin BUGMAF, Vol. 102, No. 8, p 1055-1064, August 1990. 5 fig, 2 tab, 67 ref.

Descriptors: *Finger Lakes, *Glacial drift, *Glacier mass balance, *Glaciers, *Glaciology, *Ice thickness, *New York, Drumlins, Glacial sediments, Ice pressure, Mathematical models, Shear stress.

Distribution of drumlins on the Ontario Lowlands and the northern Appalachian Plateau of New York State are utilized in a glaciological model that estimates thicknesses of the Late Wisconsin Ice Sheet along five glacial flowlines over the central section of the Finger Lakes. Dynamics of the model are based upon a force balance approach that incorporates variable width of a flowband, bedslope, radius of curvature, and center of outflow location. Drumlin axes along five hydrostatic isograms were projected northward. Points of axes convergence define the center of outflow in the eastern Ontario Basin. Flowlines along the axial trace of the major Seneca and Cayuga Troughs and bordering interfluves were constructed southward to the Valley Heads Moraine System. Calculation of flowline geometry for any assumed basal shear stress requires neither information on ice temperature nor the flow law of ice. Ice thicknesses for each flow line were calculated for various basal shear stresses. Ice thicknesses at 1 bar range from a minimum of 1,932 m for the Seneca Trough flowline to a maximum of 2,093 m at the Keuka-Seneca interfluve. Simulating ice recession, a series of ice-marginal, terminal positions were plotted for a basal shear stress of 1 bar. These predicted terminal positions agree well with locations of mapped moraine deposits. These probable values of basal shear stress support the presence of glacial flow representative of internal deformation rather than basal sliding. This evidence discounts the presence of ice streams and supports the existence of outlet glaciers in the troughs of the Finger Lakes. (Author's abstract)
W91-02151

FAST-FLOWING OUTLET GLACIERS ON SVALBARD ICE CAPS.
Scott Polar Research Inst., Cambridge (England).
J. A. Dowdeswell, and R. L. Collin.
Geology GLGYBA, Vol. 18, No. 8, p 778-781, August 1990. 5 fig, 18 ref. United Kingdom Natural Environment Grant GR3/4663.

Descriptors: *Glacier balance, *Glacier mass balance, *Glaciers, *Glaciohydrology, *Svalbard, Aerial photography, Arctic zone, Glacial streams, Remote sensing, Satellite technology.

Fast-flowing outlet glaciers and ice streams provide a mechanism for the rapid discharge of mass from ice sheets, implying that their dynamic behavior through time is of particular significance to the stability of the parent ice mass. Four well-defined outlet glaciers are present on the 2510 sq km ice cap of Vestfonna in Nordaustlandet, Svalbard. Airborne radio echo sounding and aerial photograph and satellite image analysis methods have been used to analyze the morphology and dynamics of the ice cap and its component outlet glaciers. The heavily crevassed outlets form linear depressions in the ice cap surface and flow an order of magnitude faster than the ridges of uncrevassed ice between them. Ice flow on the ridges is accounted for by internal deformation alone, whereas rates of outlet glacier flow require basal motion. One outlet has recently switched into and out of a faster mode of flow. Rapid terminal advance, a change from longitudinal compression to tension, and thinning in the upper basin indicate surge behavior. Observed outlet glacier discharge is significantly greater than current inputs of mass to the ice cap, indicating that present rates of flow cannot be sustained under the contemporary climate. (Author's abstract)
W91-02154

TILL GENESIS AND HYDROGEOLOGICAL PROPERTIES.
Norges Landbrukshoegskole, Aas.
For primary bibliographic entry see Field 2F.
W91-02165

EFFECTS OF GLACIAL SURGING ON SEDIMENTATION IN A MODERN ICE-CONTACT LAKE, ALASKA.
Illinois Univ. at Chicago Circle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2J.
W91-02520

PERIODIC-STOCHASTIC MODELING OF SEPARATION OF PRECIPITATION INTO RAINFALL AND SNOWFALL.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W91-02886

GLACIOMARINE SEDIMENTATION IN DISRAELI FJIORD, HIGH ARCTIC CANADA.
Alberta Univ., Edmonton. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W91-02929

COMPRESSIVE STRENGTH BEHAVIOR OF FINE-GRAINED FROZEN SOILS.
Calgary Univ. (Alberta). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8D.
W91-02940

2D. Evaporation and Transpiration

SIMPLIFIED METHOD TO ESTIMATE REGIONAL 24-H EVAPOTRANSPIRATION FROM THERMAL INFRARED DATA.
Winand Staring Centre for Integrated Land, Soil and Water Research, Wageningen (Netherlands).
H. A. M. Thunnissen, and G. J. A. Nieuwenhuis.
Remote Sensing of the Environment RSEEA7, Vol. 31, No. 3, p 211-225, March 1990. 11 fig, 2 tab, 36 ref.

Descriptors: *Data interpretation, *Evapotranspiration, *Infrared radiation, *Mathematical analysis, *Remote sensing, *Temperature, Analytical methods, Climates, Crops, Plants, Reflection, Thermal infrared data, Wind velocity.

A thermal infrared image provides information about crop evapotranspiration in a certain area at flight time. A simple method has been developed to convert instantaneous crop temperatures into 24-h evapotranspiration values. For clear days, good results were obtained with a linear relationship between relative 24-h evapotranspiration and the increase in crop temperature around mid-day. The crop temperature is related to the temperature of the crop that is potentially transpiring. For the typical flight days to detect crop stress conditions, the empirical coefficient B(r) appeared to be almost insensitive to variations in air temperature, relative humidity, and incoming radiation flux. On the other hand, B(r) was strongly dependent on wind velocity, crop type, and crop height. Information about crop type and crop height can be derived from reflection images. The wind velocity can be obtained from a nearby meteorological station. Overall, the method appears to be suited to the automatic mapping of 24-h evapotranspiration values with the aid of digital reflection and thermal infrared images. However, application of the method requires plots with full soil overage. (Author's abstract)
W91-02129

WATER VAPOR TRANSPORT THROUGH A FLAIL-CHOPPED CORN RESIDUE.
Wisconsin Univ., Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 3F.
W91-02130

NEW METHOD TO DETERMINE REGIONAL EVAPOTRANSPIRATION.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
M. Margaritz, A. Kaufman, M. Paul, E. Boaretto, and G. Hollos.
Water Resources Research WRERAQ, Vol. 26, No. 8, p 1759-1762, August 1990. 3 fig, 2 tab, 14 ref.

Descriptors: *Climatic changes, *Evapotranspiration, *Global warming, *Greenhouse effect, *Hydrologic budget, *Hydrologic cycle, *Model studies, Chlorides, Geochemistry, Jordan River, Precipitation, Radioisotopes.

The climatic changes which are expected to result from man-made atmospheric pollution will undoubtedly affect the natural hydrologic cycle. Models which will address the effect of man-made pollution on recharge rates to groundwater must take into account changes in the rate of evaporative loss (EL). Any geochemical model for the estimation of EL would be based upon a comparison between the concentration of some hydrophilic ion in a sample of resource water to the concentration of that ion in precipitation. A method has been developed comparing the chloride concentration and the ratio of Cl36 to total chloride of a given water body to those of precipitation to determine the fraction of the original precipitation which was lost by evapotranspiration before it reached that water body. This method was applied to 11 water sources in the upper Jordan River basin, and the evapotranspirative loss was generally found to be in the range 40-90%. This method, which is much simpler than the other methods for determining regional evapotranspiration, will enable us to mon-

itor the changes in the hydrological cycle which are expected to result from the greenhouse effect. (Tappert-PTT)
W91-02184

WATER LOSSES IN THE NILE BASIN.
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
For primary bibliographic entry see Field 2A.
W91-02298

EVAPORATION FROM FREE WATER SURFACES IN THE SUDANO-SAHELIAN CLIMATE (L'EVAPORATION DES NAPPES D'EAU LIBRE EN CLIMAT SOUDANO-SAHELIEN).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Montpellier. Centre de Montpellier.
B. Pouyaud.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 169-180, 11 ref. English summary.

Descriptors: *Africa, *Arid lands, *Evaporation, *Hydrologic budget, *Sahel, *Sudan, Climates, Estimating equations, Penman formula, Water resources management.

In the Sudano-Sahelian zone of Africa, evaporation is the most important parameter of the water balance. How to plan the management of water is problematical when this parameter is inadequately estimated, even when it exceeds precipitation by 2-10 times. Similarly, agricultural consumption is not sufficiently known, making irrigation calculations difficult. To evaluate the evaporation, the engineer must rely on data derived from nearby sites. Questions will remain concerning (1) whether there is a water management plan from which one could draw a hydrological balance; (2) whether there are climatological references stations, whether they are equipped with evaporation pans and, if so, of what type; and (3) whether all parameters are known for application of the Penman formula. Area scales (size of the water body) and time scales (time intervals in which evaporation has been determined) are reliable determinants as well. All formulas are not comparable if area and time scales are not identical. Methods described and compared here include: hydrologic balance, evaporation pan methods, the energetic approach, and evaporation from free water surfaces based on a global aerodynamic transfers. (See also W91-02288) (Rochester-PTT)
W91-02300

HYDROLOGIC REGIME UNDER NATURAL CLIMATIC CONDITIONS IN THE LATERITIC SOIL OF BURKINA FASO (REGIME HYDRIQUE EN CONDITIONS CLIMATIQUES NATURELLES D'UN SOL LATERITIQUE DU BURKINA FASO).
Ecole Inter-Etats d'Ingenieurs de l'Equipement Rural, Ouagadougou (Burkina Faso).
For primary bibliographic entry see Field 2G.
W91-02317

WATER TRANSFER IN POROUS NON-SATURATED ROCK AND AQUIFER RECHARGE IN THE SUDANO-SAHELIAN CLIMATE (TRANSFERT D'EAU EN MILIEU POREUX NON SATURE RECHARGE DES NAPPES EN CLIMAT SOUDANO-SAHELIEN).
Ecole Inter-Etats d'Ingenieurs de l'Equipement Rural, Ouagadougou (Burkina Faso).
For primary bibliographic entry see Field 2F.
W91-02319

ESTIMATES OF EVAPOTRANSPIRATION WITH A ONE- AND TWO-LAYER MODEL OF HEAT TRANSFER OVER PARTIAL CANOPY COVER.
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
W. P. Kustas.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 8, p 704-715, August 1990. 7 fig, 3 tab, 55 ref, append.

Descriptors: *Canopy, *Evapotranspiration, *Heat transfer, *Model studies, *Remote sensing, Cotton, Eddy correlation, Heat flux, Temperature, Weather.

One of the applications of remotely sensed surface temperature is to determine the latent heat flux or evapotranspiration from field to regional scales. Surface-air temperature differences have been successfully applied over uniform terrain with nearly full, actively transpiring vegetative cover; however, serious discrepancies between estimated and measured evapotranspiration have been observed when there is partial canopy cover. In an attempt to improve the estimates of heat flux and as a result compute more accurate values of evapotranspiration over partial canopy cover, one-layer and two-layer resistance models were developed to account for some of the factors causing the poor agreement between computed and measured evapotranspiration. The utility of these two approaches for estimating evapotranspiration at the field scale is tested with remotely sensed and micrometerological data collected in an arid environment from a furrowed cotton field with 20% cover and a dry soil surface. The estimates of latent heat flux were compared with values measured using eddy correlation and energy balance methods. It was found that the one-layer model generally performed better than the two-layer model under these conditions; but only when using a bluff-body correction to the resistance based on a conceptual model of heat and water vapor transfer at the surface taking place by molecular diffusion into Kolmogorov-scale eddies. The empirical adjustment to the surface resistance with the one-layer approach assumed to be applicable for a fairly wide range of conditions was found to be inappropriate. This result is attributed to the significant size of the furrows relative to the height of the vegetation. Furthermore, a sensitivity analysis showed that the one-layer model with the empirical adjustment for the resistance was significantly affected by the changes in the surface roughness, whereas the physically based bluff-body correction was relatively insensitive to these variations. For the two-layer model, a large change in the input variable for computing soil evaporation had a relatively small impact on the computed fluxes while a significant change in the leaf area index appeared to amplify the deviations between measured and modeled latent heat flux-values. (Author's abstract)
W91-02408

REMOTE SENSING APPLICATIONS FOR CONSUMPTIVE USE (EVAPOTRANSPIRATION).
For primary bibliographic entry see Field 7B.
W91-02594

COMBINED SIMULATION OF CANOPY REFLECTANCE AND THERMAL RESPONSE FOR ESTIMATING EVAPOTRANSPIRATION.
Maryland Univ., College Park. Remote Sensing Systems Lab.
A. S. Hope, D. E. Petzold, S. N. Goward, and R. M. Ragan.
IN: Remote Sensing Applications for Consumptive Use (Evapotranspiration). Papers Presented at 21st Annual AWRA Conference and Symposium, August 11-16, 1985, Tucson, Arizona. AWRA Monograph Series No. 6, (1985). p 1-11, 6 fig, 20 ref.

Descriptors: *Evapotranspiration, *Remote sensing, *Simulation analysis, Albedo, Canopy, Energy, Evaporation, Model studies, Radiation, Reflectance, Soil-water-plant relationships, Stress, Transpiration, Vegetation.

The SAIL canopy reflectance model was incorporated into the TERGRA model to simulate water and energy flows in the soil-plant-atmosphere system. The reflectance model was structured to calculate canopy albedo throughout the simulation period of TERGRA and to determine spectral reflectances at a specified time during the day. Spectral vegetation indices were then calculated from the reflectances, and related to the evapotranspiration and thermal response of the canopy. Stomatal resistances were calculated from these PAR values and integrated to give the minimum canopy resistance. Actual canopy resistances were obtained by considering environmental stresses, modeled by TERGRA, such as leaf water potential and leaf temperature. Using data from a soybean canopy, canopy evapotranspiration and temperatures were simulated for a range of leaf area index values and compared with the corresponding spectral indices of green vegetation. Results indicated that the normalized difference spectral index has an inverse linear relationship with canopy temperature, concurring with results obtained from satellite observations. The possibility of using a spectral vegetation index and thermal observations together to parametize surface moisture availability for evapotranspiration is considered. (See also W91-02594) (Author's abstract)
W91-02595

ESTIMATING AREAL EVAPOTRANSPIRATION BY COMBINING REMOTE AND GROUND-BASED DATA.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
R. D. Jackson.
IN: Remote Sensing Applications for Consumptive Use (Evapotranspiration). Papers Presented at 21st Annual AWRA Conference and Symposium, August 11-16, 1985, Tucson, Arizona. AWRA Monograph Series No. 6, (1985). p 13-23, 7 fig, 21 ref.

Descriptors: *Evapotranspiration, *Remote sensing, Albedo, Data acquisition, Radiation, Reflectance, Solar radiation, Spatial distribution, Temperature.

Evaluating transpiration on a field-by-field basis over relatively large areas can be accomplished by combining remotely sensed data with ground based measurements. Reflected solar radiation and surface temperatures vary spatially, but can be determined by multispectral measurements. Incoming solar and sky radiation can be considered to be uniformly spatially distributed (for cloudless skies). Thus, their measurement at one location can be extrapolated over an extended area. Combining remote and ground based data allows the spatial distribution of net radiation and evapotranspiration (ET) to be mapped. The evapotranspiration calculation also requires that air temperature and wind speed be areally extrapolated. The spatial variability of these two parameters may be the limiting factor in mapping evapotranspiration over large areas. Data are presented that show a comparison of remote values with traditionally measured values of reflected solar radiation, net radiation and evapotranspiration. The areal extent over which reliable ET estimates can be made depend on the distance that the ground measured parameters can be extrapolated. Calculations indicate that the extrapolation of air temperature and wind speed may be the limiting factors. (See also W91-02594) (Lantz-PTT)
W91-02596

ESTIMATES OF CONSUMPTIVE USE AND EVAPOTRANSPIRATION IN PALO VERDE VALLEY, CALIFORNIA, 1981 AND 1983.
Geological Survey, Tucson, AZ. Water Resources Div.
L. H. Raymond, and S. J. Owen-Joyce.
IN: Remote Sensing Applications for Consumptive Use (Evapotranspiration). Papers Presented at 21st Annual AWRA Conference and Symposium, August 11-16, 1985, Tucson, Arizona. AWRA Monograph Series No. 6, (1985). p 25-34, 6 tab, 6 ref.

Descriptors: *Consumptive use, *Data interpretation, *Evapotranspiration, *Palo Verde Valley, *Remote sensing, Colorado River, Crops, Data acquisition, Hydrologic budget, Landsat, Satellite technology, Vegetation.

Consumptive use was calculated in 1981 and 1983 using a water budget, and evapotranspiration was calculated using vegetative types and acreage determined from Landsat digital-image analysis and two sets of water-use rates. Evapotranspiration ranged from 73-85% of consumptive use in 1981 and 91-105% in 1983. Crop acreage and flow in the Colorado River in 1981 were more representative of normal conditions in the valley than were those in 1983, but rainfall in 1981 was 68% below average. Evapotranspiration calculated using vegetation acreage is dependent on water use rates that were developed in the field for crops and phreatophytes in other areas. These water-use rates may need to be estimated on a yearly basis, rather than using an average value for each vegetation type, because of climatic changes from year to year. The 1981 data more closely represent the results to be expected in comparing consumptive use and evapotranspiration in other years than does the 1983 data. (See also W91-02594)
W91-02597

SIMULATION OF LAKE EVAPORATION WITH APPLICATION TO MODELING LAKE LEVEL VARIATIONS OF HARNEY-MALHEUR LAKE, OREGON.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2H.
W91-02885

2E. Streamflow and Runoff

DROUGHT IN FRANCE IN 1989 (LA SECHERESSE DE 1989).
For primary bibliographic entry see Field 2B.
W91-02048

FLOODS OF 1987 IN THE GLACIAL BASINS SITUATED IN PENNINE ALPS IN SWITZERLAND (LES CRUES DE L'ETE 1987 DANS LES BASSINS VERSANTS GLACIAIRES DES ALPS PENNINES).
Grande Dixence Societe Anonyme, Sion (Switzerland).
Y. Rey, and G. Dayer.
Houille Blanche HOBLAB, Vol. 1990, No. 5, p 349-353, 1990. 1 fig, 2 tab, 6 ref. English summary.

Descriptors: *Alps, *Floods, *Glaciers, *Switzerland, Rhone River, Snowmelt.

Increased rainfall in the Pennine Alps of Switzerland during 1987 added to the swollen output of glacial meltwater during July and August, and, for more than 24 hours, some basins drained an average of 1,400 to 1,500 L/s/sq km. The flow in some basins was estimated at 4,500 to 5,000 L/s/sq km. There was a 20% increase in the level of the Rhone in Valais, Switzerland. The precipitation in some of these localities had periodicities estimated to be in the range of 80 to 100 years. The basins covered include Gornera, the Alps of Statel, Vallon de Ferpecie, Hauf d'Arolla, Gouillie Borgne, and Val des Dix. (King-PTT)
W91-02049

CHARACTERISTICS OF COARSE WOOD DEBRIS FOR SEVERAL COASTAL STREAMS OF SOUTHEAST ALASKA, USA.
Oregon State Univ., Corvallis. Forest Research Lab.
For primary bibliographic entry see Field 4C.
W91-02063

MEASURING EPILITHIC BACTERIAL PRODUCTION IN STREAMS.
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-02070

SLOPE, ASPECT, AND PHOSPHOGYPSUM EFFECTS ON RUNOFF AND EROSION.
Soil Erosion Research Station, Natanya (Israel).
M. Agassi, I. Shainberg, and J. Morin.
Soil Science Society of America Journal SSSJD4, Vol. 54, No. 4, p 1102-1106, July/August 1990. 4 fig, 2 tab, 11 ref.

Descriptors: *Erosion, *Runoff, *Slope stability, *Slopes, *Soil amendments, *Soil erosion, *Soil stabilization, Erosion rates, Field tests, Israel, Phosphogypsum, Rain gages, Rainfall, Rainfall-runoff relationships.

The effect of slope, aspect (windward vs. leeward), and phosphogypsum (PG) application on rain amount, runoff, and erosion from a Grumusol soil (Typic Chromoxerert in Israel) was measured in small field plots (1 by 1.5 m) exposed to natural rainstorms. The amount of effective rain on the slopes, as measured with small rain gauges with orifices in a plane parallel to the slope, increased slightly on the windward aspect as slope increased to approximately 58% and decreased thereafter. On the leeward aspect, the amount of effective rain dropped steadily to half of the meteorological rain at a slope of 100%. The amount of runoff was not affected by slope on the windward aspect but decreased sharply on the leeward aspect as slope increased. PG releases electrolytes into the percolating and runoff water, prevents dispersion of the particles at the surface, stabilizes the soil structure and reduced soil erosion. PG applied at 5 Mg/ha reduced runoff to about 25% of that in the control and reduced soil loss to 1 to 3% of that in the control. The dramatic effect of PG on erosion increased with increased slope steepness. (Author's abstract)
W91-02139

STREAMFLOW DATA AND SURFACE-WATER RESOURCE ASSESSMENT - A QUANTITATIVE DEMONSTRATION OF NEED FOR ADEQUATE INVESTMENT IN DATA COLLECTION IN DEVELOPING COUNTRIES.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W91-02141

SIMILARITY AND LENGTH SCALE FOR SPATIALLY VARIED OVERLAND FLOW.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
P. Y. Julien, and G. E. Moglen.
Water Resources Research WRERAQ, Vol. 26, No. 8, p 1810-1832, August 1990. 10 fig, 2 tab, 35 ref. U. S. Army Research Grant ARO/DAAL 03-86-K-0175.

Descriptors: *Overland flow, *Precipitation, *Rainfall distribution, *Rainfall intensity, *Rainfall-runoff relationships, *Surface runoff, Finite element method, Infiltration, Roughness, Runoff, Scale factors, Spatial variability, Statistical methods, Storm runoff, Topography.

The influence of the spatial variability of rainfall precipitation, infiltration, surface roughness and surface topography on surface runoff characteristics has been widely recognized in hydrology. One-dimensional finite element models enable physically based investigations of overland flow generated under spatially varied surface slope, width, roughness, and excess rainfall intensity. Simulated results of 8400 dimensionless hydrographs under spatially varied input parameters indicate that runoff discharge variations depend primarily on the ratio of rainfall duration t(r) to the time to equilibrium t(e). Peak discharge distributions change drastically as the dimensionless rainfall duration t(r)/t(e) approaches unity. Similarity conditions exist for all four parameters regardless of whether the spatial variability is correlated or uncorrelated. A length scale function of not only the spatially averaged values of surface parameters but also depending upon rainstorm duration and intensity delineates similarity conditions for spatially varied surface runoff. For surface runoff lengths much shorter than this length scale, the rainfall-runoff relationship becomes nearly independent of the spatial variability in hydrologic parameters. Conversely, for surface runoff lengths exceeding the length scale, the rainfall-runoff relationship is sensitive to spatial variability. This length scale can serve as a basis for the determination of grid sizes in hydrologic models. (Author's abstract)
W91-02189

ANALYSIS OF WATER SURFACE AND FLOW DISTRIBUTION FOR THE DESIGN FLOOD AT A PROPOSED HIGHWAY CROSSING OF THE SABINE RIVER NEAR TATUM, TEXAS.
Geological Survey, Austin, TX. Water Resources Div.
J. J. Gilbert, and D. R. Myers.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4231, 1989. 36p, 18 fig, 5 tab, 11 ref.

Descriptors: *Design floods, *Design flow, *Finite element method, *Flow models, *Highway relocation, *Model studies, *Sabine River, *Texas, Flood plains, Floods, Model testing, Simulation, Tatum.

The hydraulic effects of the proposed Texas Highway 43 crossing of the Sabine River were determined using a two-dimensional finite-element surface-water flow model (FESWMS). In the planning of the crossing by the Texas State Highway Department, accurate approximations of apportionment of flow among the openings and velocities within the openings were of concern. The model was used to simulate flow in the river floodplain system for the proposed crossing design, an alternate crossing design, and for the natural conditions. The alternate design more closely represents the existing bridge widths. Preliminary one-dimensional computations were used as an aid in establishing the boundary conditions for the two-dimensional analysis. The simulations show that, among other things, a proposed lengthening of the right overflow bridge is not beneficial. The alternate design is one that does not include the proposed lengthening of the right overflow bridge or the proposed construction of a new embankment at the existing main channel opening. The results of the two-dimensional simulation of the proposed design indicate some differences in the apportionment of flow among the openings when compared to the one-dimensional proposed crossing computations. Simulations of the alternate crossing design resulted in water-surface altitudes which are slightly lower than the proposed design. The alternate design would require less modification to the existing embankment. Velocities computed at the bridge abutments using the two-dimensional model were within the design specifications of the Texas State Department of Highways and Public Transportation. (USGS)
W91-02226

SURFACE-WATER HYDROLOGY AND SALINITY OF THE ANCLOTE RIVER ESTUARY, FLORIDA.
Geological Survey, Tampa, FL. Water Resources Div.
M. Fernandez.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4046, Feb 1990. 44p, 25 fig, 6 tab, 12 ref. Project no. FL-414.

Descriptors: *Anclote River, *Estuaries, *Florida, *Saline-freshwater interfaces, Regression analysis.

Direct measurements of streamflow, tides, and salinity in the Anclote River Estuary, Florida were made during the period January 1984 through May 1986; historical streamflow was compared to that measured during the study; the influence of well-field pumpage on streamflow was evaluated; and regression relations between salinity, tide, and average daily streamflow were developed. Mean monthly streamflows during the study period generally were lower than the corresponding long-term monthly averages yet representative of flows that typically enter the estuary. The influence of pumpage from individual well fields in or near the basin on streamflow was not statistically significant; the influence of total well-field pumpage, however, was significant at the 5% level. The upstream daily location of 0.44-, 5.0-, 10-, and 18-parts-per-thousand (ppt) salinity was quantified using multiple regression techniques. Streamflow

used in the analysis ranged from 2.3 to 263 cu ft/sec, and high tides ranged from 0.25 ft below to 2.76 ft above sea level. Vertical salinity profiles indicated partially to well-mixed conditions throughout the estuary during the study period. Results of the regression analyses show that streamflow has a large effect on the location of the saltwater-freshwater interface (defined as 0.44 ppt salinity) as well as water having a salinity of 5.0 ppt. The location of water having salinities greater than 5.0 ppt is affected increasingly by tide, with a corresponding decrease in effect by streamflow. (USGS)
W91-02229

POTENTIAL HAZARDS FROM FLOOD-FLOWS IN GRAPEVINE CANYON, DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA AND NEVADA.
Geological Survey, Sacramento, CA. Water Resources Div.
J. C. Bowers.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4063, 1990. 19p, 2 fig, 3 tab, 7 ref, 1 plate.

Descriptors: *California, *Death Valley National Monument, *Flash floods, *Flood flow, *Flood frequency, *Flood recurrence interval, *Nevada, Arid-zone hydrology, Channel erosion, Cross-sections, Discharge, Drainage basins, Flood profiles, Grapevine Canyon, Inundation, Mudflows, Regional analysis, Scottys Castle.

Grapevine Canyon is on the western slope of the Grapevine Mountains in the northern part of Death Valley National Monument, California and Nevada. Grapevine Canyon Road covers the entire width of the canyon floor in places and is a frequently traveled route to Scotty's Castle in the canyon. The region is arid and subject to flash flooding because of infrequent but intense convective storms. When these storms occur, normally in the summer, the resulting floods may create a hazard to visitor safety and property. Historical data on rainfall and floodflow in Grapevine Canyon are sparse. Data from studies made for similar areas in the desert mountains of southern California provide the basis for estimating discharges and the corresponding frequency of floods in the study area. Results of this study indicate that high-velocity flows of water and debris, even at shallow depths, may scour and damage Grapevine Canyon Road. When discharge exceeds 4,900 cu ft/sec, expected at a recurrence interval of between 25 and 50 years, the Scotty's Castle access road and bridge may be damaged and the parking lot partly inundated. A flood having a 100-year or greater recurrence interval probably would wash out the bridge and present a hazard to the stable and garage buildings but not to the castle buildings, whose foundations are higher than the predicted maximum flood level. (USGS)
W91-02230

SUMMARY OF BIOLOGICAL INVESTIGATIONS RELATING TO SURFACE-WATER QUALITY IN THE KENTUCKY RIVER BASIN, KENTUCKY.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W91-02232

MASS-CONSERVING METHOD OF CHARACTERISTICS FOR STREAMFLOW MODELING.
Geological Survey, Tacoma, WA. Water Resources Div.
W. G. Sikonia.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-414, 1989. 75p, 11 fig, 1 tab, 14 ref.

Descriptors: *Computer models, *Mathematical models, *Model studies, *Open-channel flow, *Streamflow, *Unsteady flow, Differential equations, Finite element method, Hydrodynamics, Mathematical analysis, Numerical analysis, River flow.

A robust numerical model is presented for the computation of unsteady streamflow on steep river slopes. The one-dimensional model uses the method of characteristics on a specified space-time grid to solve the Saint-Venant equations. An additional continuity equation requirement on each space-time element provides greatly improved conservation of mass over traditional implementations of the method of characteristics on a fixed grid. The space-time geometry of the problem is described in a finite element setting. Hermite interpolation of channel parameters is used to avoid numerical difficulties that may occur with steep slopes due to discontinuities in the derivatives of data such as channel top width. Manning's equation for friction slope can be modified by a factor to make the slope more appropriate for steep rivers. The standard Manning's friction slope can also be used, if preferred. The computer model is not restricted to steep slopes, and applies as well to gently sloping streams. Two numerical examples support the mathematical approach and computational algorithm. (USGS)
W91-02234

BIBLIOGRAPHY OF U.S. GEOLOGICAL SURVEY REPORTS ON THE WATER RESOURCES OF FLORIDA, 1886-1989.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 10C.
W91-02237

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1989, VOLUME 3B: SOUTHWEST FLORIDA GROUND WATER.
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02240

WATER RESOURCES DATA FOR UTAH, WATER YEAR 1989.
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02241

IMPROVED METHODS FOR REGIONAL FLOOD FREQUENCY ANALYSIS.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. D. Salas, D. C. Boes, D. C. Cunnane, S. Guo, and L. Cadavid.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-235334/AS. Price codes: A06 in paper copy, A01 in microfiche. Hydrology and Water Resources Program, Final Report, March 1990. 113p, 32 fig, 12 tab, 77 ref, 2 append. USGS Contract no. 14-08-0001-G1285.

Descriptors: *Estimating, *Flood frequency, *Frequency analysis, *Prediction, *Regional floods, Arkansas River Basin, Colorado, Colorado River Basin, Flood data, Illinois, Model studies, Planning, Regional analysis, Rio Grande Basin.

The overall objective of the research has been to develop flood frequency models and estimation methods for prediction of floods at gaged and ungaged watersheds. Several topics were studied under this project including, estimation of Pearson III model, properties and estimation of non-conventional distributions such as mixture models, and regional maximum likelihood estimation (MLE). In addition, applications to flood data in Colorado and Illinois regions were made. Population moments, moment-ratio diagrams and separation conditions of mixture and two-component product models were studied. New families of mixture of quantile models as well as estimation based on censored MLE for mixture models were developed. Likewise, moment and MLE procedures for estimating the Box-Cox transformation parameter were derived. Results based on simulation experiments indicated that regional MLE may be beneficial in estimating flood quantiles at a given site as compared to at site estimates or estimates derived by alternative least square methods, under the assumption of a reliable regional parametric structure. However, as the parametric structure becomes unreliable, the benefits of regional MLE become less apparent. Likewise, in comparing regional MLE with generalized least squares methods based on observed flood data, results indicate that both methods perform about the same. (USGS)
W91-02243

PREPARATION OF AVERAGE ANNUAL RUNOFF MAP OF THE UNITED STATES, 1951-80.
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02247

FLOODS OF FEBRUARY 1989 IN TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 4A.
W91-02260

WATER RESOURCES DATA FOR ARKANSAS, WATER YEAR 1989.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02261

GENERAL CHARACTERISTICS OF SURFACE HYDROLOGY IN ARID AND SEMI-ARID AREAS OF AFRICA AND THEIR CONSEQUENCES FOR DEVELOPMENT (CARACTERES GENERAUX DE L'HYDROLOGIE SUPERFICIELLE DES ZONES ARIDES ET SEMI-ARIDES EN AFRIQUE: LEURS CONSEQUENCES SUR LES ETUDES DES INGENIEURS).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Paris. Service Hydrologique.
J. A. Rodier.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 15-34, 7 fig, 2 tab, 38 ref. English summary.

Descriptors: *Africa, *Arid lands, *Flood hydrographs, *Floods, *Rainfall-runoff relationship, *Semiarid lands, Climates, Infiltration, Mathematical models, Prediction, Regression analysis, Statistical analysis.

Although many hydrological characteristics are the same for all arid zones, tropical Africa presents particular characteristics: well-defined rainy season, simple storm intensity patterns, high temperatures, impervious crust on many soils reducing infiltration, large part of the soil without cultivation, and few and very sparse hydrometric networks. This situation dictates certain approaches to estimating the 10-yr flood and mean annual discharge and its distribution for small and relatively small basins. In the absence of network data, precipitation series are used as a statistical basis combined with the transformation of precipitation into discharges analyzed in representative basins and transposed for unknown basins. Global models are used for the heterogeneity problems. For the 10-yr flood, the approach is deterministic and uses broadly the unit hydrograph, the flood flow being for most cases surface runoff. The product function often is simple, the storm pattern being generally the same and the precipitation depth by far the most important factor in runoff depth. In the past, empirical curves have been established giving the runoff coefficient for the 10-yr precipitation from the basin area, slope global index, and infiltrability class. For very small basins, the curves (revised in 1986) give the runoff coefficient for daily precipitation from 70 mm and 100 mm depth. A catalog of quantitative infiltrability of

surfaces makes the infiltrability classification more reliable. The transfer function corresponds to the unit hydrograph. For the transposition, empirical curves give the rise time, base time, and the peak coefficient in relation to slope area secondary factors using a checklist. The large number of representative basins permits the cautious use of multiple regression. This methodology, which presents some limitations (hydrographic degeneration), will be improved by the use of the catalog and of a checklist of the factors neglected by the regressions. The methodology can be employed for the transposition of statistical distribution of annual runoff depths. (See also W91-02288) (Author's abstract)
W91-02290

TOWARDS A REGIONAL WATER RESOURCE STUDY OF ARID AND SEMI-ARID AFRICA.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2A.
W91-02295

IMPACT OF SOIL SURFACE DETERIORATION ON RUNOFF PRODUCTION IN THE ARID AND SEMI-ARID ZONES OF WEST AFRICA.
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lome (Togo). Centre ORSTOM du Togo.
For primary bibliographic entry see Field 4C.
W91-02296

SURFACE FEATURES: ONE OF THE KEY ELEMENTS OF SAHELIAN HYDROLOGY (LES ETATS DE SURFACE: UNE DES CLEFS DE L'HYDROLOGIE SAHELIENNE).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lome (Togo). Centre ORSTOM du Togo.
For primary bibliographic entry see Field 2A.
W91-02297

ANALYSIS OF DROUGHT IN ETHIOPIA BASED ON NILE RIVER FLOW RECORDS.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2A.
W91-02299

PREDETERMINATION OF FLOODS IN SMALL SAHELIAN BASINS UNDER 10 SQUARE KILOMETERS (LA PREDETERMINATIONE DES CRUES SUR DES PETITS BASSINS SAHELIENS INFERIEURS A 10 KM2).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Montpellier. Centre de Montpellier.
P. Ribstein, and J. A. Rodier.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 222-232, 11 ref. English summary.

Descriptors: *Africa, *Arid lands, *Flood forecasting, *Flood peak, *Floods, *Sahel, *Semiarid lands, *Ungaged streams, Estimating equations, Fictitious basin concept, Infiltration, Rainfall-runoff relationships, Unit hydrographs.

Practical rules were developed for the estimation of peak discharge of the 10-yr flood on ungauged basins under 10 sq km in the Sahel, West Africa. This work was carried out on 29 representative Sahelian catchments. Problems of flood estimation in the Sahel are presented and original aspects of the procedure are pointed out. The estimation of the 10 yr flood uses observed data, the runoff coefficient, and the unit hydrograph parameters. The use of the fictitious basin concept was employed for the survey of the whole variation field of the hydrograph characteristics in relation to four main factors: area, 10-yr rainfall depth, slope, and infiltrability. The method can be employed in conjunction with a questionnaire to take into account possible extreme values of other runoff factors of possible significant influence. (See also W91-02288) (Author's abstract)
W91-02305

USE OF THE GOULD PROBABILITY MATRIX METHOD OF RESERVOIR DESIGN IN ARID AND SEMI-ARID REGIONS.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 8A.
W91-02306

UNIT HYDROGRAPH TECHNIQUE APPLIED TO SAHELIAN FLOOD MODELING: COMPARISON OF DIFFERENT IDENTIFICATION METHODS (L'HYDROGRAMME UNITAIRE APPLIQUE A L'ANALYSE DES CRUES AU SAHEL: COMPARAISON DE DIFFERENTES METHODES D'IDENTIFICATION).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Montpellier. Centre de Montpellier.
P. Ribstein, and T. Lebel.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 267-279, 7 fig, 1 tab, 11 ref. English summary.

Descriptors: *Africa, *Flood forecasting, *Flood hydrographs, *Floods, *Model studies, *Sahel, *Unit hydrographs, Catchment areas, Comparison studies, Performance evaluation, Spatial distribution, Spatial variation.

Sahelian floods are caused by heavy convective rainfall displaying some homogeneity at the small watershed scale. For that reason, and because there is no groundwater flow, the unit hydrograph (UH) is well suited to modeling of Sahelian floods. Three UH identifying methods were compared: the Nash UH, a recursive least square (RLS) identification of an autoregressive model with exogenous input (ARX), and the so-called DPFT (Difference Premiere de la Fonction de Transfert), an iterative deconvolution process. The comparison was based on data from two watersheds of less than 20 sq km and it permits an examination of the validity of the UH concept as applied to the Sahelian floods. The influence of the calibration sample and of the analytic formulation of the production function on the coefficients of the linear transfer function also were studied. In this regard, the DPFT seems to be the most objective of the methods studied. According to the methods used, the UH which were identified were obviously different, but the essential problem remains that of selecting the analytical expression of the production function, especially when the rains present an important spatial variability. (See also W91-02288) (Author's abstract)
W91-02309

USE OF A DISTRIBUTED MODEL OF A SMALL SAVANNAH CATCHMENT (BOOROBOROTOU, IVORY COAST) UTILISATION D'UN MODELE DISTRIBUE SUR UN PETIT BASSIN VERSANT DE SAVANE (BOOROBOROTOU, COTE D'IVOIRE).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Montpellier. Centre de Montpellier.
For primary bibliographic entry see Field 2A.
W91-02310

ANALYSIS OF THE SPEED OF PROPAGATION OF FLOOD WAVES (ANALYSE DE LA VITESSE DE PROPAGATION DES ONDES DE CRUES).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Dakar (Senegal). Centre de Dakar.
J.-P. Lamagat.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 291-305, 10 fig, 4 tab. English summary.

Descriptors: *Flood forecasting, *Flood waves, *Floods, *Model studies, *Wave propagation, Flood hydrographs, Gambia River, Mathematical analysis, Mathematical models, Niger River, Simulation, St Venant equation.

Analysis of the speed of propagation of flood waves was perfected to set up a model of flood propagation for the River Niger. The analytical methodology developed has led to numerous applications, now in almost daily use. These include: anticipating flow, simulation, real-time management of developments, and height-discharge transformation (non bi-univocal stations). The development of this methodology is described here and each application of the analysis is present in the form of a concrete example. These examples include: a model of the Niger flood propagation in the Koulikoro/Kemacina reach; reconstruction of the Gambia River flow at Kouncy; anticipated management flow for the OMVS Management's communal installations at Manantali Dam; and graduation at Boghe station on the Senegal River. A brief summary of the hydraulic elements used to develop the methodology and a diagrammatic approach to it based on St. Venant's equation are presented as well. (See also W91-02288) (Author's abstract)
W91-02311

HYDRAULIC WORKING OF SHALLOW WATERS IN WEST AFRICA (FONCTIONNEMENT HYDROLOGIQUE DES BAS FONDS EN AFRIQUE DE L'OUEST).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Dakar (Senegal). Centre de Dakar.
For primary bibliographic entry see Field 4A.
W91-02314

UTILIZATION OF THE ARGOS SYSTEM WITHIN THE FRAMEWORK OF THE HYDROMETRIC NETWORK OF BENIN (L'UTILISATION DU SYSTEME ARGOS DANS LE CADRE DU RESEAU HYDROMETRIQUE BENINOIS).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Niamey (Niger). Mission ORSTOM au Niger.
For primary bibliographic entry see Field 7B.
W91-02340

GLOBAL MODELLING OF THE RAIN-RUNOFF RELATIONSHIP: A TOOL FOR EVALUATION OF WATER RESOURCES (MODELISATION GLOBALE DE LA RELATION PLUIE DEBIT: DES OUTILS AU SERVICE DE L'EVALUATION DES RESSOURCES EN EAU).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Abidjan (Ivory Coast). Centre ORSTOM d'Adiopodoume.
E. Servat, and A. Dezetter.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 739-749, 5 fig, 2 tab, 10 ref.

Descriptors: *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Water supply development, Burkina Faso, Computer programs, Management planning, Mathematical models, Tunisia.

Operational versions are described of two conceptual and deterministic models for the rainfall-runoff relationship: CREC and MODGLO. These models are intended to serve as real tools for water project managers. The informatics structure as it applies to microcomputers is emphasized, with a minimum of theoretical discussion. For each model, the productional and transfer functions are discussed and methods for determing parameter values are briefly considered. Programming examples are given. Entries are available for 10-day periods, months, and/or years in the form of tables and graphs to permit the comparison of computed and observed data. Applications are presented for a catchment in

Tunisia and two in Burkina Faso. (See also W91-02288) (Author's abstract)
W91-02349

SCIENTIFIC AND TECHNICAL EVALUATION OF MATHEMATICAL MODELS IN THE PLANNING DESIGN AND OPERATION OF HYDROSYSTEMS IN AFRICA.
New Tech International Inst., Dar es Salaam (Tanzania).
A. R. Mfutakamba.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 750-771, 22 ref.

Descriptors: *Africa, *Design criteria, *Floods, *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Reservoir design, Comparison studies, Dams, Flood forecasting, Mathematical models, Nile River, Performance evaluation, Prediction, Reservoirs, Reviews, Runoff forecasting, Spillways, Stochastic process, Water resources management.

Determination of design and construction floods is critical in the choice of spillway, outlet, and reservoir design, operation, and management, and maintenance of any hydrosystem. Operation security providing a reliable flood warning system and the ability to predict high floods require that valid assumptions be made in the development and application of stochastic and deterministic models for prediction and forecasting. The need for models in the planning, design, operation, and management of water resources systems is discussed. General considerations on river basin models are delineated and some models that have been applied to the River Nile and equatorial lakes in Africa are evaluated. Limitations were identified in the Sacramento Model, Stanford Watershed Model IV, Queen's University Forecasting Model, and Streamflow Synthesis and Reservoir Regulation Model. A real-time runoff forecasting technique was developed that incorporates the soil-plant-atmospheric continuum as a way of facilitating a more realistic prediction and forecasting for use in Africa and elsewhere. The model is basically a conceptual water balance model that eliminates the problems encountered by other models through the complex soil-plant-atmosphere continuum. The model has been implemented successfully for Big Creek River basin in eastern Ontario and implementation is now in progress for the river basins Nile and Rufiji (northern and eastern Africa), Zambezi (southern Africa), and Niger (western Africa). (See also W91-02288) (Rochester-PTT)
W91-02350

TELETRANSMISSION OF HYDROLOGICAL DATA WITHIN THE FRAMEWORK OF THE PROGRAMME TO COMBAT ONCHOCERCIASIS (TELETRANSMISSION DES DONNEES HYDROLOGIQUES DANS LE CADRE DU PROGRAMME DE LUTTE CONTRE L'ONCHOCERCOSE).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lome (Togo). Centre ORSTOM du Togo.
For primary bibliographic entry see Field 7B.
W91-02353

HYDROLOGY AND RIVER CONTROL ON THE NIGER AND SENEGAL.
Gibb (Alexander) and Partners Ltd., Reading (England).
J. V. Sutcliffe, and J. B. C. Lazenby.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 846-856, 7 fig, 2 tab, 4 ref.

Descriptors: *Arid lands, *Floods, *Flow augmentation, *Niger River, *Senegal River, *Storage reservoirs, *Water resources management, Flood control, Flood plains, Hydroelectric plants, Hydrology, Irrigation water, Low flow, Mali, Mauritania, Navigation, Rainfall-runoff relationships, Reservoir operation, Seasonal distribution, Senegal, Water supply.

The Niger and Senegal rivers are extremely important sources of water for the semi-arid regions in West Africa, and a knowledge of their characteristics and the potential for control is vital for Mali, Senegal, and Mauritania in particular. These rivers exhibit extremely variable flows on seasonal and longer-term scales because rainfall in the headwaters, which provide the areas of runoff, is highly seasonal and variable. The river flows reflect the rainfall and contribute a source of water to arid areas that varies between intense flooding and extreme low flows. The seasonal inundation of riverine floodplains forms the basis of traditional land use, but reservoir storage offers the maintenance of dry season flows and thus the supply of water for hydroelectric power production, irrigation, and improved navigation conditions. The combination of these objectives, achieved by using storage projects for the maintenance of an artificial flood is illustrated by reservoir operation in different years. (See also W91-02288) (Rochester-PTT)
W91-02358

ENVIRONMENTAL AND AGRICULTURAL IMPLICATIONS OF DAM CONSTRUCTION IN THE NIGER VALLEY OF MALI.
Gesamthochschule Paderborn (Germany, F.R.).
For primary bibliographic entry see Field 6G.
W91-02359

IMPACT OF CLIMATIC CHANGES ON SURFACE WATER RESOURCES IN WEST AND CENTRAL AFRICA (IMPACT DES CHANGEMENTS CLIMATIQUES SUR LES RESSOURCES EN EAU DE SURFACE EN AFRIQUE DE L'OUEST ET CENTRALE: L'EXPERIENCE DE L'OSTROM).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Paris.
For primary bibliographic entry see Field 7A.
W91-02368

ANNUAL AND LONGITUDINAL CHANGES IN THE ENVIRONMENTAL CONDITIONS IN THREE CONSECUTIVE RESERVOIRS OF THE GUADIANA RIVER (W. SPAIN).
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W91-02372

SPATIAL ORGANIZATION AND POPULATION DENSITY OF THE FISH COMMUNITY OF THE LITTER BANKS WITHIN A CENTRAL AMAZONIAN BLACKWATER STREAM.
Central Electricity Generating Board, Fawley (England). Marine Biological Unit.
For primary bibliographic entry see Field 2H.
W91-02414

PHYSICAL, CHEMICAL AND HYDROGRAPHIC INVESTIGATIONS OF AN UPLAND STREAM: A CONTRIBUTION ON THE STANDARDIZATION OF SMALL WATERCOURSES (PHYSIKALISCHE, CHEMISCHE UND HYDROGRAPHISCHE UNTERSUCHUNGEN EINESC MITTELGEBIRGSBACHES: EIN BEITRAG ZUR TYPISIERUNG KLEINER FLIESSGEWASSER).
Konstanz Univ. (Germany, F.R.). Limnological Inst.
E. Meyer, J. Schwoerbel, and G. C. Tillmanns.
Aquatic Sciences AQSCEA, Vol. 52, No. 3, p 236-255, 1990. 9 fig, 7 tab, 30 ref. English summary.

Descriptors: *Stream discharge, *Stream profiles, *Streams, *Water chemistry, *Water temperature, Ammonium, Conductivity, Germany, Organic matter, Phosphates, Phosphorus, Seasonal variation.

Temperature, discharge, and chemical parameters were studied in the upper reach of a Black Forest stream (Germany) over a three-year period. Additionally, investigations of the upstream tributaries and of downstream sites were conducted at some occasions. While monthly and annual means of water temperature exhibited only little year-to-year variations, average annual discharge differed considerably. Total suspended organic matter was correlated to total suspended solids and discharge, orthophosphate and ammonium to temperature. Phosphorus was the only nutrient with a strong seasonal dynamic. Cumulative surface runoff of the upstream tributaries was inversely correlated to total discharge at the gauging station. Concentrations of Ca(2+) and Mg(2+) and accordingly, specific conductivity, increased in the longitudinal course of the stream, due to tributaries originating in the adjacent shell limestone and red marl formations. (Author's abstract)
W91-02449

FLUVIAL DYNAMICS AND SUCCESSION IN THE LOWER UCAYALI RIVER BASIN, PERUVIAN AMAZONIA.
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lima (Peru). Mission ORSTOM au Perou.
S. Lamotte.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 141-156, June 1990. 3 fig, 6 tab, 41 ref.

Descriptors: *Flood plains, *Fluvial sediments, *Forest ecosystems, *Peru, *Soil-water-plant relationships, *Ucayali River Basin, *Wetlands, Flooding, Reforestation, Vegetation.

During annual flooding of the Amazonian valley the sediment load of the river, resulting fron Andean erosion, is deposited into the river floo basin. In Peruvian Amazonia, the successiona vegetation on both the Putumayo River alluvia floodplain and the Madre de Dios River basin hav been described; there is little available informatio concerning the forested areas of these wetlands. I the alluvial floodplain of the Ucayali River valley a succession is evident on the convex banks. O the episodically flooded ridges, graminaean, shrub by, and arborescent pioneer stages develop. In th swales, which are flooded annually, a graminaea stage preceeds two shrubby pioneer stages. In ger eral, vegetation, growth, and survival is sensitiv to flood time, with the Moraceae evident as th most important pioneer species. In general, a rel tionship between textural soil features and vegeta tion development was apparent only at the begi ning of the succession. Species distribution profile indicated four degrees of perturbation: occasion flooding, annual short flooding, annual long floo ing, and annual vegetation submersion. If suc changes persist, both the structural and florist features of the flooded forests could be modifie potentially diminishing their future species divers ty. (D'Agostino-PTT)
W91-02480

SOUTHWESTERN RIPARIAN PLANT COM MUNITIES: SITE CHARACTERISTICS, TRE SPECIES DISTRIBUTIONS, AND SIZE-CLAS STRUCTURES.
Rocky Mountain Forest and Range Experime Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 2H.
W91-02491

GROWTH AND DEVELOPMENT OF BAL CYPRESS/WATER-TUPELO STANDS UNDI CONTINUOUS VERSUS SEASONAL FLOO ING.
Louisiana State Univ., Baton Rouge. School Forestry, Wildlife and Fisheries.
S. G. Dicke, and J. R. Toliver.
Forest Ecology and Management FECMDW, V 33/3, No. 1/4, p 523-530, June 1990. 4 tab, 9 r

Descriptors: *Baldcypress trees, *Floodi *Forest ecosystems, *Swamps, *Tupelo tre *Wetland forests, *Wetlands, Ecological effe Flood control, Plant growth, Water resour management.

The bald cypress and water tupelo are the predominant timber species in many flooded areas in the forested wetlands of the southeastern United States. Due to the projected trends of delta subsidence, sea-level rise, and human flood control measures, these species will be exposed to longer flooding durations. Information on their growth response to these changing conditions is necessary to ensure their future survival. The influence of flooding on mixed stands of bald cypress (Taxodium distichum) and water tupelo (Nyssa aquatica) was investigated using two second-growth stands, one continuously flooded (CF) and the other seasonally flooded (SF). In the SF stand, the large bald-cypress was fast-growing, whereas, the water tupelo exhibited high mortality rates. In contrast, bald-cypress growth was slower in the CF stands, and the water tupelo rate was slightly faster. As a result, although the water tupelo lost basal area in the SF stand, it was more competitive against the bald-cypress in the CF stand. While a mixture of the two species will potentially be retained under conditions of constant flooding, seasonal flooding may eliminate the water tupelo from the site. (D'Agostino-PTT)
W91-02499

COMPARATIVE STUDY OF THE RESPONSE OF TAXODIUM DISTICHUM AND NYSSA AQUATICA SEEDLINGS TO SOIL ANAEROBIOSIS AND SALINITY.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
S. R. Pezeshki.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 531-541, June 1990. 3 fig, 1 tab, 27 ref. Supported by the Louisiana Educational Quality Support Fund, Grant No. LEQSF (1987-90)-RD-A7.

Descriptors: *Anaerobic conditions, *Flooding, *Forest ecosystems, *Mississippi River, *Saline water intrusion, *Salinity, *Soil-water-plant relationships, *Swamps, *Wetland forests, *Wetlands, Baldcypress trees, Coastal environment, Land management, Plant growth, Tupelo trees.

Recent observations in Mississippi River swamp forests indicate that the combined adverse conditions of anaerobiosis, from soil flooding, and increased salinity may potentially eliminate flood tolerant tree species that are salt-sensitive. A comparison of Taxodium distichum and Nyssa aquatica seedling survival demonstrated that anaerobiosis alone resulted in a greater reduction of carbon assimilation rates in T. distichum than in N. aquatica. In a similar response, the combined stress of anaerobiosis and salinity resulted in carbon assimilation rates which decreased 46% in T. distichum and 24% in N. aquatica. Based on height growth, both species appear to have the same level of sensitivity, namely a 56% height growth reduction in T. distichum and a 54% height growth reduction in N. aquatica. Both species are also salt-sensitive. From the combined data, it was concluded that both seedling survival and regeneration will be adversly affected in coastal forests where salt water intrusion frequently occurs. (D'Agostino-PTT)
W91-02500

ASSESSMENT OF BANK SLOPE AS A PREDICTOR OF CONSERVATION STATUS IN RIVER CORRIDORS.
University Coll., Cardiff (Wales). School of Pure and Applied Biology.
For primary bibliographic entry see Field 2H.
W91-02516

DISTRIBUTION OF CALIFORNIA STREAM FISHES: INFLUENCE OF ENVIRONMENTAL TEMPERATURE AND HYPOXIA.
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 2H.
W91-02518

WATERSHED DELINEATION WITH TRIANGLE-BASED TERRAIN MODELS.
Texas Univ. at Austin. Dept. of Civil Engineering.
N. L. Jones, S. G. Wright, and D. R. Maidment.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 10, p 1232-1251, October 1990. 13 fig, 4 tab, 17 ref. NSF Grant MSM-8717452.

Descriptors: *Drainage patterns, *Flow models, *Flow pattern, *Geomorphology, *Model studies, *Surface flow, *Watersheds, Algorithms, Computer models, Computers, Flow channels, Streamflow.

An algorithm is presented for tracing the path of steepest descent from a given starting point on a terrain model defined by a triangulated irregular network. This algorithm is then extended to solve several problems. The flow patterns for a site are generated by tracing flow paths from a large number of starting points. The approximate stream network or channel network is found by tracing the channels upstream from pits or exit points. Once the stream network is found, the source areas or contributing areas for each of the sections of the stream are delineated. The source areas are then used to delineate the watersheds of selected nodes in the channel network. The watersheds of any of the delimiting nodes of the two models tested could be computed and drawn in 1-2 sec or less. The algorithms described are useful for tracing the path of drainage over the terrain surface from points of origin, in the design of site grading, and for generating the geometry required for finite element modeling of surface water flow. (MacKeen-PTT)
W91-02525

MISSISSIPPI RIVER-GULF OUTLET, LOUISIANA: FIELD DATA REPORT.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
T. L. Fagerburg.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report HL-90-7, August 1990. 172 p, 54 plates, 70 tab.

Descriptors: *Hydrologic properties, *Louisiana, *Mississippi River, *Shoals, *Suspended sediments, Canals, Flow velocity, Lake Borgne, River flow, Salinity, Water level.

Water levels, current speeds and directions, salinities, and suspended sediment concentrations were measured in the Mississippi River-Gulf Outlet Canal (MRGO), New Orleans, LA, in October and November 1988. The prototype data were collected as part of a study to incorporate these data in a numerical model for determination of shoaling rates. The following observations were made: (1) there appears to be a slight decrease in the maximum range of water surface elevation (0.12 ft) from the Chandeleur Sound location to the upper reaches of Lake Borgne; (2) the maximum velocities observed during the surveys occurred at the strength of flood periods. The maximum observed velocity was 3.6 ft/sec at one station on 26 October; (3) suspended sediment concentrations within the MRGO channel were found to be generally greater near the bottom during the strength of flood periods. The suspended sediment concentrations within Lake Borgne were high (106 to 283 mg/L) during windy periods and low (5 to 64 mg/L) during calm periods; (4) salinity values indicated that the lower portion of the MRGO could be described as being partly mixed to well mixed, while the upper portions could be described as being generally well mixed; and (5) correlation of suspended sediment data with satellite data were not successful due to cloud cover during the periods data were obtained. (Lantz-PTT)
W91-02604

WATER RESOURCES FOR CALIFORNIA, WATER YEAR 1989, VOLUME 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02624

WATER RESOURCES FOR FLORIDA, WATER YEAR 1989, VOLUME 2A. SOUTH FLORIDA - SURFACE WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02625

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1989, VOLUME 2B. SOUTH FLORIDA - GROUND WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02626

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1989, VOLUME 3A: SOUTHWEST FLORIDA SURFACE WATER.
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02627

WATER RESOURCES FOR CALIFORNIA, WATER YEAR 1989, VOLUME 4: NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02628

WATER RESOURCES DATA FOR MASSACHUSETTS AND RHODE ISLAND, WATER YEAR 1988.
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02629

WATER RESOURCES DATA FOR MISSOURI, WATER YEAR 1989.
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02630

WATER RESOURCES DATA FOR MONTANA, WATER YEAR 1989.
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02631

WATER RESOURCES DATA FOR NEW JERSEY, WATER YEAR 1989, VOLUME 1: ATLANTIC SLOPE BASINS, HUDSON RIVER TO CAPE MAY.
Geological Survey, West Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02632

WATER RESOURCES DATA FOR NEW JERSEY, WATER YEAR 1989, VOLUME 2: DELAWARE RIVER BASIN AND TRIBUTARIES TO DELAWARE BAY.
Geological Survey, West Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02633

WATER RESOURCES DATA FOR NEW YORK, WATER YEAR 1989, VOLUME 2: LONG ISLAND.
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02634

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1989. VOLUME 2: SUSQUEHANNA AND POTOMAC RIVER BASINS.
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02635

WATER RESOURCES DATA FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS, WATER YEAR 1989.
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02636

WATER RESOURCES DATA FOR SOUTH CAROLINA, WATER YEAR 1989.
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02637

WATER RESOURCES DATA FOR SOUTH DAKOTA, WATER YEAR 1989.
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02638

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1989. VOLUME 2: SAN JACINTO RIVER, BRAZOS RIVER, SAN BERNARD RIVER BASINS AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02639

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1989. VOLUME 3: COLORADO RIVER, LAVACA RIVER, GUADALUPE RIVER, NUECES RIVER, RIO GRANDE BASINS AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02640

WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1989.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02641

PRELIMINARY ANALYSIS OF WATER AND SOLUTE MOVEMENT BENEATH A CONIFEROUS HILLSLOPE IN MID-WALES, U. K.
Polytechnic South West, Plymouth (England). Dept. of Geographical Sciences.
N. A. Chappell, J. L. Ternan, A. G. Williams, and B. Reynolds.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 201-215, August 1990. 9 fig, 34 ref. Natural Environment Research Council (NERC) Student Grant GT4/AAPS/86/41.

Descriptors: *Acid rain, *Forest hydrology, *Geochemistry, *Ion transport, *Soil chemistry, *Solute transport, *Surface-groundwater relations, *Wales, *Weathering, Aluminum, Conifers, Fish populations, Groundwater movement, Hydrogen ion concentration, Perched water table, Potable water, Slopes, Soil water, Storm runoff, Streamflow, Water quality.

Streams draining coniferous forests are often loaded with solutes such as hydrogen ion, sulfate, nitrate and aluminum. As a result, fish populations can be reduced and water quality may fall below recommended potable standards. The transport of ions into water-courses is governed by the movement of water. Within most temperate and tropical areas the stream discharge and chemistry, during periods of rapid runoff, is dominated by the exfiltration of water and solutes from stream-side soils. The movement of water to stream-side or riparian areas remains, however, an enigma. Two analytical techniques, the free-surface method and tangent-continuity method, are applied to hydrological properties monitored on a steep coniferous hillslope, during a selected storm event. Comparison of the ionic concentrations of waters within each component of the hydrological systems, is used to verify the hydrological analysis. Perched water-tables developed within the basal zones of the O/Ah and Eag soil horizons of the steep podzolic hillslopes, during all major storm events. Most of the rapid response within the riparian zone could be explained by lateral flow in these near-surface soil horizons, particularly in the saturated basal zones. This pathway is corroborated by the similarity of riparian zone and near-surface (or topsoil) chemistries. Relatively low concentrations of monomeric aluminum and relatively high concentrations of chloride, sodium and hydrogen ion were observed within these zones, compared with the subsoil (Bsl and B/C) horizons. (Author's abstract)
W91-02746

STORMFLOW HYDROCHEMISTRY OF A SMALL WELSH UPLAND CATCHMENT.
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 2K.
W91-02748

CONSERVATIVE MIXING OF WATER SOURCES: ANALYSIS OF THE BEHAVIOUR OF THE ALLT A'MHARCAIDH CATCHMENT.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W91-02756

BLACKWATER PERSPECTIVE ON RIVERINE ECOSYSTEMS.
Georgia Univ., Athens. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-02778

VELOCITY-DISCHARGE RELATIONSHIPS IN THREE LOWLAND RIVERS.
Sheffield Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W91-02807

LARGE-SCALE FLOODPLAIN MODELLING.
Hydrologic Engineering Center, Davis, CA.
D. M. Gee, M. G. Anderson, and L. Baird.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 6, p 513-523, September 1990. 6 fig, 20 ref, append.

Descriptors: *Finite element method, *Flood forecasting, *Flood plains, *Flooding, *Model studies, *Sediment transport, Bed-load discharge, Flood discharge, Flood flow, Flood plain sediments, Flow models, Marshes.

With respect to both discharge and sediment load, the flood plain environment is one of increasing geomorphological attention. A two-dimensional horizontal finite element numerical model (RMA-2) was applied to a 24-km river channel-flood plain reach in West Germany. Initial results indicate that finite element schemes may successfully estimate the depth and lateral extent of inundation in large-scale flood plain applications. The model was found to be robust against field uncertainty in flood plain roughness estimation. Stability of solutions for wetting and drying of large areas was greatly improved by use of the 'marsh' element option. Potentially, the resulting detailed velocity vector distributions and identification of inundation zones throughout storm events could provide an insight into the present day sedimentary environment on the flood plain. (Fish-PTT)
W91-02808

FLOOD DYNAMICS OF A CONCRETE-LINED, URBAN STREAM IN KANSAS CITY, MISSOURI.
Jacksonville State Univ., AL. Dept. of Geography and Geology.
For primary bibliographic entry see Field 4C.
W91-02809

SEASONAL CHANGES IN IRON TRANSPORT AND NATURE OF DISSOLVED ORGANIC MATTER IN A HUMIC RIVER IN NORTHERN FINLAND.
Oulu Univ. (Finland). Dept. of Botany.
For primary bibliographic entry see Field 2K.
W91-02810

RUNOFF GENERATION IN A SANDY AREA--THE NIZZANA SANDS, WESTERN NEGEV, ISRAEL.
Hebrew Univ., Jerusalem (Israel). Inst. of Earth Sciences.
For primary bibliographic entry see Field 2A.
W91-02811

OBSERVATIONS OF THE NIAGARA RIVER THERMAL PLUME (LAKE ONTARIO, NORTH AMERICA).
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
A. K. Masse, and C. R. Murthy.
Journal of Geophysical Research (C) Oceans JGRCEY, Vol. 95, No. 9, p 16,097-16,109, September 15, 1990. 15 fig, 1 tab, 29 ref. National Water Research Institute Grant No. NKW405-8-2258/01-SE.

Descriptors: *Lake Ontario, *Niagara River, *Water temperature, Advection, Great Lakes, Seasonal variation, Thermal stratification, Tidal hydraulics, Upwelling, Water circulation.

Temperature and velocity data are used to describe the Niagara River discharge into Lake Ontario between April and November 1982. The Niagara River discharge (7000 cu m/s) is usually slightly warmer and therefore less dense than the ambient lake surface water. The density difference varies throughout the year, with the largest density differences being measured in October. Near the river mouth, where the fluid speeds are roughly 1 m/s, the plume is vertically homogeneous. Here advective forces dominate the momentum balance, even in the presence of strong wind forcing. Approximately 5 km off shore, the plume separates from the lake bottom as the water depth increases and buoyancy forces become important. At the offshore boundary of the plume, advection, Coriolis force, buoyancy, and wind stress are all important. The Coriolis effect acts to turn the plume anticyclonically and form a right bounded coastal current with speeds of 0.1-0.2 m/s. Strong upwelling favorable winds force the buoyant plume to spread offshore, thinning the plume as it spreads. Eventually, the plume water is mixed with the lake water by the wind. Strong downwelling-favorable winds concentrate the plume into a narrow and deep coastal current traveling downwind with the coast on its right. Thus, exchange between the plume and the lake is enhanced by upwelling-favorable winds and inhibited by downwelling-favorable winds. (Author's abstract)
W91-02832

SEASONAL DYNAMICS IN METHANE EMISSIONS FROM THE AMAZON RIVER FLOODPLAIN TO THE TROPOSPHERE.
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 2H.
W91-02834

METHANE FLUX FROM THE AMAZON RIVER FLOODPLAIN: EMISSIONS DURING RISING WATER.
College of William and Mary, Williamsburg, VA. Dept. of Biology.
For primary bibliographic entry see Field 2H.

W91-02837

LOW FLOW ESTIMATION BASED ON RIVER RECESSION RATE.
Clyde River Purification Board, East Kilbride (Scotland).
J. C. Curran.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 4, p 350-355, August 1990. 6 fig, 11 ref, 2 append.

Descriptors: *Data interpretation, *Forecasting, *Low flow, *Recession, *River flow, *Water pollution control, River mechanics, Statistical analysis.

Successful pollution control in a river is fundamentally based on a reliable knowledge of the flow available for dilution of the polluting discharges. Often there may be no available gaging records within a catchment or subcatchment, and it may be necessary to resort to an estimation procedure. Low flow can be predicted through the consideration of: (1) a recession period and its relation to rainfall, and (2) a recession rate and its relation to local soil types. The principal advantages of the recession method are that greater resolution for small catchments is available using the land capability maps compared to the base flow indicator map. Afforestation, influence of tributaries, and catchment storage can all be incorporated explicitly in this estimation procedure. (Lantz-PTT)
W91-02847

EVALUATION OF REGIONAL FLOOD FREQUENCY ANALYSIS WITH A REGION OF INFLUENCE APPROACH.
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
D. H. Burn.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2257-2265, October 1990. 4 fig, 1 tab, 11 ref.

Descriptors: *Flood forecasting, *Flood frequency, *Gaging stations, *Network design, *Regional floods, Drainage patterns, Error analysis, Estimating, Monte Carlo method, Statistical methods.

The region of influence (ROI) approach allows for a unique set of gauging stations to be used in the at-site estimation of extremes for every station in a collection of gaging stations. The starting point for the ROI approach to regionalization is the selection of a distance metric defining the closeness of each station to every other station. Attributes based on physical features of the contributing drainage area for a station or on statistical measures of the data record at each site can be incorporated into the distance metric. The selection of a set of attributes for inclusion in the distance metric from the array of possible attributes can be accomplished using a screening process to identify those attributes that are most indicative of similarity in extreme flow behavior. Threshold values define a cutoff for the inclusion of stations into an ROI for a site. Finally, a weighting function reflecting the relative closeness to the site of each station in a site's ROI is determined. Through a Monte Carlo experiment, the ROI approach provides improved at-site estimates of extreme flow quantiles in terms of network average root mean squared error and comparable results for bias. The method is further shown to have attractive features for estimating extremes for unusual sites in a network of gauging stations. (Brunone-PTT)
W91-02856

RELIABILITY ESTIMATION IN MODELING WATERSHED RUNOFF WITH UNCERTAINTIES.
Rutgers - The State Univ., Piscataway, NJ. Dept. of Civil and Environmental Engineering.
C. S. Melching, B. C. Yen, and H. G. Wenzel.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2275-2286, October 1990. 5 fig, 4 tab, 34 ref. Union Carbide Agricultural Company contract No. 81065-C.

Descriptors: *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Runoff, *Uncertainty, *Watersheds, Discharge capacity, Mathematical models, Probability distribution, Seasonal variation, Vermilion River.

The reliability of simulation results produced by watershed runoff models is a function of uncertainties in nature, data, model parameters, and model structure. A cumulative distribution function (CDF) and/or a probability density function of the magnitude of the predicted peak discharge accounting for the various uncertainties from different contributing factors provides a framework for using a reliability analysis method (such as first-order second-moment techniques or Monte Carlo simulation) to evaluate the combined effect of the uncertainties on the reliability of output hydrographs from hydrologic models. The peak discharge probability for the Vermilion River watershed in Illinois using the HEC-1 watershed model yields stochastic output due to the uncertainties in the basic variables of the model. The CDF of the estimation provides a visual means of assessing the estimation reliability. In the Vermilion River watershed model, results indicated that prediction of runoff resulting from non-summer rainstorms is more reliable than that for summer storms; the major contributors to unreliability of the model predictions are the initial loss and continuing loss rate parameters in HEC-1; and, hydrograph parameters and model correction factors contribute relatively little to prediction uncertainty. The study of the reliability of predictions from watershed models provides useful information on the stochastic nature of output from deterministic models subject to uncertainties and identifies the relative contribution of the various uncertainties to unreliability of model predictions. (Brunone-PTT)
W91-02858

SPATIAL UNIFORMITY OF POWER AND THE ALTITUDINAL GEOMETRY OF RIVER NETWORKS.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
V. Kapoor.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2303-2310, October 1990. 2 fig, 3 tab, 18 ref. Army Research Office Grant 26220-GS.

Descriptors: *Entropy, *Flow rates, *Geomorphology, *Model studies, *River mechanics, *River systems, *Scale factors, Climates, Mathematical models, River flow.

River networks are hypothesized to adjust their geometries in the altitudinal space to achieve a state of maximum spatial uniformity of power. A model developed to study the spatial variability of power shows that the notion of uniformity is linked to both minimum variance and maximum information theoretic entropy. The hypothesis relates the scaling exponent of link heights to the scaling exponents of instantaneous flows and predicts the superiority of the self-similar model over alternative models of link heights in channel networks. Self-similar models enable link power to be distributed with greater spatial uniformity than it is in the alternative models. The ability of the self-similar link height model to distribute power more uniformly in space should be tested for basins from different climatic regions for which both geomorphic data and flow data are available. (Author's abstract)
W91-02860

WIDTH AND DEPTH OF SELF-FORMED STRAIGHT GRAVEL RIVERS WITH BANK VEGETATION.
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
S. Ikeda, and N. Izumi.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2353-2364, October 1990. 14 fig, 20 ref, append. Ministry of Education and Culture of Japan Grant No. 01550398.

Descriptors: *Alluvial channels, *Channel morphology, *Gravel rivers, *Riparian vegetation, *River mechanics, *Vegetation effects, Flow velocity, Hydrologic models, River systems, Shear stress, Stream banks.

The influence of bank vegetation on the stable channel cross-sectional geometry of stable, straight gravel rivers is studied theoretically. Singular perturbation and matched asymptotic expansion techniques are employed to derive the lateral distribution of depth-averaged fluid velocity and the bed shear stress. A condition of sediment incipient motion is imposed at the junctions of the bed and the banks to derive the stable depth, and a formula for resistance to flow is used to obtain the stable width. The theory reveals that a thicker vegetation yields a larger depth and a smaller width. Increasing discharge increases the effect of vegetation. The analysis agrees reasonably well with available field data in natural gravel rivers in Colorado and England. (Author's abstract)
W91-02865

INCORPORATING HILLSLOPE EFFECTS INTO THE GEOMORPHOLOGIC INSTANTANEOUS UNIT HYDROGRAPH.
CH2M/Hill, Reston, VA.
L. D. Van der Tak, and R. L. Bras.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2393-2400, October 1990. 4 fig, 18 ref, append. National Science Foundation Grant 8513556-ECE.

Descriptors: *Geomorphology, *Hydrograph analysis, *Rainfall-runoff relationships, *Slopes, *Unit hydrographs, Discharge capacity, Drainage density, Flow rates, Probability distribution, Statistical analysis.

Use of gamma distributions of stream holding times, rather than the traditional exponential distribution, results in geomorphologic instantaneous unit hydrograph (GIUHs) that better fit data-based IUHs. In this paper, hillslope effects are incorporated into the gamma GIUH (GGIUH) model by assuming that the hillslope travel distance in an area of a given order is approximated by the inverse of twice the local drainage density and introducing a hillslope velocity term. A method of moments fitting procedure is used to estimate the channel and hillslope velocity terms in the GGIUH model from the moments of rainfall input and basin discharge output. Results showed that hillslope velocities are 2 orders of magnitude smaller than channel velocities. The values found for the latter are reasonable given the range of values found in the literature for channel velocities. Similarly, the hillslope velocity term found by the method of moments procedure matches macropore velocities reported in the literature. (Brunone-PTT)
W91-02868

PREDICTING RUNOFF FROM RANGELAND CATCHMENTS: A COMPARISON OF TWO MODELS.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
B. P. Wilcox, W. J. Rawls, D. L. Brakensiek, and J. R. Wight.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2401-2410, October 1990. 6 fig, 4 tab, 37 ref.

Descriptors: *Agricultural watersheds, *Hydrologic models, *Land use, *Model studies, *Prediction, *Rainfall-runoff relationships, *Runoff, *Runoff forecasting, *Watersheds, Comparison studies, Infiltration, Land management, Mathematical models, Parameterization, Resource management.

Two different hydrology models, both designed to predict runoff from ungaged rural catchments, were compared. One model is the commonly used and conceptually simple Soil Conservation Service curve number method. The other model is a process oriented model based on the Green and Ampt equation. The Green and Ampt model employs newly developed techniques for parameterizing the Green and Ampt equation based on readily available soil and vegetation information. Annual, monthly and daily predicted runoff were compared to observed on six uncalibrated rangeland catchments located in Texas, Oklahoma, Arizona, Nebraska and Idaho. Model parameterization was

based strictly on individual catchment characteristics. No model calibration was performed. Results indicate that the Green and Ampt model a potentially useful tool for predicting runoff. These results are important because they demonstrate the utility of complex physically based models as management tools for predicting land use impacts to runoff and infiltration. (Author's abstract)
W91-02869

CLIMATIC INFLUENCES ON STREAMFLOW VARIABILITY: A COMPARISON BETWEEN SOUTHEASTERN AUSTRALIA AND SOUTHEASTERN UNITED STATES OF AMERICA.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 2B.
W91-02877

LACK OF THEORETICAL BASIS FOR PREDICTING RATE AND PATHWAYS OF RECOVERY.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5G.
W91-02895

RECOVERY OF LOTIC COMMUNITIES AND ECOSYSTEMS FROM DISTURBANCE--A NARRATIVE REVIEW OF CASE STUDIES.
Environmental Research Lab., Duluth, MN.
For primary bibliographic entry see Field 5G.
W91-02897

PHYSICAL HABITAT TEMPLATE OF LOTIC SYSTEMS: RECOVERY IN THE CONTEXT OF HISTORICAL PATTERN OF SPATIOTEMPORAL HETEROGENEITY.
Colorado State Univ., Fort Collins. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-02902

DISTURBANCE REGIMES, RESILIENCE, AND RECOVERY OF ANIMAL COMMUNITIES AND HABITATS IN LOTIC ECOSYSTEMS.
North Carolina Univ. at Chapel Hill. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-02903

REGIONAL FRAMEWORK FOR ESTABLISHING RECOVERY CRITERIA.
NSI Technology Services Corp., Corvallis, OR.
For primary bibliographic entry see Field 2H.
W91-02905

BIOGEOCHEMICAL CYCLING CONSTRAINTS ON STREAM ECOSYSTEM RECOVERY.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2H.
W91-02906

DISTURBANCE AND RECOVERY OF LARGE FLOODPLAIN RIVERS.
Illinois Natural History Survey, Havana. Stephen A. Forbes Biological Station.
For primary bibliographic entry see Field 2H.
W91-02907

ROLE OF REFUGIA IN RECOVERY FROM DISTURBANCES: MODERN FRAGMENTED AND DISCONNECTED RIVER SYSTEMS.
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
For primary bibliographic entry see Field 2H.
W91-02908

RECOVERY PROCESSES IN LOTIC ECOSYSTEMS: LIMITS OF SUCCESSIONAL THEORY.
Arizona State Univ., Tempe. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-02909

ISLAND BIOGEOGRAPHICAL THEORY: CAN IT BE USED TO PREDICT LOTIC RECOVERY RATES.
Austin Peay State Univ., Clarksville, TN. Center for Field Biology.
J. A. Gore, and A. M. Milner.
Environmental Management EMNGDC, Vol. 14, No. 5, p 737-753, 1990. 4 fig, 1 tab, 135 ref.

Descriptors: *Biogeography, *Ecological effects, *Habitat restoration, *Lotic environment, *Model studies, *Stream biota, Classification, Mathematical analysis, Species diversity, Succession, Theoretical analysis.

Classic island biogeographic theory predicts that equilibrium will be reached when immigration and extinction rates are equal. These rates are modified by the number of species in a source area, the number of intermediate islands, the distance to a recipient island, and the size of the intermediate islands. This general model has been variously modified and proposed to be a stochastic process with minimal competitive interaction or heavily deterministic. Because disturbance frequency, severity, and intensity vary in their effect on community dynamics, disturbance levels should first be defined before evaluating the applicability of island biogeographical theory. A classification system is suggested consisting of four disturbance level based on recovery patterns. Level 1 disturbances completely destroy communities with no upstream or downstream sources of colonizers. Level 2 disturbances destroy the communities but leave upstream and downstream colonization sources. Level 3 disturbances result in reduction of species abundance and diversity along a stream reach. Level 4 disturbances result in reduction of abundance and diversity in discrete patches. Island biogeographical models seem appropriate to recovery by secondary processes after level 3 and 4 disturbances, where competition may be an important organizing factor, while models of numerical abundance and resource tracking are probably of better use where community development is by primary succession. (Lantz-PTT)
W91-02910

APPLICATION OF ECOLOGICAL THEORY TO DETERMINING RECOVERY POTENTIAL OF DISTURBED LOTIC ECOSYSTEMS: RESEARCH NEEDS AND PRIORITIES.
Austin Peay State Univ., Clarksville, TN. Center for Field Biology.
For primary bibliographic entry see Field 2H.
W91-02911

MODELING CHANNEL BED TRANSIENTS USING EXPLICIT F-D SCHEMES.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
B. Morse, and R. D. Townsend.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 11, p 1345-1356, November 1990. 7 fig, 1 tab, 12 ref. Natural Science and Engineering Research Council of Canada grant no. 7443; Environmental Canada contract no. KE-144-8-6376.

Descriptors: *Channel flow, *Channel morphology, *Finite difference methods, *Hydraulic engineering, *Hydraulic transients, *Mathematical models, *Model studies, *River beds, Bed load, Froude number, Mud wave, Numerical analysis, Sand waves, Sediment transport, Viscosity.

Nonlinearities of bed transients of finite height have been documented through numerical modeling using finite difference (F-D) schemes. The numerical characteristics of two explicit F-D schemes, namely: de Vries's pseudoviscosity modified-Lax and Fromm's zero-average-phase-error schemes were used as a starting point. The performance of de Vries's scheme depends primarily on the relationship of the pseudoviscosity term to the bed Courant number selected and the spatial resolution used to discretize the bed wave, whereas the performance of Fromm's scheme depends on the bed Courant number chosen for the simulation. The optimal choice of these numerical parameters is a function of the bed wave height, the wave shape, and the Peclet and Froude numbers. These schemes were used in numerical simulations to determine the nonlinear behavior of a sinusoidal-shaped bed transient of finite height. The simulated motion of the bed were compared with that obtained by (linear small-amplitude) analytical methods; correction factors for both effective bed wave celerity and attenuation were incorporated as functions of the dimensionless wave height, the Peclet and Froude numbers. Even where there is very little diffusion present in the physical system, good results can be achieved if the viscosity term is chosen carefully. Convergence is easier to achieve when the Froude number and the dimensionless bed wave amplitude are small, and when the Peclet number is large. In most of the cases tested, the developed equations provided a good representation of the governing equations. (Author's abstract)
W91-02918

RESISTANCE TO FLOW IN STEEP ROUGH STREAMS.
Universidad de Los Andes, Merida (Venezuela). Dept. of Civil Engineering.
J. Aguirre-Pe, and R. Fuentes.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 11, p 1374-1387, November 1990. 7 fig, 2 tab, 33 ref. Council for the Development of Sciences, Humanities and Technology (CDCHT) of the Universidad de Los Andes Grant I-204.

Descriptors: *Flow resistance, *Hydraulic roughness, *Mountain streams, *Open-channel flow, Boundary layers, Chezy equation, Darcy-Weisbach equation, Flow velocity, Flumes, Turbulent flow.

Flow resistance and velocity profiles associated with flow in open channels with small-scale roughness is customarily described in terms of boundary-layer theory. A theory of resistance to flow in steep, rough streams was developed that takes into account the existence of a highly turbulent wake zone near the bed of a very rough boundary. Two zones were identified in the field. The first one, close to the top of the bed, contains overlapping wakes generated by protruding roughness elements. In the second zone, located above the first one, the velocity distribution is described in terms of a logarithmic profile. Flume data were used to check the validity of this formulation. The compound velocity profile allows for equations to obtain Darcy-Weisbach and Chezy factors. The proposed approach is compared with the results of four previous theories using data obtained from several mountain rivers. Although flow in actual mountain rivers is more complicated than the idealized case treated in the study, the formulation provides equations that allow accurate prediction of flow resistance with a mean error of plus-or-minus 15%. (Author's abstract)
W91-02920

GAMMA-AUTOREGRESSIVE MODELS FOR STREAM-FLOW SIMULATION.
Pontificia Univ. Catolica de Chile, Santiago. Dept. of Hydraulic Engineering.
B. Fernandez, and J. D. Salas.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 11, p 1403-1414, November 1990. 2 fig, 6 tab, 30 ref. Fondo Nacional de Ciencia y Tecnologia de Chile, Proyecto FONDECYT 516/1989; Colorado Agricultural Experiment Station Project N. 645.

Descriptors: *Model studies, *Regression analysis, *Streamflow data, *Streamflow forecasting, *Time series analysis, Annual distribution, Computer models, Simulation analysis, Statistical analysis.

Since hydrologic time series in general, and streamflow series, in particular, are dependent and not normally distributed, use of the classical auto

egressive and moving average models to represent such series requires transformation of the original series into a normal distribution before applying the model. On the other hand, gamma-autoregressive (GAR) models assume that the underlying series is dependent with a gamma marginal distribution and the models do not require variable transformation. However, the models require the estimation of certain statistics generally leading to biased estimates of the model parameters. A procedure has been developed for bias correction, based on computer simulation studies, applicable for estimating parameters of GAR(1) models. Applications of the proposed procedure was made to annual streamflow series of several rivers. The GAR(1) model, when used in conjunction with the proposed estimation procedure, is an attractive alternative for synthetic streamflow simulation, is simple to use, and does not require any transformation of the original data. (Author's abstract)
W91-02922

TURBULENT SHEAR STRESS IN HETEROGENEOUS SEDIMENT-LADEN FLOWS.
Korea Inst. of Construction Technology, Seoul.
For primary bibliographic entry see Field 2J.
W91-02923

FIRST STEP AWAY FROM LACEY'S REGIME EQUATIONS.
For primary bibliographic entry see Field 8B.
W91-02924

BED CONFIGURATIONS IN STEADY UNIDIRECTIONAL WATER FLOWS: PART I. SCALE MODEL STUDY USING FINE SANDS.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
L. A. Boguchwal, and J. B. Southard.
Journal of Sedimentary Petrology JSEPAK, Vol. 60, No. 5, p 649-657, September 1990. 5 fig, 2 tab, 17 ref.

Descriptors: *Bed load, *Channel morphology, *Flow models, *Hydraulic models, *Model studies, *Particle size, *Sedimentary structures, *Temperature effects, Dunes, Flow velocity, Flumes, Plane flow, Ripple marks, River beds, Sand, Sedimentation, Water temperature.

Reynolds-Froude scale modeling using hot-water flows to model cold-water flows was applied to the study of unidirectional-flow bed configurations in a large, thermally-insulated laboratory flume. Three different water temperatures, ranging from 14 to 75 C, provided three different scale ratios, from 1.1 to 2.3. Effective sand sizes, scaled to 10 C water, were about 0.12 mm, 0.18 mm, and 0.28 mm. Relative to 10 C water, use of hot water multiplied the effective flow depth and all flume dimensions by factors of up to 2.3, the flow velocity by factors of up to 1.5, and the water discharge by factors of up to 8. The effective dimensions of the flume, scaled to 10 C water temperature, ranged up to over 26 m long and 2 m wide, with a flow depth of up to 0.5 m. In the coarser sand sizes (0.17-0.26 mm), three bed phases were observed: ripples, dunes, and upper-regime plane bed. Dunes tended to be two-dimensional (crests straight and continuous) at low flow velocities and three-dimensional (crests sinuous and discontinuous) at relatively high flow velocities, except that at flow velocities transitional between ripples and dunes the bed showed a complex intermingling of irregular larger dunelike bed forms and smaller irregular ripples. In the dune range, ripples were prominently superimposed at relatively low flow velocities but nearly absent at relatively high flow velocities. (See also W91-029276 and W91-02927) (Author's abstract)
W91-02925

IED CONFIGURATIONS IN STEADY UNIDIRECTIONAL WATER FLOWS: PART II. SYNTHESIS OF FLUME DATA.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
. B. Southard, and L. A. Boguchwal.
ournal of Sedimentary Petrology JSEPAK, Vol. 0, No. 5, p 658-679, September 1990. 19 fig, 3 tab, 56 ref.

Descriptors: *Channel flow, *Channel morphology, *Flow models, *Hydraulic models, *Literature review, *River beds, *Sediment transport, *Sedimentary structures, Bed load, Boundary layers, Dunes, Flow velocity, Flumes, Graphical analysis, Particle size, Plane flow, Ripple marks, Sedimentation, Shear stress, Water temperature.

Existing data on bed states have not yet been thoroughly exploited to reveal relationships among the various bed phases. Therefore, data from 39 flume studies that report equilibrium bed configuration as well as water temperature, flow depth, flow velocity, and sediment size were used to develop the best approximation to the relationships among bed phases (ripples, dunes, lower-regime plane bed, upper-regime plane bed, and antidunes) produced by flows of water over loose sediments. A three-axis graph with dimensionless measures of mean flow depth, mean flow velocity, and sediment size along the axes was used. The relationships were illustrated as a series of depth-velocity sections and velocity-size sections through the dimensionless diagram. Boundaries between stability fields of the bed phases were drawn as smooth surfaces that minimize misplacement of data points. A large subset of the data, for which reliable values of bed shear stress are reported, was used to represent the stability relationships of the bed phases in a graph of dimensionless boundary shear stress against dimensionless sediment size. The graph shows substantial overlapping of the fields for dunes, upper plane bed, and antidunes owing to the decrease in bed shear stress in the transition from dunes to plane bed with increasing flow velocity. The topology of bed-phase boundaries was guided by the relationships shown in the dimensionless depth-velocity-size diagram. (See also W91-02935 and W91-02927) (Author's abstract)
W91-02926

BED CONFIGURATIONS IN STEADY UNIDIRECTIONAL WATER FLOWS: PART III. EFFECTS OF TEMPERATURE AND GRAVITY.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
J. B. Southard, and L. A. Boguchwal.
Journal of Sedimentary Petrology JSEPAK, Vol. 60, No. 5, p 680-686, September 1990. 7 fig, 1 tab, 16 ref.

Descriptors: *Bed load, *Channel morphology, *Flow models, *Gravity flow, *Hydraulic models, *Sediment transport, *Sedimentary structures, *Sedimentation, *Temperature effects, Channel flow, Flow velocity, Graphical analysis, Mars, Model studies, Water temperature.

Understanding of the mechanics of temperature-related changes in sediment transport is still rudimentary. A change in bed configuration caused by a change in water temperature without any change in flow and sediment variables in a unidirectional flow was analyzed in the context of a dimensionless depth-velocity-size diagram. Bed states that differ only in water temperature are termed temperature-related states. These are attainable from any given state solely by a change in water temperature. Such a set of bed states forms a curve in the dimensionless depth-velocity-size diagram. This curve, a straight line in a log-log-log plot, is termed a temperature-change line. To predict the change in bed state consequent upon a change in water temperature alone, one finds the temperature-related state lying along the temperature-change line passing through the original bed state in the dimensionless depth-velocity-size diagram. Three examples from the literature were analyzed in this way to show how such changes in bed configuration can be put into the context of existing stability relationships among the various bed phases, without however addressing the general dynamical problem of why those relationships are as they are. The effect of the acceleration of gravity on the bed configuration was also examined from the standpoint of the dimensionless depth-velocity-size diagram. The results show that in a hypothetical open-channel water flow on Mars a given transition between two adjacent bed phases with increasing flow velocity (e.g., ripples to dunes) would take place at a lower velocity on Mars than on earth, by a factor of 0.74. (See also W91-02925 and W91-02926) (Author's abstract)
W91-02927

FLUME EXPERIMENTS ON THE TRANSPORT OF HEAVY MINERALS IN GRAVEL-BED STREAMS.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 2J.
W91-02928

2F. Groundwater

SOLUTE TRANSPORT THROUGH SATURATED SOILS: A STUDY OF THE PHYSICAL NON-EQUILIBRIUM MODEL.
Claremont Graduate School, CA. Dept. of Mathematics.
For primary bibliographic entry see Field 5B.
W91-02090

GLACIATION AND SALINE-FRESHWATER MIXING AS A POSSIBLE CAUSE OF CAVE FORMATION IN THE EASTERN MIDCONTINENT REGION OF THE UNITED STATES: A CONCEPTUAL MODEL.
Illinois State Geological Survey Div., Champaign.
S. V. Panno, and W. L. Bourcier.
Geology GLGYBA, Vol. 18, No. 8, p 769-772, August 1990. 3 fig, 1 tab, 40 ref.

Descriptors: *Caves, *Geohydrology, *Glaciohydrology, *Karst hydrology, *Saline groundwater, *Saline-freshwater interfaces, Aquifer characteristics, Calcite, Chemical reactions, Geologic history, Limestone, Undersaturation.

Cave formation in the phreatic zone of limestone aquifers involves the widening of mechanically opened joints, fractures, and bedding planes by groundwater that is slightly undersaturated with respect to calcite. The mixing of two groundwaters of dissimilar salinities is one of many mechanisms proposed to explain calcite undersaturation in water descending within the phreatic zone. Spatial and temporal relations among intracratonic basins, karstic terrain, and continental glaciation suggest that Pleistocene glaciation may have initiated the discharge of saline waters from the margins of these basins. Glaciation-induced discharge of saline waters could result from the consolidation of sediments due to the overlying pressure of glacial ice, and flushing of underlying aquifers as a result of bottom melting in recharge areas of basin aquifers. The upward migration of basin-derived saline waters into near-surface aquifers would result in the mixing of saline waters with infiltrating glacial meltwater and meteoric water. The development of a vertically restricted zone of mixing of saline and fresh water in limestone aquifers would result in the dissolution of limestone; this mechanism could be responsible for the formation, or at least the initiation of, some caves and associated karst features in the midcontinent region. (Author's abstract)
W91-02153

PERSISTENCE OF ALDICARB RESIDUES IN THE SANDSTONE AQUIFER OF PRINCE EDWARD ISLAND, CANADA.
Canada Centre for Mineral and Energy Technology, Elliot Lake (Ontario). Elliot Lake Lab.
For primary bibliographic entry see Field 5B.
W91-02160

STIMULATION OF BIOLOGICALLY ACTIVE ZONES (BAZ'S) IN POROUS MEDIA BY ELECTRON-ACCEPTOR INJECTION.
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-02161

TRANSFORMATION KINETICS OF TRACE-LEVEL HALOGENATED ORGANIC CONTAMINANTS IN A BIOLOGICALLY ACTIVE ZONE (BAZ) INDUCED BY NITRATE INJECTION.
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-02162

MODELING THE MASS-TRANSFER RATE OF RADIOACTIVE COBALT FROM A SYNTHETIC GROUNDWATER TO VOLCANIC TUFF MEDIA.
Howard Univ., Washington, DC. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W91-02163

ADSORPTIVE SOLUTE TRANSPORT IN FRACTURED ROCK: ANALYTICAL SOLUTIONS FOR DELTA-TYPE SOURCE CONDITIONS.
Kyoto Univ., Osaka (Japan). Research Reactor Inst.
For primary bibliographic entry see Field 5B.
W91-02164

TILL GENESIS AND HYDROGEOLOGICAL PROPERTIES.
Norges Landbrukshoegskole, Aas.
S. Haldorsen, and J. Kruger.
Nordic Hydrology NOHYBB, Vol. 21, No. 2, p 81-94, 1990. 9 fig, 33 ref.

Descriptors: *Geohydrology, *Glacial aquifers, *Glacial sediments, *Groundwater movement, *Sedimentation, *Till, Geologic fractures, Hydraulic conductivity, Saturated flow, Sediment sorting.

Hydrogeological properties of tills are highly dependent upon factors as grain-size distribution, compaction, orientation of particles, presence of fractures, and occurrence of sorted sediments. These factors are dependent upon the till forming processes. Lodgement tills formed under active, temperate sliding glaciers are usually compact, rather homogeneous, and in many cases they are fractured. Melt-out tills deposited in connection with stagnant ice are in most cases less dense, have a lower percentage of fine-grained particles, and a higher abundance of sorted sediment lenses. Flow tills, which are mainly formed by a secondary flow of supraglacial debris, are commonly very variable and may have a low content of fine-grained components, a low degree of compaction, and are often closely associated with sorted glaciofluvial sediments. Till genesis is in many cases difficult to interpret, and an objective description of all main characteristics of the till is important in hydrogeological studies. The lodgement till has a lower effective porosity than the melt-out and flow tills due to its finer grain sizes and higher compactness. The saturated hydraulic conductivity of the lodgement till is lower, and dependent upon the fracture pattern. In melt-out tills and flow tills the occurrence of well sorted sediments will in many cases control the hydraulic conductivity. In all till types the structural properties are most important for the saturated water flow. (Author's abstract)
W91-02165

METHODS FOR MEASURING THE SATURATED HYDRAULIC CONDUCTIVITY OF TILLS.
Norges Landbrukshoegskole, Aas.
For primary bibliographic entry see Field 7B.
W91-02166

SATURATED HYDRAULIC CONDUCTIVITY OF SCANDINAVIAN TILLS.
Chalmers Univ. of Technology, Goeteborg (Sweden).
B. B. Lind, and L. Lundin.
Nordic Hydrology NOHYBB, Vol. 21, No. 2, p 107-118, 1990. 10 fig, 1 tab, 33 ref.

Descriptors: *Geologic fractures, *Glacial sediments, *Groundwater movement, *Hydraulic conductivity, *Saturated flow, *Till, Porosity, Sediment sorting, Sedimentation.

There is a distinctive difference in hydraulic properties between the upper horizons of Scandinavian till soil and the deeper C-horizon. The hydraulic conductivity has been studied in different soil profile types, mainly podzolic variants. In the topsoil there are correlations from grain size and porosity to hydraulic conductivity. Both porosity and hydraulic conductivity are stratified with depth. Often high conductivity appears in the upper soil horizons decreasing with depth to low values at about one meter. This pattern varies with soil type. The soils vary with topographic location as does the groundwater level. Published data on hydraulic conductivity in the C-horizon of sandy-silty tills in Scandinavia covers a wide range, from about 5 x 10 to the minus ninth power m/s to 5 x ten to the minus fourth power m/s, with a mean of 3 x ten to the minus sixth power m/s. The correlation between porosity and hydraulic conductivity, as well as between mean grain size and hydraulic conductivity, is weak in the C-horizon. It is concluded that the sediment structure has a decisive influence on the hydraulic conductivity of till. A model of the relationship between particle orientation (in relation to water flow direction), the porosity in the pore-size interval of 30-95 micrometers, and the hydraulic conductivity suggests that if the particle orientation is near parallel to the flow, the porosity in the relevant interval has a greater impact on the hydraulic conductivity than if the orientation is transverse to the flow. (Tappert-PTT)
W91-02167

SATURATED HYDRAULIC CONDUCTIVITY OF CLAYEY TILLS AND THE ROLE OF FRACTURES.
Technical Univ. of Denmark, Lyngby. Inst. for Teknisk Geologi.
J. Fredericia.
Nordic Hydrology NOHYBB, Vol. 21, No. 2, p 119-132, 1990. 2 fig, 51 ref. Danish National Council for Technology Grant No. 5.26.13.05.

Descriptors: *Denmark, *Fracture permeability, *Glacial sediments, *Groundwater movement, *Hydraulic conductivity, *Radioisotopes, *Till, Geologic fractures, Glaciohydrology, Porosity, Sediment sorting, Sedimentation.

The number of published hydraulic conductivities of clayey till in Denmark is still small, and more data is needed. Information concerning fracture systems in till is particularly important; these systems can be revealed by geological mapping of fracture distribution, spacing, and depth of occurrence. Controlled tracer tests can provide information concerning actual transport velocities and the importance of diffusion, and isotope studies can give the age of the porewater. In thick clayey till, tritium possesses possibilities as a fracture indicator because of diffusion. Existing data show a difference of 1-2 orders of magnitude in the vertical hydraulic conductivity between values from laboratory measurements and field measurements. Based on new data, field observations, and comparison with North American studies this lack of agreement is concluded to be primarily due to fractures in the till. Hydraulic tests with direct measurements in the aquitard, such as slug tests and pumping tests, can provide bulk hydraulic conductivities for different volumes. Hydrologic and chemical data are necessary to understand how effective a barrier clayey till is against migration of pollution. (Tappert-PTT)
W91-02168

MODELING OF MULTICOMPONENT TRANSPORT WITH MICROBIAL TRANSFORMATION IN GROUNDWATER: THE FUHRBERG CASE.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5B.
W91-02180

UNIVERSAL SCALING OF HYDRAULIC CONDUCTIVITIES AND DISPERSIVITIES IN GEOLOGIC MEDIA.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman.
Water Resources Research WRERAQ, Vol. 26, No. 8, p 1749-1758, August 1990. 3 fig, 43 ref. NRC Contract No. NRC-04-86-123.

Descriptors: *Dispersion, *Dispersivity, *Ficks Law, *Geochemistry, *Geohydrology, *Hydraulic conductivity, *Model studies, *Path of pollutants, *Scale factors, Fractal mathematics, Fracture permeability, Mathematical models, Model testing, Numerical models, Porous media, Solute transport.

Chemical transport in geologic media is known to be strongly influenced by spatial variations in hydraulic conductivity. Apparent longitudinal dispersivity data from a variety of hydrogeologic settings are assumed to represent a continuous hierarchy of log hydraulic conductivity fields with mutually uncorrelated increments, each field having its own exponential autocovariance, associated integral scale, and variance that increases as a power of scale. Such a hierarchy is shown theoretically to form a self-similar random field with homogeneous increments. Regardless of whether or not the underlying assumption is valid, one can justify interpreting the apparent dispersivities in a manner consistent with a recent quasi-linear theory of non-Fickian and Fickian dispersion in a homogenous media which supports the notion of a self-similar hierarchy a posteriori. The hierarchy is revealed to possess a semivariogram and a fractal dimension which can be viewed as a universal scaling rule, about which large deviations occur due to local influences, including the existence of discrete natural scales at which log hydraulic conductivity is statistically homogenous. As such homogeneity is at best a local phenomenon occurring intermittently over narrow bands of the scale spectrum, one must question the utility of associating medium properties with representative elementary volumes and relying on Fickian models of dispersion over more than relatively narrow scale intervals. Porous and fractured media appear to follow the same idealized scaling rule for both flow and transport, raising a question about the validity of many distinctions commonly drawn between such media. Finally, the data suggest that conditioning transport models through calibration against hydraulic measurements has the effect of filtering out large-scale models from the hierarchy. (Author's abstract)
W91-02183

FLOW TO A HEATED BOREHOLE IN POROUS, THERMOELASTIC ROCK: ANALYSIS.
Sandia National Labs., Albuquerque, NM. Fluid Mechanics and Heat Transfer Div. I.
D. F. McTigue.
Water Resources Research WRERAQ, Vol. 26, No. 8, p 1763-1774, August 1990. 6 fig, 1 tab, 16 ref, append. United States DOE Contract No. DE-AC04-76DP00789.

Descriptors: *Boreholes, *Fluid flow, *Geohydrology, *Geothermal studies, *Groundwater movement, *Temperature effects, Diffusion, Heat flow, Mathematical analysis, Pore pressure, Porous media, Rock properties, Thermal conductivity.

Exact solutions are obtained for fluid flow induced by the heating of a borehole. The rock is modeled as a fluid-saturated, porous, thermoelastic medium. The temperature and pore pressure fields are governed by a pair of diffusion equations, which are coupled through a source term in the pressure equation proportional to the temperature rate. The pressure profile exhibits a maximum that grows in magnitude and propagates away from the borehole. For a constant heat flux applied as an instantaneous step, the fluid flux to the borehole takes a finite initial value, and decays monotonically. When the heat flux exhibits a finite rise time, the fluid flux is initially zero, rises to a maximum, and then decays. At late time, the inverse of the fluid flux is linear in ln(t); this observation can be ex

ploited to estimate the permeability and fluid diffusivity of low-permeability rock. Sample calculations for Westerly granite shows modest success. (Author's abstract)
W91-02185

COMPARISON OF DARCIAN FLOW IN CORRESPONDING FLAT AND FOLDED SURFACES.
Geological Survey, Denver, CO.
E. Weiss.
Water Resources Research WRERAQ, Vol. 26, No. 8, p 1775-1785, August 1990. 5 fig, 1 tab, 9 ref, append.

Descriptors: *Aquifer characteristics, *Darcys law, *Fluid flow, *Geohydrology, *Geologic formations, *Groundwater movement, *Model studies, Boundary conditions, Geologic control, Hydraulic conductivity, Hydraulic head.

Flat surfaces are frequently used as models of aquifers even though aquifers are folded and have a variation in hydraulic head along the vertical. To account for aquifer folds in groundwater flow models, the equation describing Darcian flow in a general surface is derived. The equation is used to calculate steady state hydraulic head distributions for corresponding folded and flat surfaces. Each flat surface has the same hydraulic conductivity distribution and boundary conditions as the corresponding folded surface. The folded surfaces have folds similar to the folds of selected aquifers and have folds that have much larger changes in slope. The largest difference in hydraulic head caused by all folding is only about 0.5% of the largest difference in hydraulic head across each surface. Hydraulic head distributions in surfaces composed of sinusoidal synclines and anticlines indicate that the effect of folds is not cumulative. Because of the smaller areal extent and the fact that the effect of a sequence of folds is not cumulative, the minor folds do not generate substantially larger hydraulic head differences than the major folds. (Author's abstract)
W91-02186

RESPONSE OF THE WATER LEVEL IN A WELL TO EARTH TIDES AND ATMOSPHERIC LOADING UNDER UNCONFINED CONDITIONS.
Geological Survey, Menlo Park, CA.
A. Rojstaczer, and F. S. Riley.
Water Resources Research WRERAQ, Vol. 26, No. 8, p 1803-1817, August 1990. 8 fig, 3 tab, 22 ref.

Descriptors: *Aquifers, *Atmospheric pressure, Earth tides, *Geohydrology, *Groundwater level, *Groundwater movement, *Unconfined aquifers, *Wells, Confined aquifers, Hydraulic conductivity, Hydraulic head, Unsaturated zone.

The response of the water level in a well to earth tides and atmospheric loading under unconfined conditions can be explained if the water level is controlled by the aquifer response averaged over the saturated depth of the well. Because vertical averaging tends to diminish the influence of the water table, the response is qualitatively similar to the response of a well under partially confined conditions. When the influence of well bore storage can be ignored, the response to earth tides is strongly governed by a dimensionless aquifer frequency Q'u. The response to atmospheric loading is strongly governed by two dimensionless vertical flow parameters: a dimensionless unsaturated zone frequency R, and a dimensionless aquifer frequency Qu. The differences between Q'u and Qu are generally small for aquifers which are highly sensitive to earth tides. When Q'u and Qu are large, the response of the well to earth tides and atmospheric loading approaches the static response of the aquifer under confined conditions. At all values of Q'u and Qu, well response to earth tides and atmospheric loading is strongly influenced by water table drainage. When R is large relative to Qu, the response to atmospheric loading is strongly influenced by attenuation and phase lag of the pneumatic pressure signal in the unsaturated zone. The presence of partial penetration retards phase advance in well response to earth tides and atmospheric loading. When the theoretical response of a phreatic well to Earth tides and atmospheric loading is fit to the well response inferred from cross-spectral estimation, it is possible to obtain estimates of the pneumatic diffusivity of the unsaturated zone and the vertical hydraulic conductivity of the aquifer. (Author's abstract)
W91-02188

CURIOUS BEHAVIOR OF A GROUNDWATER FLOW MODEL.
Butler Univ., Indianapolis, IN. Dept. of Mathematical Sciences.
J. P. Fink.
Water Resources Research WRERAQ, Vol. 26, No. 8, p 1833-1836, August 1990.

Descriptors: *Boundary conditions, *Flow models, *Groundwater movement, *Mathematical models, *Model studies, *Water table fluctuations, Capillary zone, Diffusion, Drawdown, Free surfaces, Unconfined aquifers.

In formulating mathematical models of unconfined groundwater flow, the nature of the transition zone between saturated and dry aquifer material has been handled in a variety of ways. The simple formulation obtained by assuming a free surface is not valid in many cases. A useful approach is to apply a capillarity correction term c to the free surface formulation. For sudden drawdown the problem has been expressed as an initial boundary value problem (IBVP). There are striking differences in the behavior of solutions to the IBVP which depend on the value of the capillarity correction term. For $c = 0$, the differential equation which reduces to the diffusion equation has a smoothing effect on the initial data. On the other hand, for $c > 0$ the differential equation preserves the discontinuity resulting from the incompatibility of the initial and boundary data. In physical terms, any initial fluctuations in the water table disappear almost immediately if $c = 0$ and persist indefinitely if $c > 0$. The properties exhibited by the IBVP suggest that it should be used with care. The diffusion equation which results when $c = 0$ should not be viewed as the proper limiting case when $c > 0$. The change in the highest order term makes the difference between a parabolic problem and a pseudoparabolic problem. (Tappert-PTT)
W91-02190

WATER-QUALITY CHARACTERISTICS OF THE COLUMBIA PLATEAU REGIONAL AQUIFER SYSTEM IN PARTS OF WASHINGTON, OREGON, AND IDAHO.
Geological Survey, Tacoma, WA. Water Resources Div.
W. C. Steinkampf.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4242, 1989. 37p, 27 fig, 4 tab, 12 ref.

Descriptors: *Aquifer systems, *Columbia Plateau, *Regional Aquifer System Analysis, *Washington, *Water quality, Grande Ronde Basalt, Groundwater, Saddle Mountains Basalt, Wanapum Basalt, Water type.

Water quality data for the period 1982 through 1983 from about 350 wells in three Miocene basalt units in the Columbia Plateau regional aquifer system, Washington, show that the quality of groundwater generally is suitable for most uses. The dominant water type is calcium magnesium bicarbonate at shallow depths, and evolves toward sodium bicarbonate at depth. Calcium magnesium sulfate chloride type waters occur less commonly and are associated with shallow wells, the absence of a thick overburden, and agricultural land use. Dissolved-solids concentrations generally are less than 500 mg/L. Water in the Saddle Mountains unit has a mean dissolved-solids concentration of 488 mg/L. Nitrogen species and sulfate concentrations relate to overburden thickness and land use. Water in the Wanapum unit, below the Saddle Mountains unit, has a mean dissolved-solids concentration of 270 mg/L. High nitrogen concentrations (10 mg/L or greater) occur mostly in wells with depths less than 300 ft in areas with little or no overburden in the central part of the plateau. The Grande Ronde unit, below the Wanapum, has the lowest mean dissolved-solids concentrations, 230 mg/L, and nitrogen concentrations ar less than 2 mg/L. (USGS)
W91-02223

ALTITUDE OF POTENTIOMETRIC SURFACE, FALL 1985, AND HISTORIC WATER-LEVEL CHANGES IN THE MEMPHIS AQUIFER IN WESTERN TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
W. S. Parks, and J. K. Carmichael.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4180, 1990. 8p, 2 fig, 1 pl, 18 ref.

Descriptors: *Aquifers, *Groundwater, *Groundwater movement, *Memphis Aquifer, *Potentiometric level, *Tennessee, *Water level fluctuations, Groundwater recharge, Memphis Sand, Water resources data.

Recharge to the Memphis aquifer of Tertiary age is from precipitation on the outcrop, which forms a broad belt across western Tennessee, or by downward infiltration of water from the overlying fluvial deposits of Tertiary and Quaternary age and alluvium of Quaternary age. In the outcrop-recharge belts, where the Memphis aquifer is under water-table conditions, the potentiometric surface is complex and generally resembles the topography. To the west of the outcrop-recharge belt where the Memphis aquifer is confined, the potentiometric surface gently slopes westward, and the water moves slowly in that direction. A major cone of depression in the potentiometric surface in the Memphis area is the result of long-term (1986-present) pumping at municipal and industrial well fields. Water levels in the Memphis aquifer have declined at average rates ranging from less than 0.1 to 1.3 ft/year during the period 1928-85. The largest declines have been in the Memphis area where withdrawals averaged about 191 million gal/day in 1985. Near the center of the major cone of depression in the Memphis area water levels ceased to decline in about 1975, and the center of the cone essentially has stabilized. Away from the center of the cone, water levels are still declining at a low rate, and the cone is still expanding as a result of the long-term effects of pumping. (USGS)
W91-02224

GEOLOGY AND GROUND-WATER RESOURCES OF THE COCKFIELD FORMATION IN WESTERN TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
W. S. Parks, and J. K. Carmichael.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4181, 1990. 17p, 2 pl, 5 fig, 4 tab, 21 ref.

Descriptors: *Aquifers, *Cockfield Formation, *Geology, *Groundwater availability, *Groundwater resources, *Tennessee, *Water quality, Aquifer characteristics, Cockfield Aquifer, Geologic formations, Groundwater movement, Groundwater recharge, Potentiometric level, Stratigraphy, Structural geology, Water level fluctuations, Water supply development.

The Cockfield Formation of the Claiborne Group of Tertiary age underlies approximately 4,000 sq mi in western Tennessee. The formation consists primarily of lenticular beds of very fine to coarse sand, silt, clay, and lignite. The Cockfield Formation has been extensively eroded, and the original thickness is preserved only in a few areas where the formation ranges from 235 to 270 ft in thickness. Recharge to the Cockfield aquifer is from precipitation on sparse outcrops or by downward infiltration of water from the overlying fluvial deposits of Tertiary and Quaternary age and alluvium of Quaternary age or, where present, the overlying Jackson Formation of Tertiary age. Data

from two observation wells indicate that water levels have risen at average rates of about 0.5 and 0.7 ft/year during the period 1980-85. Water from the Cockfield aquifer is a calcium bicarbonate type that contains low concentrations of most major constituents, and generally is suitable for most uses. Dissolved-solids concentrations range from 44 to 218 mg/L. Data from two aquifer tests indicate transmissivities of 2,500 and 6,000 sq ft/day and storage coefficients of 0.0003 and 0.0007, respectively. The Cockfield aquifer presently provides small to moderate quantities of water for several public and industrial water supplies and small quantities to numerous domestic and farm wells. Withdrawals for public and industrial supplies in 1983 averaged about 3.3 million gal/day. (USGS)
W91-02225

ESTIMATES OF GROUND-WATER FLOW COMPONENTS FOR LYMAN LAKE, APACHE COUNTY, ARIZONA, WITH A SECTION ON GEOCHEMISTRY OF SURFACE WATER AND GROUND WATER IN THE LYMAN LAKE AREA BY FREDRICK N. ROBERTSON.
Geological Survey, Tucson, AZ. Water Resources Div.
D. J. Bills, and H. W. Hjalmarson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4151, 1990. 55p, 12 fig, 4 tab, 21 ref. Project no. AZ092.

Descriptors: *Arizona, *Lakes, *Lyman Lake, *Surface-groundwater relations, Groundwater, Hydrologic budget, Isotopic tracers, Water quality.

Lyman Lake is an irrigation reservoir on the Little Colorado River near St. Johns, Arizona. The main sources of water for the lake are streamflow in the Little Colorado River and spring flow from the underlying Coconino aquifer. The use of groundwater at two electric-power generating stations in the Lyman Lake area may affect the quantity of spring flow at the lake. The water-budget method and water-chemistry and isotope data were used to compute the quantity of groundwater flow to and from Lyman Lake. Components of flow used in the water budget analysis included evaporation from the lake, transpiration from dense vegetation, seepage through the dam, streamflow in and out of the lake, precipitation on the lake, and measured or estimated changes in lake storage for 7-day periods in 1985 and 1986. Geochemical data included major ions, trace elements, and the stable isotopes of hydrogen and oxygen. During the study, the potentiometric level in the Coconino aquifer was above the lake level at the upstream end of the lake and below lake level at the downstream end. Groundwater flow from the lake is related to the head difference between the aquifer and the lake at the downstream end of the lake. Discharge from the aquifer was an average of 5.7 cu ft/sec at Salado Springs downstream from Lyman Lake and an estimated 6.0 cu ft/sec in Lyman Lake. The relation between computed groundwater inflow and the difference in head between the aquifer and the lake at the upstream end was not statistically significant. The interpretation of the geochemical data supports the conceptual model of the water budget, and the calculated percentages are within the range of the results of the water budget comparison. (USGS)
W91-02231

SELECTED GROUND-WATER INFORMATION FOR THE PASCO BASIN AND ADJACENT AREAS, WASHINGTON, 1986-1989.
Geological Survey, Tacoma, WA. Water Resources Div.
B. W. Drost, K. M. Schurr, and W. E. Lum.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-228, 1989. 91p, 2 fig, 2 tab, 8 ref.

Descriptors: *Hydrologic data, *Pasco Basin, *Washington, *Water resources data, *Well data, Data collections.

The U.S. Geological Survey, in cooperation with the United States Department of Energy, conducted a study of the Pasco basin and adjacent areas, Washington, in support of the Basalt Waste Isolation Project at the Hanford site, Washington. The purpose of the study was to develop a data set that would help define the groundwater-flow system of the Pasco Basin. This report contains the basic data, without interpretation, that were collected from the start of the project in February 1986 through January 1989. Information presented is from the U.S. Bureau of Reclamation, State of Washington Department of Ecology, US Army Corps of Engineers, Kennewick Irrigation District, and the Survey, and consists of well location and construction data, records of water levels in the wells, and aquifer designations for each well. The aquifer designation represents the geohydrologic unit to which the well is reported to be open. (USGS)
W91-02233

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Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 10C.
W91-02237

WATER-QUALITY, WELL CONSTRUCTION, AND GROUNDWATER LEVEL DATA FOR AN INVESTIGATION OF RADIONUCLIDES IN GROUND WATER, HICKMAN AND MAURY COUNTIES, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
G. E. Hileman.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-190, 1990. 13p, 2 fig, 2 tab, 9 ref.

Descriptors: *Groundwater, *Radioisotopes, *Radon, *Tennessee, *Water quality data, *Water resources data, Chattanooga Shale, Geochemistry, Phosphatic limestone, Radionuclides, Trace metals.

Water quality, well construction, and groundwater level data were collected for an investigation of radionuclides in groundwater in Maury and Hickman Counties, Tennessee. Seventeen wells and 3 springs were sampled in Hickman County, and 20 wells were sampled in Maury County. Samples from each site were analyzed for radionuclides, common and trace inorganic ions, indicators of redox conditions, selected nutrients, total organic carbon, and selected physical characteristics. Well-construction data were obtained to help determine the source of the water. Where possible, groundwater level measurements were made for each well sampled. Samples were collected from May 1989 through mid-August 1989. Data are presented in tables. Maps of each county show the location of the sites sampled. (USGS)
W91-02238

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1989, VOLUME 3B: SOUTHWEST FLORIDA GROUND WATER.
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02240

WATER RESOURCES DATA FOR UTAH, WATER YEAR 1989.
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02241

ALTITUDE OF POTENTIOMETRIC SURFACE, FALL 1985, AND HISTORIC WATER-LEVEL CHANGES IN THE FORT PILLOW AQUIFER IN WESTERN TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
W. S. Parks, and J. K. Carmichael.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4048, 1990. 8p, 3 fig, 12 ref.

Descriptors: *Fort Pillow aquifer, *Groundwater *Groundwater recharge, *Potentiometric level *Tennessee, *Water level fluctuations, Aquifers Fort Pillow Sand, Groundwater movement.

Recharge to the Fort Pillow aquifer of Tertiary age in Tennessee is from precipitation on the outcrop, which forms a narrow belt across western Tennessee, and by downward infiltration of water from the overlying fluvial deposits of Tertiary and Quaternary age and alluvium of Quaternary age or where the upper confining unit is absent, from the overlying Memphis aquifer of Tertiary age. The potentiometric surface in the Fort Pillow aquifer slopes gently westward from the outcrop-recharge area, and the water moves slowly in that direction. A depression in the potentiometric surface in the Memphis area is the result of past pumping by Memphis Light, Gas and Water Division (MLGW) well fields (1924-74), and past and present pumping at an industrial well field at Memphis, and the municipal well field at West Memphis, Ark. Water levels in areas affected by pumping have declined at average rates ranging from 0.4 to 0.9 ft/year during the period 1945-85. The greatest rate of decline was as much as 4.0 ft/year between 1949 and 1954 in an observation well in a well field of MLGW at Memphis. In 1971, MLGW ceased pumping from the Fort Pillow aquifer at this well field, and between 1972 and 1976, water levels rose about 28 ft in this well. Withdrawals from the Fort Pillow aquifer in western Tennessee in 1985 averaged about 12 million gal/day. (USGS)
W91-02248

HYDROGEOLOGIC RECONNAISSANCE OF THE SWOPE OIL SUPERFUND SITE AND VICINITY, CAMDEN AND BURLINGTON COUNTIES, NEW JERSEY.
Geological Survey, Trenton, NJ. Water Resources Div.
G. J. Barton, and M. Krebs.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-402, 1990. 247p, 5 fig, 1 pl, 7 ta, 35 ref, 4 append.

Descriptors: *Groundwater, *Groundwater pollution, *Hydrogeology, *Hydrology, *New Jersey, *Water quality data, *Well data, Coastal plain, Groundwater level, Groundwater movement, Hydrogeologic units, Hydrologic properties, Potomac-Raritan-Magothy Aquifer System, Water level fluctuations, Water use.

Groundwater beneath a former chemical reclamation facility in New Jersey is contaminated with metals and organic compounds. The off-site migration of these compounds has not been studied; however, a nearby public-supply well is contaminated, and a public-supply well 1,400 ft downgradient from the site may be threatened. The study area, in the New Jersey part of the Atlantic Coastal Plain, is underlain by alluvial deposits composed of gravel, sand, silt, and clay. These deposits comprise the water table aquifer, the confining unit, and the confined aquifer throughout the study area. The water table beneath the Swope Oil Superfund site is approximately 17 ft below sea level, and groundwater levels throughout the study area are below the stage of the Delaware River. The aquifer system is recharged by precipitation, drainage of water through confining units, and by water induced from the Delaware River. Two public supply-well fields, primarily adjacent to the Delaware River, and four waste disposal sites with observation well networks are located in the study area. Both the water table and confined aquifer are contaminated in several locations. The concentration of metals and/or purgeable organic compounds in more than 20 wells exceeds the Environmental Protection Agency primary drinking-water standard and the New Jersey Department of Environmental Protection recommended drinking water criteria. Selected data from soil and test borings are presented, including well

struction details; drillers', geologists', and geophysical logs; water levels; specific-capacity and slug test data; and chemical analysis of groundwater samples. (USGS)
W91-02249

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1990.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02250

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER OF SEPTEMBER 1986 AND SEPTEMBER 1988 IN SOUTHERN MARYLAND.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02255

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER OF SEPTEMBER 1986 AND SEPTEMBER 1988 IN SOUTHERN MARYLAND.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02256

POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND DURING SEPTEMBER 1988.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02257

WATER RESOURCES DATA FOR ARKANSAS, WATER YEAR 1989.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02261

GROUNDWATER OWNERSHIP AND CONTROL IN INDIAN COUNTRY.
Lu Bey Law Firm, Seattle, WA.
For primary bibliographic entry see Field 6E.
W91-02277

NORTHEAST GLACIAL AQUIFERS.
Regional Aquifer Systems of the United States. Papers presented at AWRA Symposium on Monitoring, Modeling, and Mediating Water Quality, May 17-20, 1987, Syracuse, New York. AWRA Monograph Series No. 11, 1988. 156 p. Edited by Allan D. Randall and A. Ivan Johnson.

Descriptors: *Geohydrology, *Glacial aquifers, *Groundwater resources, *Regional Aquifer-Systems Analysis, *Surface-groundwater relations, Symposium, Aquifers, Glacial drift, Glacial hydrology, Lithology, Radioactive tracers, Runoff.

Papers are presented from the AWRA Symposium on Monitoring, Modeling, and Mediating Water Quality, held May 17-20, 1987. The following topics are discussed: Northeast Glacial Aquifers RASA Project; Upland runoff as a major source of recharge to stratified drift in the glaciated northeast; Estimation of water available for recharge to sand and gravel aquifers in the glaciated northeastern United States; Evaluation of the continuous seismic-reflection methods for determining the thickness and lithology of stratified drift in the glaciated northeast; Continuous seismic-reflection profiling of glacial drift along the Susquehanna, Tioga, and Chenango Rivers, south-central New York and North-Central Pennsylvania; Geochemistry of the stratified-drift aquifer in the Killbuck Creek Valley west of Wooster, Ohio; and, Use of Oxygen-18 and deuterium mass-balance analysis to evaluate induced recharge to stratified drift aquifers. (See W91-02281 thru W91-02287) (Lantz-PTT)
W91-02280

NORTHEAST GLACIAL AQUIFERS RASA PROJECT--AN OVERVIEW OF RESULTS THROUGH 1987.
Geological Survey, Albany, NY. Water Resources Div.
A. D. Randall, and A. I. Johnson.
IN: The Northeast Glacial Aquifers. Regional Aquifer Systems of the United States. Papers presented at AWRA Symposium on Monitoring, Modeling, and Mediating Water Quality, May 17-20, 1987, Syracuse, New York. AWRA Monograph Series No. 11, 1988. p 1-15, 7 fig, 1 tab, 35 ref.

Descriptors: *Geohydrology, *Glacial aquifers, *Groundwater resources, *Regional Aquifer-Systems Analysis, *Surface-groundwater relations, Aquifers, Geochemistry, Groundwater movement, Groundwater recharge, New England, New York, Snowmelt.

The Northeast Glacial Aquifers project, one of the US Geological Survey's many Regional Aquifer-Systems Analyses (RASA), must evaluate a multitude of local aquifers that interact with regional streams but not with each other. These local aquifers were deposited by glacial meltwater and occur chiefly in valleys. The water they contain is generally less highly evolved geochemically than that in bedrock, probably because their small extent and high permeability allows the water to move through them quickly. Studies of the distribution of aquifers within the glacial drift have led to conceptual models of typical aquifer geometries in each of several subregions in the glaciated Northeastern United States. Although such models can help guide evaluation of local aquifers, local data are still needed; one promising new technique for obtaining data is marine seismic reflection, which can delineate aquifer geometry beneath the large streams and lakes that are potential sources of induced recharge. The exchange of water between stratified-drift aquifers and streams is a vital feature of the hydrology of the glaciated Northeast. Runoff from uplands is a major source of recharge to stratified drift under natural conditions, and recharge induced from streams by pumping can far exceed all natural recharge. Rates of induced recharge and streambed properties may be calculated from streamflow measurements, or from vertical temperature profiles beneath the stream, diurnal fluctuation in dissolved oxygen in the streambed, isotopic and dissolved chemical differences between river water and groundwater, or calibration of groundwater flow models. During periods of low flow, natural streamflow consists of groundwater that is discharged into stream channels; its magnitude is a function of the area of surficial sand and gravel in the basin, wetland area, and precipitation. A new modeling technique routes rejected recharge and groundwater discharge from upland hillsides to locations where it can infiltrate sand and gravel on the valley floor. (See also W91-02280) (Author's abstract)
W91-02281

UPLAND RUNOFF AS A MAJOR SOURCE OF RECHARGE TO STRATIFIED DRIFT IN THE GLACIATED NORTHEAST.
Geological Survey, Bow, NH. Water Resources Div.
D. J. Morrissey, A. D. Randall, and J. H. Williams.
IN: The Northeast Glacial Aquifers. Regional Aquifer Systems of the United States. Papers presented at AWRA Symposium on Monitoring, Modeling, and Mediating Water Quality, May 17-20, 1987, Syracuse, New York. AWRA Monograph Series No. 11, 1988. p 17-36. 8 fig, 5 tab, 27 ref.

Descriptors: *Geohydrology, *Glacial aquifers, *Glacial drift, *Groundwater recharge, *Groundwater resources, *Regional Aquifer-Systems Analysis, *Stratified drift, *Surface-groundwater relations, Aquifers, Case studies, Infiltration, New Hampshire, New York, Pennsylvania, Permeability, Runoff.

Most large valleys in the glaciated northeastern United States contain stratified drift that consists partly of sand and gravel. Precipitation on the valley floor has been considered to be the chief source of natural recharge to sand and gravel aquifers, augmented by some groundwater flow through the poorly permeable bedrock and till that form the adjacent uplands. Recent studies of several localities suggest, however, that well over half the natural recharge to stratified-drift aquifers can be derived from upland runoff, by infiltration of streamflow and unchanneled runoff from uplands as well as by lateral flow of groundwater. For example, at least 60% of recharge to a valley in central New York, computed by two independent methods, was ascribed to upland sources. About 58% of recharge to a nearby locality was from upland sources, according to a test application of a detailed method for estimating aquifer yields in south-central New York. More than 85% of recharge to a valley aquifer in north-central Pennsylvania was from upland sources, chiefly infiltration from upland tributaries, which averaged 10.5 cu ft/sec and which prevented persistent declines in water level in a well field new one of the tributaries except when the tributary channel was dry. Nearly 75% of the groundwater that discharged from stratified drift to a 4-mile reach of the Saco River valley in New Hampshire during two periods of low flow was concurrently replaced by seepage of tributary streamflow, and upland sources contributed 59% of the natural recharge as simulated by a steady-state groundwater flow model of the valley. Review of these case histories indicates that, in regions of high topographic relief, upland sources account for about 60% of the recharge to stratified drift in valleys 1 mile wide, and more in narrower valleys. In regions of low relief, seepage losses from tributaries may be small under natural (nonpumping) conditions. (See also W91-02280) (Author's abstract)
W91-02282

ESTIMATION OF WATER AVAILABLE FOR RECHARGE TO SAND AND GRAVEL AQUIFERS IN THE GLACIATED NORTHEASTERN UNITED STATES.
Geological Survey, Albany, NY. Water Resources Div.
F. P. Lyford, and A. J. Cohen.
IN: The Northeast Glacial Aquifers. Regional Aquifer Systems of the United States. Papers presented at AWRA Symposium on Monitoring, Modeling, and Mediating Water Quality, May 17-20, 1987, Syracuse, New York. AWRA Monograph Series No. 11, 1988. p 37-61, 7 fig, 3 tab, 28 ref.

Descriptors: *Geohydrology, *Glacial aquifers, *Groundwater budget, *Groundwater recharge, *Groundwater resources, *Regional Aquifer-Systems Analysis, *Surface-groundwater relations, Aquifers, Hydrologic budget, Infiltration, Runoff, Snow, Snowmelt.

Estimates of the volume of water available annually or monthly for recharge to sand and gravel aquifers in the glaciated Northeast are needed for aquifer modeling and assessment of potential aquifer yield. Sources of recharge include direct infiltration of precipitation on the aquifers, runoff from till-covered upland hillsides bordering the aquifers, and seepage from streams. The volume of water available annually for recharge is generally equal to annual runoff (precipitation minus evapotranspiration). This quantity ranges from 12 to 30 inches over most of the glaciated Northeast. Quantities of water available for recharge from direct infiltration can be estimated by applying the water balance equation to data presented in this paper, to routinely published data on precipitation, snowpack, and temperature, and to evapotranspiration data computed from pan evaporation or various formulas. Quantities available are greatest during November, December, March, and April and generally equal or approach zero from June through September. Quantities may exceed 6 inches per month at higher elevations and latitudes during periods of snowmelt. Quantities of water available monthly for recharge from upland hillslopes and from tributary streams where they cross valley-fill aquifers can be estimated from rates of runoff in upland areas. The Northeast can be divided into six regions, each with a distinctive monthly runoff pattern that is controlled largely by winter snow

accumulation and spring snowmelt. (See also W91-02280) (Author's abstract)
W91-02283

EVALUATION OF THE CONTINUOUS SEISMIC-REFLECTION METHOD FOR DETERMINING THE THICKNESS AND LITHOLOGY OF STRATIFIED DRIFT IN THE GLACIATED NORTHEAST.
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 7B.
W91-02284

CONTINUOUS SEISMIC-REFLECTION PROFILING OF GLACIAL DRIFT ALONG THE SUSQUEHANNA, CHEMUNG, AND CHENANGO RIVERS, SOUTH-CENTRAL NEW YORK AND NORTH-CENTRAL PENNSYLVANIA.
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7B.
W91-02285

GEOCHEMISTRY OF THE STRATIFIED-DRIFT AQUIFER IN KILLBUCK CREEK VALLEY WEST OF WOOSTER, OHIO.
Geological Survey, Columbus, OH. Water Resources Div.
K. J. Breen.
IN: The Northeast Glacial Aquifers. Regional Aquifer Systems of the United States. Papers presented at AWRA Symposium on Monitoring, Modeling, and Mediating Water Quality, May 17-20, 1987, Syracuse, New York. AWRA Monograph Series No. 11, 1988. p 105-131, 12 fig, 2 tab, 22 ref.

Descriptors: *Geochemistry, *Geohydrology, *Glacial aquifers, *Groundwater quality, *Groundwater resources, *Killbuck Creek Valley, *Regional Aquifer-Systems Analysis, *Stratified drift, *Water chemistry, Aquifers, Chlorides, Glacial drift, Groundwater chemistry, Iron, Manganese.

Water for Wooster, Ohio, is obtained from two well fields developed in the stratified glacial drift of the Killbuck Creek valley. A contamination incident in 1983 closed the city's southern well field and caused increased pumping stress on the aquifer near the remaining well field. As a result, water levels in production wells dropped to record low levels in 1984-85. A geochemical study of groundwater was conducted during this period to evaluate the processes affecting water chemistry. Results indicate that the composition of water produced from the well field is controlled, in part, by the mineralogy of the water-yielding zones and by mixing of water in the drift aquifer with water from the underlying sandstone and shale bedrock. A mixing and mass balance analysis based on sodium and chloride indicates that water from the production well at the center of the well field is about 80% drift water and 20% bedrock water. The percentage of drift water ranges from $< 10\%$ at the easternmost production well to $> 90\%$ at the westernmost production well. The aquifer matrix is comprised mostly of quartz with calcite, dolomite, illite, and iron-chlorite. Groundwater chemistry and the presence of sericitized feldspar, kaolinite, and minerals containing oxidized iron indicate that groundwaters are involved in carbon-oxygen reactions, dissolution and precipitation of carbonate minerals, hydrolysis of silicates, and iron and manganese reactions. These mixing and chemical processes produce an iron-rich, sodium calcium chloride bicarbonate-type water at the central and easternmost production wells. The two westernmost production well waters and the deep drift waters, in general, are an iron-rich, calcium bicarbonate type. (See also W91-02280) (Author's abstract)
W91-02286

USE OF OXYGEN-18 AND DEUTERIUM MASS-BALANCE ANALYSIS TO EVALUATE INDUCED RECHARGE TO STRATIFIED-DRIFT AQUIFERS.
Geological Survey, Albany, NY. Water Resources Div.
J. E. Dysart.
IN: The Northeast Glacial Aquifers. Regional Aquifer Systems of the United States. Papers presented at AWRA Symposium on Monitoring, Modeling, and Mediating Water Quality, May 17-20, 1987, Syracuse, New York. AWRA Monograph Series No. 11, 1988. p 133-154, 13 fig, 2 tab, 15 ref.

Descriptors: *Aquifers, *Deuterium, *Geohydrology, *Glacial aquifers, *Glacial drift, *Groundwater recharge, *Groundwater resources, *Mass balance, *Oxygen isotopes, *Regional Aquifer-Systems Analysis, *Stratified drift, *Surface-groundwater relations, Geochemistry, Hydraulic conductivity, Hydrogen isotopes, Infiltration, New Jersey, Ohio, Recharge.

The environmental isotopes oxygen-18 and deuterium have been used to distinguish between the native groundwater in stratified drift aquifers and stream water that may infiltrate and recharge those aquifers, commonly as a result of large groundwater withdrawals that lower the water table near streams. In the glaciated northeastern United States, the seasonal variation in the values of these isotopes in aquifers is much smaller than in river water. Where groundwater beneath or near a stream consistently has the same isotope values as the stream, infiltration is indicated. Water samples from deep and shallow wells in stratified drift, from bedrock wells, and from streams were collected near municipal well fields in Ohio and New Jersey and analyzed for deuterium, oxygen-18, tritium, and dissolved constituents. The isotope values of water from the pumped wells were compared with those of streams and native groundwater to: (1) estimate the percentage of pumped water that was derived by infiltration from the river; (2) calculate, in conjunction with head measurements, the hydraulic conductivity of the streambed; and (3) evaluate seepage from bedrock into the stratified drift. Infiltration rates calculated from deuterium and oxygen-18 data were in general agreement with those calculated from stream loss measurements. Induced stream infiltration at the New Jersey site was computed to be about 1.4 cu ft/sec with a range of 2.5 to 0.7 cu ft/sec, and streambed hydraulic conductivity was calculated to be about 1.6 ft/day. Induced infiltration at the Ohio site was determined to be negligible, but tributary streams and upward leakage of bedrock water contribute water to the stratified drift aquifer. (See also W91-02280) (Author's abstract)
W91-02287

STATE-OF-THE-ART OF HYDROLOGY AND HYDROGEOLOGY IN THE ARID AND SEMI-ARID AREAS OF AFRICA.
For primary bibliographic entry see Field 2A.
W91-02288

CONTRIBUTION OF CIEH IN THE FIELD OF HYDROGEOLOGY (CONTRIBUTION DU CIEH DANS LE SECTEUR DE L'HYDROLOGIE).
Comite Interafricain d'Etudes Hydrauliques, Ouagadougou (Burkina Faso). Dept. of Hydrology.
For primary bibliographic entry see Field 2A.
W91-02294

NATURAL GROUNDWATER RECHARGE ESTIMATION IN (SEMI-)ARID ZONES: SOME STATE-OF-THE-ART OBSERVATIONS.
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
I. Simmers.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 373-386, 2 fig, 18 ref.

Descriptors: *Arid lands, *Groundwater recharge, *Recharge, *Semiarid lands, Analytical methods, Developing countries, Estimating, Hydrologic models.

Current international developments relating to nat
ural and 'man-induced' groundwater recharge ind
cate a number of problems, including the lack of
comprehensive estimation technique, lack o
knowledge about the areal extent of any derive
recharge results, and limited applicability of dat
from any given site and extreme variability in dat
quantity and quality. With these ideas as a frame
work, specific topics are discussed, including: def
nitions (aridity, groundwater recharge), ground
water recharge processes, temporal and spatial va
iability of recharge, resource management implic
tions, and recharge requirements for groundwat
modeling. The final choice of techniques for es
mating groundwater recharge will depend o
study objectives, initial data base and the possibi
ty of supplementing the data base, and availab
financial resources. Although recharge mech
nisms are reasonably well known, deficiencies a
evident in quantifying the various elements. Und
arid conditions recharge is intermittent and co
centrated in small areas; these characteristics ma
point methods preferable to areal methods for es
mation of recharge. Issues relating to spatial a
temporal variability and result regionalizati
create a series of problems for which further inv
tigation is needed. When data are inadequate, as
often the case in developing countries, a flexi
approach to project design can be employed
collect data as resource development procee
Conceptual hydrological models are important
this process. (See also W91-02288) (Rochest
PTT)
W91-02318

**WATER TRANSFER IN POROUS NON-SAT
RATED ROCK AND AQUIFER RECHARGE
THE SUDANO-SAHELIAN CLIMATE (TRA
FERT D'EAU EN MILIEU POREUX N
SATURE RECHARGE DES NAPPES
CLIMAT SOUDANO-SAHELIEN).**
Ecole Inter-Etats d'Ingenieurs de l'Equipem
Rural, Ouagadougou (Burkina Faso).
B. Dieng.
IN: The State-of-the-Art of Hydrology and
drogeology in the Arid and Semi-Arid Area
Africa. Proceedings of the Sahel Forum, Ou
dougou, Burkina Faso, 18-23 February 1989. In
national Water Resources Association, Urbana
linois. 1990. p 387-396, 3 fig, 1 tab, 12 ref. En
summary.

Descriptors: *Africa, *Aquifers, *Arid la
*Evaporation, *Groundwater recharge, *Hy
logic budget, *Sahel, *Sudan, Estimating, Gro
water management, Performance evaluation, F
fall-runoff relationships, Recharge, Soil mois
retention, Soil water.

In the Sudano-Sahelian region of Africa, the
zation of groundwater resources is of primar
portance. For optimal management, their cap
must be known, particularly for renewal proc
With regard to recharge of the aquifers, one o
greatest difficulties in the Sudano-Sahelian cli
is associated with the effects of evaporation.
erally, recharge is estimated through the diffe
of the terms of the hydrologic balance (prec
tion, evaporation, and runoff). However,
often the evaporation that constitutes the prin
element of this balance is being estimated ine
with the result that the recharge amount de
from it is even less accurate. The inaccura
partially due to the estimation of the usable re
in the soil, which generally is assumed to equ
quantity of water stored in the first soil
(often more than 1 m), whereas field expe
shows that evaporation affects even greater d
Therefore, there is a risk that in certain cas
calculation of recharge leads to over-estim
which would result in an over-exploitati
aquifers. (See also W91-02288) (Author's ab
W91-02319

**INVESTIGATION OF GROUNDWATER
CHARGE MECHANISMS IN BURKINA
Vrije Univ., Amsterdam (Netherlands). Inst
Aardwetenschappen.
J. van Brussel, W. Geirnaert, I. Simmers, and
van der Sommen.

IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 397-405, 4 fig, 11 ref.

Descriptors: *Arid lands, *Burkina Faso, *Groundwater recharge, *Hydrologic budget, *Recharge, *Tracers, Aeration zone, Chlorides, Isotopic tracers, Network design, Performance evaluation, Rainfall, Tritium, Water chemistry.

Chloride and tritium methods were employed in a study of recharge in northwest Burkina Faso. Two recharge mechanisms are active in the thick, weathered mantle covered crystalline basement complex in Burkina Faso: (1) diffuse recharge and (2) localized recharge via preferential pathways. Due to the low chloride content in precipitation a chloride balance cannot be used to determine recharge. However, the absence of significant chloride accumulation in the upper soil indicates that the diffuse mechanism is taking place. The distribution of tritium concentrations in the unsaturated zone and in the groundwater indicates that a 'rapid' recharge component also is present. The relative importance of both recharge mechanisms can be obtained only through a combined approach of unsaturated zone and groundwater studies. Large-scale sampling of precipitation chemistry is necessary to obtain representative results. (See also W91-02288) (Rochester-PTT)
W91-02320

EXPLORATION OF KARSTIFIED JOINTS IN PRECAMBRIAN LIMESTONE AQUIFERS OF THE GONDO PLAIN (MALI) WITH ELECTROMAGNETIC HORIZONTAL-LOOP METHODS LOCALISATION DES FRACTURES KARSTIFIEES DES CALCAIRES PRECAMBBRIENS DANS LA PLAINE DU GONDO (MALI) PAR LA PROSPECTION ELECTROMAGNETIQUE BIPOLE).
Neuchatel Univ. (Switzerland). Center of Hydrology.
. Muller, and G. Bieler.
N: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 406-415, 7 fig, 10 ref. English summary.

Descriptors: *Aquifer testing, *Aquifers, *Data acquisition, *Geophysical studies, *Groundwater level, *Groundwater mining, *Mali, *Rock properties, *Wells, Gondo Plain, Irma formation, Karst hydrology, Limestone, Measuring instruments, Performance evaluation.

In the Gondo Plain (Mali) the groundwater level is declining regularly because of the poor rainfall distribution of the past few years. More and more wells have to be put down in the limestones of the Irma formation, which is overlain by 40-50 m of silt-clay deposits of the 'Continental Terminal.' For the location of productive fissures, several geophysical methods were tested in terms of accuracy. Many productive and dry wells were investigated using original prototype instruments. Low frequency (4 and 4 Hz) geoelectric, very low frequency (12-24 kHz) resistivity (VLF-R), and electromagnetic bipole instruments were compared. Geoelectrical methods were not the best suited to locate small heterogeneities at greater depth hidden by thick conductive overburden. The depth penetration with the VLF-R also was very limited. The electromagnetic bipole seems to be the best tool to get the sharpest contrast on the karstified joints. Horizontal-loop profiling (Slingram method) with optical coil separation of 80 m at 2048 hz was well adapted to realize anomaly maps. These maps make clear that all productive wells are located in those zones where the quadrature values (percent out-phase) are negative. Dry wells are always located in the positive zones of the maps. Multidirectional electromagnetic vertical soundings indicate the degree of anisotropic contrast depending on depth and permit the strike and intensity of the regional joint development to be found. One of the most important advantages of the inductive electromagnetic exploration in arid zones is the speed of data acquisition, because the coils work without soil contact. (See also W91-02288) (Author's abstract)
W91-02321

ELECTRIC METHOD IN VILLAGE HYDRAULIC PROJECTS IN BENIN: THE CASE OF CRYSTALLINE FORMATIONS (GRANITE-SANDSTONE) (LA METHODE ELECTRIQUE EN HYDRAULIQUE VILLAGEOISE: CAS DES FORMATIONS CRISTALLINES (GRANITE-GNEISS)).
Universite Nationale du Benin, Cotonou. Dept. de Physique.
R. Darboux-Afouda.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 416-424, 3 fig, 6 ref. English summary.

Descriptors: *Aquifer testing, *Aquifers, *Geophysical studies, *Groundwater mining, *Rural areas, *Wells, *West Africa, Conductivity, Geologic fractures, Gneiss, Granites, Pumps, Resistivity.

In the last few years, some hydrological projects in crystalline formations of West African countries have consisted of supplying villages with drilled wells and pumps. In these areas, economic aquifers usually occur in fissured and fractured zones. To detect such zones in the field, resistivity profiling has been used for a long time: the zones are identified as conductive compartments on resistivity profiles. However, the reverse is not always true. The studies suggest that the best qualitative interpretations can be obtained by using both Schlumberger and square arrays for horizontal profiling. Fracture zones are then identified as a combination of low apparent resistivity and low apparent anisotropy. This methodology, which is well adapted to crystalline formations (granite-gneiss) with thin weathered layers, could indicate accurately the locations of productive wells when applied to a village hydrology project in Benin. Both theoretical and empirical studies support the view that this method is well-adapted to studies of aquifers with fractures and fissures in granite-gneiss. (See also W91-02288) (Author's abstract)
W91-02322

HYDROGEOLOGICAL AND GEOPHYSICAL ELECTROMAGNETIC STUDY OF THE ALLUVIAL AQUIFER OF WADI TELOUA, AGADEZ, NIGER (ETUDE HYDROGEOLOGIQUE ET GEOPHYSIQUE ELECTROMAGNETIQUE DE LA NAPPE ALLUVIALE DU KORI TELOUA, AGADEZ, NIGER).
Institut Universitaire d'Etudes du Developpement, Agadez (Niger).
F. Balmer.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 425-434, 6 fig, 1 tab, 6 ref. English summary.

Descriptors: *Alluvial aquifers, *Aquifer characteristics, *Aquifers, *Geohydrology, *Groundwater level, *Niger, *Sahel, *Water resources development, Agricultural water, Alluvial deposits, Groundwater movement, Groundwater recharge, Piezometers, Resistivity, Tracers, Urbanization, Wadi, Wells.

In the Air Massif, in Niger's Sahelian region, the local population farms principally in the valleys. Increased use of water for agriculture and insufficient recharge due to poor rainfall over the past 15 yr, are leading to a serious imbalance. Water requirements for agricultural self-sufficiency are no longer assured and even domestic use is becoming a problem. Situated on the piedmont of the Air Massif, the alluvial aquifer of the wadi, which supplies Agadez (population 45,000) and its agricultural zone, the Teloua, has undergone a drop of 10 m over the last 5 yr. The volume of water penetrating the aquifer during the annual floods no longer compensates for natural loss and use of water in the zone. Most wells are dry despite efforts to deepen them. The alluvial deposits comprising the reservoir are essentially composed of more or less muddy sands and weathered rocks. These deposits block the sedimentary channels at the Air's edges as well as its ancient granitic valleys. In an effort to define the geological and hydrogeological structures of the aquifer and its recharge area and the path and speed of flow, piezometric, geophysical, and multitracing studies were carried out. Paleochannels comprise most of the aquifer and its zone of recharge. (See also W91-02288) (Author's abstract)
W91-02323

PROSPECTING FOR AQUIFER FRACTURES IN THE CRYSTALLINE BASEMENT BY SOIL RADON ANALYSIS (PROSPECTION DES FRACTURES AQUIFERES DU SOCLE CRISTALLIN PAR DOSAGE DU GAZ RADON CONTENU DANS LE SOL).
Bureau de Recherches Geologiques et Minieres, Orleans (France).
R. Mathieu, S. Puyoo, and M. Ricolvi.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 435-447, 4 fig, append. English summary.

Descriptors: *Aquifers, *Burkina Faso, *Geologic fractures, *Geophysical surveys, *Groundwater resources, *Isotopic tracers, *Radon, *Tracers, Lithology, Performance evaluation, Well data, Well yield.

The emanation of radon gas through the ground in areas with an igneous or metamorphic basement increases with fracturing of the underlying rock and with its water content. Radon prospecting has been used to complement photointerpretation and electrical geophysics in the search for wells with a yield greater than 5 cu m/hr at three sites in Burkina Faso with differing hydrogeological and climatic conditions. At Sanon there are about ten high-contrast to very high-contrast anomalies (up to 4480 picocuries (pCi)/l) on high background noise (540 pCi/l) despite a 20-50 m clay cover on a basement of migmatites and granites. The wells with the highest yield correspond to the strongest and most extensive radon anomalies and, with one exception, the intersect highly fractured zone. At Katchari the background noise is weak (125 pCi/l) although the sandy clay saprolites of the ampibolitic basement are only of average thickness (14-22 m). The anomalies, not of high contrast, are aligned along the conductive zones revealed by electrical geophysics. The highest yields corresponded to the strongest emanations. Barogo has a varied substratum (schist, diorite, tuff, etc.) situated under 10-40 m of clayey saprolite. The variations in the fairly low level of background noise (average 190 mCi/l) in places mark the lithological changes in the basement. Only one high-contrast anomaly (890 pCi/l) was discovered in a zone with a fairly high background noise (280 pCi/l) despite 32 m of saprolite. The well sunk there yields 25 cu m/hr, the highest yield on this site. Although radon prospecting used as a supplement to conventional methods has yielded very positive results, many questions remain to be answered. (See also W91-02288) (Author's abstract)
W91-02324

GEOPHYSICAL PROSPECTING FOR GROUND WATER EXPLORATION IN DISCONTINUOUS AQUIFERS FOR RURAL WATER SUPPLY PROJECTS IN THE SAHEL.
C.M. Consulting and Management, Rome (Italy).
C. Rossi, and R. Zoppis.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouaga-

dougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 448-455, 1 tab, 8 ref.

Descriptors: *Aquifers, *Geophysical exploration, *Groundwater resources, *Mali, *Sahel, Cost analysis, Data interpretation, Discontinuous aquifers, Economic aspects, Performance evaluation, Resistivity, Rural areas, Wells.

Geophysical prospecting for groundwater exploration for rural water supply projects in areas of the Sahel, where the aquifer is discontinuous, can no be considered indispensable for obtaining results capable of justifying the cost. This prospecting, which must be preceded by detailed photogeological studies, is based essentially on geoelectric methods, in particular electrical vertical soundings and resistivity profiles, sometimes associated with magnetic profiles. Geophysical prospecting was conducted in the Republic of Mali to establish the best location for 466 productive wells in 279 villages as part of a project funded by the Italian Technical Cooperation Agency. The large quantity of geophysical and hydrogeological data available made it possible to define both the optimal methods of prospecting and the best interpretation of the findings for the different geologic formations, which are representative of the major discontinuous aquifers in the Sahel. It is concluded that, if the methods are employed carefully and use extreme precision both in the measurements and locating the resistivity anomalies on the ground, geophysical prospecting can give excellent results. In fact, the cost of geophysical prospecting as a percentage of the total cost of a drilled well (3-4% on average) is amply covered by the greater success (up to more than 20%) that can be obtained compared to research based entirely on photointerpretation. (See also W91-02288) (Rochester-PTT)
W91-02325

NEW INSTRUMENTS FOR ELECTRICAL AND AUDIOMAGNETOTELLURIC PROSPECTING (CARACTERISTIQUES DES EQUIPEMENTS MODERNES DE PROSPECTION GEOPHYSIQUE PAR METHODS ELECTRIQUE OU AUDIOMAGNETOTELLURIQUE).
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 7B.
W91-02326

GEOPHYSICAL RECONNAISSANCE IN A FISSURED STRUCTURE: EXAMPLE IN LIPTAKO, REP. NIGER (RECONNAISSANCE GEOPHYSIQUE EN MILIEU FISSURE: EXEMPLE AU LIPTAKO, REP. NIGER).
Niamey Univ. (Niger).
B. Ousmane, J. C. Lachaud, and P. Therme.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 468-479, 6 fig. English summary.

Descriptors: *Data acquisition, *Geophysical exploration, *Groundwater prospecting, *Niger, Anisotropy, Borehole geophysics, Data processing, Geohydrology, Geologic fractures, Liptako, Performance evaluation, Remote sensing.

Measurements using electrical prospecting or physical methods are influenced by the stratification of the terrain, faults, and diaclases. Consequently, arrangements for the orientation of measurements are important. Numerous experiments and studies have been carried out in the field of electrical prospecting using a multidirectional investigation method. The aim of this technique is to bring into agreement the electrical anisotropy of the rock and the fracturing as determined by aerial photos, satellite imagery, or hydrogeological studies. By combining classical methods (electrical, geophysical) with multidirectional investigations (squares, double rectangle), a methodology has been developed to help hydrogeologists set boreholes in difficult structures. Tests conducted at 10 sites in Liptako (Niger) demonstrated the capability of the method to produce good results in the hands of a competent operator. Results from three of the sites are described in detail as examples. (See also W91-02288) (Rochester-PTT)
W91-02327

GEOPHYSICAL METHODOLOGY APPLIED TO RURAL WATER SUPPLY IN BEDROCK ENVIRONMENT: PRELIMINARY RESULTS (METHODOLOGIE GEOPHYSIQUE APPLIQUEE A L'HYDRAULIQUE VILLAGEOISE EN ZONE DE SOCLE: RESULTATS PRELIMINAIRES).
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Geophysique.
V. T. Angelillo.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 480-490, 5 fig, 5 ref. English summary.

Descriptors: *Aquifers, *Geophysical exploration, *Groundwater resources, *Measuring instruments, *Niger, *Sahel, *Subsurface mapping, Bedrock, Drilling, Geologic fractures, Rural areas, Water level, Well yield.

Many studies and surveys have demonstrated how useful geophysics can be in groundwater prospecting. In the case of fractured aquifers, the rural water supply projects of the development programs in Sahelian countries have carried out several routine surveys in the bedrock zones to locate water-bearing fractures. Generally only one method was used. Improvements in results can be obtained by appropriate combining of geophysical methods. The study area was northeast of Zinder (Niger) in Precambrian granites. During the 1987-1988 drilling campaign, geophysical prospecting was conducted by combining very low frequency (VLF) mapping with classical electrical profiling and sounding. VLF filtered data (tilt angle and quadrature measurements) were used to obtain, on the field, two different maps of the faulted area allowing for the deduction of direction and relative depth of fractionation. On favorable anomalies, a restricted geophysical survey could then locate the drilling site with greater accuracy. This approach improved the percentage of positive drillings, as well as the average well yield. In addition, placing the pumps on the deepest structures insures that installations will last longer as piezometric level declines continuously. (See also W91-02288) (Rochester-PTT)
W91-02328

AQUIFER CHARACTERISTICS IN THE SEDIMENTARY BASINS OF THE SEMI-ARID AND ARID AREAS OF KENYA.
Nairobi Univ. (Kenya). Dept. of Geology.
G. O. Krhoda.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 491-501, 6 tab, 15 ref.

Descriptors: *Aquifers, *Geohydrology, *Groundwater resources, *Kenya, *Semiarid lands, Arid lands, Lithology, Regional analysis, Sedimentary basins.

Finding and developing sources of groundwater is becoming an increasingly urgent need in many parts of Kenya. This is particularly critical in arid and semi-arid lands, which form nearly two thirds of the total area of the country. Groundwater sources were investigated in the sedimentary basins of eastern Kenya with the aim of determining aquifer characteristics. Although data are fragmentary and patchy, it is possible to identify three types of aquifers in the area in terms of both depth and lithology. There are shallow aquifers (3-10 m deep), deep aquifers (35-40 m), and deep and fractured aquifers. According to lithology, the first type of aquifer is composed of unconsolidated or poorly consolidated sand and gravel commonly interbedded with clay. The second type consists of semi-consolidated and consolidated conglomerate, sandstone, or shale formations with joints or fractures. The third type of aquifer is in limestone and gypsum beds and generally contains saline water. Further research is needed to make clear the extent of each type of aquifer and to determine the quantity and quality of water in each. (See also W91-02288) (Author's abstract)
W91-02329

HYDRAULIC PROPERTIES OF FOUR SOILS IN NIGER AND IMPLICATIONS FOR WATER BALANCE STUDIES.
International Crops Research Inst. for the Semi-Arid Tropics, Niamey (Niger).
For primary bibliographic entry see Field 2G.
W91-02330

STUDY OF GROUNDWATER RESOURCES O THE BUBAQUE AND BOLAMA ISLAND (BISSAGOS ISLANDS) (ETUDE DES RES SOURCES EN EAU SOUTERRAINE DES ILE DE BUBAQUE ET BOLAMA (ARCHIPEL DE BIJAGOS)).
Direction Generale des Ressources Hydrique Bissau (Portuguese Guinea).
M. S. Diallo.
IN: The State-of-the-Art of Hydrology and H drogeology in the Arid and Semi-Arid Areas Africa. Proceedings of the Sahel Forum, Ouag dougou, Burkina Faso, 18-23 February 1989. Inte national Water Resources Association, Urbana, linois. 1990. p 513-523, 5 ref. English summar

Descriptors: *Aquifer characteristics, *Geohydr logy, *Groundwater recharge, *Groundwater sources, *Guinea-Bissau, *Islands, Bolama Islan Bubaque Island, Groundwater level, Long-te studies, Statistics.

A program of studies and hydrogeological search on exploitation was conducted in Guin Bissau, concerning the exploitation of fresh wa on the islands of Bubaque and Bolama. Prospect and hydrogeological investigations yielded an ventory of water points, levels, geophysical da piezometric data, and boreholes. Sixty-two ye of pluviometric data and piezometric measu ments from 20 study programs were analyzed w the aid of a combined rain-water level mo Calibration of the model made it possible to est lish the elements of the hydrologic balance fo period of 62 yr, particularly recharge data. study shows that the recharge is greater on Bol (200 mm) than on Bubaque (mean value 130 m A frequency analysis of the annual recharge sh that the data follow a the Gaussian distribu curve with a coefficient of about 17%, whic evidence for a small variability in yearly val Dry decade values are on the order of 150-200 for Bolama and 90 mm for Bubaque. Since 1 the annual recharge values show a systematic cit with an exceptionally low value in 1984 aft dry period of 30 yr. (See also W91-02288) (thor's abstract)
W91-02331

GROUNDWATER RESOURCES IN A POO TRANSMISSIVE SANDSTONE IN A SE ARID ENVIRONMENT: 1. ESTIMATION RECHARGE.
Sveriges Geologiska A.B., Goeteborg (Swe
L. Carlsson, J. Bromley, and J. Smellie.
IN: The State-of-the-Art of Hydrology and drogeology in the Arid and Semi-Arid Are Africa. Proceedings of the Sahel Forum, Ou dougou, Burkina Faso, 18-23 February 1989. national Water Resources Association, Urban linois. 1990. p 524-539, 7 fig, 1 tab, 14 ref.

Descriptors: *Botswana, *Geohydro *Groundwater recharge, *Groundwater reso *Kalahari Desert, *Recharge, *Sandstones, * arid lands, Aquifers, Geochemistry, Hydro models, Model studies, Rainfall penetration gional analysis.

The eastern extremity of the Kalahari D thirstland (Botswana) is semi-arid, with a

annual rainfall of 447 mm, most of which falls erratically between October and April. However, there is little or no surface runoff because the water is rapidly absorbed by the thick sand mantle of this region. Recharge in a semi-arid area on the fringe of the Kalahari Desert thirstland in Botswana was calculated using various methods. Recharge to a sandstone aquifer concealed by Kalahari sand was found to be small and limited to the eastern escarpment of the Kalahari plateau. Geochemical and isotopic data supported active recharge, which was quantified by hydrometeorological calculations, numerical aquifer flow modeling, and chloride balance calculations. Initial soil moisture studies were used to study the recharge process. Based on these results, it is suggested that rainfall concentration might permit the retention capacity of the sand to be overcome, thus permitting some limited recharge. Longer-term and more detailed work is needed to confirm this view. (See also W91-02288, W91-02333, and W91-02334) (Rochester-PTT)
W91-02332

GROUNDWATER RESOURCES IN A POORLY TRANSMISSIVE SANDSTONE IN A SEMI-ARID ENVIRONMENT: 2. REGIONAL INVESTIGATION OF GEOLOGICAL STRUCTURES.
Sveriges Geologiska A.B., Lulea (Sweden).
For primary bibliographic entry see Field 7B.
W91-02333

GROUNDWATER RESOURCES IN A POORLY TRANSMISSIVE SANDSTONE IN A SEMI-ARID ENVIRONMENT: 3. ESTIMATION OF RESOURCES.
veriges Geologiska A.B., Goeteborg (Sweden).
. Carlsson, J. Bromley, and B. Mannstrom.
N: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of frica. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illois. 1990. p 549-561, 6 fig, 13 ref.

escriptors: *Aquifer characteristics, *Botswana, Geohydrology, *Groundwater recharge, Groundwater resources, *Sandstones, *Semiarid nds, Drawdown, Geological fractures, Groundater level, Hydraulic properties, Kalahari Desert, mping tests, Regional analysis, Water level, ells.

e Ntane (formerly Cave) sandstone aquifer stern Botswana) is in the Kalahari Desert, a ni-arid region where mean annual rainfall is a le more than one third of potential evapotranration. Hydraulic testing in this poorly transmise sandstone was performed by long-term pump- tests. Delayed yield influenced the drawdown nore than 40 days of pumping in an unconfined dition. The groundwater resource in the area s calculated as a function of well spacing and ifer transmissivity for siting both in fracture es identified and in the naturally fissured sandne. The results of the resource calculation show a required resource of 35,000 cu m/day is ilable for 25 yr from the 1700 sq km of confined ne aquifer. On a regular grid basis, 175 wells ering 350 sq km would be required. The renewe resource of the whole study area, provided gularly by intermittent recharge, is estimated to ,000 cu m/day. After abstraction for 25 yr, the ndwater level theoretically will have been ered about 40 m when no recharge is consid-. (See also W91-02288, W91-02332, and W91-33) (Rochester-PTT)
1-02334

PROVED YIELD OF RURAL WATER RKS THROUGH HYDRAULIC FRACTUR- EXPERIMENTS (AMELIORATION DE LA DDUCTIVITE DES OUVRAGES D'HYAULIQUE VILLAGEOISE PAR FRACTURAN HYDRAULIQUE EXPERIMENTATION).
au de Recherches Geologiques et Minieres, ans (France). Water Resources Dept.
primary bibliographic entry see Field 4B.
-02335

GROUNDWATER QUALITY IN RURAL AREAS IN WESTERN AFRICA.
International Bank for Reconstruction and Development, Abidjan (Ivory Coast). Regional Water and Sanitation Group.
O. Langenegger.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 574-584, 8 fig, 3 tab, 13 ref.

Descriptors: *Africa, *Geochemistry, *Geohydrology, *Groundwater pollution, *Groundwater quality, *Rural areas, *Water chemistry, *Water pollution sources, *Water quality, Burkina Faso, Chemical properties, Conductivity, Ghana, Hydrogen ion concentration, Ivory Coast, Mali, Niger, Organic wastes, Physicochemical properties, Pumps, Regional analysis, Turbidity, Wells.

The physicochemical composition of groundwater plays an important role not only because of its health impact but in terms of user acceptance, and affects technical aspects (eg, corrosion) as well as industrial and agricultural applications. A general overview of groundwater quality in western Africa is given based mainly on field trials of the World Bank-executed INT/81/026 Handpumps Project, which covered Burkina Faso, Ivory Coast, Ghana, Mali, and Niger, on the 3000 Well Drilling Program in Ghana, and the Helvetas Project in Mali. Physical parameters considered include temperature, pH, electrical conductivity, and turbidity. Chemical constituents investigated were iron, manganese, oxygen, carbon dioxide, ammonium, nitrite, and nitrate. The groundwater occurring in the Handpumps Project area is, in general, of good quality, with a low level of dissolved minerals, which is typical for non-carbonate formations that underlie much of the investigated areas. The predominance of 'acidic' rocks is the major cause of aggressive groundwater. Organic wastes in and around settlements are the single most important source of groundwater pollution in the rural environment. Livestock concentrations around water sources and dirtiness and inadequate drainage of water also cause groundwater pollution. Well pollution is caused by inadequate well construction or defective wells, poorly installed or defective handpumps, and inadequately designed handpumps and handpump corrosion. (See also W91-02288) (Author's abstract)
W91-02336

CORROSIVITY PROBLEMS IN RURAL WATER SUPPLY PROJECTS IN SAHELIAN AREAS OF WEST AFRICA.
C.M. Consulting and Management, Rome (Italy).
L. Zoppis, and R. Zoppis.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 585-589, 11 ref.

Descriptors: *Corrosion, *Geochemistry, *Groundwater quality, *Mali, *Sahel, *Water chemistry, *Wells, Geohydrology, Performance evaluation, Rural areas, Testing procedures, West Africa.

The problem of corrosive groundwaters in drilled wells has recently become a serious concern throughout the Sahelian areas of West Africa. A preliminary assessment of corrosion was conducted in the Mali Rural Water Supply Project. An investigation method was devised that permits the prior evaluation of the corrosive potential of groundwater in a relatively quick and cheap way, in line with the needs and possibilities of most village water supply projects. The proposed methodology takes into account the parameters that best identify the corrosive nature of groundwaters where iron is a factor, namely, the 'Langelier Index' and 'Tillman's Diagram.' These parameters can be used to conduct an initial evaluation of the water from each well. To assess the groundwaters of a given region, two steps are required: (1) collect and utilize all chemical analysis data concerning groundwaters tapped by existing wells in the project area and (2) perform physical and chemical analyses using rapid spectrophotometric and volumetric methods on the groundwater of each drilled well, with the sample being taken prior to pump installation. The data obtained can be used to calculate the two indexes. Results obtained from a sample of 150 wells in Mali showed that the method was generally adequate for evaluating groundwater corrosivity and for predicting its future development. (See also W91-02288) (Rochester-PTT)
W91-02337

VULNERABILITY OF THE BRAZZAVILLE AQUIFER AND THE RISK OF CONTAMINATION WITH DOMESTIC WASTES (PROBLEMES DE VULNERABILITE DE LA NAPPE DE BRAZZAVILLE ET RISQUES DE CONTAMINATION PAR LES REJETS DOMESTIQUES).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Brazzaville (Congo). Centre ORSTOM de Brazzaville.
For primary bibliographic entry see Field 5B.
W91-02339

HYDROGEOLOGICAL ROLE OF THE FAULTS IN THE VALLEYS OF THE SOUTH OF AIR (REPUBLIC OF NIGER) (SUR LES ROLES HYDROGEOLOGIQUES DES FAILLES DANS LES VALLEES DU SUD D'AIR (REPUBLIQUE DU NIGER)).
Ministere des Ressources, Animales et de l'Hydraulique, Niamey (Niger).
A. K. Dodo.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 636-647, 8 fig, 1 ref. English summary.

Descriptors: *Aquifers, *Geohydrology, *Geologic fractures, *Groundwater movement, *Groundwater recharge, *Niger, Groundwater resources, Pumping tests, Saline water, Tectonics, Water chemistry.

Short-duration pumping tests in the Awagadi valley (some 30 km north of Agadez (Niger) demonstrated that the fault was feeding the alluvial aquifer in the valley. This fault had been identified previously through photogeological studies of the catchment. Statistical studies and an analysis of fracturing showed that the direction of the fault corresponds perfectly to the delineation of the tectonics of the region. Investigation of the water chemistry in the northern part of the study area indicates the presence of saline water intrusion (conductivity: 2,000 microS/cm; pH: 8.12; Na(+): 410 mg/L; Cl(-): 360 mg/L; SO4(-): 160 mg/L). This hypermineralization is very probably the effect of another system from which water is also flowing through the faults. (See also W91-02288) (Author's abstract)
W91-02341

INFLUENCE OF CONTINENTAL RIFTING ON THE HYDROGEOLOGY OF THE BAHI DRAINAGE BASIN, DODOMA PROVINCE, CENTRAL TANZANIA.
Cooperative Inst. for Research in Environmental Science, Boulder, CO. Center for the Study of Earth from Space.
J. C. Brock, and R. F. Arenz.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 648-659, 10 ref.

Descriptors: *Geohydrology, *Groundwater movement, *Groundwater resources, *Remote sensing, *Satellite technology, *Tanzania, *Tectonics, Bahi Swamp, Chenene Hills, Rifts, Vegetation.

The control of rift-associated geologic structuring on the surficial and groundwater flow patterns of the Bahi Drainage Basin on the southern extent of the East Africa Rift (Tanzania) was investigated. Landsat multispectral scanner (MSS) image data were used to infer the presence of rift-associated regional faulting. A Landsat MSS scene was digitally processed to enhance the depiction of structurally controlled geomorphology and hydrogeologic features. Image processing procedures applied to all four MSS spectral bands included geometric rectification to a Universal Transverse Mercator map projection and contrast enhancement by linear stretch operations. The interpretations of linear faults and fracture trends was enhanced by the spatial frequency filtering of all four bands followed by the generation of band composite images. Vegetation index images were generated using a linear combination of MSS bands. The resultant images supported the interpretation of possible groundwater recharge areas and active stream channels. The distribution of potential alluvial aquifers and the drainage pattern was inferred from false-color composite images derived from the contrast-enhanced MSS bands and high pass directional spatial frequency filtered images. The Chenene Hills occupy the south-central portion of the study area, Bahi Swamp is situated to the southwest and Dodoma City lies at the southern limit of the study area. A major northeast-southwest trending fault zone extending from the northern Bahi Swamp and passing immediately to the north of the Chenene Hills was mapped based on Landsat MSS image data and previous geologic field investigations. It is proposed that this fault trend has disturbed a pre-existing northwest-southeast trending drainage system and caused the southwestward diversion of both surface and groundwater flow into the Bahi Drainage Basin. This may have results in the formation of the Bahi Swamp in a closed topographic depression west of the Chenene Hills. Accordingly, the regional northeast-southwest striking fault trends to the northeast of the Bahi Swamp are recommended for groundwater exploration. (See also W91-02288) (Author's abstract)
W91-02342

STUDY OF PIEZOMETRIC DEPRESSIONS BY ENVIRONMENTAL ISOTOPES: FIRST DATA ON EXAMPLES IN MALI (ETUDE DES DEPRESSIONS PIEZOMETRIQUES PAR LES ISOTOPES DE L'ENVIRONNEMENT: PREMIERES DONNEES SUR DES EXEMPLES AU MALI).
Projet AIEA, Dakar (Senegal).
J. F. Aranyossy, and A. Guerre.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 660-670, 5 fig, 1 tab, 25 ref.

Descriptors: *Groundwater movement, *Groundwater recharge, *Isotopic tracers, *Mali, *Piezometric head, *Tracers, Carbon isotopes, Evaporation, Groundwater resources, Interior Delta, Mathematical models, Nara Region, Simulation, Tritium, Water table.

An environmental study on the piezometric depressions of the 'Nara' region (northwest Mali) and 'Interior Delta' (central part) led to two conclusions. First, the absence of a logical distribution of radioactive water content (tritium and 14C) from the margin toward the center of the depressions demonstrates predominance of vertical movement over lateral water transfers; the seasonal recharge of the phreatic aquifer does not appear to be followed by regional circulation. Second, the clear relationship between isotopic enrichment and water table depth corresponds to the flushing of heavy isotopes accumulated in the unsaturated zone during the dry season. The evaporation flux, estimated at about 500 mm/yr at 1 m depth, decreases exponentially with depth (1 mm/yr at 15 m). These values, when employed in a mathematical simulation model gave a satisfactory fit between observed and calculated isopiezes. Considering that no recharge occurs in the central part of the basin, this evaporation flux would be sufficient to create and maintain piezometric depressions. (See also W91-02288) (Author's abstract)
W91-02343

TURBULENT FLOW THEORY FOR AFRICAN REGOLITHS.
Utah International, Inc., San Francisco, CA.
N. Krishnamurthi.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 672-685, 3 fig, 3 tab, 1 ref, append.

Descriptors: *Africa, *Groundwater movement, *Mathematical models, *Model studies, *Regoliths, *Sahel, *Turbulent flow, *Well yield, Aquifers, Geologic fractures, Groundwater recharge, Laminar flow.

Current groundwater flow theories are applicable to aquifers of granular materials. The conventional concepts of transmissivity, storage coefficient, and cone of depression may fail to explain turbulence that can be witnessed in a dug well in hard rocks. A fresh approach is needed to model the flow and the well yield in hard rocks like the African regoliths. A turbulent flow model was developed for simulating the flow in African regolithic aquifers. Three assumptions were made in developing the model: (1) flow into a well is through small conduits through the inner surface of the well; (2) water travels from a distance R (assumed constant) from the well; and (3) the operative depth of the well is reckoned below the static water level and there is no flow into the well above this static water level. Equations describing this model are developed in detail and well function and flow conductance, pumping test and analysis, and laminar inflow theory for hard rock open wells are discussed in detail. The model in its current form is suited for field testing in the Sahelian region because of the recharge potential there. (See also W91-02288) (Rochester-PTT)
W91-02344

SOLUTION OF DISSEMINATED CALCITE IN QUARTZ VEINS OF BIRRIMIEN SCHISTS IN BURKINA FASO AS A KEY TO A POSSIBLE AQUIFER MODEL.
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
W. Geirnaert, P. Bloemen, W. Kool, and J. J. van der Sommen.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 701-710, 6 fig, 6 ref.

Descriptors: *Aquifer characteristics, *Burkina Faso, *Calcite, *Geochemistry, *Geohydrology, *Hydrologic models, *Water chemistry, Clays, Microscopy, Quartz, Schist.

Borings conducted in Birrimien volcano-sedimentary schists (Burkina Faso) show solution features within quartz veins. Microscopic study of thin sections revealed the presence of calcite, intermingled with the quartz and generally recrystallized, forming an integral part of the lithological unit. Comparison of hydrochemical data from granitic and schist aquifers shows that calcite solution is mainly active in schistose rocks and occurring on a regional scale. Clayey weathering products and a more plastic deformation, a result of stress, make the currently adopted geologic model for granitic aquifers ('valley fill' model) non-applicable to schistose rocks. The calcite solution process is of major importance in developing an acceptable hydrogeological model for schist aquifers. (See also W91-02288) (Author's abstract)
W91-02346

USE OF PERSONAL COMPUTERS FOR THE ANALYSIS AND MANAGEMENT OF HYDRO-METEOROLOGICAL AND GROUNDWATER DATA.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7C.
W91-02351

ARRIVAL OF A GENERATION OF FIELD EXPERT SYSTEMS (L'AVENEMENT D'UNE GENERATION DE SYSTEMES EXPERTES DE TERRAIN).
ILOG S.A., Gentilly (France).
For primary bibliographic entry see Field 7C.
W91-02354

STATE OF THE ART HYDROLOGY FOR THE DEVELOPMENT OF SAHELIAN WATER RESOURCES.
Ohio Univ., Athens. Dept. of Hydrogeology.
M. U. Ahmad.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 812-823, 5 fig, 18 ref.

Descriptors: *Africa, *Agricultural water, *Groundwater mining, *Groundwater resources, *Hydrologic models, *Sahel, *Water resources development, Arid lands, Data acquisition, Design criteria, Developing countries, Geohydrology, Libya, Monitoring, Sahara, Satellite technology, Semiarid lands, Wells.

There is great controversy among meteorologists and ecologists about the causes of the persistent Sahelian drought. In all development planning for the Sahel, high levels of climatic variability and inevitable drought are accepted as 'normal.' Sahelian countries can benefit by knowledge of deep aquifers in the Libyan Sahara. The Kufra Production Project (KPP), Kufra Settlement Project (KSP), and the Sarir Production Project (SPP) have been operating for over 15 yr. Systematic monitoring data coupled with two-dimensional and three-dimensional modeling provide unique hydrological insight into the extraction of water for large-scale projects, such as the Great Man Made River Project. Based on experience from the Libyan projects, a plan is presented for development of groundwater resources for agriculture in the Sahelian countries. The magnitude of sustainable development does not depend on knowing the total water budget but does depend on the degree of hydrological effects that can be tolerated at any given time. A plan for study would include the following eight steps: (1) use satellite-derived data for basic geological and hydrogeological information; (2) conduct general geologic reconnaissance; (3) conduct hydrologic reconnaissance; (4) pursue test exploration and production wells for 5-day and 10-day periods to determine preliminary aquifer parameters and water quality; (5) construct a numerical identification model using all the collected data; (6) use the model and other tools (e.g., geologic maps, aerial photos, geophysical logs) to locate well fields in areas with soils suitable for growing crops; (7) employ a modern well design for high performance production; and (8) use data from the well fields to update the original three-dimensional model every year. (See also W91-02288) (Rochester-PTT)
W91-02355

INTEGRATED APPROACH FOR THE EVALUATION OF GROUNDWATER RESOURCES: CASE STUDY IN YATENGA (APPROCHE INTEGREE POUR L'EVALUATION DES RESSOURCES EN EAU SOUTERRAINES: ETUDE DE CAS AU YATENGA).
Ministry of Water Resources, Ouagadougou (Burkina Faso).
B. Wedraogo, P. Bloemen, and B. Diagana.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 824-835, 5 fig, 11 ref. English summary.

Descriptors: *Burkina Faso, *Groundwater recharge, *Groundwater resources, *Rural areas, *Water supply development, *Wells, Aerial photography, Geohydrology, Groundwater movement, Infiltration, Isotopic tracers, Pumping tests, Water supply, Well yield.

Ongoing village water supply drilling programs and detailed hydrogeological field studies (comprising core drillings, long-duration pumping tests, hydrochemical and isotope analyses, etc.) have been combined to study the basic characteristics and the recharge of aquifer systems of the crystalline shield in Yatenga Province, northwest Burkina Faso. The characteristics of the aquifers appear to be determined primarily by the lithology of the underlying bedrock. On granitic rock, the fractured zone is in continuous hydraulic contact with the overlying weathered zone and they react during pumping tests as one hydrologic medium. On schistose rock, a remarkable difference in permeability exists between the clayey alterites and the fractured bedrock. Hydrochemical and isotope analyses show that recharge by diffuse infiltration is limited (40-140 mm/yr) and slow (less than 0.3 m/yr) and a non-negligible part of the recharge takes place as rapid drainage via preferential paths (localized recharge). Interpretation of aerial photos and geophysical investigations show that the best drilling locations for village water supply programs are situated on the coincidence of major structural lineaments and the lower part of the erosional glacis. (See also W91-02288) (Author's abstract)
W91-02356

GROUNDWATER MONITORING: VOLATILE ORGANIC CHEMICALS BENEATH UNSEWERED SUBDIVISION.
Wisconsin Univ.-Eau Claire. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W91-02413

HYDROLOGICAL ASPECTS OF THE DEVELOPMENT AND RAPID DECAY OF THE 1989 DROUGHT.
nstitute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2B.
W91-02428

UBCLINICAL EFFECTS OF GROUNDWATER CONTAMINANTS. II. ALTERATION OF REGIONAL BRAIN MONOAMINE NEUROTRANSMITTERS BY BENZENE IN CD-1 MICE.
Utah State Univ., Logan. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-02469

EOPHYSICAL INVESTIGATION--SOUTHWESTERN GREAT ARTESIAN BASIN.
For primary bibliographic entry see Field 8E.
W91-02529

UPERCOMPUTERS AND THEIR USE IN MODELING SUBSURFACE SOLUTE TRANSPORT.
estern Australia Univ., Nedlands. Centre for ater Research.
r primary bibliographic entry see Field 7C.
91-02543

TEGRATED APPROACH TO QUANTIFY ROUNDWATER TRANSPORT OF PHOSHORUS TO NARROW LAKE, ALBERTA.
berta Univ., Edmonton. Dept. of Zoology.
D. Shaw, J. F. H. Shaw, H. Fricker, and E. E. epas.
mnology and Oceanography LIOCAH, Vol. 35, . 4, p 870-886, June 1990. 7 fig, 5 tab, 46 ref.

scriptors: *Alberta, *Groundwater movement, akes, *Limnology, *Narrow Lake, *Nutrients, hosphorus, Darcys equation, Mathematical dels, Piezometry, Seepage.

integrated approach was used to quantify undwater phosphorous flux to Narrow Lake, a small glacial terrain lake in central Alberta. Data from a drilling program, major ion concentrations, environmental isotopes, and computer simulations indicated that the lake gains water through the nearshore region, from a small shallow groundwater flow system; at deep offshore regions, water moves from the lake to the groundwater flow system. Seepage flux was quantified by water budget, Darcy's equation with data from wells near the lake, Darcy's equation with data from minipiezometer in the lake, and seepage meters. Whole lake seepage flux determined from minipiezometer data (30 mm/yr) was only 10-25% of the other estimates (mean, 221 mm/yr; range, 133-332 mm/yr from seepage meter and water budget data, respectively). Groundwater contributed 30% of the annual water load to the lake. The P concentration in pore water from lake sediments (mean, 175 mg cu m) was 8 times higher than groundwater from wells near the lake (mean, 21 mg m cu). Thus, if well water was used to estimate P concentrations of the seepage water, the rate of groundwater P loading to the lake would be underestimated. The rate of groundwater P loading to the lake computed from average seepage flux and average pore water P concentration was 39 mg sq m/yr, and groundwater may be the largest single source of P to epilimnetic water in the lake. (Author's abstract)
W91-02589

GROUNDWATER RECHARGE FROM LAKE CHAD.
Indiana Univ.-Purdue Univ. at Fort Wayne. Dept. of Earth and Space Sciences.
S. A. Isiorho, and G. Matisoff.
Limnology and Oceanography LIOCAH, Vol. 35, No. 4, p 931-938, June 1990. 5 fig, 1 tab, 28 ref. NSF Grant Int 83-19271.

Descriptors: *Groundwater recharge, *Lake Chad, *Limnology, *Salinity, *Salt balance, *Surface-groundwater relations, *Water chemistry, Africa, Aquifers, Flow rates, Groundwater movement, Piezometry, Seepage, Water table.

The open waters of Lake Chad are reasonably free of salt (120-320 mg/L) even though it is a shallow, old, closed-basin lake located in the highly evaporative environment of sub-Saharan Africa. It is possible that the lake remains relatively fresh due to the significant removal of water and solutes by seepage into the groundwater beneath the lake. Directly measured seepage rates (seepage meters and core tracer methods) through the sandy lake bottom are 0.00115 m/d. The regional water table derived in this study indicates the lake to be at a higher hydraulic elevation than the phreatic aquifer hydraulic elevation, and measurements of the groundwater flow direction determined from minipiezometric nests confirm that flow is SW, away from the lake. Preliminary calculations indicate that seepage plays a significant role in water and solute budgets, since it removes as much as 18% of the annual water input and 40-160% of the annual salt input to the lake. (Author's abstract)
W91-02591

WATER RESOURCES FOR FLORIDA, WATER YEAR 1989, VOLUME 2A. SOUTH FLORIDA - SURFACE WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02625

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1989, VOLUME 2B. SOUTH FLORIDA - GROUND WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02626

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1989, VOLUME 3A: SOUTHWEST FLORIDA SURFACE WATER.
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02627

WATER RESOURCES FOR CALIFORNIA, WATER YEAR 1989, VOLUME 4: NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02628

WATER RESOURCES DATA FOR MASSACHUSETTS AND RHODE ISLAND, WATER YEAR 1988.
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02629

WATER RESOURCES DATA FOR MISSOURI, WATER YEAR 1989.
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02630

WATER RESOURCES DATA FOR MONTANA, WATER YEAR 1989.
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02631

WATER RESOURCES DATA FOR NEW JERSEY, WATER YEAR 1989, VOLUME 1: ATLANTIC SLOPE BASINS, HUDSON RIVER TO CAPE MAY.
Geological Survey, West Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02632

WATER RESOURCES DATA FOR NEW JERSEY, WATER YEAR 1989, VOLUME 2: DELAWARE RIVER BASIN AND TRIBUTARIES TO DELAWARE BAY.
Geological Survey, West Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02633

WATER RESOURCES DATA FOR NEW YORK, WATER YEAR 1989, VOLUME 2: LONG ISLAND.
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02634

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1989. VOLUME 2: SUSQUEHANNA AND POTOMAC RIVER BASINS.
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02635

WATER RESOURCES DATA FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS, WATER YEAR 1989.
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02636

WATER RESOURCES DATA FOR SOUTH CAROLINA, WATER YEAR 1989.
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 7C.

W91-02637

WATER RESOURCES DATA FOR SOUTH DAKOTA, WATER YEAR 1989.
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02638

WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1989.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02641

INSTALLATION OF A MULTIPORT GROUND-WATER SAMPLING SYSTEM IN THE 300 AREA.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5A.
W91-02670

GROUNDWATER MANAGEMENT: QUANTITY AND QUALITY.
For primary bibliographic entry see Field 4B.
W91-02672

EVALUATION OF HYDROGEOLOGICAL PARAMETERS IN HETEROGENEOUS POROUS MEDIA.
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
P. Lachassagne, E. Ledoux, and G. deMarsily.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 3-18, 6 fig, 23 ref.

Descriptors: *Aquifer characteristics, *Aquifer testing, *Geohydrology, *Groundwater management, *Model studies, *Transmissivity, *Water resources management, Decision making, Heterogeneity, Injection, Numerical analysis, Parametric hydrology, Permeability, Porous media, Pumping tests, Slug tests, Soil porosity.

For most hydrogeological problems, and particularly in heterogeneous porous media, the global permeability (or transmissivity) of the aquifers is the most important parameter to be determined for long-term predictions. In practice, the most common methods used by hydrogeologists to determine these parameters consist in radial pumping or injection tests. Two approaches can thus be considered: (1) performing numerous short duration tests and then to calculate from these local values a global estimation of the transmissivity; and (2) performing long-term pumping tests where the value of the effective transmissivity is obtained directly by classical methods of interpretation. The results of the two approaches for the estimation of the global transmissivity were compared by means of numerical simulations. The slug test or injection test over a small section of a well or piezometer when performed at numerous locations is suitable to determine both the type of distribution and the variogram of the local permeability values. Long-term pumping tests can be used as a means to validate the averages which could be obtained from local measurements. The mean transmissivity value established from such a test is identical to the one derived by averaging results from local tests. Thus both methods seem to lead to similar results. Long-term pumping tests are indeed very costly, and do not provide sufficient information on the variability of the system unless a large number of piezometers is available. (See also W91-02672) (Fish-PTT)
W91-02673

SOME ASPECTS OF SOIL MOISTURE CONTROL FOR SOILS WITH SHALLOW GROUNDWATER LEVELS.
Agricultural Univ. of Warsaw (Poland). Dept. of Land Reclamation.
For primary bibliographic entry see Field 2G.
W91-02674

ACCESS OF SMALL AND MARGINAL FARMERS TO GROUNDWATER--A FIELD STUDY.
Roorkee Univ. (India). Water Resources Development Training Center.
For primary bibliographic entry see Field 4B.
W91-02675

INDICATOR CONDITIONAL SIMULATION OF THE ARCHITECTURE OF HYDRAULIC CONDUCTIVITY FIELDS: APPLICATION TO A SAND-SHALE SEQUENCE.
Stanford Univ., CA. Dept. of Applied Earth Sciences.
J. J. Gomez-Hernandez.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 41-51, 6 fig, 9 ref.

Descriptors: *Aquifer characteristics, *Geohydrology, *Model studies, *Oil fields, Algorithms, California, Hydraulic conductivity, Numerical analysis, Oil shale, Parametric hydrology, Sand aquifers, Stochastic models, Structural geology, Uncertainty.

A prior requirement to the use of a numerical model is the assignment of aquifer parameter values to the blocks of the model. Data available are few, sparse, and typically vary in space in a way that cannot be deterministically reproduced. This variability introduces uncertainty in the predicted parameter values, which will be responsible for uncertainty in the final response of the model. A new algorithm for stochastic conditional simulations has been used to generate images of the Wilmington oil field (Los Angeles, California, basin) sand-shale sequence. The range of the variable under study was subdivided into mutually exclusive classes and an indicator was associated with each class. Indicator covariances were used to characterize the random geometric pattern between classes. These indicator covariances can be used to include structural qualitative information, such as the expected amount of random shales or the expected geometric continuity of any given class or rock type. When there are not enough data to infer precisely all indicator covariances a sensitivity analysis can be performed and a visual selection among images generated using different covariance models can help in the selection of the correct covariance model. Such selection amounts to the use of implicit geological information/interpretation in the covariance modeling. (See also W91-02672) (Author's abstract) (Fish-PTT)
W91-02676

DISTRIBUTION OF AQUIFER RECHARGE FROM A CIRCULAR SPREADING BASIN UNDER TRANSIENT OPERATIONS.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W91-02678

ESTIMATION OF THE TRANSMISSIVITY OF THE SANTIAGO AQUIFER, CHILE, USING DIFFERENT GEOSTATISTICAL METHODS.
Pontificia Univ. Catolica de Chile, Santiago. Faculty of Engineering.
J. F. Munoz-Pardo, and R. Garcia.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 77-84, 1 fig, 3 tab, 7 ref.

Descriptors: *Aquifer characteristics, *Geostatistics, *Groundwater management, *Groundwater movement, *Kriging, *Model studies, *Statistical methods, *Transmissivity, *Water resources management, Chile, Data interpretation, Linear programming, Regression analysis, Specific capacity.

Deterministic numerical models simulating the behavior of groundwater are useful tools in the evaluation, planning, and management stages of this resource. More sophisticated and elaborate models are continuously being proposed. However, the information available is usually limited and subject to large sampling and interpretative errors. To overcome these difficulties, it then becomes necessary to introduce into these models the effects of quality, quantity, and spatial distribution of the input data. Three geostatistical methods to estimate the transmissivity of an aquifer using the information commonly available were developed: simple kriging, kriging combined with linear regression, and co-kriging. A comparison was performed between the accuracy of the estimations. In a study of the Santiago aquifer, Chile, it was observed that kriging combined with linear regression gave better estimates, by taking into account the additional information contained in the specific capacity values, which greatly improves the estimation of the transmissivity of an aquifer. (See also W91-02672) (Fish-PTT)
W91-02679

OUTLIERS IN GROUNDWATER QUALITY TIME SERIES.
Polish Academy of Sciences, Warsaw. Inst. o Geophysics.
For primary bibliographic entry see Field 7C.
W91-02687

THREAT TO GROUNDWATER QUALITY BY PESTICIDES IN THE NETHERLANDS.
Rijksinstituut voor de Volksgezondheid, Bilthove (Netherlands).
For primary bibliographic entry see Field 5B.
W91-02688

HYDROGEOLOGY AND WATER CHEMISTR IN THE WEATHERED CRYSTALLINE ROCK OF SOUTHWESTERN NIGERIA.
Loughborough Univ. of Technology (England Dept. of Civil Engineering.
A. Owoade, L. G. Hutton, W. S. Moffat, and M. D. Bako.
IN: Groundwater Management: Quantity a Quality. Proceedings of the Symposium held Benidorm, Spain, October 2-9, 1989. Internation Association of Hydrological Sciences, Washin ton, DC. 1989. p 201-214, 7 fig, 3 tab, 19 r

Descriptors: *Geochemistry, *Geohydrolog *Geophysical surveys, *Groundwater quality, *N geria, *Water chemistry, Crystalline roc Groundwater management, Groundwater charge, Kaolinite, Permeability, Porosity, R charge, Resistivity, Water demand, Water qual management, Water resources manageme Weathering zone, Wells.

The groundwater potential in crystalline rock t rains depends on post-emplacement processes su as tectonism and weathering which could lead the development of secondary porosity and perm ability. Geophysical and hydrochemical techniq have been used to assess the groundwater pr pects in the crystalline weathered regolith in sou western Nigeria. The resistivity measureme gave an average depth of weathering of 34 From a consideration of the hydrodynamics of weathering process, kaolinite was found to be stable clay weathering product indicating t weathering reaction products are being flus since otherwise feldspar-water equilibrium wo have been attained considering the Pre-Camb age of the rocks. The presence of kaolinite taken to imply that the groundwater is being charged but it was not possible to use the avail data to quantify the recharge. Analysis of recov observations on one of the large diameter w sampled gave an average permeability of 50 m (1.2 m/day). These results indicate that the we ered regolith in the study area could sup modest water demands. Some rethinking ma necessary regarding generalizations in the li ture vis-a-vis the groundwater potential in rock terrains. (See also W91-02672) (Author's stract)

W91-02691

CHARACTERIZING THE HYDROGEOLOGICAL VARIABILITY OF A SAND AQUIFER IN THE REGION OF A DOMESTIC WASTE DISPOSAL SITE.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 5B.
W91-02692

DECOMPOSITION AND ELIMINATION OF TYPICAL POLLUTANTS FROM SANITARY LANDFILLS IN POROUS AQUIFERS.
Technische Univ. Braunschweig (Germany, F.R.). Leichtweiss-Inst. fuer Wasserbau und Grundbau.
For primary bibliographic entry see Field 5B.
W91-02693

COUPLING OF CHEMISTRY AND TRANSPORT.
Gesamthochschule Kassel (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-02694

IDENTIFICATION OF UNSATURATED SOLUTE TRANSPORT PARAMETERS.
Pontificia Univ. Catolica de Chile, Santiago. Faculty of Engineering.
For primary bibliographic entry see Field 5B.
W91-02695

INTERACTIVE GROUNDWATER MODELING: COLOUR GRAPHICS, ICAD AND AI.
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
L. Fedra, and H. J. Diersch.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 305-320, 4 fig, 6 ref.

Descriptors: *Artificial intelligence, *Computer models, *Finite element method, *Graphical analysis, *Hydrologic models, *Mapping, *Model studies, Geohydrology, Graphical methods, Groundwater management, Groundwater movement, Groundwater pollution, Parametric hydrology, Water quality management, Water resources management.

An interactive groundwater modeling system, based on a two-dimensional finite element simulator, has been developed. Combining a finite element model for flow and transport problems with artificial intelligence (AI)-based and symbolic graphics user interface, the system is designed to allow the easy and efficient use of complex groundwater modeling technology in a problem-oriented rather than model-oriented style. Implemented on a color-graphics engineering workstation, the system provides a problem manager that allows the selection of site-specific, as well as generic, groundwater problems from problem libraries, or the interactive design of a new problem. These problems can be edited and modified and then simulated under interactive user control. The system also features an extensive Intelligent Computer Aided Design (ICAD) component that allows the user to design very efficiently, and parametrize, a new problem from the very beginning, using a map or an auxiliary grid as a background for the definition of problem geometry and hydrogeological parameters. (See also W91-02672) (Author's abstract)
W91-02699

INTEGRATED FINITE DIFFERENCE MODEL FOR GROUNDWATER FLOW AND QUALITY SIMULATION.
Bologna Univ. (Italy). Facolta di Ingegneria.
Ferraresi.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 321-330, 5 fig, 9 ref. National Public Education Ministry of Italy grant MPI 8903002.

Descriptors: *Finite difference methods, *Groundwater movement, *Groundwater quality, *Hydrologic models, *Model studies, *Path of pollutants, Aquifer characteristics, Geohydrology, Groundwater management, Mathematical analysis, Porous media, Water quality management, Water resources management.

Although the integrated finite difference method represents a powerful numerical technique for solving problems of groundwater flow in porous media, scant attention has been paid to its application to real world geohydrological studies. An integrated finite difference model for groundwater flow and quality simulation has been developed. It can deal with multidimensional, multilayered, heterogeneous, anisotropic media, both in confined and phreatic conditions. Its mathematical structure combines the advantages of an integral formulation, which allows complex geometry problems to be solved more easily than by classical finite difference methods, with the simplicity of gradient evaluation, which can be regarded as an advantage over finite element techniques. Comparison with analytical and numerical results does not offer argument for rejecting the choice of the integrated finite difference approach, while the operational activities needed for the input preparation and the model calibration seem more expeditious when this methodology is applied. (See also W91-02672) (Author's abstract)
W91-02700

LOCALIZED ADJOINT METHODS: APPLICATION TO ADVECTION DOMINATED FLOWS.
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Geofisica.
I. Herrera.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 349-357, 10 ref.

Descriptors: *Advection, *Groundwater, *Hydrologic models, *Mathematical models, *Model studies, *Path of pollutants, Algorithms, Boundary conditions, Probability distribution, Water quality management, Water resources management, Water transport.

The numerical solution of the advective-diffusive transport equation is a problem of great importance because many problems in science and engineering involve such a mathematical model. Solution of advection-dominated transport problems by discrete interior methods is usually accomplished by employing some type of upstream weighting. Upwinded finite element formulations have also been constructed. At present, a new procedure is being developed, based on Herrera's algebraic theory of boundary value problems, which systematically uses localized adjoint formulas. For one-dimensional steady state problems the procedure yielded very efficient and highly accurate algorithms which compare favorably with those previously available. For time-dependent one-dimensional cases the two algorithms applied corresponded to using two different weighting functions. Two test problems were treated to evaluate the performance of the new method: the propagation of a step discontinuity and that of a Gaussian distribution. The results and the efficiency of the procedure were compared with other methods, testing the effect of changing several parameters. The conclusion was reached that the solutions obtained with this method are at least as good as those obtained using the best available interior methods. Similar conclusions were drawn for two-dimensional problems. in general, localized adjoint methods allow very effective treatment of boundary conditions, but this is especially evident for two-dimensional problems, as a result of their greater difficulty. (See also W91-02672) (Fish-PTT)
W91-02702

TARGET LEVEL GROUNDWATER MANAGEMENT MODEL WITH LINEARIZED FLOW AND TRANSPORT CONSTRAINTS.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
S. A. Prathapar.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 369-380, 6 fig, 2 tab, 4 ref.

Descriptors: *Groundwater management, *Groundwater movement, *Groundwater pollution, *Hydrologic models, *Model studies, *Path of pollutants, *Solute transport, *Water quality management, *Water resources management, Australia, Optimization, Potentiometric level, Simulation analysis, Water table fluctuations, Water table gradient.

Simulation and optimization models are usually combined to determine groundwater management strategies, because it is unlikely that optimal groundwater management alternatives which comply with groundwater hydraulics could be determined by either simulation or optimization models alone. A two-dimensional groundwater management model with linearized flow and transport constraints was developed to determine stresses required to lower a water table to target levels. The linearized Boussinesq equation is embedded as the initial solute transport constraint, assuming constant potentiometric gradients. In addition, a mass balance equation for solutes is embedded to account for changes in concentration due to changes in potentiometric heads. Girgarre, Victoria, Australia was selected as the study area. Strategies determined by the management model with and without solute transport constraints were verified by a two-dimensional solute transport simulation model. Assumptions made with regard to solute transport constraints were satisfactory when concentration gradients were gradual. Smaller time steps will be required to determine stresses for management of aquifers where steeper concentration gradients exist. (See also W91-02672) (Fish-PTT)
W91-02704

MODELING OF VARIABLE DENSITY FLOW, APPLICATION TO THE MANAGEMENT OF COASTAL AQUIFERS (MODELISATION DES ECOULEMENTS A DENSITE VARIABLE, APPLICATION A L'EXPLOITATION DES AQUIFERES COTIERS).
Bureau de Recherches Geologiques et Minieres, Orleans (France).
J. P. Sauty.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 393-404, 6 fig, 12 ref. (English summary).

Descriptors: *Coastal aquifers, *Flow models, *Groundwater management, *Groundwater movement, *Hydrologic models, *Model studies, *Saline water intrusion, *Water quality management, *Water resources management, Density stratification, Finite difference methods, Flow equations, Saline-freshwater interfaces, Seawater, Simulation analysis, Three-dimensional model.

The modeling of variable-density flow in aquifers is useful for many applications. The production of fresh water from coastal aquifers partially invaded by seawater is a particular case of high concern for the management of maritime provinces. The use of models is necessary for understanding the phenomena, predicting the impact of new installations and optimizing freshwater production while keeping control of the inland progression of the salt water interface. Usual modeling techniques simplify the problem to a two-dimensional scheme (horizontal plane or vertical cross-section); unfortunately the modeling of real cases often requires a full three-dimensional approach. A simulation technique based on a particle tracking method is proposed;

the density of the particle population determines the local volume mass of the fluid. The vertical density gradients simply yield source terms in the equation for flow, which is solved by finite differences, in terms of water pressure. The resulting code (named TED for Transport with Effect of Density) is checked against two solutions: (1) the position of the salt water wedge close to the coast, and (2) the coning caused by drainage of fresh water above an initially horizontal interface. (See also W91-02672) (Author's abstract)
W91-02706

OPTIMAL GROUNDWATER QUALITY MANAGEMENT UNDER UNCERTAINTY: INCORPORATING THE EFFECTS OF SPATIAL VARIABILITY OF HYDRAULIC CONDUCTIVITY.
Stanford Univ., CA. Dept. of Applied Earth Sciences.
For primary bibliographic entry see Field 5G.
W91-02708

GRAVEL EXTRACTION AND WATER RESOURCES MANAGEMENT OF THE DENGE GRAVEL AQUIFER, KENT, ENGLAND.
Aspinwall and Co., Shrewsbury (England).
For primary bibliographic entry see Field 4C.
W91-02723

GROUNDWATER FLOW AND QUALITY STUDIES IN SZIGETKOZ REGION, NORTHWEST HUNGARY.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 6G.
W91-02724

MICROBIAL COLONIZATION OF AQUIFER SEDIMENT EXPOSED IN A GROUNDWATER WELL IN NORTHERN GERMANY.
Kiel Univ. (Germany, F.R.). Inst. fuer Allgemeine Mikrobiologie.
P. Hirsch, and E. Rades-Rohkohl.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 10, p 2963-2966, October 1990. 1 fig, 3 tab, 16 ref.

Descriptors: *Aquifers, *Germany, *Groundwater quality, *Microorganisms, *Sediment analysis, Carbon cycle, Interstitial water, Microbiological studies, Population dynamics, Wells.

Microbial growth within the water-saturated subsurface environment was investigated by exposing sandy sediments to groundwater for 12 weeks, at a depth of 10 or 20 m in a stainless-steel groundwater well. Washing and heating the sediment to 600 C (removal of organic carbon) prior to the exposure did not prevent the natural microbial community from colonizing the sterilized sediment samples. Total cell counts of more than 10 or 100 million/g of dried sediment were obtained. Viable cell counts of 100,000 cells/g on oligotrophic media indicated the presence, within the exposed sediment, of a highly active and multiplying biota. Microscopic analysis of enrichments inoculated with exposed sediment samples revealed a total of 45 different morphotypes, approximately 42% of the microbial community observed in studies of this site. The interstitial water running off of the retrieved sediment contained only 17 morphotypes and had 600,000 viable cells/ml. (Author's abstract)
W91-02767

QUALITY CHARACTERIZATION OF GROUNDWATER IN KOILSAGAR PROJECT AREA, MAHABUBNAGAR DISTRICT, ANDHRA PRADESH, INDIA.
Osmania Univ., Hyderabad (India).
For primary bibliographic entry see Field 2K.
W91-02815

HYDROGEOLOGICAL APPROACH TO INVESTIGATION IN KARST FOR POSSIBLE MODIFICATION OF GROUNDWATER REGIME AND INCREASE OF RECOVERABLE RESERVES.
GEOZAVOD, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 4B.
W91-02820

EXPERIMENTAL INVESTIGATION OF VARIABLE DENSITY FLOW AND MIXING IN HOMOGENEOUS AND HETEROGENEOUS MEDIA.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
R. A. Schincariol, and F. W. Schwartz.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2317-2329, October 1990. 14 fig, 5 tab, 29 ref.

Descriptors: *Density stratification, *Groundwater movement, *Heterogeneity, *Homogeneity, *Mixing, *Saline water intrusion, *Varied flow, Groundwater, Hydraulic conductivity, Porous media.

Variable density groundwater flow in homogeneous, layered and lenticular porous media was studied. At the scale of the experiments the flow of dissolved mass in water depends upon both forced and free convection. In addition, density differences as low as 0.0008 g/cc (1000 mg/L sodium chloride) between a plume of dense water and ambient groundwater in a homogenous medium produces gravitational instabilities at realistic groundwater velocities. These instabilities are manifested by lobe-shaped protuberances that formed first along the bottom edge of the plume and later within the plume. As the density difference increases to 0.0015 g/cc (2000 mg/L sodium chloride), 0.0037 g/cc (5000 mg/L sodium chloride), or higher, this unstable mixing due to convective dispersion significantly alters the spreading process. In a layered medium, reductions in hydraulic conductivity of the order of half an order of magnitude or less can influence the flow of the dense plume. Dense water may accumulate along bedding interfaces, which when dipping can result in plume migration velocities larger than ambient groundwater velocities. In a lenticular medium the combination of convective dispersion and nonuniform flow due to heterogeneities result in relatively large dispersion. Scale considerations, further, indicate that convective dispersion may provide an important component of mixing at the field scale. (Author's abstract)
W91-02862

APPARENT DISPERSION IN TRANSIENT GROUNDWATER FLOW.
Geological Survey, Reston, VA.
D. J. Goode, and L. F. Konikow.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2339-2351, October 1990. 14 fig, 19 ref, append.

Descriptors: *Dispersion, *Groundwater, *Groundwater movement, *Unsteady flow, Aquifer characteristics, Aquifers, Dispersivity, Flow characteristics, Scaling, Solute transport, Storativity, Temporal distribution.

Effects of large-scale temporal velocity fluctuations, particularly changes in the direction of flow, on solute spreading in a two-dimensional aquifer are generally believed to result from spatial variability in aquifer properties. Relations for apparent longitudinal and transverse dispersivity are developed through an analytical solution for dispersion in a fluctuating, quasi-steady uniform flow field, in which storativity is zero. For transient flow, spatial moments are evaluated from numerical solutions. Ignored or unknown transients in the direction of flow primarily act to increase the apparent transverse dispersivity because the longitudinal dispersivity is acting in a direction that is not the assumed flow direction. This increase is a function of the angle between the transient flow vector and the assumed steady state flow direction and the ratio of transverse to longitudinal dispersivity. The maximum effect on transverse dispersivity occurs if storativity is assumed to be zero, such that the flow field responds instantly to boundary conditions. Theoretical and field analyses indicate that longitudinal dispersivity is scale-dependent in porous media and that transverse dispersivity is generally one or more orders of magnitude smaller, causing solute plumes to be long and thin. (Author's abstract)
W91-02864

SOME ANOMALOUS FEATURES OF FLOW AND SOLUTE TRANSPORT ARISING FROM FRACTURE APERTURE VARIABILITY.
Royal Inst. of Tech., Stockholm (Sweden). Dept of Chemical Engineering.
L. Moreno, C. Tsang, Y. Tsang, and I. Neretnieks.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2377-2391, October 1990. 11 fig, 4 tab, 2 ref. US Department of Energy contract No. DE-AC03-76F00098.

Descriptors: *Fracture permeability, *Geologic fractures, *Groundwater movement, *Model studies, *Solute transport, *Statistical models, Dispersion, Flow equations, Hydrologic models, Injection, Tracers.

Model fractures with variable apertures were generated by a statistical method, and water flow and tracer transport in these fractures are calculated. Tracer injection and collection are simulated for parallel and convergent flow fields. The impact of the use of different injection flow rates and the different locations of injection and collection points indicates that the transport time, dispersion and the so-called mass balance fracture aperture are very sensitive to the location of the injection point and the injection flow rate. These anomalous effects appear to be consistent with observations in several recent field experiments. The implications of the calculated results on the analysis of tracer tests concludes that because of the stochastic nature of variable fracture apertures (and the permeabilities) a point tracer test in a fracture is not sufficient to characterize the properties of the fracture. Dispersivities and apertures calculated from different tracer tests in the same fracture may vary by orders of magnitude depending on the flow rate and the location of the injection. However, a line injection of tracer, averaged over a series of adjacent points, may avoid some of these problems. (Author's abstract)
W91-02867

ESTIMATING GROUNDWATER EXCHANGE WITH LAKES: 1. THE STABLE ISOTOPE MASS BALANCE METHOD.
Geological Survey, Madison, WI. Water Resources Div.
D. P. Krabbenhoft, C. J. Bowser, M. P. Anderson, and J. W. Valley.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2445-2453, October 1990. 8 fig, 2 tab, 31 ref. National Science Foundation Contract No. BSR 8514430.

Descriptors: *Groundwater, *Hydrologic budget, *Isotope studies, *Lakes, *Mass balance, *Surface-groundwater relations, *Wisconsin, Aquifers, Effluent water, Influent water, Mathematical models, Piezometers, Seepage, Spatial distribution, Temporal distribution.

Groundwater inflow and outflow contributions to the hydrologic budget of lakes can be determined using a stable isotope (oxygen-18/oxygen-16) mass balance method. The stable isotope method provides a way of integrating the spatial and temporal complexities of the flow field around a lake, thereby offering an appealing alternative to the traditional time and labor intensive methods using seepage meter and an extensive piezometer network. This method is applied to a lake in northern Wisconsin, demonstrating that it can be successfully applied to lakes in the upper Midwest where thousands of similar lakes exist. Inflow and outflow rates calculated for the Wisconsin lake using the isotope mass balance method are 29 and 54 cm/yr, respectively, which compare well to estimates, derived independently using a three-dimensional groundwater flow and solute transport model, 20 and 50 cm/yr. Such a favorable comparison lends confidence to the use of the stable isotope method to estimate groundwater exchange with lakes. In addition, utilization of stable isotope

tudies of groundwater-lake systems lends insight ito mixing processes occurring in the unsaturated one and in the aquifer surrounding the lake and erifies assumed flow paths based on head meas-rements in piezometers. (See also W91-02874) Author's abstract)
/91-02873

STIMATING GROUNDWATER EXCHANGE ITH LAKES: 2. CALIBRATION OF A THREE-IMENSIONAL, SOLUTE TRANSPORT ODEL TO A STABLE ISOTOPE PLUME.
eological Survey, Madison, WI. Water Re-urces Div.
P. Krabbenhoft, M. P. Anderson, and C. J. wser.
ater Resources Research WRERAQ, Vol. 26, . 10, p 2455-2462, October 1990. 7 fig, 4 tab, 44 . National Science Foundation Contract No. R 8514430.

scriptors: *Calibrations, *Groundwater, *Hy-logic models, *Isotope studies, *Lakes, umes, *Solute transport, *Surface-groundwater ations, *Wisconsin, Effluent water, Flow rates, luent water, Mathematical models, Seasonal dis-ution, Temporal distribution, Water table.

hree-dimensional groundwater flow and solute nsport model was calibrated to a plume of water cribed by measurements of delta-oxygen-18 and l to calculate groundwater inflow and outflow s at a lake in northern Wisconsin. The flow del was calibrated to observed hydraulic gradi-and estimated recharge rates. Calibration of solute transport submodel to the configuration stable isotope (oxygen-18) plume in the contig-aquifer on the downgradient side of the lake vides additional data to constrain the model. A l match between observed and simulated tem-l variations in plume configuration indicates the model closely simulated the dynamics of eal system. The model provides information natural variation of rates of groundwater w, lake water outflow, and recharge to the r table. Inflow and outflow estimates compare ably with estimates derived by the isotope balance method. Model simulations agree field observations that show groundwater w rates are more sensitive to seasonal vari-s in recharge than outflow. (See also W91-) (Author's abstract)
02874

PLED INVERSE PROBLEMS IN UNDWATER MODELING: 1. SENSITIVI-NALYSIS AND PARAMETER IDENTIFI-ON.
rnia Univ., Los Angeles. Dept. of Civil Engi-g.
imary bibliographic entry see Field 7C.
02879

PLED INVERSE PROBLEMS IN UNDWATER MODELING: 2. IDENTIFI-TY AND EXPERIMENTAL DESIGN.
nia Univ., Los Angeles. Dept. of Civil Engi-g.
imary bibliographic entry see Field 7C.
2880

ERICAL SIMULATION OF SOLUTE SPORT IN THREE-DIMENSIONAL, OMLY HETEROGENEOUS POROUS A.
ace Livermore National Lab., CA. Earth s Dept.
mary bibliographic entry see Field 5B.
881

YTICAL TRAVELING WAVE SOLU-FOR TRANSPORT WITH NONLINEAR ONEQUILIBRIUM ADSORPTION.
tural Univ., Wageningen (Netherlands). f Soil Science and Plant Nutrition.
mary bibliographic entry see Field 2G.
882

APPLICATION OF THE ARNOLDI ALGORITHM TO THE SOLUTION OF THE ADVECTION-DISPERSION EQUATION.
Manitoba Univ., Winnipeg. Dept. of Geological Engineering.
For primary bibliographic entry see Field 5B.
W91-02883

STOCHASTIC ANALYSIS OF THE CONCENTRATION VARIABILITY IN A THREE-DIMENSIONAL HETEROGENEOUS AQUIFER.
Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle, Baden (Switzerland).
E. G. Vomvoris, and L. W. Gelhar.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2591-2602, October 1990. 9 fig, 3 tab, 34 ref, append. U. S. EPA Cooperative Agreement CR-813359-01-1, National Science Foundation Grant CES-8814615.

Descriptors: *Aquifers, *Groundwater movement, *Heterogeneity, *Mathematical models, *Model studies, *Path of pollutants, *Solute transport, *Stochastic models, Anisotropy, Correlation analysis, Dispersivity, Hydraulic conductivity, Wave behavior.

A spectrally based perturbation approach is used to evaluate the concentration variability for a steady concentration field in a three-dimensional statistically homogeneous and anisotropic aquifer. The analysis assumes small, locally stationary concentration perturbations, and consequently, is valid only after mean displacements that are large compared to the scale of aquifer heterogeneity. The concentration variance is proportional to the square of the local mean concentration gradient and the variance and the correlation scales of log-hydraulic conductivity (ln K) and is inversely proportional to the local dispersivity. The concentration covariance function is highly anisotropic, with the largest correlation length aligned to the mean flow direction. Another important finding is the sensitivity of the longitudinal persistence of the concentration field to the high wave number behavior of the input ln K spectrum. The commonly employed exponential-type covariance function, which corresponds to a nondifferentiable random field, results in extremely large concentration correlation lengths along the flow direction. Input spectra corresponding to differentiable fields with more rapid high wave number cutoffs produce a significant reduction of the longitudinal correlation length. (Author's abstract)
W91-02884

ORIGIN AND EVOLUTION OF FORMATION WATERS, ALBERTA BASIN, WESTERN CANADA SEDIMENTARY BASIN: I. CHEMISTRY.
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W91-02888

ORIGIN AND EVOLUTION OF FORMATION WATERS, ALBERTA BASIN, WESTERN CANADA SEDIMENTARY BASIN. II. ISOTOPE SYSTEMATICS AND WATER MIXING.
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W91-02889

SULPHUR AND OXYGEN ISOTOPES OF DISSOLVED SULPHUR SPECIES IN FORMATION WATERS FROM THE DOGGER GEOTHERMAL AQUIFER, PARIS BASIN, FRANCE.
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 2K.
W91-02890

MODELLING OF THE EVOLUTION OF GROUND WATERS IN A GRANITE SYSTEM AT LOW TEMPERATURE: THE STRIPA GROUND WATERS, SWEDEN.
Paris-7 Univ. (France). Lab. de Geochimie des Eaux.
For primary bibliographic entry see Field 2K.
W91-02893

ANALYSIS OF HYDROLOGIC IMPACT OF QUARRYING SYSTEM BY 3-D FINITE ELEMENT MODEL.
Padua Univ. (Italy). Dipt. di Metodi e Modelli Matematici per le Scienze Applicate.
For primary bibliographic entry see Field 4C.
W91-02921

CONTAMINANT MIGRATION THROUGH FRACTURED TILL INTO AN UNDERLYING AQUIFER.
University of Western Ontario, London. Geotechnical Research Centre.
For primary bibliographic entry see Field 5B.
W91-02941

MIGRATION OF POLLUTANTS IN GROUNDWATER: IV. MODELING OF THE PUMPING OF CONTAMINANTS FROM FRACTURED BEDROCK.
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
D. J. Wilson, and R. D. Mutch.
Environmental Monitoring and Assessment EMASDH, Vol. 15, No. 2, p 183-199, September 1990. 13 fig, 3 tab, 27 ref.

Descriptors: *Bedrock, *Geologic fractures, *Groundwater movement, *Groundwater pollution, *Mathematical models, *Model studies, *Path of pollutants, Cleanup operations, Computer models, Diffusion, Flushing.

The removal of soluble contaminants from fractured porous bedrock by means of a recovery well was modeled by means of a lumped parameter approach. This simple mathematical model, well-adapted for use with readily available microcomputers, yielded results which depended on the various parameters of the model in intuitively expected ways. A laboratory column model in this study was helpful, within limits, in evaluating some parameters needed in the field flushing models. The use of local equilibrium models for the flushing of fractured bedrock can be expected to yield removal times which are only a small fraction of the time which will actually be required, due to the slow release of contaminant by diffusion from the immobile pore liquid. The situation could be generally worse than what was obtained in this study in which medium block radii of the order of a few centimeters were used, while spacing of the fractures could easily be a meter or more. An increase in the block size by a factor of 10 resulted in a decreased in the time constant for diffusion transport by a factor of .01. Diffusion transport may very well be a severely limiting factor in the rate of cleanup of sites by pump-and-treat operations. (See also W85-06290) (Medina-PTT)
W91-02945

MODEL TO PREDICT AND ASSESS THE EFFECTS OF GROUNDWATER WITHDRAWAL ON THE VEGETATION IN THE PLEISTOCENE AREAS OF THE NETHERLANDS.
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
For primary bibliographic entry see Field 6G.
W91-02949

2G. Water In Soils

PORE SIZE, PARTICLE SIZE, AGGREGATE SIZE, AND WATER RETENTION.
Minnesota Univ., St. Paul. Dept. of Soil Science.
L. Wu, J. A. Vomocil, and S. W. Childs.
Soil Science Society of America Journal SSSJD4, Vol. 54, No. 4, p 952-956, July/August 1990. 3 fig, 3 tab, 22 ref.

Descriptors: *Particle size, *Pore size, *Soil aggregates, *Soil moisture retention, *Soil water, Mathematical analysis, Soil properties, Soil texture, Soil types, Statistical analysis.

Measurements of water retention and pore-size distribution for a soil are time consuming and affected by changes in aggregate-size distribution. A method of compared distribution curves was used to relate distributions of pore size (PO), particle size (PA), aggregate size (AG), and pore size from water retention (WR). Seven surface soils varying in texture and aggregation were tested. After normalization to 100% volume, the pore-, particle-, and aggregate-size distribution, as well as water-retention (converted to pore diameter) curves were each fitted to a linearly transformed logistic function to evaluate their interrelations using R(m/n), a coefficient for the ratio of the diameters of component m to component n. Identical distribution curves have an R(m/n) value of 1. The R(PO/PA) and R(WR/PA) for the seven soils ranged from 0.25 to 2.26 and from 0.18 to 1.34, respectively, indicating that the theoretical packing parameters of 0.225 to 0.414 do not hold for PA distribution. The R(PO/AG) ranged from 0.06 to 0.23 and R(WR/AG) from 0.04 to 0.16. Both ranges of R values smaller than the theoretical packing parameters suggests interactions may occur between large and small aggregates. However, R(PO/AG) and R(WR/AG) values were more consistent and were significantly related to aggregation level and bulk density, suggesting that AG distribution should be used as a parameter to predict PO distribution and water retention. Comparisons between water retention curves and PO distributions from Hg intrusion gave R(PO/WR) ranging from 0.78 to 2.59, showing that equivalent PO for a given soil is not the same when different measuring methods are used. (Author's abstract)
W91-02131

COUPLED WATER AND HEAT TRANSPORT IN RIDGED SOILS.
Iowa State Univ., Ames. Dept. of Agronomy.
J. G. Benjamin, M. R. Ghaffarzadeh, and R. M. Cruse.
Soil Science Society of America Journal SSSJD4, Vol. 54, No. 4, p 963-969, July/August 1990. 7 fig, 3 tab, 26 ref.

Descriptors: *Heat transfer, *Mathematical models, *Model studies, *Ridging, *Soil temperature, *Soil water, *Tillage, Field tests, Model testing, Ridged soils.

Study of ridge-tillage effects on the soil environment has been impeded by the lack of models to describe adequately water and heat movement in the ridge system. The ridge system introduces many nonuniform characteristics into the field problem, such as variable solar radiation across the soil surface, unevenly distributed surface mulches, and variable water and heat transport properties caused by ridge construction or wheel traffic. A finite-element model was developed to simulate coupled water and heat flow in ridge systems. The finite-element solution scheme was chosen because of the ease by which nonuniform soil transport properties and nonuniform boundary conditions can be included in the problem specifications. Model predictions of soil water and temperature were compared with field measurements for two ridge configurations. Predicted and measured average daily temperatures over a 10-d period were within 1 C and water contents were within 0.02 cu m/cu m for 80% of the measurements. (Author's abstract)
W91-02133

ORGANIC SELENIUM DISTRIBUTION IN SELECTED CALIFORNIA SOILS.
Oregon Graduate Inst. of Science and Technology, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5B.
W91-02134

WATER-DROP KINETIC ENERGY EFFECT ON INFILTRATION IN SODIUM-CALCIUM-MAGNESIUM SOILS.
Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
R. Keren.
Soil Science Society of America Journal SSSJD4, Vol. 54, No. 4, p 983-987, July/August 1990. 4 fig, 30 ref. U.S.-Israel Binational Agric. Res. and Development Fund Grant I-743-84.

Descriptors: *Fluid drops, *Infiltration rate, *Ions, *Rainfall impact, *Rainfall infiltration, *Soil water, Calcium, Kinetic energy, Magnesium, Simulated rainfall, Sodium, Soil aggregates, Soil chemistry, Soil types, Surface sealing.

The effect of complementary adsorbed ion (Ca vs. Mg) in the presence of Na on seal formation and water infiltration in two soils (Calcic Haploxeralf and Typic Rhodoxeralf) at several kinetic energies of water drops was studied using rain simulators. The infiltration rate (IR) of the soils was lower for the Na-Mg soils than for the Na-Ca soils at the studied kinetic energy range of the water drops (3.2-22.9 kJ/cu m). The higher the kinetic energy, the steeper the drop in IR. The steady-state IR and the cumulative water depth required to reach steady-state IR were both decreased with increasing kinetic energy of the water drops. Adsorbed Mg on montmorillonitic soils had a specific effect on IR whether or not the soil contained calcium carbonate. Aggregates with adsorbed Na and Ca ions were more stable than those with adsorbed Na and Mg ions when they were exposed to water drops having a kinetic energy in the range of 8.0 to 12.5 kJ/cu m. The specific effect of Mg on IR was explained by the presence of Mg ions on the external surfaces of the clay tactoids and the larger hydration shell of the Mg ion compared to Ca. (Author's abstract)
W91-02135

WATER DROPLET ENERGY AND SOIL AMENDMENTS: EFFECT ON INFILTRATION AND EROSION.
Soil and Irrigation Research Inst., Pretoria (South Africa).
H. J. C. Smith, G. J. Levy, and I. Shainberg.
Soil Science Society of America Journal SSSJD4, Vol. 54, No. 4, p 1084-1087, July/August 1990. 4 fig, 2 tab, 20 ref.

Descriptors: *Erosion control, *Fluid drops, *Infiltration rate, *Rainfall impact, *Rainfall infiltration, *Soil amendments, *Soil erosion, *Soil water, Electrolytes, Kinetic energy, Simulated rainfall, Surface sealing, Water quality.

The impact energy of water droplets from rain or overhead sprinklers can cause a seal to form at the soil surface. This constitutes a severe problem in agricultural lands in the arid and semiarid regions. Spreading a soil conditioner on the surface of the soil and providing a constant source of electrolytes may prevent seal formation. The effect of droplet impact energy and water quality on infiltration and erosion was studied, using a tank drip-type rain simulator, in a sandy loam soil (Typic Rhodoxeralf) treated with an anionic polyacrylamide (PAM) and phosphogypsum. Three kinetic energies of 3-mm diameter drops were obtained by varying their falling heights. The two qualities of water were distilled water and tap water, to simulate rain and irrigation water, respectively. Increasing the impact energy reduced the infiltration rate (IR), cumulative infiltration (rain intake), and soil erosion in all treatments. Addition of PAM in the presence of electrolytes (either phosphogypsum or tap water) increased both final IR and cumulative infiltration by 7-fold to 8-fold compared to the control, and was much more effective than PAM, phosphogypsum or tap water alone. The PAM plus electrolyte treatments decreased soil erosion by more than one order of magnitude compared with the control. (Author's abstract)
W91-02136

POLYMER EFFECTS ON EROSION UNDER LABORATORY RAINFALL SIMULATOR CONDITIONS.
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
For primary bibliographic entry see Field 2J.
W91-02137

MACROPOROSITY AND ITS RELATION TO SATURATED HYDRAULIC CONDUCTIVITY UNDER DIFFERENT TILLAGE PRACTICES.
Minnesota Univ., St. Paul. Dept. of Soil Science
S. D. Logsdon, R. R. Allmaras, L. Wu, J. B. Swan and G. W. Randall.
Soil Science Society of America Journal SSSJD4, Vol. 54, No. 4, p 1096-1101, July/August 1990. fig, 4 tab, 22 ref.

Descriptors: *Hydraulic conductivity, *Porosity, *Soil water, *Tillage, Analytical methods, Infiltration, Macropores, Minnesota, Pore size, Soil texture, Soil types, Wisconsin.

Tillage management influences the distribution of macropores (biopores, cracks, interpedal planes and packing voids) that may provide pathways for rapid infiltration of water. To aid in predicting ranges of saturated hydraulic conductivity (Ksat), macropore distribution in situ was characterized by exposing selected horizontal planes and tracing macropores on clear polyethylene sheets. A methylene blue solution was used to indicate macropore continuity through the pressure pan. Sixteen undisturbed cores were taken in a grid pattern from each Ap horizon and adjacent subsoil for determination of Ksat. Field marking on plastic sheets was superior to photographic slides as a technique to characterize macropores because film noise (fine pores) was eliminated, overall analysis time was reduced, and different features could be separated for analysis. However, a bias of pore size between observers was possible. Four sites in southern Minnesota and Wisconsin with four different soil series were examined. Below the maximum tillage depth, macropores were present at all locations, but tillage disrupted continuity of pores from the surface. No-till had macropores throughout the upper 30 cm with continuity observed in the 0-35 cm range. Numbers of pores >0.4 mm diam/sq m ranged from 100 to >3,000, representing 0.1 to 2% of total area. When present, horizontal crack length ranged from 1.7 to 19.3 m/sq m. Measured Ksat of undisturbed detached cores ranged from 1.1 to 1 microm/s with CVs ranging from 44 to 197%. Ksat could be estimated within a range (out of eight classes) from descriptions of biopore, cracks, soil structure, and soil texture. (Author's abstract)
W91-02138

SOIL WATER DIFFUSIVITY DETERMINATION BY A MODIFIED ONE-STEP OUTFLOW METHOD.
Nebraska Univ.-Lincoln. Dept. of Agronomy.
S. Mu'azu, J. Skopp, and D. Swartzendruber.
Soil Science Society of America Journal SSSJD4, Vol. 54, No. 4, p 1184-1186, July/August 1990. fig, 11 ref.

Descriptors: *Analytical methods, *Diffusivity, *Hydraulic conductivity, *Mathematical analysis, *Soil water, Aeration zone, Estimating equations, Mathematical equations, One-step outflow procedures, Soil cores.

One-step outflow procedures represent potentially rapid and convenient procedures to obtain soil water diffusivity and unsaturated hydraulic conductivity data. Modifications of the existing procedures that improve and simplify the estimation of the soil water diffusivity and associated water content were derived. An equation was derived that describes the soil water diffusivity as a function of average soil water content rather than the water content at the top end of the soil core. The equation may be used over a range of water contents. The modifications presented provide a simpler analysis that is more readily applied to one-step outflow experiments. (Author's abstract)
W91-02140

FOUNDATION PROBLEMS IN CHAMPLAIN CLAYS DURING DROUGHTS. I: RAINFALL DEFICITS IN MONTREAL (1930-1988).
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field
W91-02147

ANALYSIS OF THE IN SITU CONSTANT-HEAD PERMEABILITY TEST IN CLAYS.
McGill Univ., Montreal (Quebec).
For primary bibliographic entry see Field 7B.
W91-02148

FIELD FROST HEAVE MEASUREMENT AND PREDICTION DURING PERIODS OF SEASONAL FROST.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
For primary bibliographic entry see Field 2C.
W91-02150

HYDROGEOCHEMICAL PROCESSES CONTROLLING THE TRANSPORT OF DISSOLVED ORGANIC CARBON THROUGH A FORESTED HILLSLOPE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W91-02159

SATURATED HYDRAULIC CONDUCTIVITY OF SCANDINAVIAN TILLS.
Chalmers Univ. of Technology, Goeteborg (Sweden).
For primary bibliographic entry see Field 2F.
W91-02167

SATURATED HYDRAULIC CONDUCTIVITY OF CLAYEY TILLS AND THE ROLE OF FRACTURES.
Technical Univ. of Denmark, Lyngby. Inst. for Teknisk Geologi.
For primary bibliographic entry see Field 2F.
W91-02168

UNSATURATED HYDRAULIC CONDUCTIVITY DETERMINED BY THE HOT AIR METHOD FOR SOME DANISH TILL SOILS.
Department of Soil Tillage, Soil Physics and Irrigation, Tinglev (Denmark).
H. Jacobsen, and H. E. Jensen.
Nordic Hydrology NOHYBB, Vol. 21, No. 2, p 129-140, 1990. 3 fig, 1 tab, 10 ref.

Descriptors: *Analytical methods, *Denmark, *Hydraulic conductivity, *Soil water, *Till, *Unsaturated flow, Aeration zone, Pore pressure, Pore water, Subsoil, Topsoil.

Many soil water transport processes such as infiltration, soil water redistribution, uptake of water by plants, and evapotranspiration involve flow in unsaturated soil. Hydraulic conductivity as a function of soil water content is one of the most important relations for successful simulation of unsaturated flow. Unsaturated hydraulic conductivity relations for topsoil and subsoil in 12 Danish till soils were obtained from measurements by the hot air method. The hot air method is simple, quick, and inexpensive to carry out, and it is applicable to a large range of soil water contents than most other experimental methods. In the range of pressure potentials within which the method is most suitable (pF values from 1.7 to 3.0) the hydraulic conductivities were found to be within the range of ten to the minus tenth power to ten to the minus seventh power m/s for topsoils, and ten to the minus eighth power to ten to the minus eighth power for subsoils. The hydraulic conductivity relations obtained may be related to the corresponding pF curves. At any pF-value the subsoils differed more than the topsoils in hydraulic conductivity. (Author's abstract)
W91-02169

METHODS USED FOR CALCULATION OF PLANT AVAILABLE WATER IN NORDIC SOILS.
Copenhagen Univ. (Denmark).
B. Madsen, H. Riley, and L. Lundin.
Nordic Hydrology NOHYBB, Vol. 21, No. 2, p 111-122, 1990. 4 fig, 4 tab, 32 ref.

Descriptors: *Analytical methods, *Soil moisture retention, *Soil water, *Soil-water-plant relationships, *Till, Available water, Field capacity, Plant water potential, Soil horizons, Soil water potential.

Almost all of the Nordic countries were covered by ice during the last ice age, and most of the land is covered by till, glaciofluvial sediments, and marine deposits. The storage capacity of a soil for water available for plant production is termed the root zone capacity (RZC). Three different methods of calculating the RZC for Nordic tills have been evaluated using existing published data. Calculation of the RZC utilizes the soil water retention curve for a particular till, using the field capacity and the permanent wilting point to calculate the available water content (AWC). The AWC is then combined with the root density of different soil horizons to calculate the RZC, using one of several methods. The first method calculates the AWC within an effective root depth, and is a crude indicator of the plant-available water content in the root zone. The technique is useful for transforming soil maps into RZC maps, because the data requirements are low and mean values are used, but it is not very accurate for calculating the RZC on single profiles. The second method of calculating RZC calculates the sum of water actually used by plants from different soil layers; this method requires data from the entire soil water retention curve, and very few investigations of this type have been carried out in the Nordic countries. The third method of calculating RZC uses the simulation model HEIMDAL. The model assumes that the state of water in the soil-plant-atmosphere system can be quantitatively characterized at any moment, and that changes in the system can be described by equations. Laboratory-derived parameters for soils and plants are combined with climatic factors to calculate a variety of outputs, including summed up transpiration and the soil water status at wilting. This method requires very large amounts of data and provides very detailed information for single profiles. (Tappert-PTT)
W91-02170

SLOWLY REVERSIBLE SORPTION OF ALIPHATIC HALOCARBONS IN SOILS. I. FORMATION OF RESIDUAL FRACTIONS.
Connecticut Agricultural Experiment Station, New Haven. Dept. of Soil and Water.
For primary bibliographic entry see Field 5B.
W91-02209

SLOWLY REVERSIBLE SORPTION OF ALIPHATIC HALOCARBONS IN SOILS. II. MECHANISTIC ASPECTS.
Connecticut Agricultural Experiment Station, New Haven. Dept. of Soil and Water.
For primary bibliographic entry see Field 5B.
W91-02210

ALTITUDE OF POTENTIOMETRIC SURFACE, FALL 1985, AND HISTORIC WATER-LEVEL CHANGES IN THE FORT PILLOW AQUIFER IN WESTERN TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02248

IRRIGATION TRIALS: BASIS FOR THE DESIGN OF FURROW SYSTEMS.
Irrigation Development Authority, Accra (Ghana).
For primary bibliographic entry see Field 3F.
W91-02315

HYDROLOGIC REGIME UNDER NATURAL CLIMATIC CONDITIONS IN THE LATERITIC SOIL OF BURKINA FASO (REGIME HYDRIQUE EN CONDITIONS CLIMATIQUES NATURELLES D'UN SOL LATERITIQUE DU BURKINA FASO).
Ecole Inter-Etats d'Ingenieurs de l'Equipement Rural, Ouagadougou (Burkina Faso).
E. Walbadet, P. Perrochet, and A. Mermoud.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 361-369, 3 fig. English summary.

Descriptors: *Arid lands, *Burkina Faso, *Evaporation, *Hydrological regime, *Soil moisture, *Soil moisture meters, *Soil water, Cultivated lands, Infiltration, Neutron moisture profiles, Soil profiles, Vegetation effects, Wetting.

During the first three months of the rainy season of 1987, the evolution of neutron moisture profiles was observed under traditional crops and under bare soil. The temporal variations of water storage were calculated from these measurements at two sites (at Gampela, Burkina Faso). Interesting comparisons could be made concerning infiltration, retention, and drying of the soil profiles. During the period of observation the wetting front reached a depth of 150 cm under the cultivated plot but did not penetrate farther than 50 cm under bare soil. Moreover, in less than 3 wk after the last rain the quantities of water stored in the two profiles were reduced to their initial values observed at the end of the dry season. (See also W91-02288) (Author's abstract)
W91-02317

WATER TRANSFER IN POROUS NON-SATURATED ROCK AND AQUIFER RECHARGE IN THE SUDANO-SAHELIAN CLIMATE (TRANSFERT D'EAU EN MILIEU POREUX NON SATURE RECHARGE DES NAPPES EN CLIMAT SOUDANO-SAHELIEN).
Ecole Inter-Etats d'Ingenieurs de l'Equipement Rural, Ouagadougou (Burkina Faso).
For primary bibliographic entry see Field 2F.
W91-02319

HYDRAULIC PROPERTIES OF FOUR SOILS IN NIGER AND IMPLICATIONS FOR WATER BALANCE STUDIES.
International Crops Research Inst. for the Semi-Arid Tropics, Niamey (Niger).
M. V. K. Sivakumar, R. J. Lascano, and D. R. Upchurch.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 502-512, 8 fig, 10 ref.

Descriptors: *Drainage, *Hydraulic properties, *Hydrologic budget, *Infiltration, *Model studies, *Niger, *Semiarid lands, *Soil moisture retention, Hydrologic models, Mathematical models, Millet, Seasonal variation, Simulation.

In semi-arid regions of Africa, where rainfall variability is often large, plant-available water, which is estimated by water balance procedures, is a primary determinant of crop yields. Characterization of soil hydraulic properties is important for modeling drainage, a component of the water balance that is often ignored. Water balance studies of pearl millet were conducted in Niger from 1984-1987 on four soil types: a sand, a loamy sand, a sandy loam, and a loam. Soil samples were collected at 0.3 m depth increments from the surface to 2.1 m. Laboratory measurements of the soil moisture retention (SMR) curve were made. Saturated hydraulic conductivities were measured and combined with SMR curves to calculate unsaturated hydraulic conductivity functions. These hydraulic properties then were used in a simulation model to calculate drainage, which was different for the four soil types. With the aid of a drainage model, this study demonstrated that the drainage component in the water balance can be significant, even in years of adequate rainfall. Even for soils with a higher clay content, drainage losses could be large on a seasonal basis. Hence, water balance studies should either measure or calculate the drainage component. (See also W91-02288) (Rochester-PTT)
W91-02330

WATER ASSESSMENT OF SOILS AND TRADITIONAL AGRICULTURAL CALENDARS IN UPPER BORGOU (REP. POP. DU BENIN) (BILANS D'EAU DES SOLS ET CALENDRIERS AGRICOLES TRADITIONNELS DANS LE HAUT BORGOU (R.P. BENIN)).
Universite Nationale du Benin, Cotonou. Dept. de Geographie.
For primary bibliographic entry see Field 3F.
W91-02367

RELATING SOIL COLOR TO SOIL WATER TABLE LEVELS.
Ohio State Univ., Columbus. Dept. of Agronomy.
W. R. Guertal, and G. F. Hall.
Ohio Journal of Science OJSCA9, Vol. 90, No. 4, p 118-124, September 1990. 6 fig, 1 tab, 21 ref.

Descriptors: *Soil color, *Soil properties, *Soil water table, *Water table, Drainage, Ohio, Seasonal variation, Soil profiles, Soil saturation, Soil water, Water table fluctuations, Water table profiles.

Seasonal incidence of water tables in soils is one of the most important characteristics influencing their use and management. The relationship between depth to the water table and soil color was studied on a glacial till plain toposequence containing three soils (Blount, Glynwood and Morley) representative of those common throughout northwestern Ohio. As the soil drainage class changed from well drained to moderately well drained to somewhat poorly drained, the depth to low chroma colors decreased. The Morley soil had no low chroma (less than or equal to 2) colors except in the surface, where they were the result of organic matter accumulation. The Glynwood soil had low chroma colors beginning 37 cm below the soil surface, and the Blount soil had low chroma colors 28 cm below the soil surface. Low chroma mottles were the most abundant in the Blount soil profile. Decreasing depth to low chroma colors can be related to changes in the soil water table levels. The results suggested that gray colors (chroma of less than or equal to 2) in mottles indicate that the horizon is near or just above the water table level. If the horizon is dominated by gray colors (gleyed) in the soil matrix, then that horizon is saturated much of the time. It can be concluded that the presence of colors of 2 chroma or less reliably predicts the depth to the water table. (MacKeen-PTT)
W91-02533

SOIL WATER RELATIONS ON A HILLTOP CORNFIELD IN CENTRAL APPALACHIA.
Agricultural Research Service, Beckley, WV. Appalachian Soil and Water Conservation Research Lab.
D. G. Boyer, R. J. Wright, W. M. Winant, and H. D. Perry.
Soil Science SOSCAK, Vol. 149, No. 6, p 383-392, June 1990. 6 fig, 5 tab, 15 ref.

Descriptors: *Appalachian Mountains, *Geohydrology, *Soil water, *Soil-water-plant relationships, Corn, Kriging, Loam, Mathematical analysis, Mathematical studies, Precipitation, Soil properties, Topography, West Virginia.

The topography of the Appalachian region strongly influences the environment for plant growth. A field study was conducted in 1984 and 1985 on a Gilpin silt loam in West Virginia to determine soil and environmental factors controlling corn (Zea mays L.) yield differences among landscape positions. Four plots were established at each of 9 locations including summit, shoulder (N. E. S. W. aspects) and backslope (N. E. S. W. aspects). Although common management practices were used throughout the field, corn yields varied significantly among positions. Mean 'available water' as represented by the difference between gravimetric water determined over time and water retained at 1500 kPa, was the most important factor controlling corn production. The objectives of this study were to determine the relationship between soil physical properties, surface curvature, and precipitation catch on the distribution of soil water, with emphasis on the surface layer (0-15 cm depth). Available water was always lower at the backslope sites than at the summer or shoulder sites. Higher clay content and lower infiltration capacity were associated with lower available water. Precipitation catch differences strictly followed the same pattern as available water between shoulder sites and summit. A cokriging analysis indicated that surface curvature may be useful for spatial representation of available water throughout the study site. (Author's abstract)
W91-02592

SOME ASPECTS OF SOIL MOISTURE CONTROL FOR SOILS WITH SHALLOW GROUNDWATER LEVELS.
Agricultural Univ. of Warsaw (Poland). Dept. of Land Reclamation.
T. Brandyk, and R. Romanowicz.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 19-28, 5 fig, 9 ref.

Descriptors: *Aeration zone, *Model studies, *Soil water, *Soil-water-plant relationships, Control systems, Decision making, Flow control, Hydraulic conductivity, Hydrologic models, Mathematical models, Root zone, Shallow aquifers, Soil moisture deficiency, Soil moisture retention.

Soil moisture control for soils with shallow groundwater levels is necessary to maintain the required moisture content in the root zone of the vegetation. Water management in the plant root zone requires a knowledge of the actual soil moisture content. Mathematical models based on the application of steady and unsteady soil moisture theory can be very helpful in this regard. Both steady and unsteady state soil moisture models of the unsaturated zone with an analytical exponential unsaturated hydraulic conductivity function were considered. The long-term soil moisture control problem was formulated using steady state soil moisture theory. In this case the typical control problem has an open-loop control structure. The short-term soil moisture control problem was formulated using unsteady state soil moisture theory. In this case it is possible to develop a closed-loop control structure. The long-term control concept was confirmed by field measurements of soil moisture pressure heads and numerical simulation of unsteady state soil moisture flow. Due to the very complex form of the analytical solution of the unsteady state model its further linearization should be performed. This would allow development of closed-loop control algorithms for the short-term moisture control problem. (See also W91-02672) (Fish-PTT)
W91-02674

NUMERICAL MODEL FOR SIMULATING THE IN-SITU VOLATILIZATION OF HYDROCARBON CONTAMINANTS IN SOILS.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-02705

PRECIPITATION, THROUGHFALL, SOIL SOLUTION AND STREAMWATER CHEMISTRY IN A HOLM-OAK (QUERCUS ILEX) FOREST.
Universidad Autonoma de Barcelona (Spain). Centre de Recerca Ecologica i Aplicacions Forestals.
For primary bibliographic entry see Field 2K.
W91-02744

SOIL WATER IN THE RIPARIAN ZONE AS A SOURCE OF CARBON FOR A HEADWATER STREAM.
University Coll. of North Wales, Bangor. School of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-02747

CALIBRATION OF TIME DOMAIN REFLECTOMETRY FOR WATER CONTENT MEASUREMENT USING A COMPOSITE DIELECTRIC APPROACH.
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
K. Roth, R. Schulin, H. Fluhler, and W. Attinger.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2267-2273, October 1990. 4 fig, 2 tab, 21 ref.

Descriptors: *Electrical properties, *Instrumentation, *Measuring techniques, *Soil moisture meters, *Soil water, *Soil water potential, *Time domain reflectometry, Calibrations, Mathematical models, Neutron scattering, Regression analysis, Sensitivity analysis.

Time domain reflectometry (TDR) has been developed to an operational level for the measurement of soil water content during the past decade. TDR has become an alternative to the neutron scattering method because it provides fast, precise and nondestructive in situ measurements. One of the major disadvantages of the neutron scattering technique is that, due to the relatively high sensitivity of the signal to factors other than water content, site specific calibration is usually required. A calibration curve is developed for the TDR method which is not restricted to specific soil conditions. The calibration is based on a dielectric mixing model. Measurements of volumetric water content and dielectric number at eleven different field sites representing a wide range of soil types were used to determine the parameter of the model by weighted nonlinear regression. The uncertainty (root mean square error) of water content values calculated with the optimized calibration curve was estimated not to exceed 0.013 cc/cc. This value is comparable to the precision of the thermogravimetric method. From a sensitivity analysis the temperature dependence of the TDR signal may have to be corrected to obtain optimum accuracy. (Author's abstract)
W91-02857

COMPUTER-CONTROLLED 36-CHANNEL TIME DOMAIN REFLECTOMETRY SYSTEM FOR MONITORING SOIL WATER CONTENTS.
Amsterdam Univ. (Netherlands). Lab. for Physical Geography and Soil Science.
T. J. Heimovaara, and W. Bouten.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2311-2316, October 1990. 5 fig, 14 ref.

Descriptors: *Automation, *Measuring instruments, *Reflectance techniques, *Soil moisture meters, *Soil water, *Time domain reflectometry, Computer programs, Precision, Spatial distribution, Temporal distribution.

Research on the spatial and temporal dynamics of soil water has long been impeded by the lack of an automated technique for the measurement of soil water content. A computer controlled time domain reflectometry (TDR) system makes a large number of measurements at different sites at predetermined time intervals possible. The system operates on 12 V dc and has the capability to monitor water content at 36 sites. The TDR element of the system is the TEKTRONIX 1502B metallic TDR cable tester, connected to the transmission line probes through a 36-channel coaxial relay. The system is controlled by a Pascal program which obtains the TDR wave forms required for calculating water content. The algorithm used for the automatic analysis of the measurements is based on the calculation of the travel time of the TDR signal between the beginning and the end of a three-rod probe. Quantification of the resolution of the 1502B cable tester is very difficult. Increasing the measurement frequency may be a means of filtering out noise and improving the precision of the method. (Brunone-PTT)
W91-02861

SOLUTION OF A NONLINEAR ABSORPTION MODEL OF MIXED SATURATED-UNSATURATED FLOW.
La Trobe Univ., Bundoora (Australia). Dept. of Mathematics.

P. Broadbridge.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2435-2443, October 1990. 4 fig, 22 ref, append.

Descriptors: *Absorption, *Groundwater movement, *Hydrologic models, *Saturated flow, *Saturation zone, *Soil water, *Unsaturated flow, Gravity, Heterogeneity, Mathematical models, Ponding.

In wetted soils, zones of saturation develop naturally in the vicinity of impermeable strata, surface ponds, and subterranean cavities. A nonlinear diffusion model of Fujita is adapted to solve a mixed saturated-unsaturated flow problem representing absorption of water by a soil with a constant pond epth at the surface. From the closed-form solution, an equation emerges which relates dimensionless sorptivity, dimensionless pond depth, and a ngle soil hydraulic nonlinearity parameter. For he whole range of soil types, the ratio of ponded orptivity to unponded sorptivity increases significantly with pond depth but the ponding effect is ronger in weakly nonlinear soils than in highly onlinear soils. In weakly nonlinear soils the pond- g effect is greatly enhanced by increasing the itial water content, but in extremely nonlinear ils the initial water content has little influence. he gravity-free ponded model, could be the foun- tion for other more sophisticated models which corporate gravity or heterogeneity. (Author's ab- act)
91-02872

NCERTAINTY PROPAGATION WITH NU- ERICAL MODELS FOR FLOW AND TRANS- RT IN THE UNSATURATED ZONE.
lytechnic Univ., Brooklyn, NY. Dept. of Civil l Environmental Engineering.
L. Protopapas, and R. L. Bras.
ter Resources Research WRERAQ, Vol. 26, . 10, p 2463-2474, October 1990. 6 fig, 1 tab, 23 National Science Foundation Grant No. E8211469.

scriptors: *Aeration zone, *Mathematical dels, *Parameter estimation, *Path of pollut- , *Soil mechanics, *Soil water, *Solute trans- t, *Uncertainty, *Unsaturated zone, Agricultur- ractices, Flow equations, Groundwater, Nu- ical analysis, Soil properties.

prediction of the distribution of water and tes in the soil medium is essential for both ient agricultural practice and for controlling quality of subsurface water. Uncertainty propa- on with numerical models for flow and trans- in the unsaturated zone is studied using vector -space methods. The output uncertainty is the t of spatially, randomly varying parameters ribing the soil hydraulic properties. An effi- state covariance propagation method is pro- d, based on first-order linearization of the m dynamics. The approach has been previous- ed with groundwater flow models, and com- ons are made with a Monte Carlo simulation iltration in two soils with distinctly different roperties. For coefficients of variation of the neters less than 0.3 the two methods agree The linearization method is found to be faster o its analytical nature. The results are a first for future research on parameter estimation, the state-space linearization approach. (Au- abstract)
02875

OBILE WATER DURING SOLUTE SPORT IN UNSATURATED SAND COL- S.
ionwealth Scientific and Industrial Research ization, Canberra (Australia). Div. of Soils.
Bond, and P. J. Wierenga.
Resources Research WRERAQ, Vol. 26,), p 2475-2481, October 1990. 2 fig, 2 tab, 24 pend. NRC project No. TD-2049 and EPA No. R-811862-02-0.

ptors: *Aeration zone, *Sand, *Soil col- *Soil water, *Solute transport, *Unsaturated Flow pattern, Flow rates, Interstitial water, flow, Unsteady flow.

The existence of preferential pathways for the flow of water through soils affects not only the distribution of water in the soil but also the distribution of solutes. Solute transport experiments examined the presence of immobile water in an unsaturated fine sand under different flow regimes. Both steady and unsteady flow conditions were imposed, but the average pore water velocity and water content were the same in each treatment. Evidence for the presence of an immobile water fraction was sought by fitting the concentration distributions using models both with and without an explicit term accounting for solute exchange with immobile water. Strong evidence was found for the presence of an immobile water fraction affecting the solute concentration distribution under steady flow conditions but not for unsteady flow. These apparently conflicting results are explained by the different water flow patterns arising from the two flow regimes, and suggest that care is needed when extrapolating the results of experiments carried out under one flow regime to a different flow regime. (Author's abstract)
W91-02876

MODELING INFILTRATION INTO A SEALING SOIL.
Texas Agricultural Experiment Station, Lubbock.
R. I. Baumhardt, M. J. M. Romkens, F. D. Whisler, and J. Y. Parlange.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2497-2505, October 1990. 7 fig, 4 tab, 27 ref.

Descriptors: *Hydraulic conductivity, *Infiltration, *Mathematical models, *Saturated flow, *Soil porosity, *Soil sealants, Rainfall intensity, Soil properties, Unsaturated flow.

Rain infiltration is often controlled by a less permeable layer known as a seal. An important consideration in modeling infiltration into a sealing soil is the requirement of describing changes over time in both the saturated and unsaturated hydraulic conductivity of the surface. Infiltration through this layer was modeled numerically using a numerical model based on the Richard's equation with an algorithm which continuously updating the seal properties (saturated hydraulic conductivity, porosity, water entry value, specific water capacity) as a function of rainfall characteristics. The seal remains unchanged until the surface has reached incipient ponding. Subsequently, a rapid change in the hydraulic properties of the seal is imposed to reflect the effect of raindrop impact. Finally, an equilibrium state develops between seal formulation due to raindrop impact and seal erosion due to the rainstorm intensity effects. Model-predicted infiltration was similar to that observed during simulated rainstorms having various combinations of intensities and kinetic energy rates per millimeter of rain. A sensitivity analysis was performed to determine the effects of changes in seal and bulk soil properties, as well as simulation parameters, on infiltration. Seal formation was dependent on cumulative rainfall energy and the rainstorm intensity. (Author's abstract)
W91-02878

ANALYTICAL TRAVELING WAVE SOLUTIONS FOR TRANSPORT WITH NONLINEAR AND NONEQUILIBRIUM ADSORPTION.
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Plant Nutrition.
S. E. A. T. M. Van der Zee.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2563-2578, October 1990. 8 fig, 1 tab, 56 ref, append.

Descriptors: *Adsorption, *Equilibrium, *Groundwater movement, *Path of pollutants, *Soil chemistry, *Soil porosity, *Soil water, *Solute transport, Kinetics, Mathematical models, Sorption, Traveling wave, Wave velocity.

Transport was modeled for a soil with dual porosity, or with chemical nonequilibrium, assuming first-order kinetics. The equilibrium sorption equation in the immobile region is nonlinear. The Langmuir and the Van Bemmelen-Freundlich equations were considered for sorption. The sorption equation in the mobile region is assumed to be linear. Analytical solutions were obtained for the traveling wave displacement found for initial resident concentrations that are smaller than the feed concentrations and for infinite displacement times, neglecting the coupled effects of dispersion and nonequilibrium conditions. These waves travel with a fixed shape and a fixed velocity through the homogeneous flow domain. Differences with respect to the linear sorption case are the smaller front thickness and the non-Fickian type of displacement. The non-Fickian behavior is intrinsic to the traveling wave assumption as the front does not spread with the square root of time. The analytical solutions obtained for the equilibrium and for the nonequilibrium situations are mathematically equivalent. Only the effective diffusion/dispersion coefficient needs to be adapted to account for nonequilibrium effects, as for linear dual-porosity models. Apart from early time behavior, the traveling wave solutions agree well with numerical approximations. The front steepness depends on the degree of nonlinearity. The sensitivity on the dispersion coefficient and first-order rate coefficient may be large but depends on which mechanism controls front spreading. (Author's abstract)
W91-02882

OBSERVATIONS ON THE DEVELOPMENT OF PORE-WATER STRESSES DURING PIEZOCONE PENETRATION IN CLAYS.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 7B.
W91-02938

CONTAMINANT MIGRATION THROUGH FRACTURED TILL INTO AN UNDERLYING AQUIFER.
University of Western Ontario, London. Geotechnical Research Centre.
For primary bibliographic entry see Field 5B.
W91-02941

2H. Lakes

EFFECTS OF CALCIUM AND PH ON THE REPRODUCTIVE SUCCESS OF AMNICOLA LIMOSA (GASTROPODA).
Guelph Univ. (Ontario). School of Engineering.
For primary bibliographic entry see Field 5C.
W91-02064

DISTRIBUTION OF SHRIMP AND FISH BY-CATCH ASSEMBLAGES IN THE CANADIAN EASTERN ARCTIC IN RELATION IN WATER CIRCULATION.
Arctic Biological Station, Ste. Anne de Bellevue (Quebec).
For primary bibliographic entry see Field 2L.
W91-02066

RECIPROCAL DIEL VERTICAL MIGRATION BEHAVIOR IN PLANKTIVORES AND ZOOPLANKTON IN BRITISH COLUMBIA LAKES.
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
D. A. Levy.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1755-1764, September 1990. 7 fig, 51 ref.

Descriptors: *Crustaceans, *Diurnal variation, *Ecosystems, *Fish behavior, *Lakes, *Limnology, *Migration, *Predation, *Salmon, *Vertical distribution, *Zooplankton, British Columbia.

Simultaneous comparison of planktivore and crustacean zooplankton distribution patterns in a set of British Columbia lakes suggested coupled diel vertical migration behavior in the two adjacent trophic levels. In lakes where juvenile sockeye salmon performed diel vertical migrations, most zooplankton were non-migratory and concentrated in shallow surface waters over the diel cycle. In contrast, in one lake where pelagic threespine sticklebacks were present, and where juvenile sockeye diel

vertical migrations were periodically reversed, most zooplankton undertook diel vertical migrations. The presence of diel vertical migration behavior in zooplankton thus appears to be related to the presence or absence of the behavior in the predominant planktivores. (Author's abstract)
W91-02067

OCCURRENCE, RELATIVE ABUNDANCE, AND SIZE OF LANDLOCKED SEA LAMPREY (PETROMYZON MARINUS) AMMOCOETES IN RELATION TO STREAM CHARACTERISTICS IN THE GREAT LAKES.
Department of Fisheries and Oceans, Sault Ste. Marie (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
R. J. Young, J. R. M. Kelso, and J. G. Weise.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1773-1778, September 1990. 2 fig, 4 tab, 38 ref.

Descriptors: *Eel, *Fishkill, *Great Lakes, *Lamprey, *Streambeds, Correlation analysis, Discriminant analysis, Gravel, Sand, Substrates, Water temperature.

The sea lamprey is of economic importance to the Great Lakes because it parasitizes salmonids and other game species resulting in significant mortality. The effect of 14 environmental variables on the occurrence of sea lamprey (Petromyzon marinus) ammocoetes was examined in 73 tributaries of the Great Lakes. We successfully classified 86% of streams without lamprey and 90.5% of streams with ammocoete populations using discriminant analysis. Eighty percent of streams in a test data set were also successfully classified. The classification success was largely determined by differences in stream substrate characteristics based on the magnitude of canonical coefficients and contribution to the multivariate F-statistic. Streams with ammocoetes had a significantly ($P < 0.10$) higher proportion of sand and a lower proportion of bedrock and clay than streams without ammocoetes. Catch per unit effort of ammocoetes collected with electrofishing gear was also significantly related ($P = 0.004$) to the proportion of rubble, gravel, and clay. A significant ($P < 0.01$) positive relationship existed between conductivity and temperature with size of 2+ ammocoetes. Results indicate that predictions could be developed for the number of metamorphosing ammocoetes based upon substrate differences in stream characteristics. (Author's abstract)
W91-02068

RATIOS IN AQUATIC SCIENCES: STATISTICAL SHORTCOMINGS WITH MEAN DEPTH AND THE MORPHOEDAPHIC INDEX.
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 7C.
W91-02069

MEASURING EPILITHIC BACTERIAL PRODUCTION IN STREAMS.
Guelph Univ. (Ontario). Dept. of Zoology.
J. J. Hudson, J. C. Roff, and B. K. Burnison.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1813-1820, September 1990. 4 fig, 1 tab, 30 ref.

Descriptors: *Bacteria, *Data acquisition, *Ecosystems, *Lotic environment, *Productivity, *Sampling, *Streams, Bacterial physiology, Metabolism, Riffles, Stream biota, Temporal variation.

Techniques have been developed for the measurement of bacterial production (by the rate of tritiated thymidine and disturbance artifacts (TdR) incorporation into DNA), isotope dilution, time course of incorporation of nucleoside, and disturbance artifacts in natural epilithic communities of headwater streams. The epilithon in riffles was subsampled by carefully chipping upper rock surfaces. Chips were placed in test tubes and incubated in situ. Test tubes were rotated to reduce the formation of artificial diffusion barriers to TdR transport. DNA was isolated using a double filtration technique. Summertime production had a range of 1.3 to 51 mg carbon/sq m/hr in five southern Ontario streams. Precursors to DNA synthesis, which diluted tritiated TdR, had a range of 63 to 440 nM. Incorporation of tritiated TdR was linear for at least one hour. Disturbance artifacts did not appear from rock chipping or from extended sample rotation. The techniques can be applied to other microbial groups from various aquatic hard substrata. (Author's abstract)
W91-02070

EFFECTS OF IRON CYCLING ON PB-210 DATING OF SEDIMENTS IN AN ADIRONDACK LAKE, USA.
Syracuse Univ., NY. Environmental Engineering Program.
For primary bibliographic entry see Field 2J.
W91-02071

MICROGRAZER IMPACT AND SUBSTRATE LIMITATION OF BACTERIOPLANKTON IN LAKE MICHIGAN.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
G. L. Pernie, D. Scavia, M. L. Pace, and H. J. Carrick.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1836-1841, September 1990. 5 fig, 3 tab, 27 ref.

Descriptors: *Aquatic bacteria, *Bacteria, *Food chains, *Lake Michigan, *Limnology, *Plankton, Bacterial physiology, Growth rates, Organic carbon, Predation, Substrates.

The roles of both heterotrophic and autotrophic picoplankton in aquatic food webs are increasingly recognized as ecologically important. Lake Michigan epilimnetic heterotrophic bacterial loss rates, predator size, and substrate limitation was estimated in 1986 and 1987. The bacterial growth rates were always enhanced by organic substrate additions indicating that bacterial growth is limited, to some degree, by substrate availability. Loss rates and growth rates between 0.32 and 1.45 per day were obtained. The grazers were predominantly picoplankton-size organisms, presumably heterotrophic flagellates. Using radiolabeled bacteria, only a small percentage (2 to 3%) of bacterial cells were incorporated into larger size fractions after 24 hours. These results indicate that heterotrophic bacteria were not a direct, significant, carbon source for the upper trophic levels. (Author's abstract)
W91-02072

LARGE-LAKE RESPONSES TO DECLINES IN THE ABUNDANCE OF A MAJOR FISH PLANKTIVORE--THE LAKE MICHIGAN EXAMPLE.
Michigan Univ., Ann Arbor. Center for Great Lakes and Aquatic Sciences.
M. S. Evans.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1738-1754, September 1990. 10 fig, 41 ref.

Descriptors: *Alewife, *Algal control, *Fish populations, *Food chains, *Lake Michigan, *Lake restoration, *Limnology, Aquatic plants, Biomass, Copepods, Phytoplankton, Predation, Seasonal variation, Water transparency, Waterfleas, Zooplankton.

Alewife abundances declined dramatically in southeastern Lake Michigan over 1973 to 1977, several years before the lakewide decline occurred. The regional effects of this decline on adult copepod abundances, zooplankton biomass, and water clarity were investigated. In the offshore region, the two largest copepods, Limnocalanus macrurus and Diaptomus sicilus, increased in abundance during the mid-1970's reflecting the decrease in alewife predation. L. macrurus abundances declined in later years, reflecting increased predation pressures from the increasing bloater population. The small-bodied D. minutus and the medium-bodied D. ashlandi exhibited no apparent response to the decline in alewife abundance. Large-bodied D. oregonensis and small-bodied Calanus bicuspidatus thomasi declined in abundance. Size-selective fish predation pressures continued to remain high in the inshore region; increased abundance of yellow perch and rainbow smelt apparently compensated for the alewife decline. Zooplankton biomass, zooplankton mean dry weight, and water clarity apparently were not affected by the decline in alewife abundance in either the inshore or offshore regions. The results were evaluated in terms of the lakewide decline in alewife abundance, the summer 1983 dominance of Daphnia pulicaria in offshore waters, the 1983 marked improvement in offshore water clarity, and later changes in summer offshore D. pulicaria populations, and suggest that phytoplankton control strategies should not be based solely on top-down management strategies. Moreover, top-down management strategies are probably more useful for moderately productive than for eutrophic systems and for small lakes rather than large and ecologically complex systems such as the Great Lakes. (Author's abstract)
W91-02073

LAKE ACIDIFICATION AND FISHERIES PROJECT: BROOK TROUT (SALVELINUS FONTINALIS) EARLY LIFE STAGES.
Wyoming Univ., Laramie. Fish Physiology and Toxicology Lab.
For primary bibliographic entry see Field 5C.
W91-02102

MODELLING PHYTOPLANKTON PRODUCTIVITY IN TURBID WATERS WITH SMALL EUPHOTIC TO MIXING DEPTH RATIOS.
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
J. U. Grobbelaar.
Journal of Plankton Research JPLRD9, Vol. 12, No. 5, p 923-931, September 1990. 4 fig, 1 tab, 21 ref.

Descriptors: *Algae, *Algal growth, *Aquatic productivity, *Light penetration, *Limnology, *Mathematical models, *Model studies, *Phytoplankton, *Turbidity, Euphotic zone, Light quality, Mixing depth, Photosynthesis, Prediction, Respiration, Turbid water.

A model which was developed and calibrated for predicting algal growth in mass cultures was modified for natural systems. In turbid systems, the ratio of euphotic to aphotic depth is usually small and mixing may exceed the compensation depth in order to compensate for the various light regimes to which the phytoplankton would be subjected. the losses due to dark respiration were modified that the effective light history would determine actual rate. The efficiency of light utilization changes under different light regimes and the model was modified to take these variations into account. Both of these modifications resulted different production profiles being generated the same surface conditions, but with different mixing depths, where the phytoplankton became more efficient as the light regime deteriorated less respiration and greater light utilization efficiency). A further consequence is that the 'critical mixing depth' is approximately 2.5 times greater than that which was previously accepted, namely about 20 times the euphotic depth. The model predicted productivities to within 90% of observed rates. The predictions could also be used to determine the extent of nutrient limitation. The predictions have biomanipulatory consequences, as variations of the light regime through the additional non-photosynthesizing materials, under certain conditions, may even result in a stimulation of phytoplankton productivity. (Author's abstract)
W91-02115

PHOTOTAXIS IN DAPHNIA MAGNA: THE INFLUENCE OF TEMPERATURE AND ACCLIMATION ON THE PHOTOTACTIC BEHAVIOUR OF DAPHNIA GENOTYPES.
Ghent Rijksuniversiteit (Belgium). Inst. of Animal Ecology.
J. Van Uytvanck, and L. De Meester.
Journal of Plankton Research JPLRD9, V

No. 5, p 1089-1097, September 1990. 3 fig, 5 tab, 23 ref. State University of Ghent Grant 01.1905.85.

Descriptors: *Acid rain effects, *Acidity, *Animal behavior, *Aquatic animals, *Light effects, *Limnology, *Temperature effects, Daphnia, Genotypes, Hydrogen ion concentration, Phototaxis, Thermal stress, Water temperature, Waterfleas.

The influence of culture temperature, temperature shocks and pH shocks on the phototactic behavior of four Daphnia magna clones was studied. Test animals tended to become more positively phototactic when the pH of the medium was raised, in the pH range of 6 to 9. D. magna clones were less positively phototactic when cultured at high (27 C) temperature. Responses to temperature changes at the start of the experiment were clone-dependent. Only substantial temperature shocks (>10 C) seemed to alter the phototactic behavior significantly. Differences between genotypes remained highly significant despite the broader environmental conditions in which experiments were carried out. Broad heritability estimates for the phototactic behavior of Daphnia under the different environmental conditions studied ranged from 0.78 to 0.88. (Author's abstract)
W91-02117

TTACHED AND FREE-LIVING DIVIDING CTERIA IN TWO AQUATIC SYSTEMS.
iversidad del Pais Vasco, Bilbao (Spain). Dept. Microbiologia e Inmunologia.
riberri, M. Unanue, B. Ayo, I. Barcina, and L. ea.
ters in Applied Microbiology LAMIE7, Vol. No. 2, p 87-89, August 1990. 2 tab, 7 ref.

criptors: *Aquatic bacteria, *Bacterial physiol-, *Coastal environment, *Marine bacteria, Bios, Butron River, Dissolved organic carbon, wth rates, La Salvaje Beach, Nutrients, Organarbon, Particulate matter, Rivers, Spain, Viz-.

percentage of dividing biomass was calculated ttached and free-living bacteria in a coastal ne system (La Salvaje Beach, Vizcaya, Spain) a freshwater system (Butron River, Vizcaya, n). In the marine system, which had low averconcentrations of total and dissolved organic on (1.7 mg/L TOC and 1.4 mg/L DOC), the ntage of dividing biomass was higher for hed (41.4 +/-13.9%) than for the free-living ria (22.0 +/-11.7%). However, in the freshr system, which had mean concentrations of mg/L TOC and 9.8 mg/L DOC, the percentf dividing biomass was similar for both comties: attached, 53.4 +/-26.5%; free-living, +/-21.9%. Thus the attachment to particulate ial is not necessarily an advantage in waters e dissolved organic nutrients are readily avail-(Author's abstract)
02121

P: MODELLING ENVIRONMENTAL ARIOS IN PONDS.
uth Univ. (Germany, F.R.). Chair of Ecologhemistry and Geochemistry.
imary bibliographic entry see Field 7C.
02176

ABILITY IN CONCENTRATIONS OF SED TRACE ELEMENTS IN WATER AND MENT OF SIX ACIDIC LAKES.
Coll., New Brunswick, NJ. Dept. of Enviental Science.
imary bibliographic entry see Field 5B.
2193

LATION-SPECIFIC TOXICITY RESES BY THE FRESHWATER OLIGOTE, STYLODRILUS HERINGIANUS, IN RAL LAKE MICHIGAN SEDIMENTS.
l Oceanic and Atmospheric Administran Arbor, MI. Great Lakes Environmental ch Lab.
mary bibliographic entry see Field 5C.
213

HYDROLOGY OF GOAT LAKE WATERSHED, SNOHOMISH COUNTY, WASHINGTON, 1982-87.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-02227

ESTIMATES OF GROUND-WATER FLOW COMPONENTS FOR LYMAN LAKE, APACHE COUNTY, ARIZONA, WITH A SECTION ON GEOCHEMISTRY OF SURFACE WATER AND GROUND WATER IN THE LYMAN LAKE AREA BY FREDRICK N. ROBERTSON.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02231

SUMMARY OF BIOLOGICAL INVESTIGATIONS RELATING TO SURFACE-WATER QUALITY IN THE KENTUCKY RIVER BASIN, KENTUCKY.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W91-02232

FATHOMETER DATA FROM BART LAKE AND LAKE DOROTHY NEAR JUNEAU, ALASKA, 1988-89.
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02254

DIEL AND SEASONAL ENERGY TRANSFER, STORAGE AND STRATIFICATION IN AFRICAN RESERVOIRS AND LAKES.
Freshwater Biological Association, Ambleside (England).
J. F. Talling.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 651-660, 1990. 5 fig, 34 ref.

Descriptors: *Africa, *Energy transfer, *Heat storage, *Lakes, *Limnology, *Reservoirs, *Thermal stratification, Diurnal variation, Humidity, Lake evaporation, Seasonal variation, Tropical regions, Water temperature.

Relationships between water temperature, heat storage, and other components of the energy budget for African reservoirs and lakes were surveyed. The seasonal variations of surface temperature and incident short-wave solar radiation are broadly correlated in a latitudinal series, with minimum amplitude and phase reversal near the equator. Some divergences can be related to changes of the evaporative (latent heat) flux density, conditioned by seasonally altered humidity and wind regime. Within the tropics there is a close relationship between bottom temperature and altitude, as yet unsupported by finer physical analysis. The resolution of component flux densities in the diel energy budget is illustrated by three examples from work on Lake Chad and a Nile reservoir. For the latter, the residual ascribed to diel heat storage was broadly consistent with observed rates of heat storage, although these also suffered irregularities from horizontal advection. Such diel heat storage is ecologically influential, through induced thermal stratification, in many African water bodies. Its magnitude is compared, across a range of latitudes, with the much larger amplitude of annual heat storage. (Author's abstract)
W91-02370

LIMNOLOGY AND EUTROPHICATION OF BARRA BONITA RESERVOIR, S. PAULO STATE, SOUTHERN BRAZIL.
Sao Paulo Univ., Sao Carlos (Brazil). Escola de Engenharia.
J. G. Tundisi, and T. Matsumura-Tundisi.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 661-676, 1990. 16 fig, 26 ref.

Descriptors: *Barra Bonita Reservoir, *Brazil, *Eutrophication, *Limnology, *Phytoplankton, *Reservoirs, *Water pollution effects, *Zooplankton, Chlorophyll, Flushing, Nitrogen, Phosphorus, Primary productivity, Rainfall, Reservoir sediments, Residence time, Thermal stratification, Wind.

Limnological studies coupled with climatological measurements were made in the Barra Bonita reservoir, Brazil. One year of sampling showed a pattern in which main forcing functions were rainfall, wind, flushing rate, and residence time. Summer months were characterized by short water residence time (one month) while in the autumn, winter and spring periods the residence time was higher (six months). The seasonal cycle of phytoplankton biomass and composition, primary production and nutrient cycles are controlled by the coupling of the above four factors. The reservoir is polymictic with short periods of stratification. Primary production ranges from 200 to 800 mg C/sq m/day. The phytoplankton change from a flagellate/diatom community to a diatom/blue green one during periods of long residence time. Chlorophyll values range from 5 to 238 micrograms/L during heavy blooms. Concentration of phosphorus is maintained at low levels due to continuous circulation and precipitation to the sediment. Nitrogen is not limiting for phytoplankton production. Cyclopoida dominate over the Calanoida in the zooplankton community, a fact that confirms the eutrophic nature of the reservoir. Adequate treatment along with the introduction of periods with lower or higher discharge coupled with the hydrologic cycle and flushing rate is an important step in the management of this reservoir. Nutrient reduction could also be achieved by aeration of the tributaries that are major sources of P inflow, increasing the through-flow of spill water during the rainy season thus eliminating possible phytoplankton concentrations, and introducing artificial mixing in the main channel. Other techniques would include reduction of the bottom deposits of sediments and organic matter at intake structures for the turbines in deep water, and land use practices such as protection zones, application of fertilizers, crop rotation, and spoil stabilizing tillage techniques. (Author's abstract)
W91-02371

ANNUAL AND LONGITUDINAL CHANGES IN THE ENVIRONMENTAL CONDITIONS IN THREE CONSECUTIVE RESERVOIRS OF THE GUADIANA RIVER (W. SPAIN).
Barcelona Univ. (Spain). Dept. de Ecologia.
J. Armengol, F. Sabater, J. L. Rierra, and J. A. Morgui.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 679-687, 1990. 4 fig, 2 tab, 15 ref. Comision Aserora de Investigation Cientifico y Tecnica, Programa PB85-0166.

Descriptors: *Environmental gradient, *Guadiana River, *Limnology, *Multireservoir networks, *Reservoirs, *Spain, Alkalinity, Chemical properties, Chlorides, Chlorophyll a, Conductivity, Flow, Hydrogen ion concentration, Nitrates, Nitrites, Oxygen, Phosphates, Physical properties, Principal component analysis, Seasonal variation, Secchi disks, Sulfides, Water temperature.

Temporal and longitudinal changes in the environmental conditions in a cascade of three reservoirs on the Guadiana River (Spain) were studied. Physical and chemical parameters were used to characterize longitudinal patterns of change: conductivity, Secchi disk, pH, alkalinity, temperature, oxygen, nitrate, nitrite, phosphate, chloride, sulfide, monthly water, flow volume, water speed and chlorophyll a. Temporal heterogeneity along two years with different climatic conditions was also considered. By means of principal component analysis (PCA) a gradient analysis was performed using the scores of each sampling point in the space defined by the first three principal axes. The first principal component axis was strongly correlated with a group of variables that jointly determine the salinity of the water and can be simply be expressed as conductivity. In Guadiana reservoirs, salinity/conductivity are a consequence of water inputs from the endorreic upstream catchment. The variables more correlated with the second axis

were represented by water temperature and varied according to a seasonal cycle. The third principal component represented the average and annual pattern of spatial evolution produced by the combination of physical, chemical, and biological processes taking place along the main axis of the reservoirs. The results demonstrate three levels of temporal and spatial organization: (1) annual changes common to the three reservoirs--PCA axes 1 and 2, (2) differences among reservoirs--PCA axis 1, and (3) differences among stations inside each reservoir--PCA axis 3. (Author's abstract)
W91-02372

CLIMATE AND CLIMATIC RESOURCES OF RESERVOIRS.
Limnologicheskii Inst., Irkutsk (USSR).
N. P. Ladeishchikov, and V. A. Obolkin.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 689-693, 1990. 1 tab, 7 ref.

Descriptors: *Climatology, *Environmental effects, *Lakes, *Limnoclimatology, *Reservoirs, Air pollution, Air temperature, Heat budget, Limnology, Model studies, Precipitation, Recreation, Siberia, USSR.

A model of reservoir limnoclimate can be represented as a function of: (1) the thermal flow at the reservoir surface; (2) the thermal capacity of the reservoir; (3) the loss of heat from the reservoir surface to the atmosphere; (4) moisture exchange between the atmosphere and the lake; (5) the intensity of local circulation exchange in the reservoir's coastal zone; (6) the degree of orographic isolation; and (7) the intensity of macroadvection over the reservoir. The relative stability of a reservoir's limnoclimate stabilizes its ecological surroundings against the external influences of seasonal and secular variations of climate. Therefore, limnoclimate must be considered along with other factors in the creation and development of reservoirs. A comparison of mean air temperature and atmospheric precipitation in the region of three Siberian reservoirs before and after reservoir formation indicates that reservoirs significantly influence the climate. The reservoirs and lakes have a smoothing effect on the climate of surrounding areas, lowering the amplitude of both daily and annual temperature and precipitation variations. The climatic effect (cooling in summer) of these Siberian reservoirs causes some aggravation of atmospheric pollution over their surfaces due to an increase in inversion frequency and a decrease of topographic relief. On the other hand, reservoir areas have greater overall atmospheric clarity, less weather severity and variability, and longer-lasting periods of favorable meteorological conditions than comparable continental regions. The construction of man-made reservoirs results in a wide variety of recreation resources in both the reservoir and its surroundings. This recreational potential is enhanced by the climatic amelioration. (Sand-PTT)
W91-02373

LONG-TERM TRENDS IN THE SESTON CONTENT OF A SHALLOW EUTROPHIC LAKE AND SOME RELATIONS TO CLIMATIC ELEMENTS.
Institute of Geography and Geoecology, Berlin (German D.R.). Dept. of Hydrology.
R. Stellmacher.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 695-699, 1990. 2 fig, 1 tab, 10 ref.

Descriptors: *Algae, *Climatology, *Eutrophic lakes, *Limnology, *Seston, Air temperature, Germany, Lake Muggelsee, Population dynamics, Regression analysis, Seasonal variation, Thermal radiation, Time series analysis.

Seasonal time series of the buoyant part of the seston content of Lake Muggelsee, the sums of negative daily mean temperatures in Berlin, and the global radiation in Potsdam have been collected for as long as 50 years. The structure of these time series and the relationships between them were investigated. The series are characterized by more or less strong cyclic variations of from 2 to 24 years. A moving spectral estimation of daily mean temperatures gives an idea of the change of spectral behavior over time: in the past, periodicities of about 3.4, 5, and 10 years dominated, but at present there are cycles of about 2.3 and 7 years. Regression analysis showed that winter severity influences only the starting phase of algal development. It was concluded that monthly values are not sufficient to describe causal relations between seston content and the population dynamics of individual algal species; shorter average periods are necessary. However, monthly, seasonal, and annual values are useful for determining correlations between more general entities such as the buoyant part of seston and certain climatic elements. (Author's abstract)
W91-02374

BIOLOGICALLY AVAILABLE PHOSPHORUS RETENTION BY THE KIS-BALATON RESERVOIR.
Ulster Univ., Coleraine (Northern Ireland). Limnology Lab.
J. Zlinsky, and S. Herodek.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 703-707, 1990. 3 fig, 1 tab, 10 ref.

Descriptors: *Eutrophication, *Limnology, *Nutrient transport, *Path of pollutants, *Phosphorus, *Reservoirs, *Water pollution control, Algal blooms, Cyanophyta, Hungary, Lake Balaton, Phytoplankton, Wastewater treatment, Zala River.

The largest tributary of Lake Balaton, the River Zala, discharges 50 tons of dissolved phosphorus (DP) and 40 tons of particle-bound phosphorus (PP) per year, causing serious eutrophication of the westernmost basin of the lake. To complement other measures of water quality protection in the catchment area, the shallow reservoir Kis-Balaton was built to reduce the nutrient load and prevent silting. The changes in the concentration and relative importance of P fractions entering and leaving the reservoir were investigated. The dissolved biologically available P (BAP) concentrations usually equal the soluble reactive P (SRP). The non-reactive DP concentration remained unchanged along the river. Winter experiments showed a PP and a total dissolved P (TDP) retention of 87% and 49%, respectively, giving a total P (TP) retention of 70%. The availability of the effectively withheld PP proved to be only 17-19%, lowering the overall BAP retention to 60% of the TP. During the summer there were blue-green algal blooms in the reservoir. The P uptake of the phytoplankton increased the TDP and SRP retention to 74% and 86%, respectively, but there was more PP leaving the reservoir than entering it. At the lowest reach of the River Zala, the significant increase of dissolved BAP and PP concentrations indicates important sources of pollution. The major part of P leaving the reservoir in readily available dissolved forms originates from sewage. The contribution of diffuse P loading (like soil erosion in the watershed) to eutrophication is much less than that of the sewage plants, if judged with respect to BAP rather than to TP measurements. Eutrophication models suggest that to prevent the algal blooms, the BAP loading should be reduced by 75%. Considering the higher availability and lower retention rate of sewage P, tertiary treatment plants both upstream and downstream of the reservoir seem to be the most effective investment to achieve this goal. (Sand-PTT)
W91-02375

PHOSPHORUS CYCLE AND ITS SIGNIFICANCE IN THE EUTROPHICATION OF LAKE SEVAN.
Akademiya Nauk Armyanskoi SSR, Sevan. Hydrobiological Station.
For primary bibliographic entry see Field 5C.
W91-02376

PELAGIC CALCITE PRECIPITATION AND TROPHIC STATE OF HARDWATER LAKES.
Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
R. Koschel.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 713-722, 1990. 3 fig, 2 tab, 56 ref.

Descriptors: *Calcite precipitation, *Calcium carbonate, *Hardness, *Hardwater lakes, *Limnology, *Trophic level, Chlorophyll, Eutrophication, Germany, Phosphorus, Phytoplankton.

The CaCO3 concentration of different hardwater lakes of the Mecklenburg District was analyzed and related to trophic conditions. The results indicate that calcite precipitation is associated with coreactions which play a fundamental role in self-purification of the lakes. High calcite precipitation provides a high autochthonous self-protection potential and helps counteract eutrophication. The relation between the chlorophyll a content of the phytoplankton and the total phosphorus content is a sigmoid function in the lakes examined. This sigmoid character is lost in stratified hardwater lakes. The calcite precipitation causes the phyto plankton biomass to be reduced during the summe stagnation period. Calcite precipitation slows u eutrophication and diminishes the exponential in crease in phytoplankton biomass in relation t phosphorus supply. The regulation of trophic stat is obviously different for hardwater lakes an softwater lakes. Therefore, for lakes with a hig temporary hardness (with calcite precipitation classification of trophic state, especially in terms o the phosphorus and phytoplankton biomass, shoul be performed differently from classification those with a low temporary hardness (witho calcite precipitation). (Sand-PTT)
W91-02377

LONGITUDINAL DIFFERENTIATION AC CORDING TO ENVIRONMENTAL FACTOR AND PHYTOPLANKTON IN ARACENA AN LA MINILLA RESERVOIRS (SEVILL SPAIN).
Seville Univ. (Spain). Faculty of Biology.
J. Toja.
Ergebnisse der Limnologie ERLIA6, Vol. 33, N 3, p 733-747, 1990. 7 fig, 4 tab, 12 ref.

Descriptors: *Eutrophic lakes, *Limnology, *Ph toplankton, *Reservoirs, *Spain, Arecena Res voir, Environmental gradient, Eutrophication, Minilla Reservoir, Lake stratification.

The possible differentiation of the environmen characteristics and phytoplankton communi along the Aracena and La Minilla reservoirs studied from April 1977 to May 1978. In e reservoir five sampling stations were studied. A cena had a behavior similar to a lake and envir mental factors and phytoplankton developm both showed little difference among various zo of the reservoir. The characteristics of the sam depended on organism activity in response to p esses linked to the mixed-stratification cycle. H ever, the secondary branch of the reservoir w little more eutrophic than the primary branch, summer conditions appeared there before they at the other stations. La Minilla reservoir beha more like a river and the water flow determ the characteristics of each zone. There was a ferentiation between the environmental factor the dam and river zones, but differences in phytoplankton communities were not signific (Author's abstract)
W91-02379

LONG-TERM RELATIONSHIPS BETW PHYTO- AND ZOOPLANKTON IN T MESO-EUTROPHIC RESERVOIR SAID BACH.
Akademie der Wissenschaften der DDR, Lei Hydrobiologisches Lab.
W. Horn, and H. Horn.
Ergebnisse der Limnologie ERLIA6, Vol. 33 3, p 749-762, 1990. 12 fig, 2 tab, 23 ref.

Descriptors: *Food chains, *Limnology, *P plankton, *Population dynamics, *Reser *Zooplankton, Chlorophyta, Correlation an Crustaceans, Cyanophyta, Daphnia, Diatoms, many, Limiting nutrients, Phosphorus, Saide Reservoir, Seasonal variation, Secchi disks.

The variability and interactions of phytopla and zooplankton over seasons and years we

rpreted from plankton samples taken at nearly eekly intervals for 11 years. The soluble reactive ncentrations of the growth-limiting nutrient osphorus underwent great variation, but no cor- ation with the phytoplankton could be detected. rong interactions were found between phyto- nkton and zooplankton. A direct and significant rrelation became evident between the maximum limnetic biomass of crustacean zooplankton and onial green algae, whose apparent indigestibility y protect them from grazing. A negative rela- nship existed between the epilimnetic biomasses Asterionella, diatoms, and nanoplankton and the stacean (Daphnia) biomass, indicating that high icentrations of herbivores are able to control se algae. No correlation could be found be- en crustacea and blue-green algae or Fragilaria. chi-disk readings showed a weak positive rela- ship to the crustacean biomass. The main result his investigation was the evidence of strong ractions between phytoplankton and zooplank- over whole seasons. (Author's abstract)
1-02380

COMMUNITIES AS A BIOMANIPULAT- TOOL IN A TEMPERATE LOWLAND ERVOIR.
z Univ. (Poland). Inst. of Environmental Biol-

Zalewski, B. Brewinska-Zaras, and P. kiewicz.
bnisse der Limnologie ERLIA6, Vol. 33, No. 763-774, 1990. 5 fig, 1 tab, 40 ref.

riptors: *Fish food organisms, *Food habits, ch, *Reservoir fisheries, *Reservoirs, *Water ty, Daphnia, Growth, Phytoplankton, Poland, oduction, Sulejow reservoir, Water quality ol, Zooplankton.

e basis of a five-year study a high variability e reproductive success of the dominant perch a fluviatilis) and accompanying Cyprinidae s in the Sulejow Reservoir in central Poland determined. Recruitment was significantly ated with the water level and its stability. ain food component of perch fry was zoo- on; however, its proportion to other inverte- varied from station to station. Zooplankton ost intensely consumed at dusk and night During the year of highest perch density, stomach fullness and percentage of eaten ia drastically declined. In parallel the t of phytoplankton remarkably increased. eding strategy of perch and the strong cor- n between the density of the dominating fry and their growth rate, indicates their ce on the density of large zooplankton fil- which determined water quality. (Author's t)
2381

HYTON AS INDICATOR OF THE RES- IR WATER QUALITY: III. BIOMONI- G TECHNIQUES.
Dept. of Water Technology and Environ- Engineering (Czechoslovakia).
mary bibliographic entry see Field 5A.
382

CTION ON EUTROPHICATION OF VOIR YUQIAO.
Inst. of Environmental Protection and Sci- China).
mary bibliographic entry see Field 5G.
383

PHICATION OF NIGERIA'S LAKE E.
niv., Benin City (Nigeria). Dept. of Zoolo-

ary bibliographic entry see Field 5C.
84

FICATION OF THE PRINCIPAL H RESERVOIRS.
te de France, Paris. Direction de l'Equipe-

A. Gregoire.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 807-818, 1990. 5 fig, 1 tab, 36 ref.

Descriptors: *France, *Lake classification, *Lake morphology, *Limnology, *Reservoirs, Cluster analysis, Correlation analysis, Factor analysis, Principal component analysis, Water quality trends.

To help forecast trends in the water quality of reservoirs, classification of 185 French reservoirs was carried out on the basis of their physical characteristics. The 22 abiotic characters used were selected according to the importance placed on them in the literature to explain the biological structure of lake ecosystems. These variables were evaluated statistically. Correlation analysis showed that these descriptive factors can be divided into five clusters: (1) factors describing inflow to the reservoir; (2) morphometric characteristics; (3) reservoir operating conditions; (4) technical specifications of the hydraulic machinery; and (5) qualitative data--catchment geology, geographic position, river regime, type of dam, reason for construction, etc. The automatic clustering of the reservoirs defines 7 principal types whose differences are explained by a multiple-correspondence factor analysis: (1) reservoirs on smaller streams, but situated far from the headwaters, and having major water-level fluctuations; (2) reservoirs on France's largest rivers, with minimal water-level fluctuations, and with current-powered generating plants; (3) deep reservoirs on the high-altitude headwaters of streams; (4) the largest reservoirs, characterized by a low water-mass renewal rate and great lake-level fluctuation; (5 and 6) reservoirs 30 to 40 m deep, situated at moderate altitudes, and having important water-level fluctuations (these two types differ from one another in the amount of their inflow); and (7) reservoirs on the headwaters of small streams. (Sand-PTT)
W91-02385

WATER QUALITY IN CZECHOSLOVAK WATER-SUPPLY IMPOUNDMENTS.
Prague Dept. of Water Technology and Environmental Engineering (Czechoslovakia).
V. Sladecek.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 819-825, 1990. 3 fig, 4 tab, 23 ref.

Descriptors: *Czechoslovakia, *Lake classification, *Limnology, *Reservoirs, *Water quality criteria, Ecosystems, Environmental effects, Pollution index, Trophic level, Water supply.

The saprobic index and the trophic potential were used for the evaluation of water quality in Czechoslovakian water-supply impoundments. Of 57 such reservoirs, sufficient data were available from 49 for assignment of a saprobity/trophism rank. Four reservoirs were xenosaprobic or ultra-oligotrophic, 18 were oligosaprobic or oligotrophic, 16 were gamma-mesosaprobic or mesotrophic, 7 were beta-mesosaprobic or beta-eutrophic, and 1 was alpha-mesosaprobic or alpha-eutrophic. In addition, 3 impoundments fell between the oligosaprobic/oligotrophic and the gamma-mesosaprobic/mesotrophic categories. The water-quality criteria themselves were also evaluated in this study. Both criteria are quantitative ones and appropriate for such classifications. They are able to distinguish relatively weak differences in time and space for one ecological community as well as differences among various communities within the impoundment. Both are not stable phenomena and their changes indicate fluctuations in the saprobic and trophic conditions, especially along longitudinal and vertical distributions. They react to environmental factors acting within and from outside the body of water. (Sand-PTT)
W91-02386

WATER QUALITY IN RESERVOIRS: THE EFFECT OF INFLOWING POLLUTION.
Vyzkumny Ustav Vodohospodarsky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 5B.
W91-02387

CLASSIFICATION OF SOME RESERVOIRS IN SR SERBIA (SFR YUGOSLAVIA) BASED ON ANALYSIS OF PLANKTON SPECIES AS INDICATORS OF TROPHIC CONDITIONS.
Institute for Biological Research, Belgrade (Yugoslavia).
V. Martinovic-Vitanovic, and V. Kalafatic.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 831-837, 1990. 1 tab, 18 ref.

Descriptors: *Bioindicators, *Lake classification, *Limnology, *Plankton, *Reservoirs, *Trophic level, *Yugoslavia, Eutrophication, Lentic environment, Nitrates, Nutrients, Phosphates.

During the last few decades, a number of reservoirs have been built in Serbia, creating new aquatic ecosystems with characteristics differing from those of the original river systems. This has resulted in the appearance of biotic assemblages specific to lentic waters, and completely different from those characteristic of flowing rivers. Changes have also occurred in the structure and composition of plankton communities, due to their adaptation to the new environmental conditions. A qualitative and quantitative analysis of plankton was undertaken as an indication of the trophic status of several characteristic reservoirs. Measurements were made of concentrations of phosphates and nitrates--known chemical factors relevant to eutrophication. Based on their morphometric features, nutrient concentrations, and plankton populations, the six reservoirs studied can classified as to trophic type: Bor--oligotrophic; Bovan--oligotrophic-mesotrophic; Zaton--mesotrophic; Gruza--eutrophic; Sava Lake--eutrophic-hypereutrophic; Djerdap--hypereutrophic. It should be emphasized that concentrations of phosphates in the surface waters were generally high. Consequently, these values cannot serve as the only parameter defining organic production of an aquatic ecosystem, and classifying reservoirs solely by determining the concentrations of phosphates may produce erroneous conclusions regarding the trophic status. (Sand-PTT)
W91-02388

ECOLOGY OF LOWLAND ZEGRZYNSKI RESERVOIR NEAR WARSAW.
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
Z. Kajak.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 841-850, 1990. 2 fig, 7 tab, 32 ref.

Descriptors: *Limnology, *Phytoplankton, *Reservoirs, *Seston, *Trophic level, *Zegrzynski reservoir, *Zooplankton, Nitrogen, Phosphates, Phosphorus, Poland, Primary productivity, Secchi disks, Secondary productivity, Transparency, Water quality.

The main parameters of the Lake Zegrzynski reservoir are: length 70 km, surface area 33 sq km, average depth 3-4 m, and retention time 5-10 days. Two main inlets provide 58% and 42% of the total inflow, respectively; total P and seston (up to several times). The trophic status of the lake is very high: Secchi disk transparency 0.7-1.3 m, total P 150-300 micrograms/L, phosphate-P 50-170 micrograms/L, total N 2.0-3.0 mg/L. Seston (mg dry weight/L) on the average from 40 in more polluted inlets to 9 at the dam, phytoplankton (mg fresh wight/L) decreases from 30 to 8. Zooplankton biomass is higher (up to 10 mg/L) in standing portions of the reservoir, with rotifers more abundant in the fluvial areas (up to 2 times). Benthos biomass is high, especially in middle lotic areas (up to 1.8 kg/sq m fresh weight), with mollusks being dominant (60-80%). The average biomass (g/sq m) in the middle and lower portions of the lake is 29.0 for phytoplankton, 10.5 for zooplankton, and 1000 for zoobenthos. The estimated annual production (kg/sq m) is 2.9 for phytoplankton, 0.4 for zooplankton, and 1.5 for zoobenthos. The efficiency of plankton plus benthos secondary production expressed as its ratio to seston load and primary production is rather high, 13.7%. (Author's abstract)
W91-02389

INFLUENCE OF IMPOUNDMENTS ON PHYTOSESTON BIOMASS OF TWO SMALL LOWLAND RIVERS-SKIERNIEWKA AND RAWKA IN 1983.
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
A. T. Simm.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 851-860, 1990. 6 fig, 10 ref.

Descriptors: *Biomass, *Dam effects, *Limnology, *Phytoplankton, *Rawka river, *Seston, *Skierniewka River, Algae, Diatoms, Dinoflagellates, Ecosystems, Flagellates, Poland, Population dynamics, Reservoirs, Rivers, Seasonal variation, Species composition, Strowbow Reservoir.

Phytoseston of the Skierniewka River can be defined as a community of planktonic species, typical for polluted rivers in moderate zone. Communities of Pennatae diatoms, typical for clear rivers, occur as the dominant species in the Strowbow Reservoir upstream from the impoundments. In the Rawka River, in spite of the domination by planktonic species, significant participation of Pennatae diatoms can be noticed, from a weak loading of wastewaters. In spring and autumn, centric diatoms (mainly S. hantzschii) dominated in both the Skierniewka and Rawka Rivers. During the summer, the biomass of diatoms decreases, changing into Cylotella spp., Melosira spp., and green algae. In the Skierniewka River the important phytoseston participants were: cryptomonads, euglenoids, and on the lower stretch of the river, blue-green algae. In the Rawka River centric diatoms dominate in the summer. In both rivers, nannoplanktonic species dominated, but their participation decreased in the summer to 60% or less. The most intensive increase of nannoplankton participation was recorded in the largest reservoir in Skierniewice and in the impoundment in Myslakow, situated on the lower stretch of the Skierniewka River where the participation of large flagellates and blue-green algae has been increasing simultaneously with the increase of river pollution. The Strobow (with a 2-7 day retention time) and Skierniewice (8-12 day retention time) Reservoirs had the highest increase in biomass. In the Strowbow Reservoir, a 20-40 times increase of biomass was observed in comparison with a control station situated 250 m downstream. In the Skierniewice Reservoir, the increase was 2-4 times lower, with a maximum of biomass. In reservoirs with retention times not longer than half a day (ie., the Myslakow and Suliszew), the biomass growth was low, and the decrease of phytoseston biomass was noted more often. The lower increase of phytoseston biomass in the impoundment at Skierniewice can be connected with too high a retention time, causing the growth of herbivorous zooplankton, and sedimentation of passively floating diatoms, that could clear up the domination of large flagellates during the summer. (Sand-PTT)
W91-02390

WATER QUALITY OF SOME RESERVOIRS.
Vyzkumny Ustav Vodohospodarsky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 5A.
W91-02391

WATER QUALITY IN THE SANCE RESERVOIR (NORTH MORAVIA).
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
For primary bibliographic entry see Field 5G.
W91-02392

RELATING EMPIRICAL WATER QUALITY DIAGRAMS AND PLANKTON-DYNAMICAL MODELS: THE SAMPLE METHODOLOGY APPLIED TO A DRINKING WATER STORAGE RESERVOIR.
Rijksinstituut voor de Volksgezondheid, Utrecht (Netherlands).
For primary bibliographic entry see Field 5F.
W91-02395

IMPORTANCE OF GEOGRAPHICAL ASPECTS IN ENVIRONMENTAL STUDIES OF HYDRO-QUEBEC RESERVOIRS.
Hydro-Quebec, Montreal.
C. Demers.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 913-918, 1990. 1 fig, 1 tab.

Descriptors: *Geography, *Geomorphology, *Hydroelectric power, *Limnology, *Quebec, *Reservoir operation, *Reservoirs, *Surveys, Acid rain, Canada, Erosion, Fertilizers, Floods, Geologic formations, Geologic history, Irrigation, Municipal wastewater, Navigation, Precipitation, Recreation, Social aspects, Stream fisheries, Wastewater disposal.

In addition to the biological and water quality aspects, geographical considerations are important in providing a basis for environmental studies of reservoirs. For the case of Hydro-Quebec reservoirs, knowledge of the specific geographic context allows one to estimate the size and date of the spring flood, using the ratio between rain and snow precipitation, and thus to minimize the risks of flooding. Relationships can be established between sources of acid rain production, prevailing winds and the sites of reservoirs that may be subject to acidification, because of the geology of the subsoil. A definition of the territory in its physiographic regions and smaller sub-regions, as well as knowledge of its recent geological history and past and present geomorphological processes are essential and must be available at the start of a study program. Reservoirs located on a plateau, valley or plain will not have the same surface-to-depth ratio or the same ratio of original area to flooded area. Their shorelines will be differently defined and consist of different materials, and subject to quite different dynamics. Access to tributaries by spawning fish will also be determined by the morphology of the environment. Knowledge of the effects of the last Quaternary glaciation, which resulted in the deposition of erodable clays are important in determining the location of shores sensitive to reservoir erosion. In addition to physical geography, there also aspects associated with human geography which are often overlooked in environmental studies of reservoirs. Aspects of human geography include: native groups performing traditional hunting and fishing activities; recreational activity; industry utilizing water as a production resource; use of irrigation water; release of fertilizers and other chemicals by infiltration; discharge of animal and/or municipal waste; and river navigation. (Sand-PTT)
W91-02396

WAYS OF EVALUATING HUMAN-INDUCED IMPACTS ON THE FUNCTIONING OF WATERBODY ECOSYSTEMS.
Institute of Ecology of the Volga River Basin, Tolyatti (USSR).
For primary bibliographic entry see Field 4C.
W91-02397

ANNUAL CYCLES OF PLANKTON SPECIES COMPOSITION AND PHYSICAL CHEMICAL CONDITIONS IN SLAPY RESERVOIR DETECTED BY MULTIVARIATE STATISTICS.
South Bohemian Biological Centre, Ceske Budejovice (Czechoslovakia). Biomathematical Lab.
J. Leps, M. Straskraba, B. Desertova, and L. Prochazkova.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 933-945, 1990. 8 fig, 2 tab, 21 ref.

Descriptors: *Limnology, *Phytoplankton, *Population dynamics, *Reservoirs, *Zooplankton, Cluster analysis, Czechoslovakia, Multivariate analysis, Physicochemical properties, Principal component analysis, Seasonal variation, Slapy Reservoir, Species composition.

Data on phytoplankton and zooplankton species composition and abundance as well as physical and chemical conditions from Slapy Reservoir in Czechoslovakia were treated by different methods of multivariate statistics. Three to four consecutive years with rather diversified, extreme hydrological conditions were analyzed. The following methods were used: classification of samples (dissimilarity Euclidian distance; hierarchical clustering: Ward method and average linkage), classification of spe cies and physical-chemical factors (similarity: co relation coefficient; hierarchical clustering: ave age linkage) and ordination (by principal compo nent analysis, correspondence analysis and co strained ordinations: redundancy analysis and c nonical correspondence analysis). The method classification of sequences was used for the fi time for limnological data. Agglomerative classi cation of samples based on standardized data yiel ed five distinct groups: winter samples, late wint to spring samples, mainly summer samples, f summer samples and the winter Closterium aspe Other classifications, although differing, follow t basic seasonal pattern. In the ordination space fined by two principal component axes, three co munity compositional patterns were distinguish for phytoplankton: the September to April patt with low biomass of many species, the May pe characterized by the Cryptomonas aspect and June to August peak with Chlorophyta and bl green algae. The summer peak composition different for the three years observed. In the years with strong stratification blue-green al were highly developed, whereas during the m wet years with reduced stratification a strikin low phytoplankton biomass was observed. (thor's abstract)
W91-02398

RELATIONSHIP OF RESERVOIR BIOG CHEMICAL PROCESSES TO THE STRUCT AL INTEGRITY OF THE WORLD'S FIRST TALLY ROLLER COMPACTED CONCR DAM.
Army Engineer District, Portland, OR. Reser Regulation and Water Quality Section.
For primary bibliographic entry see Field 8F.
W91-02399

GROWTH, PRODUCTION, AND DECOMP TION DYNAMICS OF SPHAGNUM UN NATURAL AND EXPERIMENTALLY AC FIED CONDITIONS.
Alberta Univ., Edmonton. Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-02404

PATTERNS AND CONTROLS OF NITRO IN TALLGRASS PRAIRIE STREAMS.
Kansas State Univ., Manhattan. Div. of Bio
C. M. Tate.
Ecology ECOLAR, Vol. 71, No. 5, p 2007-
October 1990. 6 fig, 3 tab, 55 ref. National Sc Foundation grants BSR-8012166 and 8207214.

Descriptors: *Cycling nutrients, *Kansas, * ing nutrients, *Nitrogen, *Prairies, *St Algae, Nitrates, Phosphates, Riparian vege

A descriptive and experimental approach wa to study patterns of nitrogen concentrati tallgrass prairie streams in Kansas. Nitrate c trations varied depending on the year, seaso of day, stream flow conditions, source of and location where the sample was taken. nitrate concentrations during the dormant decreased from 1982 to 1984, correspond above-normal precipitation during this period. Nitrate concentrations decreased third-order (grass/shrub riparian vegetati fourth-order channels (gallery forests). Nitr ganic N, and total N were higher in a third intermittent stream than in a third-order pe stream. Water from seeps and tributari higher nitrate concentrations than stream however, streams and tributaries had higher ic N than seeps. Maximum nitrate concen during storm flows were directly related magnitude of storms and inversely related frequency of storm events. The activity o trial vegetation influence nitrate concen within streams, seeps, and tributaries; nitr centrations were always higher during pe vegetation dormancy. Aquatic biota inf both spatial patterns (downstream decrea

rate concentrations and increase in organic N) and iel patterns of nitrate concentration (night > ay). Uptake rates of nitrate by biota were greater uring the day than during the night as determined y experimental addition of nitrate. Nitrogen and/ r phosphorus limitations of algal growth were sted experimentally using nutrient-diffusing sub- rata (clay saucers filled with enriched agar) and richment of artificial channels. Addition of N d P in combination increased algal biomass hlorophyll a and ash-free dry mass) over control single addition of N or P. Thus, algal biomass as N and P limited; however, individual taxa sponded to specific N and/or P concentrations atomic N:P ratio. (Author's abstract)
91-02405

REDATION ON AMPHIBIAN EGGS AND DPOLES BY COMMON PREDATORS IN IDIFIED LAKES.
eteborg Univ. (Sweden). Dept. of Zoology.
r primary bibliographic entry see Field 5C.
91-02407

ATIAL ORGANIZATION AND POPULA- ON DENSITY OF THE FISH COMMUNITY THE LITTER BANKS WITHIN A CENTRAL AZONIAN BLACKWATER STREAM.
tral Electricity Generating Board, Fawley gland). Marine Biological Unit.
. Henderson, and I. Walker.
rnal of Fish Biology JFIBA9, Vol. 37, No. 3, p 411, September 1990. 5 fig, 2 tab, 12 ref.

criptors: *Amazon River Basin, *Aquatic habi- *Ecological distribution, *Fish populations, ter, *Population density, *Stream biota, Adap- n, Blackwater streams, Brazil, Evolution, Fish, behavior, Population dynamics, Rain forests, iation.

ral Amazonian blackwater rivers and streams nown to be poor in minerals and until recently held to hold a low animal biomass. The ma-Mirim is an acidic, blackwater, forest Am- an stream which flows through igapo forest enters the Rio Negro close to Manaus, Brazil. commonly held view that these blackwaters an impoverished ichthyofauna is challenged e results of a study of the fish community of eaf litter banks in the lower reaches of the ma-Mirim. The studied litter banks held about ecies of fish, all of which were found to live n distinct subregions of the habitat. Average lensity was about 100 individuals/square m. lute population sizes were found to be re- bly small; within a 200 square m area the abundant species had a population size of 10,000 and the least abundant <100 individ- High species richness linked to specialized t requirements and small population size indi- considerable population stability. Evolution tinually acting on the fish to create spatial specialists since the fitness of an individual is the ability to find and retain a place within bitat. Such specialization is only made possi- cause within the litter a locally generated of food is available. The spatial constraints to the annual cycle of inundation may have the evolution of such a rich ichthyofauna in Amazonia. (Mertz-PTT)
2414

GE LAGOON TO SPLENDID LAKES.
rimary bibliographic entry see Field 5G.
2425

TAL DEFORMITIES IN SMALL- H BASS, MICROPTERUS DOLOMIEUI, SOUTHERN APPALACHIAN RESER-
a Cooperative Fishery and Wildlife Re- Unit, Athens.
mary bibliographic entry see Field 5C.
440

TERM RESPONSE TO EUTROPHICA- BATEMENT.
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5G.
W91-02447

SEASONAL DELIVERY OF THE PARTICULATE FORMS OF PHOSPHORUS TO LAKE GENEVA FROM THE UPPER RHONE RIVER.
Geneva Univ. (Switzerland). Inst. F.-A. Forel.
D. Burrus, R. L. Thomas, J. Dominik, and J. P. Vernet.
Aquatic Sciences AQSCEA, Vol. 52, No. 3, p 221-235, 1990. 5 fig, 3 tab, 15 ref.

Descriptors: *Eutrophication, *Lake Geneva, *Nutrients, *Path of pollutants, *Phosphorus, *Rhone River, *River sediments, *Seasonal variation, *Switzerland, *Water pollution sources, Pollution load, River flow, Sediment discharge, Turbidity.

Large volume water samples were taken at the mouth of the Upper Rhone River as it enters Lake Geneva (Switzerland). Samples were taken every two weeks from January 1982 until August 1983. Water samples were analyzed for total phosphorus, and soluble reactive phosphorus and were centrifuged in the field using a continuous flow centrifuge to recover the suspended solids following sieving at 63 micrometers. The <63 micrometers solids were analyzed for total particulate phosphorus, organic phosphorus, apatite phosphorus and non-apatite inorganic phosphorus. The >63 micrometer particles were similarly analyzed and the weight of total solids in both size fractions recorded. Results were compared throughout the period of record to the hydrograph situated at Porte de Scex. The annual cycle of the Rhone can be divided into a low turbidity, low flow winter period and high flow, high turbidity summer season. Turbidity was well related to discharge. The >63 micrometer sediment was mobilized at 200 cu m/second and thereafter increased in concert with, though at a faster rate than, the <63 micrometer fraction. The coarse fraction contained significant quantities of phosphorus and in 1982 accounted for 26% of the total particulate phosphorus loading. Organic phosphorus and non-apatite inorganic phosphorus were higher in the winter period than in the summer season though apatite phosphorus remained constant throughout the year. Organic phosphorus was believed to be driven primarily from point sources whercas non-apatite inorganic phosphorus, in addition to point sources, had secondary sources in spring and summer due to sheet erosion from the agricultural soils of the valley. Loadings of phosphorus were calculated by four methods which showed internal consistency though they were higher than previous estimates. Bioavailable phosphorus was estimated to account for some 20% of the total phosphorus loading of some 1500 tons, bioavailable phosphorus was taken to be the sum of soluble reactive phosphorus and non-apatitie inorganic phosphorus and was that portion of the phosphorus load believed to be available to generate phytoplankton growth. (Author's abstract)
W91-02448

PHYSICAL, CHEMICAL AND HYDROGRAPHIC INVESTIGATIONS OF AN UPLAND STREAM: A CONTRIBUTION ON THE STANDARDIZATION OF SMALL WATERCOURSES (PHYSIKALISCHE, CHEMISCHE UND HYDROGRAPHISCHE UNTERSUCHUNGEN EINESC MITTELGEBIRGSBACHES: EIN BEITRAG ZUR TYPISIERUNG KLEINER FLIESSGEWASSER).
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2E.
W91-02449

VERTICAL MIXING IN UBERLINGER SEE, WESTERN PART OF LAKE CONSTANCE.
Heidelberg Univ. (Germany, F.R.). Inst. fuer Umweltphysik.
G. Heinz, J. Ilmberger, and M. Schimmele.
Aquatic Sciences AQSCEA, Vol. 52, No. 3, p 256-268, 1990. 6 fig, 3 tab, 25 ref.

Descriptors: *Eddy diffusion, *Germany, *Lake Constance, *Lake morphometry, *Limnology, *Water circulation, *Water temperature, Diffusion coefficient, Fluctuations, Lake circulation, Lakes, Phosphorus, Seasonal variation.

Depth variable vertical eddy diffusion coefficients for heat were calculated from continuously measured temperature profiles in Uberlinger See (western part of Lake Constance, Germany). The temperatures were averaged over vertical intervals of 10 m yielding 14 discrete values (maximum depth of Uberlinger See: 147 m). A linear fit from June 10 to September 29, 1987 was used to smooth the significant temperature fluctuations caused by internal seiches of Lake Constance. Assuming horizontal homogeneity for the smoother data, the Gradient-Flux-Method was applied to compute vertical diffusion coefficients for heat at different depths using the depth variable volumes and surfaces of the 14 layers. The resulting mean diffusion coefficients for the period from June to September were 0.04 sq cm/sec near the thermocline and up to 0.8 sq cm/sec in deeper strata (accuracy: +/- 50%). It was shown that horizontal mixing between Uberlinger See and Obersee (main lake) altered the computation of vertical diffusion coefficient by less than 50%. A relationship between vertical diffusion coefficients and stability frequency was found that corresponded well to the theory of internal wave induced turbulence. Combining the diffusion coefficients with measured phosphorus profiles, a phosphorus flux from the hypolimnion to the epilimnion of mg P/sq m/day was calculated, corresponding to about 20% of the average external loading per area of Lake Constance in 1986. (Author's abstract)
W91-02450

PLANKTONEUSTONIC ALGAE IN THE SURFACE FILMS OF LAKE ZURICH: OCCURRENCE AND DEPENDENCE ON PHYTOPLANKTON SUCCESSION.
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
A. Nageli, and F. Schanz.
Aquatic Sciences AQSCEA, Vol. 52, No. 3, p 269-286, 1990. 6 fig, 1 tab, 48 ref.

Descriptors: *Lake Zurich, *Limnology, *Phytoplankton, *Succession, *Switzerland, *Taxonomy, Algae, Aquatic populations, Lakes, Neuston, Population density, Species composition.

Samples of surface films and of the underlying bulk water at 0.2 m depth were taken in Lake Zurich (Switzerland) on 48 occasions in 1986, 1988 and 1989, with the aim of assessing the appropriateness of applying existing neuston nomenclature to the organisms found in these films, of determining which organisms accumulate there during which periods of time, and of assessing the importance of the phytoplankton community in the development of neustonic biocoenoses. Lake Zurich surface films were found to support a community of high population density, consisting of organisms which had migrated from the benthal or pelagial, or which had entered the film via the atmosphere or inflowing rivers. In all samples, species originating from within the phytoplankton community accounted for the greatest proportion of the total abundance. Several of these species were found to exhibit a special preference for the surface biotope, for example, those with a relative frequency exceeding 10%, a mean enrichment factor exceeding 100, and in the majority of cases, with a greater concentration of individuals in the surface film than in the underlying bulk water layer. Those organisms occurring in the surface films of large water bodies exhibiting these criteria should be considered planktoneustron, whereas the occurrence of other species in surface films should be considered merely coincidental. The fact that planktoneustonic algae are dominant in the surface films of Lake Zurich means that changes in the species composition of the planktonic algal biocoenosis directly affect the species composition of the neustonic algal biocoenosis. Thus, just as in the underlying bulk water, a succession can be observed in the algal biocoenosis of the surface films. However, because of the higher abundance of

planktoneustonic algae there, this succession is distinct from that occurring in the pelagial. Factors bringing about these differences which are appropriate for dominant planktoneustonic algae are: alterations in specific gravity; positive phototaxis; and enhancement of growth rates in surface films as compared with the underlying bulk water. (Mertz-PTT)
W91-02451

EXPERIMENTAL COMPARISON OF THE EFFECTS OF BENTHIVOROUS FISH AND PLANKTIVOROUS FISH ON PLANKTON COMMUNITY STRUCTURE.
Oklahoma Univ., Norman. Dept. of Zoology.
J. Qin, and S. T. Threlkeld.
Archiv fuer Hydrobiologie AHYBA4, Vol. 119, No. 2, p 121-141, 1990. 6 fig, 5 tab, 26 ref. NSF grant DEB 8506112.

Descriptors: *Experimental design, *Fish behavior, *Fish diets, *Fish populations, *Lake fisheries, *Limnology, Algal growth, Benthos, Carp, Ecological effects, Fish, Lake sediments, Lakes, Oklahoma, Phytoplankton, Plankton, Population dynamics, Silverside.

Three experiments of factorial design were conducted to evaluate how benthivorous fish, carp (Cyprinus carpio) and planktivorous fish, silverside (Menidia beryllina) alter plankton community structure. Experiment 1 involved two benthivorous fish treatments (Cyprinus and no fish), three treatments affecting resuspension of sediments (mixing by paddle, use of screens to limit fish access to sediments, and no mixing), and two sediment treatments (present and absent) in water from two lakes (Lakes Broken Bow and Texoma, Oklahoma) in a cross-classified experimental design. Experiment 2 included either addition or no addition of planktivorous fish (Menidia), nitrogen or phosphorus in a cross-classified design. Experiment 3 examined the combined effects of planktivorous fish and benthivorous fish on plankton. Treatments included presence or absence of Cyprinus, Menidia and sediment and nutrient treatments using presence or absence of dead fish, in a cross-classified experimental design. In Experiments 1 and 3, benthivorous fish enhanced algal fluorescence, seston particles and algal filament abundance. The enhancement of phytoplankton by benthivorous fish occurred whether or not sediment was present and, when sediment was present, whether or not fish had access to the sediment. These results suggest that benthivorous fish do not affect phytoplankton solely by releasing sediment-bound nutrients. Planktivorous fish enhanced phytoplankton and suppressed large herbivorous zooplankton in experiment 2, but in experiment 3, planktivorous fish did not enhance phytoplankton although crustacean zooplankton were suppressed. The lack of effect of planktivorous fish on phytoplankton was not altered by the addition of nutrients. In experiment 3, neither benthivorous nor zooplanktivorous fish affected how the other fish affected phytoplankton when they were stocked alone. (Mertz-PTT)
W91-02452

FOODWEB RESPONSE TO THE EXPERIMENTAL MANIPULATION OF A BENTHIVORE (CYPRINUS CARPIO), ZOOPLANKTIVORE (MENIDIA BERYLLINA) AND BENTHIC INSECTS.
Oklahoma Univ., Kingston. Biological Station.
W. B. Richardson, S. A. Wickham, and S. T. Threlkeld.
Archiv fuer Hydrobiologie AHYBA4, Vol. 119, No. 2, p 143-165, 1990. 5 fig, 3 tab, 83 ref. NSF grant BSR 8805681 and DOE contract DE-AC-09-76SR00819.

Descriptors: *Algal growth, *Aquatic insects, *Benthos, *Carp, *Food chains, *Limnology, *Population dynamics, *Zooplankton, Aquatic production, Benthic fauna, Biomass, Ecological effects, Fish behavior, Fish diets, Protozoa, Rotifers, Secondary productivity.

Key components of benthic and water column foodwebs were manipulated in 18 large outdoor tanks to test the hypothesis that these foodwebs are strongly coupled. Using a replicated, cross-classified design the presence and absence of (1) a benthivore (common carp: Cyprinus carpio), (2) particulate feeding zooplanktivore silversideL: (Menidia beryllina), and (3) insect benthos were controlled. Fish were the primary determinants of foodweb structure. Both fish strongly enhanced algal biomass (in situ algal fluorescence), but only Cyprinus enhanced algal production. Both fish suppressed large zooplankton, while Menidia also suppressed small individuals. Rotifers and protozoa were enhanced in the presence of both fish. This suggests phytoplankton were responding primarily to fish biomass, not suppression of algal grazers. Cyprinus enhanced bacterial secondary production, while bacterial biomass was enhanced by Cyprinus only in the presence of Menidia. Only Cyprinus significantly suppressed densities of benthic invertebrates. Benthic insects had few direct effects on the water column foodweb. Large numbers of significant 2-way interactions suggest that treatment effects were rarely additive. This result precluded predictions of the effects of combinations of the two fish species based on single species experiments. There was little indication of strong coupling between benthic and water column foodwebs. Only through the feeding activity of Cyprinus were benthic resources translated into water column biomass. (Author's abstract)
W91-02453

FIELD STUDY OF THE EFFECTS OF WATER TEMPERATURE, DISCHARGE AND TROUT ODOUR ON THE DRIFT OF STREAM INVERTEBRATES.
Toronto Univ. (Ontario). Div. of Life Sciences.
D. D. Williams.
Archiv fuer Hydrobiologie AHYBA4, Vol. 119, No. 2, p 167-181, 1990. 2 fig, 5 tab, 33 ref.

Descriptors: *Fish behavior, *Invertebrates, *Stream biota, *Stream discharge, *Temperature effects, *Water temperature, Amphipods, Beetles, Caddisflies, Chironomids, Copepods, Dipterans, Ecological effects, Fish, Mayflies, Oligochaetes, Ostracods, Stoneflies, Streams.

A manipulative field study was conducted on a uniform riffle on the east branch of Duffin Creek, Durham County, Ontario, Canada, in September, 1981 to examine the effects of three important environmental factors on a variety of drifting invertebrate taxa. Factors chosen included water temperature, discharge, and presence of predatory fishes. Day/night differences and catch-net variation were also examined. Drift response varied according to the scale of changes in water temperature and discharge and also among taxa in the hardwater stream. During the period of wide-ranging discharge and water temperature, overall night-time drift density was positively related to both discharge and minimum temperature, whereas during more constant conditions it was related to discharge alone. Analysis of catches of individual replicated drift nets showed considerable variance. No taxon showed a significant relationship with temperature or discharge during the day but some did at night. Chironomids and mayflies were associated with minimum night-time temperature only, while caddisflies, beetles and ostracods were associated with discharge; stoneflies and mites were associated with both factors; amphipods, oligochaetes, copepods and non-chironomid dipterans were not associated with either factor. During the day, the overall density of drifting animals was greater in the presence of trout odor although density of some taxa was the same in both fish and fishless sections of the stream. At night, only three taxa drifted significantly more in the presence of trout. Mayflies, stoneflies and caddisflies drifting at night were larger in the presence of trout but amphipods were smaller. (Mertz-PTT)
W91-02454

EFFECT OF WATER QUALITY ON BACTERIOPLANKTON DENSITIES IN RIVER, BROOK AND PEAT MINING WATER IN THE BASIN OF THE HUMIC RIVER KIIMINKIJOKI, NORTHERN FINLAND.
Water and Environment District of Oulu (Finland).
For primary bibliographic entry see Field 5C.
W91-02455

EFFECT OF URANIUM MINE TAILINGS ON RADIONUCLIDE CONCENTRATIONS IN LANGLEY BAY, SASKATCHEWAN, CANADA
Environmental Protection Service, Regina (Saskatchewan).
For primary bibliographic entry see Field 5B.
W91-02460

POLYCHLORINATED BIPHENYL CONGENERS IN SEDIMENTS, PLANKTON, MOLUSCS, CRUSTACEANS, AND EEL IN A FRESHWATER LAKE: IMPLICATIONS OF USING REFERENCE CHEMICALS AND INDICATOR ORGANISMS IN BIOACCUMULATION STUDIES.
Amsterdam City Environmental Health Research Lab. (Netherlands).
For primary bibliographic entry see Field 5B.
W91-02465

IDENTIFICATION AND INVENTORY OF PHILIPPINE FORESTED-WETLAND RESOURCE.
Philippines Dept. of Environment and Natural Resources, College. Coastal Zone and Freshwater Ecosystems Research Div.
S. R. Baconguis, D. M. Cabahug, and S. N. Alonzo-Pasicolan.
Forest Ecology and Management FECMDW, V 33/3, No. 1/4, p 21-44, June 1990. 4 tab, 56 r

Descriptors: *Aquaculture, *Ecological effe *Forest ecosystems, *Forest management, *For ry, *Land management, *Literature review, *M grove swamps, *Philippines, *Wetlands, Classifi tion, Forest watersheds, Silviculture, Water source management, Wetland forests.

The Philippine Archipelago, which compr more than 7100 islands, has an approximate are 1,083,000 ha of wetlands. Although the wetl types have been classified as mangroves, swam estuaries and deltas, freshwater marsh, aquacult ponds, rivers, lakes, and man-made resevoirs, coastal region is predominantly a mangrove system. In 1918, the mangrove forest was appr mately 400,000 ha; by 1978, the area was redu to 146,140 ha, with only 100,564 ha remainin 1987. This rapid loss has been caused mainly timber extraction and aquaculture developm Currently, about 95% of the aquaculture indus supporting about 2,000,000 people, is done ponds which were once mangroves, causing loss of another 3500 ha every year. In an atte to rectify this alarming situation, both governm and private agencies have conducted extensiv ventories to determine the exact area of remai mangroves. The rehabilitation of those areas w were destroyed as a result of repeated overuse previous mismanagement is the specific focu future government policies. (D'Agostino-PTT) W91-02473

MANGROVE FOREST RESOURCES IN IN NESIA.
Louisiana State Univ., Baton Rouge. Scho Forestry, Wildlife and Fisheries.
E. T. Choong, R. S. Wirakusumah, and S. S. Achmadi.
Forest Ecology and Management FECMDW 33/3, No. 1/4, p 45-57, June 1990. 2 fig, 1 t ref.

Descriptors: *Ecological effects, *Forest ma ment, *Forestry, *Indonesia, *Mangrove sw *Wetland forests, *Wetlands, Agriculture, culture, Regulations, Resources managemen viculture.

Mangroves are highly specialized and co ecosystems which form a transitional link be terrestrial and aquatic biota. In Indonesia, groves occupy approximately 4.25 million h resenting almost 20% of the world's mar

forests. Of this, 2.94 million ha are stretched along the coast line of Irian Jaya and are still relatively virgin and unexploited. However, the remaining 1.31 million ha are located in the more populated areas, such as Java, Sumatra, and Kalimantan, where these habitats have been extensively exploited. The primary human disturbances include residential settlement, agricultural land use, aquaculture development, and the for-profit activities of forestry and fisheries. Limiting the exploitation of the mangroves based on conservation principles has been attempted. Some forest companies have used a management scheme which divides the mangrove forest into sub-blocks of 120 ha, and permits only 4 ha/yr to be cut from each sub-block to insure a 30-year rotation. The government, through the Ministry of Fisheries and the Ministry of Forestry, has adopted a general policy for the protection, conservation, and wise use of the mangrove resources. It imposes limitations on cutting and preservation of mangrove forests. A 'green belt' 100-400 m wide must be retained along the coast in order to preserve the ecosystem and to insure natural regeneration. A number of mangrove reserves in coastal areas and natural conservation areas have been established. Other government agencies and research institutions are studying the ecosystem in an effort to preserve the mangroves for perpetual human use. (D'Agostino-PTT)
W91-02474

MANGROVES IN KAMPUCHEA.
Humboldt State Univ., Arcata, CA. Dept. of Forest Economics.
M. S. Sin.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 59-62, June 1990. 4 ref.

Descriptors: *Forest management, *Forestry, *Kampuchea, *Land use, *Mangrove swamps, *Wetland forests, Agriculture, Aquaculture, Resource management, Water resources management.

The total area of mangroves in Kampuchea is estimated at 37,000 ha. However, the forest area of primary importance is located north of Koh Kong within a rectangular area of only 8 x 20 km. This is a multi-use resource, consisting mainly of Rhizophora conjugata, R. mucronata, Avecennia, Bruguiera, and Ceriops. Large quantities of mangrove are used in the production of firewood and charcoal, tannin, and nipa for domestic use. Little is known about how much the mangrove forest affects the production of fish. However, the practice of active aquaculture is insignificant at present. In some areas where mangrove forests have been reclaimed for agricultural use, coconut, pineapple, rice, and black pepper have been planted. Although there is no apparent population pressure on the mangrove forest, some areas have already been reduced to low shrubs of no value. It is suggested that future development of well-formulated management plans will ensure both optimal use of land already cleared, as well as reforestation of areas where declines have occurred. (D'Agostino-PTT)
W91-02475

INVENTORY AND MONITORING OF FORESTED-WETLAND RESOURCES OF ASEAN.
Pertanian Malaysia Univ., Serdang. Faculty of Forestry.
A. Jusoff, and N. M. Majid.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 63-79, June 1990. 2 fig. 2 tab. 24 ref.

Descriptors: *Forest management, *Land management, *Network design, *Resources management, Surveys, *Wetland forests, *Wetlands, Brunei, Data acquisition, Ecological effects, Estuaries, Forest ecosystems, Indonesia, Malaysia, Monitoring, Philippines, Singapore, Thailand, Water quality, Water resources management, Wetland restoration.

Forested wetlands are highly productive ecosystems which not only provide valuable forest products, but also contribute to estuarine water quality, and play a crucial role in the life-cycles of commercially important aquatic species. In this regard, there is an urgent need for the proper classification, management, and utilization of these lands to maximize their productivity in response to the growing demands of the increasing population in the ASEAN region (Brunei, Indonesia, Malaysia, The Philippines, Singapore, and Thailand). The authors suggest that an initial step toward this goal is an extensive inventory of the forested-wetland resources, organized and reported from a regional perspective. Furthermore, the causes of degradation of forested areas should also be identified and monitored. It is also proposed that a network should be established to create and maintain a multi-level information structure for the monitoring of ASEAN forested-wetland resources for information exchange and future planning. Careful inventory and monitoring of these resources will, it is hoped, provide reliable and relevant information for a future long-term management of the wetland forests in the ASEAN region. (D'Agostino-PTT)
W91-02476

STATUS AND DISTRIBUTION OF FORESTED WETLANDS IN TROPICAL SOUTH AMERICA.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
H. Klinge, W. J. Junk, and C. J. Revilla.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 81-101, June 1990. 1 fig, 5 tab, 130 ref.

Descriptors: *Ecological effects, *Forest ecosystems, *Forest management, *Forest watersheds, *Land use, *Soil-water-plant relationships, *South America, *Wetland forests, *Wetlands, Brazil, Forestry, Agriculture, Guyana, Hydroelectric plants, Paraguay, Reforestation, Tropical regions, Wetland restoration.

Physiographically, tropical South America is characterized primarily by large watersheds (Amazon, Orinoco, Magdalena, Parana-Paraguay, Sao Francisco), a very long coastland, and uplands (Andean Cordillera, the highlands of Guayana, and central Brazil). Poor drainage, sheet-flooding, fluctuating water levels, and flood pulses contribute to the maintenance of wetlands, mostly forested, which cover approximately 20% of this region's total area. This literature review data discusses which classifies these tropical forests into four types: tidal, seasonal, aseasonal, and permanent. Their geographical delineation, extent, floristics, and structure are also documented. As observed in other wetland areas, agriculture, animal husbandry, and timber production, as well as hydroelectric power projects, exploit these sites and are the main causes of their destruction. It is concluded that future studies addressing mapping, ecological interplay, seedling establishment, and forest regeneration should be carried out to obtain a more complete knowledge of the composition of these wetlands. (D'Agostino-PTT)
W91-02477

VENEZUELAN FLOODPLAIN STUDY ON THE ORINOCO RIVER.
Fundacion La Salle de Ciencias Naturales, San Felix (Venezuela). Estacion Hidrobiologica de Guayana.
G. Colonnello.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 103-124, June 1990. 12 fig, 2 tab, 25 ref. CONICIT (The National Council of Scientific and Technological Investigations) Grant S1-1920.

Descriptors: *Flood plain forests, *Flood plains, *Forest ecosystems, *Orinoco River, *Soil-water-plant relationships, *Venezuela, *Wetland forests, Ecology, Ecosystems, Geomorphology, Species diversity, Topography, Vegetation.

To date, most studies concerning floodplain ecology have been conducted in the Amazon basin. Information about the Orinoco flood plain in Venezuela is currently lacking. With the use of transact surveys, aerial photographs, and horizontal profile elaboration, the floodplain origins, principal geomorphological formations and floristic composition of Laguna de Mamo in eastern Venezuela can be described. The forest has been physiognomically characterized by three strata: species typical of the lower stratum (Simira rubescens and Caesaria), of the intermediate stratum (Symmeria paniculata and Pterocarpus), and of the upper strata (Piranhea trifoliata and Lonchocarpus). Ten species of climbing vines and 34 tree species have been recorded on a 0.2-ha sample plot. The observed difference in floristic diversity between the depression areas and levees was attributed to differences in inundation and soil types. Together, the topographical and geomorphological make-up of this area will continue to maintain the present physico-biotic characteristics of the existing floodplain complex. (D'Agostino-PTT)
W91-02478

WETLAND AND UPLAND FOREST ECOSYSTEMS IN PERUVIAN AMAZONIA: PLANT SPECIES DIVERSITY IN THE LIGHT OF SOME GEOLOGICAL AND BOTANICAL EVIDENCE.
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lima (Peru). Mission ORSTOM au Perou.
J. F. Dumont, S. Lamotte, and F. Kahn.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 125-139, June 1990. 4 fig, 85 ref. Supported by ORSTOM/IGP PICG Project 279: Terranes in LatinoAmerica.

Descriptors: *Amazon River Basin, *Forest ecosystems, *Soil-water-plant relationships, *Species diversity, *Wetland forests, *Wetlands, Ecosystems, Flood plains, Flooding, Surveys, Tectonics, Vegetation.

Western Amazonia is a mosaic of fossil and current floodplains produced by vast lateral river migrations. Forest ecosystems of the Amazon basin are known to reach very high diversity. Floristic inventories show that species richness is clearly higher in upland than in wetland forests. The analysis of differential faulting and folding tectonic effects on the two western Amazonian morphostructural units clearly indicates that area affected by fluvial dynamics are rather limited within well-defined depressions, the tendency of which is subsidence or entrenchment. Most upland forests have not been affected by fluvial dynamics since the Pleistocene: plant species diversity is highest in these 'terra firme' forests which cover vast areas. While it is argued that the reduced diversity in the wetlands could be due to flooding consequences, it is mainly concluded that the richness of species in the upland forests is the result of their constant favorable ecological conditions. (D'Agostino-PTT)
W91-02479

GEOGRAPHICAL ASPECTS OF FORESTED WETLANDS IN THE LOWER UCAYALI, PERUVIAN AMAZONIA.
Instituto de Investigaciones de la Amazonia Peruana, Iquitos.
J. L. Parodi, and D. Freitas.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 157-168, June 1990. 1 fig, 2 tab, 21 ref.

Descriptors: *Flooding, *Forest ecosystems, *Land use, *Resources management, *Ucayali River, *Vegetation, *Wetland forests, *Wetlands, Agriculture, Forest management, Forestry, Land management, Peru.

In Peruvian Amazonia, eleven types of vegetation have been determined in a 2200 square km area of the lower Ucayali River. Of these, ten are forests and one is a floating meadow. Forest ecosystems cover 2133 square km (97%), of which 1335 square km (61%) are wetlands with six forest types, two under the influence of local rainfall and the other four related to the river's flooding pattern. Furthermore, a consistent correlation was observed between flooding patterns, physiographic characteristics and types of vegetation. Although most of the economic activities of the area's fifteen villages are carried out in forested wetlands, little attention has focused on their structure, composition, or fluvial dynamic patterns. Consequently, no regula-

tions which address optimal multi-land use practices, including agriculture, cattle-raising, wood extraction, agroforestry, fishing, and hunting, have been developed. It is concluded that future studies involving floristics, regeneration, reproductive biology, and water dynamics are necessary to construct a sound management policy for these wetland resources. (D'Agostino-PTT)
W91-02481

PALM COMMUNITIES IN WETLAND FOREST ECOSYSTEMS OF PERUVIAN AMAZONIA.
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lima (Peru). Mission ORSTOM au Perou.
F. Kahn, and K. Mejia.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 169-179, June 1990. 6 tab, 21 ref.

Descriptors: *Flooding, *Forest ecosystems, *Palm trees, *Peru, *Soil-water-plant relationships, *Wetland forests, *Wetlands, Distribution patterns, Ecosystems, Huallaya River Basin, Population density, Species diversity, Ucayali River Basin.

Palms are found in all wetland forests throughout the Amazon basin, with their species distribution being clearly related to flooding patterns and water properties. In this study, surveys of palm communities were carried out in the lower Ucayali and upper Huallaya River valleys, located in the lowland and Andean piedmont regions of Peruvian Amazonia. These ecosystems were characterized by species association, density, and vertical distribution of their palm communities. Palms may form almost monospecific stands (e.g. Mauritia flexuosa swamps) or multispecific communities (e.g. seasonal swamp forests in the upland valleys or the periodically flooded alluvial soils). In forests flooded by blackwater streams, palm diversity is low. However, palm density is often high with a characterstic patchy distribution pattern due to clustered species. Together these data delineate the distinct characteristics of each palm community, information which is potentially useful for a more complete definition and identification of the wetland forests in Peruvian Amazonia. (D'Agostino-PTT)
W91-02482

STATUS AND TRENDS OF U.S. WETLANDS AND DEEPWATER HABITATS.
National Wetlands Inventory, Washington, DC.
For primary bibliographic entry see Field 4C.
W91-02483

FORESTED-WETLAND TRENDS IN THE UNITED STATES: AN ECONOMIC PERSPECTIVE.
Southern Forest Experiment Station, New Orleans, LA.
C. A. Hickman.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 227-238, June 1990. 2 fig, 22 ref.

Descriptors: *Forest ecosystems, *Land management, *Management planning, *Resources management, *Wetland forests, *Wetlands, Land use, Policy making, Resources development.

Forested wetlands are an invaluable ecological resource which provide wildlife habitats, outdoor recreation, and forestry products, and affect both flood control and water quality. Despite such benefits, wetland areas in the United States have decreased dramatically, with some striking regional losses as high as 40-80%. To a large extent, this is the result of past policies, mainly at the federal level, based on economic decisions which favored wetlands development. Historically, however, both public and private agencies have differed in their assessment of the cost to benefit ratio regarding the preservation of such lands versus converting them to other uses. Projected trends, such as decreased availability of wetland areas suitable for agriculture, current protective federal policies, changes in the legal system, and improved evaluation techniques, will ensure more intelligent management decisions and reduced wetland losses in the future. (D'Agostino-PTT)
W91-02486

CAT ISLAND SWAMP: WINDOW TO A FADING LOUISIANA ECOLOGY.
Southern Forest Experiment Station, New Orleans, LA.
For primary bibliographic entry see Field 4C.
W91-02490

SOUTHWESTERN RIPARIAN PLANT COMMUNITIES: SITE CHARACTERISTICS, TREE SPECIES DISTRIBUTIONS, AND SIZE-CLASS STRUCTURES.
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
R. C. Szaro.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 315-334, June 1990. 4 fig, 3 tab, 51 ref.

Descriptors: *Arizona, *Distribution patterns, *Flood plains, *Forests, *Geomorphology, *New Mexico, *Riparian vegetation, *Species composition, *Wetland forests, Statistical analysis, Streamflow, Trees.

Although fluvial geomorphic processes determine the characteristics of a stream channel and its adjacent floodplain terraces, their relationships to riparian vegetation patterns are not completely understood. The effects of elevation, stream direction, stream gradient, and valley cross-sectional area on the distribution of riparian tree species and community types were examined at 153 sites in Arizona and New Mexico. Canonical discriminant analysis of physical site characteristics both within and among the 28 classified communities demonstrated that elevation was the most significant factor for all community types, all riparian forest community types, and all riparian scrub community types. Both stream gradient and stream direction also correlated significantly, but on a more limited and local level. Valley cross-sectional area had the least association with riparian vegetation of the four variables examined. Tree distribution studies showed that for some species, dominance or codominance was also directly related to site characteristics such as elevation and direction of stream flow. On west-flowing streams, for example, Arizona walnut (Juglans major) was codominant with Arizona sycamore (Platanus wrightii), while on east-flowing streams, sycamore was absent while the walnut species dominated the stands. The conclusion that distinctive geomorphic settings and riparian plant communities characteristically coexist along an elevational gradient agrees with similar findings in eastern Nevada. (D'Agostino-PTT)
W91-02491

SAMPLING INTENSITY AND SPECIES RICHNESS: EFFECTS ON DELINEATING SOUTHWESTERN RIPARIAN PLANT COMMUNITIES.
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
R. C. Szaro, and R. M. King.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 335-349, June 1990. 9 fig, 1 tab, 19 ref.

Descriptors: *Data acquisition, *Land management, *Land use, *Network design, *Population density, *Riparian vegetation, *Sampling, *Species composition, *Wetland forests, Classification, Comparison studies, Streams, Trees.

The classification of plant communities is a particularly useful tool for the comparison of similar ecological areas in the development of land management plans. Although numerous protocols are currently available, it is of prime importance to determine the minimal number of observations necessary to adaquately delineate an individual plant population. In addition, riparian communities in the southwestern United States often occur in patches and isolated pockets along stream corridors, making classifications of community types highly dependent on sampling design and methodology. In this study, the relationship between sampling intensity and species richness was investigated at five sites in south-central Arizona, with dif
fering species richness. The findings consistentl
showed that species ranks, tree density, and basa
area estimates required a minimum of 10 observa
tions to stabilize the standard error. Using boot
strap subsampling techniques, it was determine
that the variability in species density ranks for th
most frequent species, stabilized with approximate
ly 10-20 plots. As species richness increased, so di
the variability associated with estimating rank
Studies based on only a few specifically selecte
sample plots may not produce reliable and repea
able results. (D'Agostino-PTT)
W91-02492

**POSSIBLE EFFECTS OF RESIDENTIAL DE
VELOPMENT ON STREAMFLOW, RIPARIA
PLANT COMMUNITIES, AND FISHERIES O
SMALL MOUNTAIN STREAMS IN CENTRA
ARIZONA.**
Rocky Mountain Forest and Range Experime
Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 4C.
W91-02493

**UTILITY OF STREAM HABITAT AND BIOT
FOR IDENTIFYING POTENTIAL CONFLIC
ING FOREST LAND USES: MONTANE RIPA
IAN AREAS.**
Rocky Mountain Forest and Range Experime
Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 4C.
W91-02494

**POTENTIAL FOR ENHANCING RIPARIA
HABITATS IN THE SOUTHWESTE
UNITED STATES WITH WATERSHED PRA
TICES.**
Rocky Mountain Forest and Range Experim
Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 4A.
W91-02495

**USE OF GEOMORPHOLOGY IN THE CLAS
FICATION OF RIPARIAN PLANT ASSOC
TIONS IN MOUNTAINOUS LANDSCAPES
CENTRAL OREGON, U.S.A.**
Silviculture Lab., Bend, OR.
B. L. Kovalchik, and L. A. Chitwood.
Forest Ecology and Management FECMDW, V
33/3, No. 1/4, p 405-418, June 1990. 7 fig, 1 tab
ref.

Descriptors: *Classification, *Forest ecosyste
*Geomorphology, *Oregon, *Riparian vegetat
*Riparian waters, Ecosystems, Land use, Moun
streams, Resources management, Streams.

Due to the unique position of riparian zones
tween aquatic and terrestrial ecosystems, resou
managers have become increasingly interested
their importance, classification, and managem
Understanding of riparian zone ecology, howe
is complicated by the extreme variation in its g
ogy, climate, terrain, and hydrology, as wel
continued human disturbance. As a result, an a
rate determination of the vegetation potentia
riparian sites in an effort to develop managem
options is difficult. A classification system has
cently been developed in central Oregon wh
uses geomorphology to supplement traditional
ristic classification, to circumvent this prob
The four level system includes physiographic a
watershed, riparian landform, and fluvial surf
riparian plant association. It is particularly us
on sites where the natural vegetation composi
soils, or water regimes have been altered by n
ral or human-induced disturbance. It is sugge
that this scheme is not limited to riparian classi
tions, but may also be applicable to stream cla
cation, classification of landforms and plant a
ciations in upland ecosystems, and model deve
ments for water regimes. (D'Agostino-PTT)
W91-02496

**STREAMSIDE MANAGEMENT UNITS IN T
PACIFIC NORTHWEST.**

Forest Service, Portland, OR. Pacific Northwest Region.
For primary bibliographic entry see Field 6B.
W91-02497

WOODY PLANT SUCCESSION ON EARTHQUAKE-UPLIFTED COASTAL WETLANDS OF THE COPPER RIVER DELTA, ALASKA.
Pacific Northwest Forest and Range Experiment Station, Juneau, AK. Forestry Sciences Lab.
J. F. Thilenius.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 439-462, June 1990. 1 fig, 1 tab, 27 ref.

Descriptors: *Alaska, *Copper River, *Deltas, *Earthquake flood, *Forest ecosystems, *Plant populations, *Tidal floods, *Wetland forests, *Wetlands, Coastal environment, Earthquakes, Estuaries, Levees, Salinity, Suspended sediments, Tectonics, Vegetation.

The delta formed by the Copper River stretches for more than 75 km along the south central coastline of the Gulf of Alaska. All major rivers that flow into the delta carry extremely high levels of suspended sediments. Due to an earthquake in 1964, subtidal and intertidal areas became interchanged, and marshland advanced into the intertidal zone. Concurrently, vegetation on many new levees began to change from herbland to shrubland, most probably due to changes in tidal inundation and water salinity. Since the estuarine circulation is dominated by freshwater, higher tides merely raised the level of freshwater on the wetlands. The initial post-earthquake invasion of woody plants was confined to natural levees. However, recently the shrubs have moved seaweed into new inter-tidal marshland. Furthermore, shrubland, woodland, and forest vegetation analogous to that developing on some supertidal levees is now present on older wetland habitats further inland. Although the uplift has altered locations and growth rates of the various plant species, the characterisitic nature of wetland plant succession has not been changed. (D'Agostino-PTT)
W91-02498

GROWTH AND DEVELOPMENT OF BALD-CYPRESS/WATER-TUPELO STANDS UNDER CONTINUOUS VERSUS SEASONAL FLOODING.
Louisiana State Univ., Baton Rouge. School of Forestry, Wildlife and Fisheries.
For primary bibliographic entry see Field 2E.
W91-02499

COMPARATIVE STUDY OF THE RESPONSE OF TAXODIUM DISTICHUM AND NYSSA AQUATICA SEEDLINGS TO SOIL ANAEROBIOSIS AND SALINITY.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 2E.
W91-02500

LONG-TERM TRENDS IN THE BALD-CYPRESS (TAXODIUM DISTICHUM) RESOURCE IN LOUISIANA (U.S.A).
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
V. H. Conner, and J. R. Toliver.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 543-557, June 1990. 4 fig, 2 tab, 74 ref. Louisiana Sea Grant Program and McIntire-Stennis Project LABO1591.

Descriptors: *Baldcypress trees, *Ecological effects, *Forest ecosystems, *Forestry, *Louisiana, Swamps, *Wetland forests, *Wetlands, Hydrology, Long-term planning, Nutria, Plant populations, Reforestation.

The baldcypress has long been a dominant timber species in Louisiana's wetland forests. Early settlers recognized the value of this species, and due to its durability and workability it remained a valuable commodity of the lumber industry from the 18th through the early 20th centuries. Early estimates of the area of baldcypress forests range from 0.67 to 3.64 million ha. Baldcypress timber was cut extensively from 1890 to 1925 when the last virgin stands of timber in the state were depleted. In 1934, there were 0.66 million ha of cutover baldcypress forests in Louisiana. However, recent estimates indicate that there are only 0.14 million ha of baldcypress swamp forest remaining in the state. Regeneration problems have increased in recent years due to human changes in hydrology and natural subsidence, and the introduction of the rodent, nutria, from South America. Furthermore, even though the growing stock in the state continues to increase, larger trees are being harvested and regeneration is insufficient to restock these stands, resulting in declining total acreage. Methods to plant and protect seedlings and to stem alteration of the area's natural hydrologic processes must be developed to ensure the survival of these wetland forests for the future. (D'Agostino-PTT)
W91-02501

INVENTORY TECHNOLOGY: 'EBB TIDES', 'FLASH FLOODS', AND 'WHIRLPOOLS'.
Forest Service, Washington, DC. Timber Management Staff.
For primary bibliographic entry see Field 7A.
W91-02502

PC-BASED ANALYTICAL STEREOPLOTTER FOR WETLAND INVENTORIES: AN EFFICIENT AND ECONOMICAL PHOTOGRAMMETRIC INSTRUMENT FOR FIELD OFFICES.
Norges Landbrukshoegskole, Aas. Inst. for Georesources and Pollution Research.
For primary bibliographic entry see Field 7B.
W91-02503

CLASSIFICATION OF MANGROVE FOREST BY USING 1:40,000-SCALE AERIAL PHOTOGRAPHS.
Pertanian Malaysia Univ., Serdang. Faculty of Forestry.
S. Ibrahim, and I. Hashim.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 583-592, June 1990. 7 tab, 12 ref.

Descriptors: *Aerial photography, *Classification, *Mangrove swamps, *Mapping, *Species composition, *Surveys, *Wetland forests, *Wetlands, Data acquisition, Forests, Remote sensing, Vegetation, Watershed management.

The species groups of mangrove forest can be delineated, classified, and mapped by using 1:40,000-scale aerial photographs. A peninsular Malayan mangrove forest (from Kemaman to Kuantan) was delineated in two phases: interpretation of black-and-white panchromatic photographs, and field survey. The results indicate that there are three mangrove forest types, namely the Rhizophora, the Avicennia-Sonneratia, and the mixed-mangrove type which can be delineated with 90% correct interpretation. In an area of 2214 ha, of which 2% is Avicennia-Sonneratia, 24% Rhizophora and 74% mixed-mangrove, Avicennia-Sonneratia has the highest stand density with 13,348 trees ha -1, followed by Rhizophora with 6697 and mixed-mangrove forest with 1997. It is concluded that aerial photography is a useful method for the delineation, classification, and mapping of mangrove forests. (D'Agostino-PTT)
W91-02504

USE OF HIGH-ALTITUDE AERIAL PHOTOGRAPHY FOR INVENTORYING FORESTED WETLANDS IN THE UNITED STATES.
Fish and Wildlife Service, Newton Corner, MA.
R. W. Tiner.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 593-604, June 1990. 2 tab, 10 ref.

Descriptors: *Aerial photography, *Mapping, *Wetland forests, *Wetlands, Classification, Data interpretation, Forests, Infrared imagery, Maps, National wetlands, Surveys, Watershed management.

Currently, the National Wetlands Inventory Project (NWI) prepares wetland maps using stereoscopic interpretation of high-altitude aerial photographs. This is a multi-step procedure which includes preliminary aerial photography, selection of specific field study sites, stereoscopic interpretation of aerial photos, preparation of large-scale wetland maps, coordination of preliminary map review, and subsequent editing for final map production. Leaf-off, color infrared aerial photography from the early spring is the method of choice for detecting deciduous forested wetlands in temperate regions. Wetlands which are difficult to identify on the ground, such as evergreen forested wetlands, flooded deciduous forests, rain forest regions and hydrologically altered forests are the most difficult to photo-interpret. In these cases topographic landscape position studies, subtle photo signatures, more extensive field-work, and collateral information, such as soil surveys, must be included to produce useable maps. It is concluded that high-altitude aerial photography is an efficient and cost-effective means of identifying and classifying wetlands for inventory preparation on a national, regional, and statewide basis. (D'Agostino-PTT)
W91-02505

SYNOPTIC INVENTORY OF RIPARIAN ECOSYSTEMS: THE UTILITY OF LANDSAT THEMATIC MAPPER DATA.
Environmental Monitoring Systems Lab., Las Vegas, NV.
M. J. Hewitt.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 605-620, June 1990. 8 fig, 6 tab, 17 ref.

Descriptors: *Data acquisition, *Mapping, *Riparian vegetation, Ecosystems, Washington, Yakima River.

It has been estimated that almost 66% of the naturally occurring riparian vegetation in the United States has been eradicated since 1776. In spite of the critical importance of riparian zones to the maintenance of wildlife populations, no adequate methods currently exist for the synoptic inventory and assessment of this critical resource. This study analyzes the feasibility of utilizing Landsat Thematic Mapper data for the inventory of riparian habitats along the Yakima River of central Washington. Although final map accuracy assessment was determined to be only 80%, it was concluded that an adjustment of the experimental design could significantly increase map accuracy. The recommended parameters include the employment of both a temporal approach, such as selecting images from different seasons, as well as a buffer algorithm that masks out all pixels greater than n distance from the water class. With these modifications, high-resolution satellite systems are potentially useful in providing synoptic inventory maps of riparian habitats. (D'Agostino-PTT)
W91-02506

ECOLOGY OF WATER-FILLED TREEHOLES IN AUSTRALIAN RAINFORESTS: FOOD WEB REASSEMBLY AS A MEASURE OF COMMUNITY RECOVERY AFTER DISTURBANCE.
University of New England, Armidale (Australia). Dept. of Ecosystem Management.
B. Jenkins, and R. L. Kitching.
Australian Journal of Ecology AJECDQ, Vol. 15, No. 2, p 199-205, June 1990. 5 fig, 29 ref.

Descriptors: *Ecology, *Ecosystems, *Food chains, *Rain forests, *Treeholes, Australia, Phytotelemata, Predation, Species composition, Species diversity, Subtropic zone.

Ten water-filled tree holes which belong to the groups of lentic, aquatic ecosystems known as phytotelmata, in a subtropical rainforest were emptied out thereby posing a major perturbation on the community of organisms which occupied these habitat units. During the process of food web reassembly following this disturbance, the average number of predator species in the web increased as did the average number of prey species. Predator-

prey ratios increased in magnitude with the number of days after the disturbance. Furthermore, the characteristic mean predator-prey ratio of the original community was gradually restored as the food web reassembled. The number of prey species was found to be a better predictor of the number of predator species during community recovery than vice versa. The increasing number of trophic links in the food web over the period of reassembly, due mainly to the increase in the number of predacious species in the web, provided a good overall measure of community recovery. A model of food web reassembly using the relationships among food web statistics can be used to assess the rate of recovery of a community after a disturbance of the food web at the regional level of resolution. Food web statistics may also be useful in developing models for large ecosystems. (Author's abstract)
W91-02514

VEGETATION CHANGE ON THE OUSE WASHES WETLAND, ENGLAND, 1972-1988 AND EFFECTS ON THEIR CONSERVATION IMPORTANCE.
Royal Society for the Protection of Birds, Sandy (England).
N. D. Burgess, C. E. Evans, and G. J. Thomas.
Biological Conservation BICOBK, Vol. 53, No. 3, p 173-189, 1990. 5 fig, 4 tab, 22 ref.

Descriptors: *Conservation, *Ecology, *Ecosystems, *Grasses, *Grasslands, *Vegetation, *Wetlands, England, Flooding, Grazing, Hay, Ouse Washes, Resources management, Species composition, Species diversity, Vegetation effects.

A re-survey of wetland vegetation on the Ouse Washes in 1988 indicated that it has changed dramatically in 16 years. Glyceria maxima swamp (National Vegetation Classification (NVC) S5) and Agrostis stolonifera-Alopecurus geniculatus inundation grassland (NVC S13) have more than doubled their area, whereas Phalaris arundinacea swamp (NVC S28), Holcus lanatus-Deschampsia cepitosa coarse grassland (NVC MG9) and Carex riparia swamp (NVC S6) have declined by at least three-quarters of their previous area. Increased flooding, especially in the late spring and early summer, and reduced levels of grazing and haymaking are believed to have caused these changes, with increased flooding probably the single most important factor. The increased incidence of flooding is caused by four factors: (1) upstream channel improvements on the Ouse River and better land drainage; (2) increased siltation of waterways on either side of the Washes which reduces their water channel capacity; (3) increased siltation at the outflow of the Washes which slows water flow out of the system; and (4) possible changes in the operation of a sluice which allows water onto the Washes. The vegetation changes have resulted in a reduction of plant species diversity in grazed, hayed and unmanaged Washes, but especially in the unmanaged Washes. They may have also affected ornithological use of the site but this requires further investigation. (Author's abstract)
W91-02515

ASSESSMENT OF BANK SLOPE AS A PREDICTOR OF CONSERVATION STATUS IN RIVER CORRIDORS.
University Coll., Cardiff (Wales). School of Pure and Applied Biology.
M. A. Learner, D. W. Bowker, and J. Halewood.
Biological Conservation BICOBK, Vol. 54, No. 1, p 1-13, 1990. 4 fig, 5 tab, 12 ref.

Descriptors: *Conservation, *Ecology, *Ecosystems, *Rivers, *Stream banks, *Taxonomy, Bank slope, Fauna, Flora, Population density, River Arrow, River Monnow, River Wye, Species composition, Species diversity, Statistical analysis, Wales.

The importance of bank slope as a predictor of conservation status in river corridors was assessed by means of a survey of the taxonomic richness, taxonomic density and relative abundance of aquatic and terrestrial macro-invertebrates, vascular plants and bryophytes in aquatic, marsh, bank and adjacent land habitats at 22 sites on three rivers (River Wye and two of its tributaries, the Rivers Arrow and Monnow) at bank slopes ranging from 3 to 50 degrees. Bivariate and multivariate analyses demonstrated that bank slope was a poor predictor of conservation status in terms of the evaluation criteria employed. However, the taxonomic richness of the flora was positively correlated with the width and height of the bank. There was some indication that narrow banks with steep slopes supported a greater density of plant taxa than wide banks with shallow slopes. The taxonomic richness of the flora was not correlated with that of the fauna. No correlations were found between the taxonomic richness and density on the bank and those on the adjacent land. (MacKeen-PTT)
W91-02516

EFFECTS OF POOL SIZE AND ISOLATION ON AMPHIBIAN COMMUNITIES.
Katholieke Univ. Nijmegen (Netherlands). Dept. of Animal Ecology.
R. Laan, and B. Verboom.
Biological Conservation BICOBK, Vol. 54, No. 3, p 251-262, 1990. 2 fig, 4 tab, 14 ref.

Descriptors: *Amphibians, *Aquatic habitats, *Ecology, *Ecosystems, *Species diversity, Fauna, Forests, Habitats, Isolation, Limburg, Pools, Regression analysis, Species composition, The Netherlands.

An investigation of the presence of amphibians was carried out in 38 old and 39 recently constructed pools in the South of Limburg, The Netherlands. In order to assess possible effects of pool size and isolation on the number of species, characteristics of the pools and the surrounding landscape were analyzed by means of stepwise multiple regression analysis. In all analyses habitat variables concerning the pool were corrected for. Significant effects of pool size were found for old pools only. In both old and new pools species number turned out to be positively influenced by the vicinity of a wood. Woodland is considered here as an element increasing the connectivity of a landscape and as a part of the land habitat of amphibians. Pool age was the best predictor of species number in the new pools. The three most abundant species displayed differences in colonization rate. These differences turned out to be related to their abundance. (Author's abstract)
W91-02517

DISTRIBUTION OF CALIFORNIA STREAM FISHES: INFLUENCE OF ENVIRONMENTAL TEMPERATURE AND HYPOXIA.
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
J. J. Cech, S. J. Mitchell, D. T. Castleberry, and M. McEnroe.
Environmental Biology of Fishes EBFID3, Vol. 29, No. 2, p 95-105, October 1990. 1 fig, 4 tab, 35 ref.

Descriptors: *Dissolved oxygen, *Ecology, *Environmental effects, *Fish, *Fish physiology, *Stream fisheries, *Water temperature, California, Fish populations, Habitats, Metabolism, Streams.

Metabolic rates of seven fish species were used to assess the importance of temperature and dissolved oxygen as factors affecting the longitudinal distributions of stream fish within California drainages. Metabolic rates of all species generally increased at higher acclimation temperatures and with abrupt temperature increases. In response to low dissolved oxygen, four species showed no change in metabolic rates up to a threshold temperature where hypoxia-induced metabolic depression was apparent. These threshold temperatures were near the lethal temperatures for each species. In contrast, two species showed metabolic depressions at every temperature, whereas one showed no depression at any temperature. In general, species occupying similar longitudinal positions in California streams behaved similarly in their metabolic responses. For most species, there was good correspondence between metabolic response and relevant field observations of occurrence. In cases where the analysis of metabolic rates predicted species presence in waters where they did not exist, other abiotic factors, such as flow rate, or biotic factors, such as predation or competition must be considered. (Author's abstract)
W91-02518

COONGIE LAKES CONTROL ZONE--A MAP AND NOTE FOR THE SURFACE GEOLOGY AND TERRAIN.
G. W. Krieg, and R. A. Callen.
Mines and Energy Review South Australia, No. 157, p 59-61, 1990. 2 figs, 4 ref.

Descriptors: *Australia, *Habitats, *Lakes, *Maps, *Wetlands, Arid lands, Coongie Lakes, Cooper Creek, Innamincka Station Regional Reserve, Surficial geology, Topology.

The Coongie Lakes wetland, fed by Cooper Creek, is an almost permanent, freshwater, shallow lake system extending for over 50 km in South Australia's arid northeastern desert dunefields. This unique habitat, which supports an abundant aquatic and bird life, and a fringing eucalypt wood is protected under the National Parks and Wildlife Act as part of the Innamincka Station Regional Reserve, while allowing other economically important activities to proceed. An accompanying map, shows the surface geology and terrain, differentiates the main landscape units, and was compiled to assist land management of the area. Research into the sedimentology and hydrodynamics of the Coongie Lakes system would be warranted if any major surface or subsurface extraction of materials is contemplated. (Author's abstract)
W91-02531

SENSITIVITY ANALYSIS OF NINE DIVERSITY AND SEVEN SIMILARITY INDICES.
National Park Service, Fort Collins, CO. Water Resources Div.
T. P. Boyle, G. M. Smillie, J. C. Anderson, and D. R. Beeson.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 6, p 749-762, September/October 1990. 22 fig, 1 tab, 17 ref.

Descriptors: *Aquatic ecosystems, *Limnology, *Monitoring, *Sensitivity analysis, *Species diversity, *Water quality, Ecology, Population density, Simulation analysis, Species composition, Statistical analysis.

Sixteen indices commonly used to assess the status of aquatic communities in water quality studies were evaluated using computer simulation techniques to determine specific index responses. Three communities of different initial structure (19, 3 and 83 species) were generated using the logonormal equation. Each community was then perturbed in three ways: common species disproportionally reduced, all species proportionally reduced, and rare species disproportionally reduced. The behavior of the indices was analyzed graphically and differential response due to initial community structure and type of community change was documented. The results indicated that the response of the community level indices was dependent on the initial structure of the community and the manner in which the community was perturbed. In general, community level indices at the present stage of technical development may give very misleading biological interpretations of the data they are intending to summarize. Diversity indices, in particular, should not be used except in concert with other indices. Further research is recommended to determine the applicability of the specific indices to different aquatic ecosystems. (MacKeen-PTT)
W91-02534

BREEDING BIOLOGY OF THE SPOTTED SALAMANDER AMBYSTOMA MACULATUM (SHAW) IN ACIDIC TEMPORARY PONDS AT CAPE COD, USA.
Cape Cod National Seashore, South Wellfleet, MA.
For primary bibliographic entry see Field 5C.
W91-02550

SEDIMENT OXYGEN DEMAND MODEL: METHANE AND AMMONIA OXIDATION.
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
D. M. Di Toro, P. R. Paquin, K. Subburamu, and D. A. Gruber.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 945-986, 1990. 13 fig, 5 tab, 50 ref, 2 append.

Descriptors: *Ammonia, *Methane, *Model studies, *Sediment chemistry, *Sediment oxygen demand, *Water pollution control, Chemical analysis, Lake sediments, Mathematical analysis, Mathematical models, Oxidation, Stream sediments.

A model of sediment oxygen demand (SOD) is presented that relates SOD to the extent of oxidation of dissolved methane and ammonia generated in the anaerobic zone of the sediment of lakes and streams. The fluxes of dissolved methane and ammonia from the sediment to the overlying water, as well as methane and nitrogen gas fluxes that escape as bubbles, are included in the model. The three model parameters--the dissolved methane mass transfer coefficients and the two oxidation rate parameters--were estimated from laboratory and field data sets. The effect of overlying water dissolved oxygen and temperature was also examined. The importance of the gas fluxes and their quantitative relationship to SOD was established. Any field program that includes the measurement of SOD should also include the measurement of nitrogen and methane fluxes as well. The model is limited to freshwater sediments since the oxidation of sulfides is not included. The contribution from the respiration of benthic macro fauna is also not incorporated. (Author's abstract)
W91-02576

ACCURATE METHOD FOR CALCULATION OF SATURATION DO.
Yuxi Pearl Lustre Pigment Factory (China).
For primary bibliographic entry see Field 5G.
W91-02577

AQUATIC AND CERTAIN WETLAND VASCULAR VEGETATION OF REELFOOT LAKE, 1920S-1980S. III. SUBMERSED MACROPHYTES.
Tennessee Univ. at Martin.
J. W. Henson.
Journal of the Tennessee Academy of Science JTASAG, Vol. 65, No. 4, p 107-111, 1990. 1 fig, 1 tab, 23 ref, Tennessee Wildlife Resources Agency Contracts ID 2282, ID 2539, and ID 2611.

Descriptors: *Aquatic plants, *Limnology, *Macrophytes, *Reelfoot Lake, *Submerged aquatic plants, *Wetlands, Ecosystems, Hornwort, Pondweeds, Seasonal variation, Species composition, Tennessee, Water level, Waterlilies, Waterweeds.

Ceratophyllum demersum L. has been known from Reelfoot Lake since the early 1920s and was the predominant submersed macrophyte from 1933 through the 1950s. In 1983 it was dominant during the summer and early fall months. Potamogeton crispus L., an exotic, rapidly became spring dominant soon after its introduction in 1959. Life cycle differences reduce competition between these plants. The 1983 distributions of 4 other less-prevalent species, P. pectinatus L., P. pusillus L., Elodea nuttallii St John, and Cabomba carloiniana Gray, appeared to be similar to those of the early 1940s but abundances likely had been reduced. Fluctuations of all had occurred over the years. Rare species in 1983, previously occurring in quantity were: P. nodosus Poir., Najas guadalupensis Magnus., Heteranthera dubia MaxM., Ranunculus Sabellaris Raf., and Zannichellia palustris L. At last since 1983, Utricularia biflora Lam. has persisted in numerous shallow pools as sparse plants within other dense vegetation. Elevated mean lake levels during the last four decades, and species competition, are considered primary factors contributing to the reduction of less dominant species. Fluctuations of submersed species have occurred since the White Amur (Ctenopharyngodon idella Val.) was released into the lake during the winter of 1983-84. (See also W91-02582) (Author's abstract)
W91-02581

AQUATIC AND CERTAIN WETLAND VASCULAR VEGETATION OF REELFOOT LAKE, 1920S-1980S. IV. SEASONALLY EMERGENT MACROPHYTES.
Tennessee Univ. at Martin.
J. W. Henson.
Journal of the Tennessee Academy of Science JTASAG, Vol. 65, No. 4, p 112-116, 1990. 2 tab, 27 ref. Tennessee Wildlife Resources Agency Contracts ID 2282, ID 2539, and ID 2611.

Descriptors: *Aquatic plants, *Emergent aquatic plants, *Macrophytes, *Reelfoot Lake, *Water pollution effects, *Wetlands, Herbicides, Limnology, Marshes, Pesticides, Primrose, Seasonal variation, Smartweed, Species composition, Species diversity, Swamps, Tennessee, Water level, Waterlilies.

Seasonally emergent macrophytes of Reelfoot Lake were surveyed from 1983-88. These nonpersistent marshes are compared and contrasted with those reported for earlier periods. Since about 1943, the foremost abiotic influence upon vegetational change is believed to have been higher, average water depths. Previous herbicide applications are thought to have exerted minimal effects upon the status of nonpersistent marshes of the 1980s. Two anchored species have been continually dominant: Nelumbo lutea Pers. and Nuphar luteum subsp. macrophyllum Beal. Relatively pure strands of both were more extensive 30-60 years ago. Nymphaea odoata Ait, has increased since the 1930s, likely because of reduced competition from the dominant anchored species. Concurrently, the earlier shallow-water habitat of Brasenia schreberi Gmel. has been essentially eliminated by thick stands of both seasonally emergent and submersed species. The following three species have spread into the expanding swampy areas over the past 40 years: Polygonum densiforum Meisn., Ludwigia peploides (HBK) Raven and Limnobium spongia (Bosc.) Steud. In shallow water, nonpersistent marshes, P. densiflorum promotes the slow succession to tree swamps. The small floating macrophytes (Duckweeds, Lemna minor L. and Spirodela polyrhiza (L.) Schleid.; Watermeals, Wolffia spp.; and Mosquito Fern, Azolla caroliniana L.) have been abundant and widespread within nonpersistent marshes and swamps for many years. Justicia americana (L.) Vahl and Hydrocotyle ranunculoides L. f., recent introductions and still localized on the lake, have the potential for spreading into other lake selections. (See also W91-02581) (Author's abstract)
W91-02582

RESPONSE OF THE MICROBIAL LOOP TO PHYTOPLANKTON SPRING BLOOM IN A LARGE PREALPINE LAKE.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
T. Weisse, H. Muller, R. M. Pinto-Coelho, A. Schweizer, and D. Springmann.
Limnology and Oceanography LIOCAH, Vol. 35, No. 4, p 781-794, June 1990. 6 fig, 3 tab, 62 ref. Deutsche Forschungsgemeinschaft Grant I/63 699, and Brazilian Ministry of Education Grant CAPES PROC. 386/86.2.

Descriptors: *Algal blooms, *Limnology, *Mountain lakes, *Phytoplankton, Bacteria, Biomass, Food chains, Germany, Lake Constance, Microbiological studies, Phosphates, Population dynamics, Primary productivity, Seasonal variation.

Abundance, biomass, production, and grazing loss rates of phytoplankton, free-living bacteria, and Protozoa were assessed during an intense spring phytoplankton bloom in prealpine Lake Constance (Bodensee). More than 50% of the primary production was channeled through the microbial loop. Bacteria and ciliates responded rapidly to increasing phytoplankton biomass and production. Maximal growth rates of bacteria and protozoa were slightly lower than those of the dominating phytoplankton species. Averaged over the spring bloom, bacterial C amounted to 21% of phytoplankton C, and bacterial production to 18% of particulate primary production. An increase of heterotrophic flagellate populations was prevented by grazing within the microbial loop, probably by the feeding impact of ciliates. Although ciliates controlled flagellate production, they satisfied their own food demand by feeding on algae, and consumed 14% of primary production. Metazoan microzooplankton (copepod nauplli and rotifers) removed 7% of the phytoplankton production. Herbivorous metazooplankton ingested slightly less. Therefore the phytoplankton bloom was not terminated by excess grazing. PO4 depletion and subsequent sedimentation was most likely the prime cause for the termination of the spring bloom. (Author's abstract)
W91-02584

PLANKTONIC COMMUNITY STRUCTURE DETERMINES THE FATE OF BACTERIAL PRODUCTION IN A TEMPERATE LAKE.
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
M. L. Pace, G. P. McManus, and S. E. G. Findlay.
Limnology and Oceanography LIOCAH, Vol. 35, No. 4, p 795-805, June 1990. 4 fig, 3 tab, 60 ref. NSF Grant BSR88-05893.

Descriptors: *Bacteria, *Limnology, *Plankton, *Primary productivity, *Species composition, Daphnia, Ecosystems, Food chains, Microbiological studies, New York, Phytoplankton, Rotifers, Seasonal variation, Upton Lake.

An examination was made of the fate of planktonic bacterial production and the balance between bacterial growth and grazing mortality in the surface waters of Upton Lake, New York. Growth rates were measured by the incorporation of (3-H)thymidine into DNA. Grazing rates on bacteria were determined with small cells produced by a mutant strain of E. coli and made either florescent or radioactive to monitor feeding. Bacterial community turnover times calculated from either growth or grazing rates ranged from 1.5 to 16 days. On the basis of these data and the results of 29 other studies, most bacterial communities appear to have turnover times substantially > 1 day. The measurements of feeding rates on bacteria frequently exceeded estimates of growth. Limitations of precision and doubts about the accuracy of methods make attempts to balance measurements of bacterial growth and grazing with current techniques unrealistic. The fate of bacterial production depends on planktonic community structure. Flagellates were the primary consumers of bacteria in winter and fall. At other times, Daphnia galeata consumed most of the bacterial production. Ciliates and rotifers were never important bacterial grazers. In Upton Lake, large populations of daphnia effectively break the microbial loop and funnel bacterial production to higher consumers. (Author's abstract)
W91-02585

TYPE OF SUSPENDED CLAY INFLUENCES LAKE PRODUCTIVITY AND PHYTOPLANKTON COMMUNITY RESPONSE TO PHOSPHORUS LOADING.
Hampton Univ., VA. Center for Marine and Environmental Studies.
B. E. Cuker, P. T. Gama, and J. M. Burkholder.
Limnology and Oceanography LIOCAH, Vol. 35, No. 4, p 830-839, June 1990. 8 fig, 1 tab, 23 ref. EPA Grant R813315-01-0.

Descriptors: *Aquatic productivity, *Clays, *Limnology, *Phosphorus, *Phytoplankton, *Suspended sediments, Algae, Biomass, Kaolinite, Lake sediments, Montmorillonite, North Carolina, Primary productivity, Sediment chemistry, Turbidity.

The effects on phytoplankton and limnetics of two different types of suspended sediments, and their interactions with P loading, were tested in a small North Carolina piedmont lake. Limnocorrals were used in a complete, triplicated six-treatment, blocked design. Treatments were loaded with P, kaolinitic clay (K), K+P, montmorillonitic clay (M) and M+P. M caused more turbidity and stayed in suspension longer than K. Consequently, the light dependent parameters, net community

productivity (NCP), chlorophyll concentration, and algal density were lowest in the M and highest in the P treatment. Combined P and K loading promoted clearing for both sediments and mitigated their effects on algal densities and NCP. Flagellated algae and nonfilamentous cyanophytes dominated the control community. The P treatment had blooms of Anabaena. Without fertilization, both clays resulted in sparse, flagellate-dominated communities. The M+P community, like that of the P treatment, was dominated by Anabaena, but total algal densities were suppressed. In contrast, the K+P community lacked Anabaena and was similar to the control in algal quantity and composition. (Author's abstract)
W91-02586

QUANTITATIVE ASSESSMENT OF THE SOURCES AND GENERAL DYNAMICS OF TRACE METALS IN A SOFT-WATER LAKE.
Lancaster Univ. (England). Inst. of Environmental and Biological Sciences.
For primary bibliographic entry see Field 5B.
W91-02587

SULFUR STORAGE AND ALKALINITY GENERATION IN NEW ENGLAND LAKE SEDIMENTS.
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
A. E. Giblin, G. E. Likens, D. White, and R. W. Howarth.
Limnology and Oceanography LIOCAH, Vol. 35, No. 4, p 852-869, June 1990. 9 fig, 2 tab, 71 ref. NSF Grant BSR 86-15191.

Descriptors: *Acid rain, *Acid rain effects, *Alkalinity, *Lake sediments, *New England, *Path of pollutants, *Sulfur, *Water pollution sources, Pyrite, Sediment contamination, Sulfates, Sulfides, Water quality.

Measurements of the rates of burial and forms of reduced S in lake sediments were made to evaluate the importance of SO4 reduction to the alkalinity budget of several New England lakes. The contribution of dissimilatory SO4 reduction to alkalinity generation in these lakes was estimated conservatively to range from 1 to 75 meq/sq m/yr. The contribution of both assimilatory and dissimilatory SO4 reduction ranged from 10-159 meq/sq m/yr. For lakes with water residence times on the order of years, SO4 reduction can be important in controlling lake water alkalinity. Substantial quantities of inorganic reduced S were found in sediments of nearly all lakes studied. The majority was present as pyrite. In most lake concentrations of inorganic reduced S were higher in sediments deposited in the last 85 yr when compared to older sediments. In contrast, the ratio of C to organic S showed no consistent trend with depth in most lakes. It appears that in these lakes, most of the sulfide produced from SO4 reduction is stored primarily as inorganic forms rather than as C-bonded S. In lakes with highly organic sediments and low Fe concentrations, it was found that a considerable portion of the sedimentary Fe was present as ferrous sulfides. If these lakes were typical, alkalinity generation by reduced S storage in lakes with organic rich sediments in the northeastern US already may be limited by Fe availability. (Author's abstract)
W91-02588

INTEGRATED APPROACH TO QUANTIFY GROUNDWATER TRANSPORT OF PHOSPHORUS TO NARROW LAKE, ALBERTA.
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 2F.
W91-02589

GROUNDWATER RECHARGE FROM LAKE CHAD.
Indiana Univ.-Purdue Univ. at Fort Wayne. Dept. of Earth and Space Sciences.
For primary bibliographic entry see Field 2F.
W91-02591

RE-EXAMINATION OF SEICHE PERIODS OF LAKE VATTERN.
Goeteborg Univ. (Sweden). Dept. of Oceanography.
G. G. A. Bjork, and P. A. Lundberg.
Tellus TELLAL, Vol. 42A, No. 5, p 615-626, 1990. 7 fig, 2 tab, 17 ref. Swedish Natural Science Research Council Contract NFR G-4768.

Descriptors: *Lake Vattern, *Limnology, *Seiches, *Sweden, Lake morphology, Mathematical equations, Mathematical studies, Sensitivity analysis, Topography, Water level.

A newly developed perturbation technique for resolving Chrystal's classical seiche problem has been applied to Vattern, a deep and elongated lake in central Sweden. Theoretical predictions of the standing wave periods were compared to those from the spectral analysis of a 3-month water level record. The results for the gravest-mode seiche were found to be in good agreement, whereas the second and third mode showed a systemic deviation from the observations. A sensitivity analysis of the computational procedure indicates that this discrepancy can most likely be ascribed to insufficient knowledge of the detailed topography of the lake. (Author's abstract)
W91-02593

BUGLE LAKE PROTECTION AND REHABILITATION PROJECT.
Independence Public Inland Lake Protection and Rehabilitation District, WI.
For primary bibliographic entry see Field 5G.
W91-02621

WETLANDS AND GROUNDWATER: NEW CONSTRAINTS IN GROUNDWATER MANAGEMENT.
Universidad Complutense de Madrid (Spain). Dept. of Geodynamics.
For primary bibliographic entry see Field 6G.
W91-02722

FROM RAIN TO LAKE: WATER PATHWAYS AND CHEMICAL CHANGES.
Oslo Univ. (Norway). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W91-02734

ECOSYSTEM MODELLING: SCIENCE OR TECHNOLOGY.
Goettingen Univ. (Germany, F.R.). Abt. Bodenkunde und Waldernahrung.
M. Hauhs.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 25-33, August 1990. 3 fig, 17 ref.

Descriptors: *Acid rain, *Acidification, *Climatic changes, *Ecology, *Ecosystems, *Model studies, Data acquisition, Data interpretation, Data requirements, Future planning, Model testing.

Recent interest in ecosystem modelling emerges from large-scale problems such as acid deposition or climatic change. Knowledge about future states of ecosystems can be based on management experience and scientific observation. The former cannot be extrapolated outside the range of past variations in boundary conditions. Thus, the long-term changes in the chemical or physical climate require the identification of key-processes for successful model predictions. This scientific task is implicitly based on assumptions about the appropriate scale of integration in space and time. No scientific discipline exists by which these assumptions can be formally derived at the ecosystem level. The example of modeling soil and water acidification is used to discuss the possible consequences of a technological or a scientific perception of the problem posed, respectively. These approaches often suffer from inconsistent treatment of their basic assumptions in the first case, and from lack of theory in the latter case. On the basis of the available data and theory the question posed remains undecided. However, there is a risk that focusing ecosystem research on technological perception becomes a self-fulfilling prophesy. (Author's abstract)
W91-02736

SOIL WATER IN THE RIPARIAN ZONE AS A SOURCE OF CARBON FOR A HEADWATER STREAM.
University Coll. of North Wales, Bangor. School of Biological Sciences.
D. M. Fiebig, M. A. Lock, and C. Neal.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 217-237, August 1990. 6 fig, 2 tab, 53 ref.

Descriptors: *Dissolved organic carbon, *Geochemistry, *Headwaters, *Soil water, *Stream banks, *Streams, *Surface-groundwater relations, Nitrogen, Solute transport, Streambeds, Wales.

A comparison of the organic chemistries of soil waters in the riparian zone and an adjacent stream at an upland site in mid-Wales was made over a period of one year. Dissolved organic carbon (DOC) distributions in riparian soil waters showed little temporal or spatial consistency, but concentrations almost always exceeded those in the stream (mean = 9.4 and 2.1 mg/l, respectively). Three major hydrological flow paths in the riparian zone were inferred by correlating dynamics of the organic chemistry, as well as inorganic nitrogen (ammonium and nitrate), between sampling points. A lack of any dynamic relationship between organic concentrations in saturated throughflow of the stream bank and the stream suggested an efficient immobilization of this soil water DOC within the streambed, prior to its discharge into the stream. Correlations for both DOC and inorganic N between the stream bank unsaturated zone and the stream suggested that, at higher flows, this soil water input could directly influence the stream. A high degree of correlation between soil water of the forest edge (6 m from the stream) and the stream suggested that some form of macroporous transfer of soil water from further back in the riparian zone would also directly influence the stream. It is concluded that the riparian zone can contribute substantial amounts of DOC to a stream ecosystem, and that the streambed must be a key area of chemical reactivity where much of this material is initially processed. (Author's abstract)
W91-02747

GEOCHEMICAL CONTROL OF ALUMINIUM CONCENTRATIONS IN ACIDIFIED SURFACE WATERS.
Oslo Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W91-02752

PRODUCTION OF DISSOLVED DNA, RNA AND PROTEIN BY MICROBIAL POPULATIONS IN A FLORIDA RESERVOIR.
University of South Florida, St. Petersburg. Dept of Marine Science.
J. H. Paul, W. H. Jeffrey, and J. P. Cannon.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 10, p 2957-2962, October 1990. 4 fig, 29 ref. National Science Foundation Grant 8601570.

Descriptors: *Biochemistry, *Limnology, *Microorganisms, *Nucleic acids, *Radioactive tracers, *Reservoirs, Algal growth, Bacterial physiology, Carbon fixation, Carbon radioisotopes, Florida, Macromolecules, Phosphorus radioisotopes, Phytoplankton, Proteins.

Production of dissolved macromolecules by ambient autotrophic and heterotrophic microbial populations was measured in a eutrophic Florida reservoir by in situ labeling with various radioactive substrates. When tritiated thymidine was used as the precursor, production of labeled dissolved DNA, RNA and protein was observed. The rate of production of labeled dissolved macromolecules was 3.1%, the rate of cellular incorporation of tritiated thymidine and the production of dissolved DNA represented 2.3% the rate of cellular DNA incorporation. Microautotrophic populations labeled with 14-C labeled sodium carbonate produced dissolved RNA and protein at rates of 0.1 and 0.11 microg of C/L/hr, or 1.8% the total r

of carbon fixation, with no measurable dissolved DNA production. In an attempt to specifically label phytoplankton DNA, samples were incubated with tritiated adenine or intracellular 32-P in the presence and absence of the photosynthetic inhibitor 3-(3,4-dichlorophenyl)-1,1-dimethylurea (DCMU). Although DCMU inhibited 14-C fixation by approximately 99%, this antimetabolite had only a slight effect on tritiated adenine incorporation and no effect on 32-Pincorporation into cellular macromolecules. Significant amounts of dissolved DNA were produced in both tritiated adenine and intracellular 32-P incubations, but again DCMU had no effect on the production rates. These results indicate that actively growing populations of both phytoplankton and bacterioplankton produced dissolved RNA and protein, while only active bacterioplankton produced measurable quantities of dissolved DNA. Dead or senescent phytoplankton may have produced dissolved DNA, but would not be measured in the relatively short incubations used. (Author's abstract)
W91-02766

BLACKWATER PERSPECTIVE ON RIVERINE ECOSYSTEMS.
Georgia Univ., Athens. Dept. of Zoology.
J. L. Meyer.
Bioscience BISNAS, Vol. 40, No. 9, p 643-651, October 1990. 3 fig, 60 ref.

Descriptors: *Blackwater streams, *Ecosystems, *Organic matter, *River systems, Carbon cycle, Cycling nutrients, Dissolved solids, Food chains, Microorganisms, Model studies, Suspended sediments.

Streams are a vital natural resource, providing fresh water to support a growing human population as well as transport and treatment for wastewater. Blackwater rivers contain a low level of suspended sediments but a high concentration of dissolved organic matter. Basin-wide perspectives of rivers indicate that much of the degradation of organic matter added to streams is occurring in moderate-size channels rather than in headwaters, despite the headwaters' greater length. An expanded spatial perspective is necessary to investigate element cycling in lotic ecosystems where cycles are continuously depleted downstream by flowing water. The microbial loop is an effective pathway for recycling inorganic nutrients, as well as providing food for consumers and organic matter for nutrient regeneration. The lotic food web can be viewed as a mosaic of consumers and producers, located in the water column, the stable substrates of the blackwater river, and the unstable substrates (such as sandy sediments). Quantification is needed of the rates of exchange of nutrients and organic matter between the different components of the stream ecosystem, as well as an assessment of factors controlling these links. Empirical and modeling studies are needed to assess the significance of the microbial food web as a pathway of organic carbon transfer and nutrient spiraling in flowing waters. (Brunone-PTT)
W91-02778

MULTIPLE DEMANDS ON WETLANDS.
Florida Univ., Gainesville. Dept. of Forestry.
L. C. Ewel.
Bioscience BISNAS, Vol. 40, No. 9, p 660-666, October 1990. 6 fig, 1 tab, 33 ref.

Descriptors: *Cypress swamps, *Ecological effects, *Land use, *Water level fluctuations, *Wetlands, Competition, Evapotranspiration, Flooding, Nutrients, Population density, Population dynamics, Primary productivity, Seasonal variation, Water table.

In a world with a rapidly increasing population and a shrinking resource base, uncontroversial land use decisions are becoming increasingly difficult. Wetlands are particularly vulnerable because they often represent the only undeveloped land in an area. Cypress swamps provide a variety of benefits, and are useful for demonstrating the kinds of landuse conflicts that may arise. Bald cypress trees are common where flowing water brings in nutrients and ameliorates reducing conditions in the soil; pond cypress trees are common in small stillwater swamps. Water level fluctuates in all cypress swamps, and cypress seeds will not germinate under standing water. High water is necessary to reduce competition from more rapidly growing vegetation. Gross primary productivity in cypress swamps is closely related to the rate of nutrient inflow, and aboveground net primary productivity tends to be highest in swamps with intermediate hydroperiods. Because the water level in a cypress pond is generally continuous with the water table in the surrounding landscape, groundwater flows into the swamp when heavy rainfall raises the water table, and groundwater is recharged at the end of the rainy season when water tables drop more rapidly than water levels in the ponds. In addition, cypress ponds seem to have a lower evapotranspiration rate than surrounding ecosystems, provide flood and water quality control, and serve as a source of wood. Decisions about use of an individual swamp must consider its regional importance. The time course of succession must be considered, as well as the possible importance of fire to a cypress swamp. (Brunone-PTT)
W91-02779

USE OF KINETIC BIOASSAY PROCEDURE TO ESTIMATE SULFATE AND CYSTEINE CONCENTRATIONS IN SEDIMENT.
Portland State Univ., OR. Environmental Sciences and Resources.
D. A. Dunnette, D. P. Chynoweth, and K. H. Mancy.
Water Research WATRAG, Vol. 24, No. 11, p 1395-14000, November 1990. 2 fig, 3 tab, 27 ref. NIH Grant 5T01-EC0030 and EPA Grant 5P3-WP-177.

Descriptors: *Amino acids, *Bioassay, *Cysteine, *Eutrophication, *Hydrogen sulfide, *Limnology, *Nutrients, *Path of pollutants, *Sediment chemistry, *Sulfates, Kinetics, Lake sediments, Michaelis-Menten model, Putrefaction, Tracers.

There are often difficulties in estimating the bioavailability of essential nutrients and energy sources for aquatic microorganisms involved in mediating key sedimentary biotransformations. In order to estimate rates of sulfate reduction and putrefaction in sedimentary hydrogen sulfide production, a kinetic bioassay procedure was utilized to confirm the concentrations of hydrogen sulfide precursors determined by standard analytical procedures. S35-labeled sulfate and cysteine were added separately to freshwater lake sediment which had been transferred to plastic disposable syringes and incubated at 10 C for 2 h. Substrate depletion during the 2 h incubation ranged from approx. 1 to 5%. Final labeled plus unlabeled concentrations of sulfate and cysteine varied from 4.3 to 12.3 and 2.2 to 5.6 mg S/L, respectively. Precision of the method was +/-15%. The results were suggestive but inconclusive that sulfide production via sulfate reduction and putrefaction adhere to the Michaelis-Menten kinetic model. Nevertheless, the kinetic bioassay procedure of Wright and Hobbie appears to be useful in estimating substrate bioavailability for cysteine and sulfate and perhaps other sedimentary substrates. In addition, the method permits reliable tracer estimates of sulfide production in freshwaters with low sulfate concentrations which might otherwise not be possible. (White-Reimer-PTT)
W91-02796

CONTROLS AND EFFECTS OF CONTINENTAL BRINE FORMATION IN A SUPRATIDAL EPHEMERAL LAKE IN THE SEMI-ARID ENVIRONMENT OF SPENCER GULF, SOUTH AUSTRALIA.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
L. A. Chambers, J. Ferguson, and R. V. Burne.
Australian Journal of Earth Sciences AJESE7, Vol. 37, No. 1, p 71-84, March 1990. 9 fig, 4 tab, 54 ref, append.

Descriptors: *Australia, *Coasts, *Ephemeral lakes, *Saline lakes, *Saline-freshwater interfaces, *Semiarid lands, *Tide lands, Brines, Cyanophyta, Gypsum, Isotope studies, Marine environment, Metals, Oxidation-reduction potential, Spencer Gulf, Sulfates, Sulfides.

Ephemeral saline lakes form along the eastern shore of Spencer Gulf, in semiarid southern Australia, where beach ridges isolate areas of the high supratidal zone. Lacustrine sediments studied contain abundant discoidal gypsum. Isotope distributions and ion ratios indicate that groundwater from landward of and within the lake is non-marine in origin. The marine-terrestrial groundwater interface is mobile; after heavy rain, continental-derived brines flow seaward as far as the high intertidal zone. Within the lake, seasonal changes result in alternate desiccation and flooding by mildly acidic and oxidizing waters. The consequent variability in salinity and redox conditions is inimical to sustained biological activity or sulfide preservation. During dry periods, a halite crust forms on the surface and, as anaerobic conditions and bacterial sulfate reduction are established, iron sulfides precipitate in the vadose sediments. However, when water table levels rise, cyanobacteria colonize wetted surface sediments and the iron sulfides become oxidized. Mobilization of Zn indicates that metals can be transported in the oxidized brines, but such an environment would not favor their preservation as sulfides. The lake is most notable for its gypsum formation and can be differentiated from other well-documented sites in that both the water and the sulfate ions have continental signatures despite the proximity to marine-influenced zones. These coastal, gypsiferous, ephemeral lakes are more akin to a continental playa but with some aeolian influences, and thus extend the spectrum of coastal sabkha-like environments, particularly as a consequence of the semiarid climate. (Author's abstract)
W91-02806

SEASONAL CHANGES IN IRON TRANSPORT AND NATURE OF DISSOLVED ORGANIC MATTER IN A HUMIC RIVER IN NORTHERN FINLAND.
Oulu Univ. (Finland). Dept. of Botany.
For primary bibliographic entry see Field 2K.
W91-02810

OBSERVATIONS OF THE NIAGARA RIVER THERMAL PLUME (LAKE ONTARIO, NORTH AMERICA).
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
For primary bibliographic entry see Field 2E.
W91-02832

SEASONAL DYNAMICS IN METHANE EMISSIONS FROM THE AMAZON RIVER FLOODPLAIN TO THE TROPOSPHERE.
Washington Univ., Seattle. School of Oceanography.
A. H. Devol, J. E. Richey, B. R. Forsberg, and L. A. Martinelli.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 95, No. 10, p 16,417-16,426, September 10, 1990. 5 fig, 3 tab, 64 ref. NSF Grant Nos. BSR-83-16359 and BSR-87-18423; NASA Grant No. NAGW-1066.

Descriptors: *Amazon River Basin, *Atmospheric chemistry, *Flood plains, *Methane, *Seasonal variation, Air pollution, Annual floods, Aquatic plants, Flooding, Lakes, Macrophytes, Tropical regions, Water level.

Methane fluxes to the troposphere from the three principal habitats of the floodplain of the Amazon River main stem (open waters, emergent macrophyte beds, and flooded forests) were determined along a 1700-km reach of the river during the low water period of the annual flood cycle (November-December 1988). Overall, emissions averaged 68 mg CH4 and were significantly lower than similar emissions determined previously for the high water period, 184 (+/-41) mg CH4/sq m/d. This difference was due to significantly lower emissions from floating macrophyte environments. Low water emissions from open waters and flooded forest

areas were not significantly different than at high water. A monthly time series of methane emissions from eight lakes located in the central Amazon Basin showed similar results. Average annual emission from the lakes was 125 (+/-28) mg CH4/sq m/day. Methane emissions from lakes were significantly higher during the high water period, again, primarily due to an increase in emissions from macrophyte habitats. The data were used to calculate a seasonally weighted annual emission to the troposphere from the Amazon River main stem floodplain of 5.1 Tg/yr which indicates the importance of the area in global atmospheric chemistry. (See also W91-02837) (Author's abstract)
W91-02834

METHANE FLUX FROM THE AMAZON RIVER FLOODPLAIN: EMISSIONS DURING RISING WATER.
College of William and Mary, Williamsburg, VA. Dept. of Biology.
K. B. Bartlett, P. M. Crill, J. A. Bonassi, J. E. Richey, and R. C. Harriss.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 95, No. 10, p 16,773-16,788, September 20, 1990. 8 fig, 4 tab, 66 ref.

Descriptors: *Amazon River Basin, *Atmospheric chemistry, *Flood plains, *Methane, *Seasonal variation, Air pollution, Aquatic plants, Fluctuations, Tropical regions, Water level, Wetlands.

During April and May 1987, an extensive methane flux data set from Amazonian wetland habitats was collected during the wet season as river water levels were high and rising. This work extended measurements made in the dry season of 1985, when water levels were falling. Comparisons between these two data sets allows the estimation of the amount of seasonal variability in this globally significant source of tropospheric methane. A total of 284 flux measurements were made in the three primary floodplain environments of open water lakes and channels, floating grass mats, and flooded forests, along approximately 1500 km of the central floodplain. Emissions (means and standard errors) were 74 +/-14 mg CH4/sq m/d (open water), 201 +/-35 mg CH4/sq m/d (grass mats), and 126 +/-20 mg CH4/sq m/d (flooded forests). These values were not significantly different from the majority of those from 1985, due in part to the high variability in flux seen at both times. Although ebullition was a significant component of methane emissions at both periods, the frequency of bubbling and its contribution to total flux was lower during the period of rising water than of falling water. A prominent diurnal pattern in atmospheric methane concentrations was observed, with minimum levels of about 1.75 ppm at midday and a maximum of 2.12 ppm at around midnight. Given the relatively small seasonal changes observed in flux at the two stages of the rivers hydrographic curve, earlier estimates of regional methane flux remain largely unchanged. Revision of global estimates of wetland methane sources based on these tropical data and recently published figures for northern peatlands indicated that tropical wetlands may be more important than previously suggested, but that wetland sources overall remain at approximately 110 Tg/yr. (See also W91-02834) (Author's abstract)
W91-02837

ESTIMATING GROUNDWATER EXCHANGE WITH LAKES: 1. THE STABLE ISOTOPE MASS BALANCE METHOD.
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02873

ESTIMATING GROUNDWATER EXCHANGE WITH LAKES: 2. CALIBRATION OF A THREE-DIMENSIONAL, SOLUTE TRANSPORT MODEL TO A STABLE ISOTOPE PLUME.
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02874

SIMULATION OF LAKE EVAPORATION WITH APPLICATION TO MODELING LAKE LEVEL VARIATIONS OF HARNEY-MALHEUR LAKE, OREGON.
Geological Survey, Denver, CO.
S. W. Hostetler, and P. J. Bartlein.
Water Resources Research WRERAQ, Vol. 26, No. 10, p , October 1990. 14 fig, 40 ref. Department of Energy Grant DEFG02-85ER60304.

Descriptors: *Climatic changes, *Hydrologic cycle, *Lake evaporation, *Oregon, *Water level fluctuations, Closed basins, Eddy diffusion, Evaporation, Hydrologic models, Water temperature.

The hydrologic balance of a lake represents a direct response to prevailing climatic conditions in unregulated lake basins. Evaporation is a primary path for water loss from most lakes; therefore in order to assess the relation between climatic variations and fluctuations in the size of a lake a method for estimating evaporation rates that is sensitive to climatic variations is required. A physically based eddy diffusion model can stimulate the seasonal variation in lake temperature and evaporation. Because no lake-specific fitting of the parameters of the model is necessary, the model can be used to simulate evaporation in studies of climate change and lake hydrology in a variety of settings. The eddy diffusion model is used to simulate evaporation for input to a simple lake level model that is applied to reconstruct recent fluctuations in the level of Harney-Malheur Lake, in the high desert of southeastern Oregon, caused by climatic variations. Beginning in 1982, an increase in effective moisture throughout the Harney-Malheur basin caused the lake to rise over 2 m and attain a depth of more than 4 m during 1984 and 1985. The meteorologic input data for the thermal model and the hydrological data for the lake level model either were obtained from observations or were estimated. Monthly values of the meteorological data were fitted with cubic splines to derive daily input values. The observed fluctuations in lake level were accurately reproduced by the lake level model. Because the model is sensitive to the climatic input variables, it can provide a tool for investigating the response of lake level to climate change. (Author's abstract)
W91-02885

METAL-ORGANIC ASSOCIATIONS IN SEDIMENTS--II. ALGAL MATS IN CONTACT WITH GEOTHERMAL WATERS.
Munich Univ. (Germany, F.R.). Mineralogisch-Petrographisches Inst.
For primary bibliographic entry see Field 2J.
W91-02892

RECOVERY OF LOTIC COMMUNITIES AND ECOSYSTEMS FROM DISTURBANCE--A NARRATIVE REVIEW OF CASE STUDIES.
Environmental Research Lab., Duluth, MN.
For primary bibliographic entry see Field 5G.
W91-02897

RECOVERY OF LOTIC PERIPHYTON COMMUNITIES AFTER DISTURBANCE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
A. D. Steinman, and C. D. McIntire.
Environmental Management EMNGDC, Vol. 14, No. 5, p 589-604, 1990. 1 tab, 120 ref. NSF Interagency Agreement 40-689-78 with the DOE under Contract DE-AC05-840R21400.

Descriptors: *Ecological effects, *Ecosystems, *Habitat restoration, *Lotic environment, *Periphyton, *Rehabilitation, *Restoration, *Stream biota, *Water pollution effects, Bioindicators, Cycling nutrients, Dehydration, Floods, Metals, Nutrients.

Periphyton communities represent potentially excellent candidates for assessing the recovery of lotic ecosystems after disturbance. These communities are ubiquitous, relatively easy to sample and measure (in terms of total community biomass), have short generation times, and may influence the recovery rates of higher trophic levels. The first section of the article analyzes how site availability, species availability, and differential species performance influence periphyton successional dynamics. This background information provides a foundation for understanding how periphytic organisms respond after a disturbance. The second section of the article analyzes how periphyton communities respond to four different types of disturbance (flood events, dessication, organic nutrient enrichment, and toxic metal exposure). Although data are limited, it is concluded that the fast growth rates and short generation times of periphytic organisms, coupled with their flexible life history strategies and good dispersal ability, allow lotic periphyton communities to recover relatively quickly after a disturbance. In addition, disturbance type and severity, local environmental conditions, and site specific factors also will influence recovery rates. Future research needs include a better understanding of: (1) what periphyton properties would serve as the best index of recovery; (2) whether or not the robustness of this index varies among different environments and different disturbances; (3) interactions between autotrophs and heterotrophs within the periphyton mat, particularly with respect to nutrient cycling; (4) competitive interactions among organisms; (5) functional redundancy of organisms; and (6) the influence of the riparian zone and channel geomorphology on periphyton recovery rates. (Author's abstract)
W91-02899

RECOVERY OF LOTIC MACROINVERTEBRATE COMMUNITIES FROM DISTURBANCE.
Georgia Univ., Athens. Dept. of Entomology.
J. B. Wallace.
Environmental Management EMNGDC, Vol. 14, No. 5, p 605-620, 1990. 3 fig, 1 tab, 135 ref. NSF Grant Nos. BSR83-16082, BSR87-18005, and BSR85-16497.

Descriptors: *Ecosystems, *Habitat restoration, *Lotic environment, *Macroinvertebrates, *Rehabilitation, *Stream biota, *Water pollution effects, Ecological effects, Ecotoxicology, Life history studies, Pesticides, Recolonization, Toxicity.

Ecosystem disturbances produce changes in macrobenthic community structure (abundances, biomass, and production) that persist for a few weeks to many decades. Examples of disturbances with extremely long-term effects on benthic communities include contamination by persistent toxic agents, physical changes in habitats, and altered energy inputs. Stream size, retention, and local geomorphology may ameliorate the influence of disturbances on invertebrates. Disturbances can alter food webs and may select for favorable genotypes (e.g., insecticidal resistance). The introduction of pesticides into lotic ecosystems, which do not result in major physical changes within habitats, illustrate several factors that influence invertebrate recovery time from disturbance. These include: (1) magnitude of original contamination toxicity, and extent of continued use; (2) spatial scale of the disturbance; (3) persistence of the pesticide: (4) timing of the contamination in relation to the life history stages of the organisms; (5) vagility of populations influenced by pesticides and (6) position within the drainage network. The ability of macroinvertebrates to recolonize denuded stream habitats may vary greatly depending on regional life histories, dispersal abilities, and position within the stream network. Although downstream drift is the most frequently cited mechanism of invertebrate recolonization following disturbance in middle and larger-order streams, evidence is shown which shows aerial recolonization to be potentially important in headwater streams. There is an apparent stochastic element operating for aerial recolonization, depending on the timing of disturbance and flight periods of various taxa. Available evidence indicates that recolonization of invertebrate taxa without an aerial adult stage requires longer periods of time than for those that possess winged, terrestrial adult stages (most insects). Innovative, manipulative experiments are needed in order to address recolonization mechanisms of animals inhabiting streams that differ

size, latitude, disturbance frequency and magnitude, as well as the potential influence of early colonists on successional sequences of species following disturbance. (Author's abstract)
W91-02900

ENVIRONMENTAL VARIATION, LIFE HISTORY ATTRIBUTES, AND COMMUNITY STRUCTURE IN STREAM FISHES: IMPLICATIONS FOR ENVIRONMENTAL MANAGEMENT AND ASSESSMENT.
North Dakota Univ., Grand Forks. Dept. of Biology.
I. J. Schlosser.
Environmental Management EMNGDC, Vol. 14, No. 5, p 621-628, 1990. 3 fig, 3 tab, 45 ref. EPA Grant No. R806391; NSF Grants BSR8320371 and BSR8804926.

Descriptors: *Ecosystems, *Environmental policy, *Life history studies, *Stream fisheries, *Water pollution effects, Biological studies, Downstream, Ecological effects, Fish behavior, Monitoring, Temporal distribution, Upstream.

Fishes in midwestern streams of the United States experience strong upstream-downstream gradients in natural environmental variability. Upstream fishes experience greater temporal variability in physical-chemical conditions than downstream fishes. As a whole, upstream species have a shorter life span, smaller body size, and earlier sexual maturity than downstream species. Descriptive studies also suggest upstream species exhibit more rapid recolonization after severe physical disturbance than downstream species, and fish community structure is temporally more variable in upstream than downstream areas. These longitudinal differences in life history characteristics suggest that upstream fish communities will exhibit a more rapid recovery from severe anthropogenic disturbances than downstream fish communities. The greater temporal variability of fish community structure in upstream areas also suggests it will be more difficult in upstream than downstream areas to use fish based indices to distinguish whether subtle changes in environmental quality are due to natural or anthropogenic disturbances. Long-term monitoring of fishes throughout drainage basins is critically needed to establish more precisely the natural range of variation in community structure. Such monitoring will allow regulatory agencies to distinguish, with greater confidence, the influence of anthropogenic disturbances on stream fishes from the influence of natural environmental variation. (Author's abstract)
W91-02901

PHYSICAL HABITAT TEMPLATE OF LOTIC SYSTEMS: RECOVERY IN THE CONTEXT OF HISTORICAL PATTERN OF SPATIOTEMPORAL HETEROGENEITY.
Colorado State Univ., Fort Collins. Dept. of Biology.
N. L. Poff, and J. V. Ward.
Environmental Management EMNGDC, Vol. 14, No. 5, p 629-645, 1990. 3 fig, 1 tab, 128 ref.

Descriptors: *Ecological effects, *Habitat restoration, *Heterogeneity, *Lotic environment, *Rehabilitation, *Stream biota, Ecosystems, Habitats, Spatial distribution, Streams, Temporal distribution, Water pollution effects.

Spatial and temporal environmental heterogeneity in lotic ecosystems can be quantitatively described and identified with characteristic levels of ecological organization. The long-term pattern of physicochemical variability in conjuction with the complexity and stability of the substratum, establishes a physical habitat template that theoretically influences which combinations of behavioral, physiological, and life history characteristics constitute appropriate ecological strategies for persistence in the habitat. Physical habitat templates and associated ecological attributes differ geographically because of biogeoclimatic processes that constrain lotic habitat structure and stability, and that influence physiochemical variability and disturbance patterns (frequency, magnitude, and predictability). Theoretical considerations and empirical studies suggest that recovery from natural and anthropogenic disturbances also will vary among lotic systems, depending on historical temporal variability regime, degree of habitat heterogeneity, and spatial scale of the perturbation. Characterization of physical habitat templates and associated ecological dynamics along gradients of natural disturbance would provide a geographic framework by predicting recovery from anthropogenic disturbance for individual streams. Description of lotic environmental templates at the appropriate spatial and temporal scale is therefore desirable to test theoretical expectations of biotic recovery rate from disturbance, and to guide selection of appropriate reference study sites for monitoring impacts of anthropogenic disturbance. Historical streamflow data, coupled with stream-specific thermal and substratem-geomorphologic characteristics, are suggested as minimum elements needed to characterize physical templates of lotic systems. (Author's abstract)
W91-02902

DISTURBANCE REGIMES, RESILIENCE, AND RECOVERY OF ANIMAL COMMUNITIES AND HABITATS IN LOTIC ECOSYSTEMS.
North Carolina Univ. at Chapel Hill. Dept. of Biology.
S. R. Reice, R. C. Wissmar, and R. J. Naiman.
Environmental Management EMNGDC, Vol. 14, No. 5, p 647-659, 1990. 7 fig, 114 ref.

Descriptors: *Ecological effects, *Ecosystems, *Habitat restoration, *Habitats, *Lotic environment, *Stream biota, Algae, Aquatic environment, Bank erosion, Channelization, Erosion, Scour, Sediment transport, Sedimentation, Spatial dynamics.

Disturbance regime is a critical organizing feature of stream communities and ecosystems. The position of a given reach in a river basin and the sediment type within that reach are two key determinants of the frequency and intensity of flow induced disturbances. The differences between predictable and unpredictable events are considered; it is suggested that predictable discharge events are not disturbances. The most frequently and predictably disturbed sites can be expected to demonstrate the highest resilience. Spatial scale is an important dimension of community structure, dynamics, and recovery from disturbance. The effects on small patches (< 1 sq m) were compared to the effects of large reaches at the river basin level. At small scales, sediment movements and scour are major factors affecting the distribution of populations of aquatic insects or algae. At larger scales, channel formation, bank erosion, and interactions with the riparian zone that will affect all taxa and processes must be examined. An understanding of stream ecosystem recovery rests on an understanding of the historical, spatial, and temporal background of contemporary disturbance events. (Author's abstract)
W91-02903

ASSEMBLAGE STABILITY IN STREAM FISHES: A REVIEW.
Georgia Univ., Athens. School of Forest Resources.
G. D. Grossman, J. F. Dowd, and M. Crawford.
Environmental Management EMNGDC, Vol. 14, No. 5, p 661-671, 1990. 4 fig, 9 tab, 46 ref. McIntire-Stennis Grant No. GEO-0035-MS.

Descriptors: *Literature review, *Population dynamics, *Stream biota, *Stream fisheries, *Water pollution effects, Baseline studies, Ecological effects, Ecosystems, Fish populations, Species composition, Statistical studies, Variation coefficient.

The stability of nine fish stream assemblages were quantified by calculating coefficients of variation of population size for assemblage members. Coefficients of variation were high and averaged over 96%, indicating that most assemblages were quite variable. Coefficients of variation (CV) estimates were not significantly affected by: (1) years of study, (2) mean abundance, (3) familial classification, or (4) mean interval between collections. Minor regional differences were also detected in CVs. The high variability exhibited by many stream fish assemblages suggest that it may be difficult to detect the effects of anthropogenic disturbances using population data alone; consequently, caution is urged when evaluating the effects of these disturbances. Many long-term studies of the ecological characteristics of undisturbed stream fish assemblages are needed to provide a benchmark against which disturbed systems can be compared. CVs are a better estimator of population/assemblage stability than either Kendall's W or the standard deviation of the logarithms of numerical censuses. This conclusion is based on the following reasons: (1) CVs scale population variation by the mean and, hence, more accurately measure population variability; and (2) this scaling permits the comparison of populations with different mean abundances. Finally, the interpretation of CV values is less ambiguous than either of the aforementioned metrics. (Author's abstract)
W91-02904

REGIONAL FRAMEWORK FOR ESTABLISHING RECOVERY CRITERIA.
NSI Technology Services Corp., Corvallis, OR.
R. M. Hughs, T. R. Whittier, C. M. Rohm, and D. P. Larsen.
Environmental Management EMNGDC, Vol. 14, No. 5, p 673-683, 1990. 7 fig, 44 ref. EPA Contract No. 68-C8-0006.

Descriptors: *Aquatic environment, *Habitat restoration, *Lotic environment, *Resources management, *Stream fisheries, Arkansas, Case studies, Ecosystems, Management planning, Montana, Ohio, Oregon.

Effective assessments of aquatic ecosystem recovery require ecologically sound endpoints against which progress can be measured. Site by site assessments of endpoints and potential recovery trajectories are impractical for water resources agencies. Because of the natural variation among ecosystems, applying a single set of criteria nationwide is not appropriate either. The use of a regional framework for stratifying natural variation and for determining realistic biological criteria was examined. A map of ecoregions, drawn from landscape characteristics, formed the framework of three statewide case studies and three separate studies at the river basin scale. Statewide studies of Arkansas, Ohio, and Oregon, streams demonstrated patterns in fish assemblages corresponding to ecoregions. The river basin study in Oregon revealed a distinct change at the ecoregion boundary; those in Ohio and Montana demonstrated the value of regional reference site for assessing recovery. Ecoregions can be used to facilitate the application of ecological theory and to set recovery criteria for various regions of states or of the country. Such a framework provides an important alternative between site specific and national approaches for assessing recovery rates and conditions. (Author's abstract)
W91-02905

BIOGEOCHEMICAL CYCLING CONSTRAINTS ON STREAM ECOSYSTEM RECOVERY.
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. L. DeAngelis, P. J. Mulholland, J. W. Elwood, A. V. Palumbo, and A. D. Steinman.
Environmental Management EMNGDC, Vol. 14, No. 5, p 685-697, 1990. 4 fig, 6 tab, 42 ref. NSF Ecosystems Study Agreement No. 40-689-78; DOE Contract No. DE-AC05-840R21400.

Descriptors: *Biogeochemistry, *Cycling nutrients, *Ecosystems, *Limiting nutrients, *Lotic environment, *Model studies, *Stream biota, Ecological effects, Equilibrium, Floods, Grazing, Mathematical models, Nutrients, Periphyton, Population dynamics, Restoration, Scour, Snails.

In systems where production is limited by the availability of a nutrient, nutrient input to and recycling within the system is related to the resilience, or speed of recovery, of a system to its steady state following a disturbance. In particular,

it is shown that the return time of the system to a steady state, or the inverse of the resilience, is approximately equal to the mean turnover time of the limiting nutrient in the system. From this relationship it is possible to understand and predict how various properties of food webs and their environments affect resilience. These properties include nutrient input rate, loss rate, size of the detritus compartment, and trophic structure. The effects of these properties on resilience are described by using simple mathematical models. To test model predictions, experimental studies of the response of periphyton-dominated stream ecosystems to disturbance are being conducted on a set of laboratory streams in which nutrient inputs and grazing intensity are regulated at different levels. In streams without snail grazers (low-grazed streams), 90% recirculation of stream water to reduce nutrient inputs resulted in longer turnover times of phosphorous within the stream compared with once-through flow. However, in streams with snail grazers (high-grazes streams) there were no differences in phosphorous turnover time between once-through and partially recirculated treatments. Results on the rate of recovery of periphyton from a flood/scour disturbance to each stream partially support the model prediction of a positive relationship between ecosystem return time and nutrient turnover time within the streams. (Author's abstract)
W91-02906

DISTURBANCE AND RECOVERY OF LARGE FLOODPLAIN RIVERS.
Illinois Natural History Survey, Havana. Stephen A. Forbes Biological Station.
R. E. Sparks, P. B. Bayley, S. L. Kohler, and L. L. Osborne.
Environmental Management EMNGDC, Vol. 14, No. 5, p 699-709, 1990. 5 fig, 1 tab, 30 ref. NSF Grant Nos. BSR-8114563 and BSR-8612107.

Descriptors: *Ecological effects, *Ecosystems, *Flood flow, *Flood plains, *Illinois River, *Mississippi River, *River basins, Annual floods, Aquatic plants, Drought, Flooding, Habitat restoration, Runoff, Suspended sediments, Turbidity, Vegetation.

Disturbance in a river-floodplain system is defined as an unpredictable event that disrupts structure or function at the ecosystem, community or population level. Disturbance can result in species replacements or losses, or shifts of ecosystems from one persistent condition to another. A disturbance can be a discrete event or a graded change in a controlling factor that eventually exceeds a critical threshold. The annual flood is the major driving variable that facilitates lateral exchanges of nutrients, organic matter, or organisms. The annual flood is not normally considered a disturbance unless its timing or magnitude is atypical. The record flood of 1973 had little effect on the biota at a long-term study site on the Mississippi River, but the absence of a flood during the 1976-1977 Midwestern drought caused short and long-term changes. Body burdens of contaminants increased temporarily in key species, because of increased concentration resulting from reduced dilution. Reduced runoff and sediment input improved light penetration and increased the depth at which aquatic macrophytes could grow. Developing plant beds exerted a high degree of biotic control and were able to persist, despite the resumption of normal floods and turbidity in subsequent years. In contrast to the discrete event that disturbed the Mississippi River, a major confluent, the Illinois River, has been degraded by a gradual increase in sediment input and sediment resuspension. From 1958-1961 formerly productive backwaters and lakes along a 320 km reach of the Illinois River changed from clear, vegetated areas to turbid, barren basins. The change to a system largely controlled by abiotic factors was rapid and the degraded condition persists. Greater use should be made of man made or natural disturbances and environmental restoration as opportunistic experiments to measure thresholds and monitor the recovery process. (Lantz-PTT)
W91-02907

ROLE OF REFUGIA IN RECOVERY FROM DISTURBANCES: MODERN FRAGMENTED AND DISCONNECTED RIVER SYSTEMS.
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
J. R. Sedell, G. H. Reeves, F. R. Hauer, J. A. Stanford, and C. P. Hawkins.
Environmental Management EMNGDC, Vol. 14, No. 5, p 711-724, 1990. 1 fig, 2 tab, 80 ref. NSF Grant Nos. BSR-8414325, BSR-8508356, BSR-8416127, and BSR-8705269.

Descriptors: *Habitat restoration, *Refugia, *River systems, *Stream biota, Detritus, Flood plains, Research priorities, Riparian vegetation, River channels, Surface-groundwater relationships.

Habitats and environmental factors that convey spatial and temporal resistance and/or resilience to biotic communities that have been impacted by biophysical disturbances may be called refugia. Most refugia in rivers are characterized by extensive coupling of the main channel with adjacent streamside forests, floodplain features, and groundwater. These habitats operate at spatial scales, from localized particles, to channel units such as pools and rifles, to reaches and longer sections, and at the basin level. A spatial hierarchy of different physical components of a drainage network is proposed to provide a context for the different refugia. Examples of refugia operating at different spatial scales, such as pools, large woody debris, floodplains, below dams, and catchment basins are discussed. It is recommend that several research sites be established within ecoregions of the United States. These demonstration sites would be dedicated to understanding processes, including spatial and temporal dynamics of refugia, that control biodiversity and the functional integrity of river ecosystems. (Lantz-PTT)
W91-02908

RECOVERY PROCESSES IN LOTIC ECOSYSTEMS: LIMITS OF SUCCESSIONAL THEORY.
Arizona State Univ., Tempe. Dept. of Zoology.
S. G. Fisher.
Environmental Management EMNGDC, Vol. 14, No. 5, p 725-736, 1990. 1 fig, 3 tab, 79 ref. NSF Grant Nos. BSR-8406891 and BSR-88-18612.

Descriptors: *Habitat restoration, *Lotic environment, *Stream biota, *Succession, Climates, Ecosystems, Life history studies, Streams.

The concept of succession has a distinguished history in general ecology and has applied to stream ecosystems with some success. Succession in streams is largely secondary, follows initial floristics models, and occurs through a variety of mechanisms. The process is moderately predictable and highly influenced by climatic factors, particularly nutrient chemistry. In desert streams, succession does not result in a climax state. While evidence is slim, succession may not be a significant process in steams of certain types or in certain regions. Successional theory is difficult to apply to spatially heterogeneous, hierarchically organized ecosystems. It also suffers in being only one component of a better integrated concept, that of ecosystem stability, which deals more directly with disturbance and ecosystem resistance in addition to resilience (which encompasses succession). Succession has so suffered from a half century of confusion that a strong case can be made for abandoning the term, at least as it applies in streams, in favor of a broader view provided by the stability theory. (Author's abstract)
W91-02909

APPLICATION OF ECOLOGICAL THEORY TO DETERMINING RECOVERY POTENTIAL OF DISTURBED LOTIC ECOSYSTEMS: RESEARCH NEEDS AND PRIORITIES.
Austin Peay State Univ., Clarksville, TN. Center for Field Biology.
J. A. Gore, J. R. Kelly, and J. D. Yount.
Environmental Management EMNGDC, Vol. 14, No. 5, p 755-762, 1990. 37 ref. Cornell University and EPA Cooperative Agreement No. CR812685.

Descriptors: *Ecological effects, *Ecosystems, *Habitat restoration, *Lotic environment, *Research priorities, Heterogeneity, Monitoring, Spatial variation, Species diversity, Stream biota, Theoretical analysis.

Views of aquatic scientists who gathered to assess the ability of stream ecosystem theory to predict recovery from disturbance are summarized. Two views of disturbance were evident: a discrete removal of organisms versus an unusual deviation from normal. These were perceived as applying to different scales and/or objectives. Long-term information is required from both points of view to define recovery. Recovery has both spatial and temporal components, and includes both physical and biological processes. Consensus was very strong that a major role for theory lies in the understanding of spatial aspects, temporal scales, coupling of physics and biology, and the interaction of these features in recovery processes. Some progress is evident, but among the topics identified as critical were: homo-versus heterogeneous distribution of disturbance, local extent of disturbance relative to regional context, critical vs. noncritical patches (size and location) of disturbance at different spatial scales and temporal frequencies, delineation of reversible and nonreversible processes, and physical and biological constraints on the time frame for recovery. Such concepts need attention across different types of lotic ecosystems. There was a strong consensus that a national monitoring system of representative lotic ecosystems within ecological regions be established. The purpose of this monitoring system would be to acquire long-term data on natural variability, to establish viable indicators of spatial and temporal aspects of recovery, and to develop and test emerging theoretical developments. (Author's abstract)
W91-02911

STUDY ON THE HYDROLOGY AND PHYTOPLANKTON OF THE VARANO LAKE (ADRIATIC SEA) DURING AN ANNUAL CYCLE (MAY 1985-APRIL 1986). (ETUDE SUR LAC DE VARANO (MER ADRIATIQUE): MAI 1985-AVRIL 1986).
Padua Univ. (Italy). Dept. of Biology.
For primary bibliographic entry see Field 2L.
W91-02934

ASIATIC CLAM, CORBICULA SPP., AS A BIOLOGICAL MONITOR IN FRESHWATER ENVIRONMENTS.
Syracuse Research Corp., NY. Aquatic Toxicology Lab.
For primary bibliographic entry see Field 5A.
W91-02944

2I. Water In Plants

SCREENING FOR DROUGHT TOLERANCE SOYBEAN GERMINATION AND ITS RELATIONSHIP TO SEEDLING RESPONSES.
Alabama A and M Univ., Normal. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 3F.
W91-02074

INFLUENCE OF PLANT WATER STRESS ON NET PHOTOSYNTHESIS AND LEAF AREA OF TWO MAIZE (ZEA MAYS L.) CULTIVARS.
Orange Free State Univ., Bloemfontein (South Africa). Faculty of Agriculture.
For primary bibliographic entry see Field 3F.
W91-02075

METHODS USED FOR CALCULATION OF PLANT AVAILABLE WATER IN NORDIC TILL SOILS.
Copenhagen Univ. (Denmark).
For primary bibliographic entry see Field 2G
W91-02170

STATUS AND DISTRIBUTION OF FORESTED WETLANDS IN TROPICAL SOUTH AMERICA.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).

For primary bibliographic entry see Field 2H.
W91-02477

VENEZUELAN FLOODPLAIN STUDY ON THE ORINOCO RIVER.
Fundacion La Salle de Ciencias Naturales, San Felix (Venezuela). Estacion Hidrobiologica de Guayana.
For primary bibliographic entry see Field 2H.
W91-02478

WETLAND AND UPLAND FOREST ECOSYSTEMS IN PERUVIAN AMAZONIA: PLANT SPECIES DIVERSITY IN THE LIGHT OF SOME GEOLOGICAL AND BOTANICAL EVIDENCE.
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lima (Peru). Mission ORSTOM au Perou.
For primary bibliographic entry see Field 2H.
W91-02479

FLUVIAL DYNAMICS AND SUCCESSION IN THE LOWER UCAYALI RIVER BASIN, PERUVIAN AMAZONIA.
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lima (Peru). Mission ORSTOM au Perou.
For primary bibliographic entry see Field 2E.
W91-02480

PALM COMMUNITIES IN WETLAND FOREST ECOSYSTEMS OF PERUVIAN AMAZONIA.
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lima (Peru). Mission ORSTOM au Perou.
For primary bibliographic entry see Field 2H.
W91-02482

FLOODING AND SALTWATER INTRUSION: POTENTIAL EFFECTS ON SURVIVAL AND PRODUCTIVITY OF WETLAND FORESTS ALONG THE U.S. GULF COAST.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 4C.
W91-02489

2J. Erosion and Sedimentation

EFFECTS OF IRON CYCLING ON PB-210 DATING OF SEDIMENTS IN AN ADIRONDACK LAKE, USA.
Syracuse Univ., NY. Environmental Engineering Program.
C. P. Gubala, D. R. Engstrom, and J. R. White.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1821-1829, September 1990. 7 ref, 3 tab, 31 ref.

Descriptors: *Adirondack Mountains, *Diagenesis, *Iron, *Lake sediments, *Radioactive dating, *Sediment chemistry, *Sediment contamination, Acid lakes, Lead radioisotopes, Model studies, Sediment analysis, Sediment-water interfaces, Sedimentation rates.

In three cores from an acidic lake in the Adirondack State Park of New York, iron cycling accounted for diagenetic enrichment of up to 14% of sediment dry mass. The accuracy of the sediment accumulation rates calculated from the constant rate of supply (CRS) model and the dating and sediment accumulation rates calculated from the constant initial concentration (CIC) lead-210 models were affected by post-depositional movement of iron about the sediment-water interface and through the sediment. Dating biases from iron diagenesis reached as high as 57% and biases to calculated sediment accumulation rates ranged up to approximately 15%. The difference between the iron-corrected and uncorrected dating was not much greater than the error expected from routine analytical precision. However, under circumstances of low sediment accumulation rates and high iron enrichment, significant deviations in dating and sediment accumulation calculations for both CRS and CIC lead-210 models may become noteworthy. The accuracy of any sediment dating technique, normalized to dry sediment mass, should be carefully evaluated in low sedimentation rate environments which show evidence of post-depositional movement of iron or other diagenetically active materials. (Author's abstract)
W91-02071

INVESTIGATION OF THE COAGULATION MECHANISM OF THE SUSPENDED PARTICULATE MATTER IN COASTAL WATERS.
Patras Univ. (Greece). Physical Chemistry Lab.
A. Koliadima, E. Dalas, and G. Karaiskakis.
Water, Air and Soil Pollution WAPLAC, Vol. 51, No. 1/2, p 65-73, May 1990. 6 fig, 2 tab, 7 ref. International Atomic Energy Agency Grant No. 4621/EP.

Descriptors: *Coagulation, *Coastal waters, *Particle size, *Sediment concentration, *Suspended solids, Accumulation, Diffusion, Estuaries, Flocculation, Greece, Patras, Sedimentation.

The granulometry of the suspended matter in various coastal waters collected around Patras, Greece, together with the average particle diameters, have been determined during a twelve month period by a simple, quick, inexpensive and relatively accurate photosedimentometer. The particle size distributions were found to be self-preserving and independent of time, hydrologic regime, nature and amount of particulate materials and particle mobility. The experimental results show that Brownian diffusion is the dominant factor in flocculation processes in coastal waters. The flocculation processes of the suspended particles taking place when river meets sea water occur because of the increase of ionic strength during mixing. As a consequence, intensive sedimentation and accumulation of this material can occur generally in somewhat restricted zones in an estuary. (Brunone-PTT)
W91-02083

STREAM SEDIMENT LOADING AND RAINFALL--A LOOK AT THE ISSUE.
Economic Research Service, Washington, DC.
For primary bibliographic entry see Field 2B.
W91-02086

CONTROL OF MEIOBENTHIC ABUNDANCE BY MACROEPIFAUNA IN A SUBTIDAL MUDDY HABITAT.
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2L.
W91-02127

WATER DROPLET ENERGY AND SOIL AMENDMENTS: EFFECT ON INFILTRATION AND EROSION.
Soil and Irrigation Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 2G.
W91-02136

POLYMER EFFECTS ON EROSION UNDER LABORATORY RAINFALL SIMULATOR CONDITIONS.
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
M. Ben-Hur, J. Letey, and I. Shainberg.
Soil Science Society of America Journal SSSJD4, Vol. 54, No. 4, p 1092-1095, July/August 1990. 2 fig, 1 tab, 27 ref.

Descriptors: *Erosion, *Erosion control, *Infiltration rate, *Rainfall impact, *Rainfall infiltration, *Soil amendments, *Soil erosion, *Soil water, Fluid drops, Particulate matter, Polymers, Simulated rainfall, Soil aggregates, Surface sealing.

The effects of nonionic, anionic and two charge densities of cationic derivatized guar products on erosion and infiltration rates were investigated. The polymers were mixed with distilled water at concentrations from 0 to 20 g/cu m and applied through a rainfall simulator in the laboratory. Untreated distilled water was applied to an Arlington sandy loam soil (Haplic Durixeralf) with the soil surface both unprotected and protected by a fiberglass sheet placed 0.5 cm above the soil surface. All polymer treatments were applied to the unprotected soil surface. Distilled water drop impact greatly reduced infiltration rate and increased erosion, compared with no impact. The anionic and nonionic polymers did not significantly affect erosion or infiltration rate, compared with distilled water. The cationic polymers significantly increased infiltration rate and erosion. The higher charge cationic polymer produced significantly higher values than the lower charge polymer at the same concentration. The distilled water treatment with impact caused severe aggregate disruption and dispersion, producing a layer of fine material at the surface that decreased infiltration rate. Apparently, the very fine particulates became imbedded in the soil matrix, which made them less susceptible to lateral transfer with flowing water. The flocculating action of the cationic polymer created larger particulates, which had very little effect in reducing infiltration rate but were more susceptible to erosion. Under the conditions of the experiment, particulates between 0.05 and 0.25 mm were most susceptible to transport by a thin sheet of flowing water. (Author's abstract)
W91-02137

SLOPE, ASPECT, AND PHOSPHOGYPSUM EFFECTS ON RUNOFF AND EROSION.
Soil Erosion Research Station, Natanya (Israel).
For primary bibliographic entry see Field 2E.
W91-02139

HALITE DEPOSITIONAL FACIES IN A SOLAR SALT POND: A KEY TO INTERPRETING PHYSICAL ENERGY AND WATER DEPTH IN ANCIENT DEPOSITS.
ARCO Oil and Gas Co., Plano, TX.
C. R. Handford.
Geology GLGYBA, Vol. 18, No. 8, p 691-694, August 1990. 7 fig, 17 ref.

Descriptors: *Brines, *Chemical precipitation, *Crystallization, *Deposition, *Geologic history, *Halite, *Sedimentary structures, Aragonite, Evaporation ponds, Gypsum, Saline water, Salt pans, Salts, Sedimentary rocks.

Subaqueous deposits of aragonite, gypsum, and halite are accumulating in shallow solar salt ponds constructed in the Pekelmeer, a sea-level salina on Bonaire, Netherlands Antilles. Several halite facies are deposited in the crystallizer ponds in response to differences in water depth and wave energy. Cumulate halite, which originates as floating rafts, is present only along the protected, upwind margins of ponds where low-energy conditions foster their formation and preservation. Cornet crystals with peculiar mushroom and mortarboard shaped caps precipitate in centimeter deep brine sheets within a couple of meters of the upwind or low-energy margins. Downwind from these margins, cornet and chevron halite precipitate on the pond floors in water depths ranging from a few centimeters to approximately 60 cm. Halite pisoids with radial-concentric structure are precipitated in the swash zone along downwind high-energy shorelines where they form pebbly beaches. This study suggests that primary halite facies are energy and/or depth dependent and that some primary features, if preserved in ancient halite deposits, can be used to infer physical energy conditions, subenvironments such as low to high-energy shorelines, and extremely shallow water depths in ancient evaporite basins. (Author's abstract)
W91-02152

TILL GENESIS AND HYDROGEOLOGICAL PROPERTIES.
Norges Landbrukshoegskole, Aas.
For primary bibliographic entry see Field 2F.
W91-02165

ESTIMATING EROSION RISK ON FOREST LANDS USING IMPROVED METHODS OF DISCRIMINANT ANALYSIS.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
J. Lewis, and R. M. Rice.
Water Resources Research WRERAQ, Vol. 26, No. 8, p 1721-1733, August 1990. 2 fig, 6 tab, 37 fig, append.

Descriptors: *Discriminant analysis, *Erosion, *Forest soils, *Forest watersheds, *Land use, *Logging, *Risk assessment, *Soil erosion, Estimating equations, Forest hydrology, Model studies, Statistical analysis.

Excess erosion from logging and forest roads has long been of concern to forest managers and the general public. Studies in California concluded that the key to reducing erosion from logged areas was to identify critical sites yielding at least 189 cu m/ha; this led to a definition of a critical site as any 0.81 ha acre area enclosing more than 153 cu m of erosional voids. A population of 638 timber harvest areas in northwestern California was sampled for data related to the occurrence of critical amounts of erosion. Separate analyses were done for forest roads and logged areas. Linear discriminant functions were computed in each analysis to contrast site conditions at critical plots with randomly selected controls. Bootstrapping was used extensively in the development and testing of the equations, in estimating prediction bias, and in placing confidence limits around parameters and posterior probabilities. The resulting three-variable equations had classification accuracy, corrected for prediction bias, of 77.7% for road plots and 69.2% for logged area plots. The variables appear to be expressing three important site conditions related to erosion risk: (1) instability-promoting effects of gravity (slope steepness), (2) the convergence of subsurface water, and (3) strength of materials (parent rock strength). The use of linear discriminant functions facilitates the explicit consideration of erosion risk when planning land-disturbing activities. None of the steps required for the utilization of the equations are particularly difficult, but they do require a more rigorous approach to erosion risk analysis. (Tappert-PTT)
W91-02181

COMPARATIVE EVALUATION OF FIVE TOXICITY TESTS WITH SEDIMENTS FROM SAN FRANCISCO BAY AND TOMALES BAY, CALIFORNIA.
National Ocean Service, Seattle, WA. Ocean Assessments Div.
For primary bibliographic entry see Field 5A.
W91-02218

IMPACT OF SOIL SURFACE DETERIORATION ON RUNOFF PRODUCTION IN THE ARID AND SEMI-ARID ZONES OF WEST AFRICA.
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lome (Togo). Centre ORSTOM du Togo.
For primary bibliographic entry see Field 4C.
W91-02296

FAN-DELTA AND BRAID-DELTA SYSTEMS IN PENNSYLVANIAN SANDIA FORMATION, TAOS TROUGH, NORTHERN NEW MEXICO: DEPOSITIONAL AND TECTONIC IMPLICATIONS.
Texas Univ. at Dallas, Richardson. Inst. for Geosciences.
K. Soegaard.
Geological Society of America Bulletin BUGMAF, Vol. 102, No. 10, p 1325-1343, October 1990. 14 fig, 2 tab, 79 ref.

Descriptors: *Alluvial channels, *Channel morphology, *Deltas, *Geology, *Geomorphology, *Paleohydrology, *Sedimentary basins, *Tectonics, Alluvial deposits, Alluvial fans, New Mexico, Pennsylvanian Sandia Formation, Sandstones, Sedimentation rates, Taos Trough.

Fan-delta and braid-delta deposits were distinguished in the Pennsylvanian Sandia Formation, Taos Trough, New Mexico. Fan deltas were deposited in close proximity to the active western boundary fault of the Taos Trough and occur as coarse-grained aggradational sequences. Alluvial processes in fan-delta complexes were characterized by unrestricted sheetflood and ephemeral stream flow deposition. Subaqueously deposited, fan-delta conglomerates and sandstones arranged in lenticular units encased by basinal mudstones were emplaced by a variety of high density and dilute gravity flow processes. Braid-delta complexes were characterized by channelized alluvial deposition in which discharge was variable, but perennial. Perennial discharge in the braid deltas was in response to expansion of the drainage area in the Taos Trough hinterland through time. This resulted in increased sediment discharge into the trough and enabled basinward extension of the alluvial plain by braid-delta progradation. It is concluded that fan deltas are associated with steep basin margins in which overall subsidence rates exceed sedimentation rates. Braid deltas are related to low gradient basin margins along which sedimentation rates are greater than subsidence rates. Distribution of fan-delta and braid-delta complexes in the Sandia Formation is dictated by tectonic load-induced subsidence in the Taos Trough and may be used as a guide for resolving evolutionary history of other types of active sedimentary basins. (Author's abstract)
W91-02519

EFFECTS OF GLACIAL SURGING ON SEDIMENTATION IN A MODERN ICE-CONTACT LAKE, ALASKA.
Illinois Univ. at Chicago Circle. Dept. of Geological Sciences.
N. D. Smith.
Geological Society of America Bulletin BUGMAF, Vol. 102, No. 10, p 1393-1403, October 1990. 13 fig, 1 tab, 42 ref. NSF Grants DPP84-20807 and 86-18789.

Descriptors: *Glacial lakes, *Glacier surges, *Glaciers, *Glaciohydrology, *Lake sediments, *Sedimentation, Alaska, Carroll Glacier, Erosion, Glacier Bay, Lake basins, Sediment concentration, Sediment load, Sedimentation rates, Suspended sediments.

In June 1987, Carroll Glacier (Glacier Bay, southeast Alaska) began to surge southeastward toward Wachusett Inlet. Between 9 June and 1 July 1987, the terminus advanced with a mean velocity of 29 m/day, slowing afterward but attaining a net displacement of >1 km by July 1988. A proglacial lake lay directly in the path of the surge and became partly overridden, with only 25% of its former basin remaining exposed after 1 yr. The effects of the ice advance on the lake were profound. Early in the surge, lake water samples attained suspended sediment concentrations exceeding 9 g/L well above bottom. Extremely rapid sedimentation, locally attaining 8 m in 36 days, produced nearly uniform depths of 8-9.5 m by August 1987. Sediment deposited during the surge was extremely soft and underconsolidated, composed of massive to irregularly layered muddy silt produced by disruptions of the lake floor and by remobilization of lake bottom sediment by sediment gravity flows. A prominent push moraine, developed from a low ridge initiated by glacial loading, formed where the glacier overrode sandy substrate, but no similar feature was observed in the muddy lake floor. By July 1988, the surge had greatly diminished, and the remaining lake basin was slowly uplifted by displacement from the weight of the ice. By the end of August 1988, most of the lake floor was completely exposed and undergoing erosion by meltwater channels, causing abnormally high suspended sediment loads at the outlet compared to the previous year when the lake was an effective sediment sink. (Author's abstract)
W91-02520

CONTROLLING MECHANISM OF LOCAL SCOURING.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering.
B. Dargahi.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 10, p 1197-1214, October 1990. 11 fig, 14 ref.

Descriptors: *Channel erosion, *Erosion, *Flow around objects, *Scour, *Sediment transport, *Vortices, Boundary layers, Clear water, Flow, Mathematical analysis, Mathematical equations, Turbulent flow.

Experimental study of clear water scouring around a circular cylinder showed that the scour mechanism is coupled to the three-dimensional separation of the upstream boundary layer and the periodic vortex shedding in the wake of the cylinder. The first scour appears in the wake of the cylinder. The main scouring in the upstream region is a system of horseshoe vortices. The vortices have a periodical character that causes a triple-scour effect to develop in the upstream region. During scouring, the number and periods of horseshoe vortex shedding undergo no appreciable change. Despite the clear water stage, the transport phenomenon is periodical. Transport of sediment takes place through turbulent scales of comparable size to macro-length scales. The size of the horseshoe vortices is representative for the macroscale. Wake scouring is caused by the primary wake vortices and the accelerated side flow. The process is characterized by a strong periodical transport and the formation of ripples. The periodicity is controlled by the shedding frequency of the wake vortices. Collars attached to the cylinder cannot prevent the formation of the vortices. (Author's abstract)
W91-02523

FIELD VERIFICATION OF 2-D AND 3-D SUSPENDED-SEDIMENT MODELS.
Waterloopkundig Lab. te Delft (Netherlands).
L. C. van Rijn, H. van Rossum, and P. Termes.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 10, p 1270-1288, October 1990. 11 fig, 1 tab, 13 ref, append.

Descriptors: *Model studies, *Model testing, *Sediment concentration, *Sediment transport, *Suspended sediments, Eastern Scheldt Estuary, Estuarine sediments, Flow velocity, The Netherlands, Unsteady flow.

A tidal channel in the Eastern Scheldt estuary in the Netherlands was closed by pumping a sand-water mixture into the closure gap. During the closure, field measurements of flow velocities and sand concentrations were carried out. Based on the results of the field measurements, computations with two-dimensional and three-dimensional sediment transport models were performed. The two-dimensional computations showed that the depth-integrated transport rates could be reasonably predicted (within a factor of 2) in case of diverging flow. However, less satisfactory results were obtained for converging flow. The three-dimensional computations showed quite good agreement between measured and predicted flow velocities, sediment concentrations, and transport rates, both for flood and ebb flow. A sensitivity analysis with respect to the time-dependent concentration term, the shape of the velocity profiles, the turbulent mixing coefficients, and the bed material gradation indicated no significant influence of these parameters. The main reason for the difference between measured and predicted results was caused by the formula modeling the sediment pickup rate (at the bottom). (Author's abstract)
W91-02527

MISSISSIPPI RIVER-GULF OUTLET, LOUISIANA: FIELD DATA REPORT.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2E.
W91-02604

STUDY OF EMBANKMENT PERFORMANCE DURING OVERTOPPING AND THROUGHFLOW. REPORT 2: HYDRAULIC STUDY AND MODELING OF MODELS.
Colorado Univ., Boulder.

For primary bibliographic entry see Field 8B.
W91-02608

STUDY OF EMBANKMENT PERFORMANCE DURING OVERTOPPING AND THROUGH-FLOW. REPORT 3: MODEL-PROTOTYPE COMPARISON STUDIES.
Colorado Univ., Boulder.
For primary bibliographic entry see Field 8B.
W91-02610

SEDIMENT-WATER-EQUILIBRIA: THE SORPTION OF VOLATILE CHLORINATED HYDROCARBONS AND DICHLORO BENZENES BY SEDIMENTS. (SEDIMENT-WASSER-GLEICHGEWICHTE: VERHALTEN FLUCHTIGER CHLORKOHLENWASSERSTOFFE UND DER DICHLORBENZOLE AN GEWASSERSEDIMENTEN).
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
For primary bibliographic entry see Field 5B.
W91-02668

GEOSTATIC COMPACTION BEHAVIOUR OF KAOLIN MUDS--EFFECTS OF DIFFERENT SAMPLE PREPARATION PROCEDURES.
Kiel Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum.
V. Feeser, and H. Knoke.
Applied Clay Science ACLSER, Vol. 5, No. 1, p 67-83, May 1990. 8 fig, 3 tab, 18 ref.

Descriptors: *Clays, *Consolidation sedimentation, *Laboratory methods, *Sample preparation, *Sedimentology, *Soil compaction, *Soil mechanics, Boundary conditions, Fabrics, Mud-water interfaces, Slurries.

Experimental laboratory studies of initial compaction mechanisms in clay muds may be performed either by artificially sedimented samples or by simple stirred pastes (without consideration as to application of the results for natural processes). Little intensive research has been performed on the differences in the two preparation procedures. Homogeneous kaolin was geostatically consolidated in the laboratory. Samples were prepared by mixture of a clay-water slurry and sedimentation with clay-water suspension. The stress-strain behavior was analyzed by rigid analytical and experimental boundary conditions. It was found that the method of sample preparation does not qualitatively affect the initial compaction behavior of clay muds. The correlations between compression and swelling parameters indicate that all the samples, regardless of the method of preparation and the resulting differences in fabric, show no significant differences in plastic potential. Less deformation work needs to be performed to consolidate sedimented samples than is the case with stirred samples. With regard to reproducibility, significance, and application of correlations between physicochemical and mechanical behavior, normal soil mechanical standards are not sufficient to reveal all the mechanisms of clay mud compaction. Stirred samples can be used for basic research in studies of material laws without affecting qualitatively the degree of prediction. Sedimented samples adapted to the respective environment must be employed if a direct application to natural conditions is desired. These results are in contrast to previous findings. (Fish-IT)
W91-02802

LARGE-SCALE FLOODPLAIN MODELLING.
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 2E.
W91-02808

HYDROLOGICAL RESPONSE OF SOIL SURFACES TO RAINFALL AS AFFECTED BY COVER AND POSITION OF ROCK FRAGMENTS IN THE TOP LAYER.
Katholieke Univ. Leuven (Belgium). Lab. voor Experimentele Geomorfologie.
D. Poesen, F. Ingelmo-Sanchez, and H. Mucher.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 7, p 653-671, November 1990. 12 fig, 2 tab, 53 ref. Commission of the European Communities D. G. XII contract no. EV4V-0112-C.

Descriptors: *Infiltration, *Rainfall-runoff relationships, *Soil erosion, *Soil properties, *Soil surfaces, *Topsoil, Hydraulic conductivity, Hydrologic models, Model studies, Morphology, Overland flow, Runoff coefficient, Runoff volume, Saturated soils, Surface sealing.

Rainfall experiments have been conducted in the laboratory in order to assess the hydrological response of topsoils very susceptible to surface sealing and containing rock fragments in different positions with respect to the soil surface. For a given cover level, rock fragment position in the topsoil has an ambivalent effect on water intake and runoff generation. Compared to a bare soil surface rock fragments increase water intake rates as well as time of runoff concentration and decrease runoff volume if they rest on the soil surface. For the same cover level, rock fragments reduce infiltration rate and enhance runoff generation if they are well-embedded in the top layer. The effects of rock fragment position on infiltration rate and runoff generation are proportional to cover percentage. Micromorphological analysis and measurements of the saturated hydraulic conductivity of bare topsoils and of the top layer underneath rock fragments resting on the soil surface reveal significant differences; runoff generated as rock flow or as Horton overland flow can (partly) infiltrate into the unsealed soil surface under the rock fragments, provided that they are not completely embedded in the top layer. Hence, rock fragment position, beside other rock fragment properties, should be taken into account when assessing the hydrological response of soils susceptible to surface sealing and containing rock fragments in their surface layers. A simple model, based on the proportions of bare soil surface, soil surface occupied by embedded rock fragments, and soil surface covered with rock fragments resting on the soil surface, describes the runoff coefficient data relatively well. (Author's abstract)
W91-02812

NOURISHMENT OF PERCHED SAND DUNES AND THE ISSUE OF EROSION CONTROL IN THE GREAT LAKES.
Michigan Univ.-Flint. Dept. of Resource Science.
W. M. Marsh.
Environmental Geology and Water Sciences EGWSEI, Vol. 16, No. 2, p 155-164, 1990. 6 fig, 1 tab, 24 ref.

Descriptors: *Dunes, *Erosion control, *Great Lakes, *Lake shores, *Wind erosion, Aeolian deposits, Lake management, Sand, Vegetation effects, Water level fluctuations.

Although limited in coverage, perched sand dunes situated on high coastal bluffs are considered the most prized of Great Lakes dunes. Grand Sable Dunes on Lake Superior and Sleeping Bear Dunes on Lake Michigan are featured attractions of national lakeshores under National Park Service management. The source of sand for perched dunes is the high bluff along their lakeward edge. As onshore wind crosses the bluff, flow is accelerated upslope, resulting in greatly elevated levels of wind stress over the slope brow. On barren, sandy bluffs, wind erosion is concentrated in the brow zone, and for the Grand Sable Bluff, it averaged 1 cu m/yr per linear meter along the highest sections for the period 1973-1983. This mechanism accounts for about 6,500 cu m of sand nourishment to the dunefield annually and clearly has been the predominant mechanism for the long-term development of the dunefield. However, wind erosion and dune nourishment are possible only where the bluff is denuded of plant cover by mass movements and related processes induced by wave erosion. In the Great Lakes, wave erosion and bluff retreat vary with lake levels; the nourishment of perched dunes is favored by high levels. Lake levels have been relatively high for the past 50 years, and shore erosion has become a major environmental issue leading property owners and politicians to support lake-level regulation. Trimming high water levels could reduce geomorphic activity on high bluffs and affect dune nourishment rates. Locally, nourishment also may be influenced by sediment accumulation associated with harbor protection facilities and by planting programs aimed at stabilizing dunes. (Author's abstract)
W91-02821

SPATIAL UNIFORMITY OF POWER AND THE ALTITUDINAL GEOMETRY OF RIVER NETWORKS.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 2E.
W91-02860

WIDTH AND DEPTH OF SELF-FORMED STRAIGHT GRAVEL RIVERS WITH BANK VEGETATION.
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-02865

METAL-ORGANIC ASSOCIATIONS IN SEDIMENTS--I. COMPARISON OF UNPOLLUTED RECENT AND ANCIENT SEDIMENTS AND SEDIMENTS AFFECTED BY ANTHROPOGENIC POLLUTION.
Munich Univ. (Germany, F.R.). Mineralogisch-Petrographisches Inst.
For primary bibliographic entry see Field 5B.
W91-02891

METAL-ORGANIC ASSOCIATIONS IN SEDIMENTS--II. ALGAL MATS IN CONTACT WITH GEOTHERMAL WATERS.
Munich Univ. (Germany, F.R.). Mineralogisch-Petrographisches Inst.
A. V. Hirner, R. E. Krupp, A. R. Gainsford, and H. Staerk.
Applied Geochemistry APPGEY, Vol. 5, No. 4, p 507-513, July/August 1990. 1 fig, 3 tab, 40 ref.

Descriptors: *Algae, *Chemical interactions, *Geothermal water, *Metals, *Organic matter, *Sediments, *Water chemistry, Arsenic, Cesium, Iron, Kerogen, Lanthanum, New Zealand, Phosphorus, Tin, Trace elements, Zinc.

Organic matter from living algal mats and their decay products from mud pools of the geothermal areas at Rotokawa and Waimangu, New Zealand, was separated into solvent-extractable and protokerogen fraction. Fourteen elements were determined in the bulk samples and the solvent extractable fractions by optical emission spectroscopy, and 15 elements (including some rare earth elements) in the protokerogen concentrates by instrumental neutron activation analysis. Many elements were strongly enriched in the organic fractions as compared to the bulk sample: concentrations in the extracts are of the order of grams per kg for P, Zn and Sb, and 10g/kg for As; those in protokerogens are 10 g/kg for Fe and Sb, and 100 mg/kg for La and Ce. The results demonstrate that in contact with metal-rich geothermal waters, biogenic material is able to incorporate high amounts of metals into the organic matrix. While inorganic contributions to the solvent-extractable fractions are shown to be minimal, the presence of inorganic microinclusions in protokerogen concentrates cannot be excluded. (See also W91-02891) (Author's abstract)
W91-02892

CORRELATION OF EROSION MEASUREMENTS AND SOIL CAESIUM-137 CONTENT.
Soil Conservation Service, Gunnedah (Australia).
G. L. Elliott, B. L. Campbell, and R. J. Loughran.
International Journal of Radiation Applications & Instrumentation. A, Appl. Radiation & Isotopes ARISEF, Vol. 41, No. 8, p 713-717, 1990. 2 fig, 1 tab, 43 ref.

Descriptors: *Cesium radioisotopes, *Erosion, *Land use, *Regression analysis, *Soil erosion, *Tracers, Australia, Cultivated lands, Data inter-

pretation, Land management, Rills, Sheet erosion, Soil management.

Progress in erosion research has been substantially restrained because there is no simple technique for the estimation of long-term soil loss rates. A technique has been developed that uses a calibration between measured soil loss from small plots with measured soil CS-137 content (expressed as a percentage loss relative to the Cs-137 content of a local stable reference soil). Sites of soil loss measurement throughout Australia were sampled by coring to determine their relative Cs-137 content. Measurements made on erosion/runoff plots are confined to the effects of shallow, ephemeral rills and sheet erosion by water. Plotting the average soil loss results against residual cesium content relative to a local, stable reference site indicated that their relationship was exponential. Soil loss data were therefore log-transformed and a regular regression analysis was performed on the data. Precision was considerably improved by partitioning the data into sets for cultivated soils and pasture land. These regressions were highly significant for pasture plot results and for cultivated sites. The measured soil losses form erosion/runoff plots are real data which may be extrapolated to other areas if an acceptable correlation is found with an easily measured soil attribute. The 95% confidence limits on the regressions reflect real field variability. Comparisons of prediction of soil erosion by the regression method and by the proportional method indicate that estimates by the proportional method are approximately 10 times greater. The regression represents a simple and rapid tool for the estimation of net soil loss from sites which have a uniform and continuous history of land-use. (Fish-PTT)
W91-02913

MODELING CHANNEL BED TRANSIENTS USING EXPLICIT F-D SCHEMES.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-02918

TURBULENT SHEAR STRESS IN HETEROGENEOUS SEDIMENT-LADEN FLOWS.
Korea Inst. of Construction Technology, Seoul.
H. Woo, and P. Y. Julien.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 11, p 1416-1421, November 1990. 1 fig, 1 tab, 6 ref, append.

Descriptors: *Alluvial channels, *River mechanics, *Sediment transport, *Shear stress, *Turbulent flow, Fall velocity, Open-channel flow, Particle size, Sediment discharge, Sedimentation rates, Settling velocity.

Current knowledge of the mechanics of alluvial channels depends very largely on calculations of turbulent shear stress; typical examples are the beginning of motion of sediment particles and sediment transport in alluvial channels. Comparatively little is known about shear stresses in sediment-laden flows. The analysis of turbulent shear stress for steady-uniform flows carrying heterogeneous sediment mixtures provides additional insight on the role played by sediment size gradation and fall velocity by size fraction. A derivation has been developed of turbulent stress in heterogeneous sediment-laden flows, and considers the steady and uniform motion of this flow type in an open channel. These relationships demonstrate that the average velocity in the vertical direction is not zero but proportional to the fall velocity of sediment particles and the concentration of each size fraction. The derivation shows that turbulent shear stress in sediment-laden flows is similar to that of the water flow except that the fluid mass density is replaced with the density of the water sediment mixture. It was concluded that the sediment size distribution and the fall velocity of sediment particles do not affect turbulent shear stress of heterogeneous sediment mixtures under steady-uniform flow conditions. (Author's abstract)
W91-02923

FIRST STEP AWAY FROM LACEY'S REGIME EQUATIONS.
For primary bibliographic entry see Field 8B.
W91-02924

BED CONFIGURATIONS IN STEADY UNIDIRECTIONAL WATER FLOWS: PART I. SCALE MODEL STUDY USING FINE SANDS.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
For primary bibliographic entry see Field 2E.
W91-02925

BED CONFIGURATIONS IN STEADY UNIDIRECTIONAL WATER FLOWS: PART II. SYNTHESIS OF FLUME DATA.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
For primary bibliographic entry see Field 2E.
W91-02926

BED CONFIGURATIONS IN STEADY UNIDIRECTIONAL WATER FLOWS: PART III. EFFECTS OF TEMPERATURE AND GRAVITY.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
For primary bibliographic entry see Field 2E.
W91-02927

FLUME EXPERIMENTS ON THE TRANSPORT OF HEAVY MINERALS IN GRAVEL-BED STREAMS.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
R. A. Kuhnle, and J. B. Southard.
Journal of Sedimentary Petrology JSEPAK, Vol. 60, No. 5, p 687-696, September 1990. 9 fig, 2 tab, 40 ref. Anglovaal Mining Company, the MIT Department of Earth, Atmospheric, and Planetary Sciences, and the National Science Foundation Grant EAR 84-15466.

Descriptors: *Flow models, *Flumes, *Hydraulic models, *Minerals, *Sediment transport, Channel flow, Degradation, Erosion, Gravel, Sedimentation, Slopes, Stream discharge, Streamflow data.

Heavy-mineral transport and deposition by shallow unidirectional flows in a gravel-bed channel were studied in a water-recirculating sediment-feed flume. The heavy minerals became concentrated into a thin layer (the heavy infralayer) composed of nearly 100% heavy minerals lying beneath a thin surficial layer of low-density sediment (the light supralayer). Heavy minerals were not transported past a given location on the bed until the heavy infralayer was fully developed there. Heavy minerals were transported on the upper surface of the heavy infralayer only when local and temporary erosion of the light supralayer exposed the heavy infralayer. In two runs, one with sediment feed and one without, overall degradation of the bed was forced by slow lowering of a tailgate at the downstream end of the channel. In the sediment-feed run a downstream-prograding heavy infralayer formed as in the nondegrading runs. In the run without feed, the surficial heavy-mineral concentration increased gradually at all points along the channel to the end of the run. These results indicate that ultimately the surficial heavy-mineral concentration would reach a steady state and the bed slope would change until the flow can transport all of the heavy-mineral sediment supplied by local exhumation. A too-small initial slope caused overall bed aggradation in the early parts of two runs. Heavy minerals in the feed sediment were transported only a short distance downstream to form a zone of higher but downstream-decreasing heavy mineral concentration extending vertically through the deposit. It is hypothesized that the downstream length of this zone would increase as the heavy-mineral feed rate increases relative to the bed aggradation rate. (Author's abstract)
W91-02928

GLACIOMARINE SEDIMENTATION IN DISRAELI FJIORD, HIGH ARCTIC CANADA.
Alberta Univ., Edmonton. Dept. of Geography.
D. S. Lemmen.
Marine Geology MAGEA6, Vol. 94, No. 1/2, p 9-22, July 1990. 8 fig, 1 tab, 69 ref. Natural Sciences and Engineering Research Council of Canada grant A6680; Boreal Institute for Northern Studies, University of Alberta grant.

Descriptors: *Arctic zone, *Canada, *Fjords, *Glacial sediments, *Glaciohydrology, *Glaciology, *Sediment transport, *Sedimentation, Climatic changes, Deposition, Ellesmere Island, Geologic history, Glacial drift, Glaciation, Glaciers, Holocene Epoch, Sea ice, Sedimentation rates, Settling velocity, Snowmelt.

Disraeli Fjiord, in High Arctic Canada, represents a glaciomarine environment unique to the north coast of Ellesmere Island, featuring floating glacier tongues, multi-year landfast sea ice and a strongly stratified water body which results from enclosure of the fiord by Ward Hunt Ice Shelf. It is a very low energy depositional environment, even at sites proximal to glaciers. Sediment enters the fiord by interflow and is deposited through suspension settling. Ice rafting is precluded by the year-round sea ice cover. Sedimentation rates in the inner fiord since about 7000 years B.P. are estimated to be 5-10 cm/ka, a reflection of the limited sediment influx from cold-based glaciers which contact the fiord. Changes in sediment structure through the Holocene reflect changes in the rate and process of sediment input as well as changes in fiord circulation, all of which relate to regional climate. During deglaciation (early Holocene) sedimentation rates were orders of magnitude greater than at present. Subglacial meltwater was the dominant source of inflow, with sediment transported in turbid plumes as overflow or interflow and deposited through suspension settling. This is supportive of other studies indicating that a pronounced climatic amelioration led to warm-based glaciers at this time. (Author's abstract)
W91-02929

INTEGRATED CHEMICAL AND BIOLOGICAL STUDY OF THE BIOAVAILABILITY OF METALS IN SEDIMENTS FROM TWO CONTAMINATED HARBOURS IN NEW BRUNSWICK, CANADA.
Environmental Protection Service, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 5B.
W91-02931

2K. Chemical Processes

HALITE DEPOSITIONAL FACIES IN A SOLAR SALT POND: A KEY TO INTERPRETING PHYSICAL ENERGY AND WATER DEPTH IN ANCIENT DEPOSITS.
ARCO Oil and Gas Co., Plano, TX.
For primary bibliographic entry see Field 2J.
W91-02152

PRECONCENTRATION OF COPPER ON ALGAE AND DETERMINATION BY SLURRY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY.
Texas Univ. at Austin. Dept. of Chemistry and Biochemistry.
For primary bibliographic entry see Field 5A.
W91-02191

ENZYME-LINKED IMMUNOSORBENT ASSAY COMPARED WITH GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR THE DETERMINATION OF TRIAZINE HERBICIDES IN WATER.
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5A.
W91-02192

SLOWLY REVERSIBLE SORPTION OF ALIPHATIC HALOCARBONS IN SOILS. I. FORMATION OF RESIDUAL FRACTIONS.
Connecticut Agricultural Experiment Station

New Haven. Dept. of Soil and Water.
For primary bibliographic entry see Field 5B.
W91-02209

COMPARISON OF QUARTER-HOURLY ON-LINE DYNAMIC HEADSPACE ANALYSIS TO PURGE-AND-TRAP ANALYSIS OF VARYING VOLATILE ORGANIC COMPOUNDS IN DRINKING WATER SOURCES.
Drexel Univ., Philadelphia, PA. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-02219

WATER-QUALITY CHARACTERISTICS OF THE COLUMBIA PLATEAU REGIONAL AQUIFER SYSTEM IN PARTS OF WASHINGTON, OREGON, AND IDAHO.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02223

GEOCHEMISTRY OF THE STRATIFIED-DRIFT AQUIFER IN KILLBUCK CREEK VALLEY WEST OF WOOSTER, OHIO.
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02286

GROUNDWATER QUALITY IN RURAL AREAS IN WESTERN AFRICA.
International Bank for Reconstruction and Development, Abidjan (Ivory Coast). Regional Water and Sanitation Group.
For primary bibliographic entry see Field 2F.
W91-02336

CORROSIVITY PROBLEMS IN RURAL WATER SUPPLY PROJECTS IN SAHELIAN AREAS OF WEST AFRICA.
BCEOM Consulting and Management, Rome (Italy).
For primary bibliographic entry see Field 2F.
W91-02337

IMPACT OF HANDPUMP CORROSION ON WATER QUALITY.
International Bank for Reconstruction and Development, Abidjan (Ivory Coast). Regional Water and Sanitation Group.
For primary bibliographic entry see Field 5F.
W91-02338

DISSOLUTION OF DISSEMINATED CALCITE IN QUARTZ VEINS OF BIRRIMIEN SCHISTS IN BURKINA FASO AS A KEY TO A POSSIBLE AQUIFER MODEL.
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 2F.
W91-02346

BIOLOGIC CALCITE PRECIPITATION AND TROPHIC STATE OF HARDWATER LAKES.
Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
For primary bibliographic entry see Field 2H.
W91-02377

MEASUREMENT AND CALCULATION OF NITROGEN FIXATION IN WATER BODIES.
Humboldt-Univ. zu Berlin (German D.R.). Sektion Biologie.
R. Dudel, M. Schlangstedt, A. Heder, and J. G. Kohl.
Archiv fuer Hydrobiologie ERLIA6, Vol. 33, No. 3, p 723-731, 1990. 4 fig, 2 tab, 28 ref.

Descriptors: *Analytical techniques, *Limnology, *Nitrogen cycle, *Nitrogen fixation, *Stagnant water, *Water analysis, Acetylene reduction, Enzymes, Hydrogen, Light effects, Nitrogenase.

An optimal test system for the use of the acetylene reduction technique to determine the nitrogenase activity and the calculation of atmospheric nitrogen input to stagnant water bodies requires rapid measurements over a small range of substrate concentrations, especially in the case of a narrow vapor-aqueous phase relation. An equation is presented for the calculation of real optimal acetylene concentrations in the aqueous phase at different aqueous-vapor phase relations and variable injection volumes. Comparison of the acetylene reduction with the real dinitrogen fixation showed that the commonly assumed conversion factor of 3 is untenable. In the course of a simulated light-dark cycle a substantial dark acetylene reduction was observed. Relatively high rates were measurable immediately after the beginning of the light period. This discrepancy of acetylene and dinitrogen reduction rates can be explained in the context of the hydrogenase function of nitrogenase. Steady state uptake kinetics show that with substrate-saturated N2 assimilation one mole of H2 is produced per mole of fixed N2. Therefore the assumed theoretical factor must not be lower than 4. The relatively high conversion factors could be explained by using acetylene as substrate; the whole electron flow capacity of the nitrogenase complex is used. Under this condition H2 production may be completely inhibited. Therefore a considerable overestimation of the dinitrogen input calculated from acetylene reduction rates occurs if a conversion factor is used without regarding its light dependence. (Author's abstract)
W91-02378

ORGANIC SOLVENT-SOLUBLE CONTENTS OF NICKEL AND COBALT IN SOME ALGAE.
Mainz Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie und Analytische Chemie.
For primary bibliographic entry see Field 5B.
W91-02401

RELATIONSHIP BETWEEN MIXING PROCESS AND CONCENTRATIONS OF MAJOR IONS IN SPANISH MEDITERRANEAN BRACKISH WATERS.
Barcelona Univ. (Spain). Dept. de Ecologia.
P. Lopez.
Archiv fuer Hydrobiologie AHYBA4, Vol. 119, No. 2, p 231-241, 1990. 3 fig, 3 tab, 28 ref.

Descriptors: *Brackish water, *Coastal waters, *Saline-freshwater interfaces, *Water chemistry, Calcium, Carbonates, Chlorides, Gypsum, Ions, Magnesium, Mediterranean Sea, Potassium, Seas, Sodium, Sulfates.

The chemical composition of 17 coastal systems located in the Mediterranean Spanish basin was studied in order to identify the main processes controlling the concentrations of major ions (HCO3(-), Cl(-), SO4(2-), Ca(2+), Mg(2+), Na(+), K(+)) in the brackish waters of the region. Theoretical concentrations of ions were calculated assuming a single mixing process between seawater and mineralized freshwaters. In the El Hondo area, seawater and freshwater inputs entered the lagoons partially by underground inflow, leaching areas with gypsum deposits. Both sea and freshwaters were undersaturated with respect to gypsum, so redissolution took place, increasing the concentrations of Ca(2+) and SO2(2-). A good correlation between percentage of seawater and concentrations of Na(+), SO2(2-) and Mg(2+) was found at El Hondo. Ca(2+) concentration was more independent of seawater and the mixing process due to the participation of Ca(2+) in chemical precesses. On the Valencia coast, the systems studied always received a very low percentage of seawater, so this parameter was not correlated to observed ionic concentrations. Highly significant coefficients found between observed and predicted values for Na(+), SO2(2-) and Mg(2+) would be due to freshwater influence. As in El Hondo area, reaction between seawater and fluvial clays involved a decrease of K(+) concentration, which in this area was not compensated by marine contribution. In the Castellon region, there were no perennial rivers entering the lagoons and inflow was by groundwater upwelling, seawater filtration through sand barriers and ephemeral runoff. The substrate was mainly calcareous, so redissolution of calcite took place causing an increase in HCO3(-) and Ca(2+) inputs. In the regions studied, Na(+) was the only ion that could be considered dependent on the proportion of seawater alone. SO4(2-), Mg(2+), and K(+) were also greatly influenced by marine inputs, but their concentrations were modified by geological, hydrological and biological factors. (Mertz-PTT)
W91-02456

HYDROGEOCHEMICAL AND ISOTOPICAL INVESTIGATIONS OF GROUND AND SURFACEWATERS AT THE SOUTHWEST EDGE OF THE HARZMOUNTAINS DURING AN ARTIFICIAL INDUCED HIGH WATER (HYDROGEOCHEMISCHE UND ISOTOPENCHEMISCHE UNTERSUCHUNGEN AN GRUND UND OBERFLACHENWASSERN AM SUDWESTRAND DES HARZES WAHREND EINES KUNSTLICH INDUZIERTEN HOCHWASSERS).
Goettingen Univ. (Germany, F.R.). Sedimentpetrographisches Inst.
M. E. Bottcher, and I. Rienacker.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 23, No. 4, p 136-140, August 1990. 5 fig, 2 tab, 21 ref. English summary.

Descriptors: *Acid rain, *Artificial recharge, *Geochemistry, *Path of pollutants, *Stable isotopes, *Water chemistry, Germany, *Surface-groundwater relations, Springs, Karst hydrology, Sulfur radioisotopes, Oder River, Basin of Pohlde, Rhume River, Harz Mountains.

An investigation was conducted during a dry period of weather in August 1988, the influence of artificially high water at the Oder River on the hydrochemical and isotopic composition of karstwaters from the 'Basin of Pohlde', and the springs of the Rhume River. For the first time, the separate effects of the infiltrating Oder River water on the discharge and hydrochemical composition of the springs were clearly demonstrated. In response to the high water, the well water BL5 showed a complex subsurface mixing behavior. The delta S-34 values of the dissolved sulfate indicated 18 to 36 mg/L of anthropogenic sulfate. (Author's abstract)
W91-02545

TYPE OF SUSPENDED CLAY INFLUENCES LAKE PRODUCTIVITY AND PHYTOPLANKTON COMMUNITY RESPONSE TO PHOSPHORUS LOADING.
Hampton Univ., VA. Center for Marine and Environmental Studies.
For primary bibliographic entry see Field 2H.
W91-02586

QUANTITATIVE ASSESSMENT OF THE SOURCES AND GENERAL DYNAMICS OF TRACE METALS IN A SOFT-WATER LAKE.
Lancaster Univ. (England). Inst. of Environmental and Biological Sciences.
For primary bibliographic entry see Field 5B.
W91-02587

SEDIMENT-WATER-EQUILIBRIA: THE SORPTION OF VOLATILE CHLORINATED HYDROCARBONS AND DICHLORO BENZENES BY SEDIMENTS. (SEDIMENT-WASSER-GLEICHGEWICHTE: VERHALTEN FLUCHTIGER CHLORKOHLENWASSERSTOFFE UND DER DICHLORBENZOLE AN GEWASSERSEDIMENTEN).
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
For primary bibliographic entry see Field 5B.
W91-02668

HYDROGEOLOGY AND WATER CHEMISTRY IN THE WEATHERED CRYSTALLINE ROCKS OF SOUTHWESTERN NIGERIA.
Loughborough Univ. of Technology (England). Dept. of Civil Engineering.

For primary bibliographic entry see Field 2F.
W91-02691

FROM RAIN TO LAKE: WATER PATHWAYS AND CHEMICAL CHANGES.
Oslo Univ. (Norway). Dept. of Geology.
I. T. Rosenqvist.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 3-10, August 1990. 2 fig, 1 tab, 9 ref.

Descriptors: *Acid lakes, *Acid rain, *Acidic water, *Acidification, *Chemical interactions, *Chemistry of precipitation, *Geochemistry, *Hydrologic cycle, *Soil chemistry, *Water chemistry, *Weathering, Acid streams, Acidic soils, Biogeochemical interactions, Chemical reactions, Hydrogen ion concentration, Ion exchange, Norway, Soil properties, Soil types.

Southernmost Norway is one of the areas of the industrialized world where many of the streams and lakes are most acid, even though the air and the rainfall is among the least polluted. Chemical composition of stream and lake water depend upon complicated biogeochemical ion exchanges and weathering reactions between precipitation water and permeable material in the catchments. An examination of streams in southern Norway reveals that acid streams are mainly found in areas with sparse mineral soil and acid raw humus (mor) top soils. Changes in vegetation may change mull to mor and vice versa. In addition, three lakes in areas with acid precipitation and mor top soil in southern Norway were investigated. Two of them had acid after 1950 and had also acid periods in pre-industrial time following vegetation changes similar to the changes in the twentieth Century. The third lake in a catchment with thick mineral subsoils was never acidified. (Author's abstract)
W91-02734

LIMITATIONS TO THE UNDERSTANDING OF ION-EXCHANGE AND SOLUBILITY CONTROLS FOR ACIDIC WELSH, SCOTTISH, AND NORWEGIAN SITES.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5C.
W91-02735

ORIGINS OF ACID RUNOFF IN A HILLSLOPE DURING STORM EVENTS.
Sveriges Lantbruksuniversitet, Umea. Dept. of Forest Site Research.
For primary bibliographic entry see Field 5C.
W91-02737

EVIDENCE FOR LONG-TERM DETERIORATION OF STREAMWATER CHEMISTRY AND SOIL ACIDIFICATION AT THE BIRKENES CATCHMENT, SOUTHERN NORWAY.
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5C.
W91-02738

REVERSAL OF STREAM ACIDIFICATION AT THE BIRKENES CATCHMENT, SOUTHERN NORWAY: PREDICTIONS BASED ON POTENTIAL ANC CHANGES.
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W91-02739

ELEMENT BUDGETS OF TWO CONTRASTING CATCHMENTS IN THE BLACK FOREST (FEDERAL REPUBLIC OF GERMANY).
Freiburg Univ. (Germany, F.R.). Inst. of Soil Science and Forest Nutrition.
For primary bibliographic entry see Field 5B.
W91-02740

INFLUENCE OF ACID ATMOSPHERIC INPUTS ON SURFACE WATER CHEMISTRY AND MINERAL FLUXES IN A DECLINING SPRUCE STAND WITHIN A SMALL CATCHMENT (VOSGES MASSIF, FRANCE).
Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
For primary bibliographic entry see Field 5B.
W91-02741

EFFECTS OF VEGETATION TYPE ON THE BIOGEOCHEMISTRY OF SMALL CATCHMENTS (MONT LOZERE, FRANCE).
Orleans Univ. (France). Lab. d'Hydrogeologie.
F. Lelong, C. Dupraz, P. Durand, and J. F. Didon-Lescot.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 125-145, August 1990. 8 fig, 7 tab, 32 ref.

Descriptors: *Acid rain effects, *Acidification, *France, *Geochemistry, *Ion transport, *Land use, *Path of pollutants, *Small watersheds, *Solute transport, *Vegetation effects, Acid rain, Air pollution, Beech trees, Forest management, Grasslands, Hydrologic budget, Mont Lozere, Soil chemistry, Spruce trees, Sulfates.

Input-output budgets are presented for three granitic catchments, with contrasting vegetation types (Spruce, Beech, and grasslands), for the Mont Lozere region of France. Budget results are compared with information for analogous catchments with varying atmospheric pollution loading. Comparisons show relatively small losses of cations and marked sulfate retention in the soils (particularly for the beech and grassland sites) of the Mont Lozere catchments. Retention of sulfate may be underestimated, particularly for the spruce site, owing to occult and dry deposition inputs which have not been measured. Losses of the base cations are least significant for the beech forest, and this is linked to low bicarbonate production coupled with high sulfate retention in the soil. The spruce afforestation programme has led to a marked cation-loss increase although the streams have yet to acidify. Deforestation leads to further cation losses in relation to increased nitrate leaching. The biogeochemical functioning of the Mont Lozere ecosystems, although slightly disturbed, is not in steady state; sulfate is still accumulating and the effects of afforestation and harvesting are marked. (Korn-PTT)
W91-02742

LONGITUDINAL PATTERNS OF CONCENTRATION-DISCHARGE RELATIONSHIPS IN STREAM WATER DRAINING THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE.
Maine Univ. at Orono. Dept. of Plant and Soil Sciences.
For primary bibliographic entry see Field 5B.
W91-02743

PRECIPITATION, THROUGHFALL, SOIL SOLUTION AND STREAMWATER CHEMISTRY IN A HOLM-OAK (QUERCUS ILEX) FOREST.
Universidad Autonoma de Barcelona (Spain). Centre de Recerca Ecologica i Aplicacions Forestals.
F. Roda, A. Avila, and D. Bonilla.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 167-183, August 1990. 5 tab, 20 ref. CAICYT Project 2129/83.

Descriptors: *Forest hydrology, *Geochemistry, *Ion transport, *Oak trees, *Precipitation, *Soil chemistry, *Streams, *Throughfall, *Water chemistry, Acid rain, Calcium, Magnesium, Neutralization, Potassium, Silicates, Weathering.

Bulk precipitation, throughfall, soil solution at 20 and 40 cm depths, and stream water were monitored for 2-4 years in a holm-oak forest on schists in the Montseny Mountains (NE Spain). Bulk precipitation was mildly acidic, with Ca(2+) and SO4(2-) as dominant ions. Canopy interactions produced a throughfall less acidic than bulk precipitation and enriched in all other ions. Large amounts of K(+) were leached from the canopy. It is believed that leaching makes a major contribution to Mg (2+) enrichment beneath the canopy. Sulfate was the dominant mobile anion in the soil water, being largely accompanied by Ca(2+). Potassium and NO3(-) were depleted within the soil water with respect to throughfall, probably owing to biological uptake and cation exchange, and incorporation of K (+) into clay lattices. Subsurface flow dominated the hydrology of the small forested catchment studied. Stream water was basic and rich in bicarbonate. Its chemistry revealed fast rates of weathering of sodium-, and magnesium-bearing silicates (mainly albite and chlorite, respectively). Soil respiration and silicate hydrolysis resulted in HCO3(-) being the dominant mobile anion in stream water. Calcium to chloride ratios were similar in bulk precipitation and in stream water, indicating that Ca (2+) release from weathering has been counteracted by plant uptake. Nutrient uptake by this aggrading forest strongly influences the solution dynamics of K (+), NO3 (-), and Ca (2+). It is concluded that: (1) this forest does not currently receive acidic atmospheric deposition, (2) the neutralization capacity of the soil-bedrock system is quite high, (3) biotic regulation and silicate weathering are the major processes shaping the solution biogeochemistry in this Mediterranean forest ecosystem. (Author's abstract)
W91-02744

HYDROGEOCHEMICAL VARIATIONS IN HAFREN FOREST STREAM WATERS, MID-WALES.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4C.
W91-02745

PRELIMINARY ANALYSIS OF WATER AND SOLUTE MOVEMENT BENEATH A CONIFEROUS HILLSLOPE IN MID-WALES, U. K
Polytechnic South West, Plymouth (England). Dept. of Geographical Sciences.
For primary bibliographic entry see Field 2E.
W91-02746

STORMFLOW HYDROCHEMISTRY OF A SMALL WELSH UPLAND CATCHMENT.
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
A. D. Muscutt, H. S. Wheater, and B. Reynolds.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 239-249, August 1990. 5 fig, 2 tab, 25 ref

Descriptors: *Geochemistry, *Rainfall-runoff relationships, *Runoff, *Small watersheds, *Storm runoff, *Storm water, *Water chemistry, *Weathering, Acid rain, Aluminum, Calcium, Ion transport, Overland flow, Rainfall, Streamflow, Wales

The hydrochemistry of a small upland catchment during a summer storm, following six weeks of low flow, is described. The storm exhibited several unusual features which may be attributed to the dry antecedent conditions. Streamwater concentrations of all ions analyzed increased during the event but the timing of the increases varied according to the initiation of flows controlling the supply of particular ions. The increase in the concentration of calcium in the stream coincided with onset of overland flow, and appears to result from flushing of accumulated weathering products from a narrow strip of mire which provides a major pathway for storm water in the catchment. Natural soil pipes appear to be the main source of the increase in streamwater concentrations of both organically and inorganically complexed aluminum. Concentrations of inorganic aluminum in pipe water were considerably greater than those observed during previous events, possibly another result of the long period without flow. During the stream recession inorganic aluminum remained high, reflecting contribution from aluminum-rich throughflow. It is concluded that the chemistry of the stream at a given time is controlled by the relative importance of contributing sources of water which is, in turn, controlled by hydrological factors such as antecedent conditions and rainfall intensity and duration. (Author's abstract)
W91-02748

HYDROLOGICAL AND HYDROCHEMICAL FLUXES THROUGH VEGETATION AND SOIL IN THE ALLT A'MHARCAIDH, WESTER

CAIRNGORMS, SCOTLAND: THEIR EFFECT ON STREAMWATER QUALITY.
Macaulay Land Use Research Inst., Aberdeen (Scotland).
For primary bibliographic entry see Field 5B.
W91-02749

SHORT-TERM IONIC RESPONSES AS INDICATORS OF HYDROCHEMICAL PROCESSES IN THE ALLT A'MHARCAIDH CATCHMENT, WESTERN CAIRNGORMS, SCOTLAND.
Freshwater Fisheries Lab., Pitlochry (Scotland).
For primary bibliographic entry see Field 5B.
W91-02750

EFFECT OF CLEARFELLING A SITKA SPRUCE (PICEA SITCHENSIS) PLANTATION ON SOLUTE CONCENTRATIONS IN DRAINAGE WATER.
Institute of Terrestrial Ecology, Grange over Sands (England). Merlewood Research Station.
For primary bibliographic entry see Field 4C.
W91-02751

GEOCHEMICAL CONTROL OF ALUMINIUM CONCENTRATIONS IN ACIDIFIED SURFACE WATERS.
Oslo Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W91-02752

MODELLING STREAMWATER CHEMISTRY AS A MIXTURE OF SOILWATER END-MEMBERS--A STEP TOWARDS SECOND-GENERATION ACIDIFICATION MODELS.
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W91-02753

MODELLING STREAMWATER CHEMISTRY AS A MIXTURE OF SOILWATER END-MEMBERS-AN APPLICATION TO THE PANOLA MOUNTAIN CATCHMENT, GEORGIA, U. S. A.
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-02754

HYDROGRAPH SEPARATION USING CHEMICAL TECHNIQUES: AN APPLICATION TO CATCHMENTS IN MID-WALES.
Institute of Hydrology, Wallingford (England).
. Robson, and C. Neal.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/ p 345-363, August 1990. 6 fig, 6 tab, 29 ref. epartment of the Environment Contract PECD 10/73.

escriptors: *Acid rain effects, *Acidification, Geochemistry, *Hydrograph analysis, *Hydraphs, *Wales, *Water chemistry, Acid neutralizg capacity, Groundwater, Groundwater chemisy, Hydrogen ion concentration, Land use, ixing, Model studies, Reforestation, Soil chemisy, Soil water, Storm runoff, Streams.

chemical technique is used to provide hydraph separation for streams in the Llyn Brianne ea of Mid-Wales. Hydrograph separation can be ployed to determine the relative proportions of ch component and the changes in the relative portions of components, which occur during a rm event. These short-term responses can be mbined with the output from long-term models enable a more comprehensive assessment of sitivities to acidification. The chemical techque uses mixing relationships for a conservative mponent, the acid neutralization capacity NC). A relationship is established between pH d ANC using the chemical analyses for spot mples and with this the ANC is calculated from ntinuous pH measurements. The technique sepaes the hydrograph into soil waters and deeper ters. A comparison of the effects of land-use ferences is made. The results suggest that nges in both soil chemistry and hydrological hways may result from afforestation. Long-term modeling work may benefit form a combined approach in which mixing-model results are used to allow predictions of short-term stream chemistry changes. (Author's abstract)
W91-02755

CONSERVATIVE MIXING OF WATER SOURCES: ANALYSIS OF THE BEHAVIOUR OF THE ALLT A'MHARCAIDH CATCHMENT.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
F. M. Kleissen, H. S. Wheater, M. B. Beck, and R. Harriman.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/ 4, p 365-374, August 1990. 4 fig, 1 tab, 12 ref.

Descriptors: *Geochemistry, *Mixing, *Runoff, *Streamflow, *Streams, *Water chemistry, Alkalinity, Base flow, Scotland, Soil water, Solutes, Total organic carbon.

Stream chemistry data from the Allt a'Mharcaidh catchment (10 sq km) in Scotland have been the subject of an analysis in which conservative mixing of two sources of constant concentration is assumed for individual chemical species. The mixing analysis has been carried out for alkalinity, silica, calcium, magnesium, sodium, chloride, and total organic carbon (TOC). The analysis shows a consistent behavior of alkalinity and TOC, but other species have an apparently contrasting response. The implications are that event response is due primarily to low alkalinity, high TOC water (associated with soil water) and that baseflow is from an unidentified high alkalinity source. However, displacement of alkaline-rich water is apparent during larger events. Other species show contrasting response, possibly as a result of spatial heterogeneity. Despite the fact that many questions remain unanswered, this mixing analysis is a powerful tool for examining the data and can produce hypotheses for more detailed examination. (Author's abstract)
W91-02756

METHOD FOR PREDICTING THE EXTREMES OF STREAM ACIDITY AND OTHER WATER QUALITY VARIABLES.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
For primary bibliographic entry see Field 5B.
W91-02757

TOWARDS DEVELOPING A NEW SHORT-TERM MODEL FOR THE BIRKENES CATCHMENT--LESSONS LEARNED.
Norges Vassdrags- og Elektrisitetsvesen, Oslo.
D. Lundquist, N. Christophersen, and C. Neal.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/ 4, p 391-401, August 1990. 6 fig, 1 tab, 14 ref.

Descriptors: *Acid rain effects, *Aluminum, *Geochemistry, *Model studies, *Norway, *Soil water, *Water chemistry, *Weathering, Calcium, Hydrogen ion concentration, Hydrograph analysis, Hydrographs, Model testing, Oxygen isotopes, Runoff.

New hydrochemical information is available on soil waters for the Birkenes catchment in southern Norway. This information is in disagreement with the existing Birkenes model: the two reservoirs of the model cannot easily be identified with particular areas or soil horizons in the catchment. Here, a new model is presented allowing such an identification while still representing a simple, lumped structure. The simulated flow patterns in the model are evaluated through a three-step procedure involving: (1) reproduction of the hydrograph, (2) reproduction of the chemically inert (18)O isotope in runoff, and (3) simulation of H(+), Al(i) (inorganic monomeric aluminum), and Ca in runoff by mixing of measured soil water end member compositions attributed to each model reservoir. The first two tests are met reasonably well within the proposed structure, whereas the third requirement, if indeed the measured end-member compositions are representative for the catchment, implies structural changes in the way the Birkenes model describes water routing. More field work is required on soil water chemistry, for instance in the deeper layers in the valley bottom, before a further iteration in model development can be undertaken. (Author's abstract)
W91-02758

POLYCHLORINATED BIPHENYLS PARTITIONING IN WATERS FROM RIVER, FILTRATION PLANT AND WASTEWATER PLANT: THE CASE FOR PARIS (FRANCE).
Paris-6 Univ. (France). Inst. d'Hydrologie et de Climatologie.
For primary bibliographic entry see Field 5B.
W91-02786

DIFFERENCES BETWEEN FRESHWATER AND SEAWATER-ACCLIMATED GUPPIES IN THE ACCUMULATION AND EXCRETION OF TRI-N-BUTYLTIN CHLORIDE AND TRIPHENYLTIN CHLORIDE.
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
For primary bibliographic entry see Field 5C.
W91-02793

USE OF KINETIC BIOASSAY PROCEDURE TO ESTIMATE SULFATE AND CYSTEINE CONCENTRATIONS IN SEDIMENT.
Portland State Univ., OR. Environmental Sciences and Resources.
For primary bibliographic entry see Field 2H.
W91-02796

SEASONAL CHANGES IN IRON TRANSPORT AND NATURE OF DISSOLVED ORGANIC MATTER IN A HUMIC RIVER IN NORTHERN FINLAND.
Oulu Univ. (Finland). Dept. of Botany.
K. Heikkinen.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 7, p 583-596, November 1990. 3 fig, 6 tab, 60 ref.

Descriptors: *Dissolved organic carbon, *Dissolved solids, *Finland, *Iron, *Organic matter, *River flow, Color, Flooding, Fluorescence, Humic substances, Seasonal variation, Stream discharge.

Seasonal changes in the nature of dissolved organic matter have been reported in streams and organically colored rivers in the boreal region. These changes influence the biology of flowing water in many ways, but are still poorly known and understood. Changes in the concentration of iron and dissolved organic matter (DOM), and in the color and fluorescence properties in the River Liiminkkijoki in northern Finland were investigated as functions of the seasonal flow regime over a two-year period. The iron concentration in filtrates and the ratio of iron to dissolved organic carbon (DOC) in the river increased under low flow conditions and decreased during the flood periods. The color of the dissolved organic matter increased with increasing iron content, the effect being more pronounced during the warm period of the year than in winter. The ratio of fluorescence to DOC increased during the warm period of the year but not in winter, and decreased rapidly with discharge at the beginning of the flood period in autumn. The results give indications of the origin, formation, nature and fate of the DOM in the river water. Temperature-dependent microbiological processes in the formation of iron-organic colloids seem to be important. (Author's abstract)
W91-02810

QUALITY CHARACTERIZATION OF GROUNDWATER IN KOILSAGAR PROJECT AREA, MAHABUBNAGAR DISTRICT, ANDHRA PRADESH, INDIA.
Osmania Univ., Hyderabad (India).
C. SudarsanaRaju, and P. V. PrakeshGoud.
Environmental Geology and Water Sciences EGWSEI, Vol. 16, No. 2, p 121-128, 1990. 3 fig, 3 tab, 12 ref.

Descriptors: *Groundwater quality, *India, *Water chemistry, Acidic water, Alkaline water, Anions, Bicarbonates, Calcium, Cations, Ion exchange, Irrigation water, Magnesium, Saline water, Sodium.

Studies of groundwater chemistry in the Koilsagar project area of Andhra Pradesh, India, indicate that the waters are sodium bicarbonate, sodium chloride, mixed cationic-mixed anionic, mixed cationic Na dominating bicarbonate, and mixed cationic Ca dominating bicarbonate types. Of these, sodium bicarbonate and mixed cationic Mg dominating bicarbonate types of waters are more prevalent. Isocone mapping of specific conductance indicates that the ionic concentration increases from east to west in the area. Graphical treatment of chemical data reveals that, in general, the area has basic water, whereas the left flank canal area is dominated by secondary alkaline water, and Pallamarri and Pedda Rajmur villages have strongly acidic waters. Ion-exchange studies show that cation-anion exchanges exist all over the area except for two places, which have a base exchange hardened type of water. Graphical representation further shows that most of the area has medium salinity-low sodium (C2S1) water useful for irrigation purposes. High salinity-low sodium (C3S1) and high salinity-medium sodium (C3S2) waters are present in some areas, which need adequate drainage to overcome the salinity problem. (Author's abstract)
W91-02815

GAMMA EMITTERS IN HONG KONG WATER.
Hong Kong Polytechnic, Kowloon. Dept. of Applied Physics.
For primary bibliographic entry see Field 5B.
W91-02816

ESTIMATION OF THE CONTRIBUTION OF THE SULFATE ION TO RAINWATER ACIDITY.
Kanazawa Univ. (Japan). Faculty of Technology.
For primary bibliographic entry see Field 5B.
W91-02827

ACID DEPOSITIONS, SUMMER DROUGHTS, FOREST DECLINE: DEVELOPMENT OF THE NITROUS ACID HYPOTHESIS.
Association pour la Prevention de la Pollution Atmospherique, Bordeaux (France).
For primary bibliographic entry see Field 5C.
W91-02828

CHEMICAL CONSTITUENTS OF PRECIPITATION AND THEIR ROLE IN DETERMINING ITS ACIDITY IN BOMBAY.
Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
For primary bibliographic entry see Field 5B.
W91-02829

SOURCES AND SINKS OF FORMIC, ACETIC, AND PYRUVIC ACIDS OVER CENTRAL AMAZONIA. 2. WET SEASON.
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 5B.
W91-02838

ATMOSPHERIC SULFUR CYCLE OVER THE AMAZON BASIN. 2. WET SEASON.
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W91-02839

DETERMINATION OF PHOTOCHEMICALLY PRODUCED HYDROXYL RADICALS IN SEAWATER AND FRESHWATER.
Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Marine and Atmospheric Chemistry.
For primary bibliographic entry see Field 5A.
W91-02852

ORIGIN AND EVOLUTION OF FORMATION WATERS, ALBERTA BASIN, WESTERN CANADA SEDIMENTARY BASIN: I. CHEMISTRY.
Alberta Univ., Edmonton. Dept. of Geology.
C. A. Connolly, L. M. Walter, H. Baadsgaard, and F. J. Longstaffe.
Applied Geochemistry APPGEY, Vol. 5, No. 4, p 375-395, July/August 1990. 16 fig, 2 tab, 87 ref. NSF Grant No. EAR-8657180 and NSERC Operating Grant Nos. A7387 and OGP1168.

Descriptors: *Alberta, *Connate water, *Geochemistry, *Groundwater chemistry, *Water chemistry, Aliphatic hydrocarbons, Brines, Carbonates, Dissolved solids, Meteoric water.

Formation waters from Devonian through Cretaceous carbonate and clastic reservoirs in the Alberta Basin were examined for short chained aliphatic acids (SCAs) and major and minor elements. The abundance and distribution of SCA's in Alberta Basin formation waters do not appear influenced or related to reservoir temperature, sampling depth or geological age. However, a strong association between SCA concentration and proximity to the Jurassic shales is evident, with water washing and meteoric flushing providing a contributing influence. The distinct water groups evident in the Alberta Basin are: (1) Group I waters which are dominantly carbonate hosted and are stratigraphically the lowest; (2) Group II waters which are primarily from clastic reservoirs; and (3) Group III waters which are completely clastic hosted and comprise the stratigraphically highest zone. Group I and II form a distinct hydrochemical regime, which is decoupled from the dilute waters of Group III. Group III water chemistry is dominated by Na and HCO3 (alkalinity). Formation waters from Group I and II form two component mixtures of residual evaporite brine and post Laramide but pre-present day meteoric water. The brine end member was formed by the evaporation of sea water beyond the point of halite saturation, and was not influenced by the congruent dissolution of evaporite deposits. These carbonate hosted waters were subsequently influenced by silicate hydrolysis and clay-carbonate reactions in surrounding shales and ankeritization reactions of reservoir carbonates. The clastic-hosted waters of Group II were affected by feldspar-clay mineral leaching reactions initiated by gravity driven flow of meteoric waters, resulting from Laramide orogenesis. Both Group I and II waters may also have been altered by ion exchange processes. (See also W91-02889) (Lantz-PTT)
W91-02888

ORIGIN AND EVOLUTION OF FORMATION WATERS, ALBERTA BASIN, WESTERN CANADA SEDIMENTARY BASIN. II. ISOTOPE SYSTEMATICS AND WATER MIXING.
Alberta Univ., Edmonton. Dept. of Geology.
C. A. Connolly, L. M. Walter, H. Baadsgaard, and F. J. Longstaffe.
Applied Geochemistry APPGEY, Vol. 5, No. 4, p 397-413, July/August 1990. 9 fig, 2 tab, 62 ref. NSF Grant No. EAR-8657180 and NSERC Operating Grant Nos. A7387 and OGP1168.

Descriptors: *Alberta, *Chemical analysis, *Connate water, *Geochemistry, *Groundwater chemistry, *Isotopic tracers, *Mixing, *Sedimentary basins, *Water chemistry, Deuterium, Hydrological regime, Oxygen radioisotopes, Strontium radioisotopes.

Isotopic measurements (Sr, O, D) on formation waters from the Alberta Basin have been made, covering a stratigraphic range from Devonian to Upper Cretaceous. These measurements, combined with chemical compositional trends, give evidence for two distinct water regimes. One hydrological regime is composed of waters hosted in Devonian-Lower Cretaceous reservoirs, the other waters from Upper Cretaceous and younger sedimentary rocks. The waters within the Devonian-Lower Cretaceous regime exhibit a large range in 87-Sr/86-Sr values (0.7076-0.7129), but have similar Sr concentrations, regardless of host lithology. Bulk rock and late stage diagenetic cements are less radiogenic than present brines. Importantly, brines from Devonian carbonates possess the most radiogenic Sr isotopic signatures of the waters examined. Devonian shales and/or Cambrian shales may be sources of high 87-Sr/86-Sr ratios in the carbonate hosted waters. Waters from the upper Cretaceous clastic units, which have ratios as low as 0.7058, and diagenetic cements from Upper Cretaceous clastic units appear to have precipitated from fluids similar in Sr isotropic value to modern brines. Waters in upper Cretaceous reservoirs have O and D isotopic compositions similar to those of present day rainfall, which in conjunction with very dilute Sr concentrations and low Sr ratios suggest hydrological isolation from the stratigraphically lower system. (See also W91-02888) (Lantz-PTT)
W91-02889

SULPHUR AND OXYGEN ISOTOPES OF DISSOLVED SULPHUR SPECIES IN FORMATION WATERS FROM THE DOGGER GEOTHERMAL AQUIFER, PARIS BASIN, FRANCE.
Bureau de Recherches Geologiques et Minieres, Orleans (France).
C. Fouillac, A. M. Fouillac, and A. Criaud.
Applied Geochemistry APPGEY, Vol. 5, No. 4, p 415-427, July/August 1990. 6 fig, 4 tab, 40 ref. Bureau de Recherches Geologiques et Miniers DG 12 EN3G 0033F, and The Commission of the European Communities Contract EN4G 0038F.

Descriptors: *Connate water, *France, *Geochemistry, *Geothermal water, *Groundwater chemistry, *Isotope studies, *Oxygen isotopes, *Sulfur, *Sulfur isotopes, *Water chemistry, Aquifers, Paris Basin, Sulfates, Sulfides, Sulfur compounds.

Isotopic analysis of the S in sulfides and sulfates from formation waters were made at 35 geothermal wells exploiting the Dogger geothermal aquifer of the Paris Basin. Isotopic analysis of the O of the dissolved sulfates was also made on 12 of these samples. The results show a distribution of the delta-34-S of the sulfates according to geographic zones that also correspond to variations in the geochemistry of the fluids, in particular, the sulfide content. Samples taken in the Seine-St-Denis area and in the areas north and west of Paris show high delta-34-S values ranging from +26.3 to +48.9%. Values of delta-34-S for sulfides range from -8.5 to 5%, and are interpreted as reflecting the effect of bacterial reduction in a confined part of the basin. Modeling this reduction by Rayleigh distillation mechanism made it possible to calculate a value of 1.038 +/-0.003 for the coefficient of fractionation between the sulfates and sulfides. An important part of the sulfides formed by bacterial reduction has been subtracted from the fluid by deposition South of Paris and in the Val de Marne, the delta 34-S values for the sulfates are more uniform ranging between 22.4 and 26.6%, despite the existence of bacterial activity. This is most probably due to a higher rate of flow of the waters, entailing renewal of the sulfate stock. The isotopic composition of the O of the sulfates for the Seine-St-Denis area and the areas west and north of Paris is very uniform, between 16.1 and 17.1%, despite the wide range in delta-34-S (26.3 to 48.9%) for the same samples. The calculated isotopic temperatures are close to those measured in situ. These results suggest either that sulfate water isotopic equilibrium was established after the reduction, or that the coefficient of O fractionation is very low (<1.00 during bacterial reduction. (Author's abstract)
W91-02890

METAL-ORGANIC ASSOCIATIONS IN SEDIMENTS--II. ALGAL MATS IN CONTACT WITH GEOTHERMAL WATERS.
Munich Univ. (Germany, F.R.). Mineralogisch-Petrographisches Inst.
For primary bibliographic entry see Field 2J.
W91-02892

MODELLING OF THE EVOLUTION OF GROUND WATERS IN A GRANITE SYSTEM AT LOW TEMPERATURE: THE STRIPA GROUND WATERS, SWEDEN.
Paris-7 Univ. (France). Lab. de Geochimie des Eaux.
D. Grimaud, C. Beaucaire, and G. Michard.
Applied Geochemistry APPGEY, Vol. 5, No. 4, p 515-525, July/August 1990. 7 fig, 3 tab, 39 ref.

Descriptors: *Connate water, *Geochemistry, *Groundwater chemistry, *Model studies, *Sweden, *Water chemistry, Aluminum, Chlorides, Granites, Groundwater resources, Minerals.

From previously collected chemical data on Stripa groundwaters, a model of evolution of the chemical composition of groundwater in a granite system at low temperatures is proposed. The existence of two end-member groundwater compositions made it possible first, to test the conventional model of a geothermal system according to which an overall equilibrium between the waters and a given mineral assemblage can be defined, and then to show that such a model could be extended to low temperatures (10 C). Conversely, if the mineral assemblage is known, the equilibration temperature and the charge of the mobile ions (in this case, Cl), the composition of the solution is entirely fixed. In this model of the Stripa groundwaters, the existence of two end-member groundwater compositions can be explained by an evolution from a 'kaolinite-albite-laumontite' equilibrium to a 'prehnite-albite-laumonite' equilibrium, which requiring less Al. The Cl ion concentrations of the groundwaters, are emphasized because they can be considered as indicators of the degree of reaction progress between rock and water, thus determining the degree of equilibration of the system. (Author's abstract)
W91-02893

2L. Estuaries

MONTHLY VARIATIONS OF DISSOLVED FREE AMINO ACIDS (DFAA) OBSERVED IN THE BAY OF VILLEFRANCHE-SUR-MER, FRANCE: EXPERIMENTAL STUDY ON THEIR UPTAKE BY PARACENTROTUS LIVIDUS AND SPHAERECHINUS GRANULARIS LARVAE (VARIATIONS MENSUELLES DES ACIDES AMINES LIBRES DISSOUS (AALD) PRESENTS EN UN POINT DE LA RADE DE VILLEFRANCHE-SUR-MER: UTILISATION PAR LES LARVES DE PARACENTROTUS LIVIDUS ET DE SPHAERECHINUS GRANULARIS).
Institut Oceanographique, Paris (France). Lab. de Physiologie des Etres Marins.
J. F. Pavillon, and P. Rault.
Aquatic Living Resources ALREEA, Vol. 3, No. 2, p 147-150, 1990. 2 tab, 6 ref. English summary.

Descriptors: *Amino acids, *Bioavailability, *Echinoderms, *Estuarine environment, *Larvae, *Nutrients, *Villefranche-sur-Mer, Bays, France, High performance liquid chromatography, Seasonal variation, Water analysis.

The harbour waters of Villefranche-sur-Mer were analyzed for dissolved free amino acids dissolved (DFAA), and the consumption of DFAA by larvae was studied to establish a relationship between the concentration of the DFAA, the nature of the DFAA and their consumption by larvae. Sea water was sampled at a depth of seven meters, filtered through a 0.22 micrometer Gelman membrane filter and frozen at -70 C. Analysis was carried out by forming a fluorescent derivative with o-phthalaldehyde and 2-mercaptoethanol, followed by HPLC analysis with a fluorescence detector on a C-18 column. The mobile phase was sodium acetate and methanol. The laboratory experiments were carried out in March and October of 1986 and June of 1987, with sea water taken in December 1985, March and October of 1986 and June of 1987. The larvae were obtained by the method reported by Davis. The pluteus larvae of Paracentrotus lividus and Sphaerechinus granularis were used to study the consumption of DFAA. Paracentrotus lividus consumed 0.3 to 1.6 microcal/larvae/hr in the endotrophic phase and Sphaerechinus granularis 0.45 to 0.74 microcal/larvae/hr. During the exotrophic phase the value was 0.08 to 0.7 microcal/larvae/hr for Paracentrotus lividus. The concentration of DFAA in the sea water varied from 640 (June 1986) to 4421 (May 1987) nmole/L in the period from October 1985 to June 1987. (King-PTT)
W91-02047

MACROBENTHIC POPULATION OF THE PORT OF ALGIERS (LES PEUPLEMENTS MACRO BENTHIQUES DU PORT D'ALGER).
Laboratoire de Chemie Marine, Algiers (Algeria).
For primary bibliographic entry see Field 5B.
W91-02054

INFLUENCE OF SEDIMENT DISTURBANCE AND WATER FLOW ON THE GROWTH OF THE SOFT-SHELL CLAM, MYA ARENARIA L.
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
C. W. Emerson.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1655-1663, September 1990. 4 fig, 2 tab, 42 ref.

Descriptors: *Clams, *Environmental effects, *Flow discharge, *Growth rates, *Mollusks, *Sediment distribution, *Sediment disturbance, *Sediment-water interfaces, Bottom sediments, Coastal waters, Flow velocity, Flumes, Laboratory methods, Shear stress.

The importance of sediment disturbance and water flow to the production of the soft-shell clam, Mya arenaria, was assessed in laboratory flumes by measuring growth rates of clams exposed to a gradation of bed shear stress, free-stream velocity, and frequency and depth of sediment disturbance over 10-month period. In the absence of sediment disturbance, growth of soft tissue was directly proportional to both free stream and shear velocity (r-squared = 0.64 and 0.72, respectively). Increased organic seston flux may have linked higher water flow to higher growth. In all treatments, maximum growth rates were observed with daily disturbance of the top centimeter of sediment. No level of disturbance resulted in growth rates lower than that of undisturbed clams in low flow (free stream velocity of 0.4 cm/s and shear velocity of 0.1 cm/sec). The stimulation of growth under maximum sediment disturbance was removed when free stream velocity exceeded 3 cm/sec. An energy budget for M. arenaria indicated that the amount of organic matter suspended during sediment disturbance was insufficient to account for the increased growth in clams subjected to high levels of disturbance. The sediment disturbance associated with intense clam harvesting, and changes in local hydrography resulting from coastal development, may be responsible for some of the unexplained growth variation in commercial clam stocks. (Author's abstract)
W91-02062

SOLUBLE FLUORESCENCE: EFFECTS ON CHLOROPHYLL DETERMINATION AT DIFFERENT SALINITIES.
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
A. A. Keller, L. L. Beatty, L. E. Weber, and C. A. Heil.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1700-1709, September 1990. 8 fig, 2 tab, 31 ref.

Descriptors: *Chlorophyll, *Estuarine environment, *Fluorescence, *Laboratory methods, *Measuring instruments, *Phytoplankton, *Salinity, Biomass, Pawcatuck River Estuary, Regression analysis, Rhode Island, Sampling.

Measurements of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (DCMU) enhanced fluorescence, provided reliable estimates of phytoplankton biomass along a salinity gradient when adjusted for soluble enhanced fluorescence, <1 microm size fraction. Positive linear relationships ($P<0.0001$) were observed between fluorescence and extracted chlorophyll at salinities of 0, 5, 10 and 30 in experimental mesocosms and the Pawcatuck River Estuary, Rhode Island, both before and after subtraction of soluble enhanced fluorescence. Adjusting for soluble enhanced fluorescence did not reduce variability in the DCMU enhanced fluorescence to extracted chlorophyll relationships or alter slopes of the regression equations at different salinities. Positive intercepts (which varied with salinity) were, however, reduced to zero after correction. Results further indicated that soluble enhanced fluorescence decreased with increasing salinity (primarily as a result of dilution with seawater), that it was relatively constant at a given salinity, and was unrelated to total DCMU enhanced fluorescence. Relying solely on in vivo fluorescence techniques, without correction for soluble fluorescence, would thus increasingly lead to overestimates of phytoplankton biomass at decreasing salinities. Over the experimental period, 32% (range 8 to 93%) of total DCMU enhanced fluorescence was present in the soluble fraction with the majority (83%) non-photosynthetic material and most likely dissolved humic substances. The soluble fraction and light extinction coefficients were significantly and positively related in the mesocosms and the field. (Author's abstract)
W91-02065

DISTRIBUTION OF SHRIMP AND FISH BY-CATCH ASSEMBLAGES IN THE CANADIAN EASTERN ARCTIC IN RELATION IN WATER CIRCULATION.
Arctic Biological Station, Ste. Anne de Bellevue (Quebec).
C. Hudson.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1710-1723, September 1990. 7 fig, 4 tab, 45 ref.

Descriptors: *Arctic Ocean, *Canada, *Fish, *Shrimp, *Species diversity, *Water circulation, Coastal waters, Hudson Strait, Labrador, Latitudinal studies, Salinity, Water temperature.

In the Canadian eastern Arctic, the catches of common species of decapods and fish in bottom trawls reveal a continuum of increasing species richness and abundance in an easterly direction through Hudson Strait. Species richness is greatest in Ungava Bay, where Arctic and Labrador Sea components of the fauna coexist. Over the study area, species could be divided in three associations corresponding to the origin of the predominant water masses; Arctic cod, cottids, zoarcids, and liparids predominate in the Arctic waters of western and central Hudson Strait; Greenland halibut, roughhead grenadier, and three-beard rockling are characteristic of the northern Labrador Sea; pandalid shrimp are abundant in areas of deep (> 300), intensely mixed waters near the mouth of Hudson Strait. Pink shrimp (Pandalus borealis) predominates in Davis Strait-Labrador, whereas it is replaced by the striped pink shrimp (P. montagui) in eastern Hudson Strait, reflecting environmental optima in subarctic and Arctic dominated waters, respectively. The yearly catches of striped pink shrimp are highly variable, possibly related to mixing intensity in eastern Hudson Strait. In Canadian Arctic waters, species richness, distribution, and abundance are related to temperature, salinity, mixing, and general circulation of water masses. (Author's abstract)
W91-02066

INVESTIGATION OF THE COAGULATION MECHANISM OF THE SUSPENDED PARTICULATE MATTER IN COASTAL WATERS.
Patras Univ. (Greece). Physical Chemistry Lab.
For primary bibliographic entry see Field 2J.
W91-02083

CHANGES IN SEASONAL SUCCESSION OF PHYTOPLANKTON INDUCED BY THE STORM-SURGE BARRIER IN THE OOSTERSCHELDE (S.W. NETHERLANDS).
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
C. Bakker, P. M. J. Herman, and M. Vink.
Journal of Plankton Research JPLRD9, Vol. 12,

No. 5, p 947-972, September 1990. 9 fig, 3 tab, 58 ref.

Descriptors: *Algae, *Algal growth, *Barriers, *Check structures, *Environmental effects, *Estuaries, *Estuarine environment, *Phytoplankton, *Population dynamics, *Succession, *The Netherlands, Hydrodynamics, Light penetration, Oosterschelde Estuary, Salinity, Seasonal variation, Sedimentation, Species composition, Storm surges, Storm water management, Storm-surge barrier, Water currents.

Seasonal succession of phytoplankton was followed weekly in the eastern and western parts of the Oosterschelde estuary, before (1982-1983) and during (1984-1986) the construction of the storm-surge barrier. Construction of the barrier seriously influenced the hydrodynamics of the estuary. In the eastern part, decreased current velocities led to the emergence of a vertical salinity gradient, to increased sedimentation of suspended matter and to a rise in transparency during a prolonged period of the year. The relationship between species composition and biomass on the one hand and environmental variables on the other hand was analyzed in a Canonical Correspondence Analysis, for both compartments separately. The analysis revealed that the phytoplankton assemblage more and more obtained a summer character, extending its growth season both earlier and later in the year. The transition of spring to summer phytoplankton assemblages proceeded parallel to the main light-turbidity gradient. The light factor not only explained the seasonal pattern, but also the long-term trend from pre-barrier to barrier period. Partial Detrended Correspondence Analysis after correction for mean seasonal pattern confirmed this trend significantly. (Author's abstract)
W91-02116

ATTACHED AND FREE-LIVING DIVIDING BACTERIA IN TWO AQUATIC SYSTEMS.
Universidad del Pais Vasco, Bilbao (Spain). Dept. de Microbiologia e Inmunologia.
For primary bibliographic entry see Field 2H.
W91-02121

FACTORS INFLUENCING COMMUNITY STRUCTURE AND DISTRIBUTION OF DIFFERENT LIFE-CYCLE CATEGORIES OF FISHES IN SHALLOW WATERS OF A LARGE AUSTRALIAN ESTUARY.
Murdoch Univ. (Western Australia). School of Biological and Environmental Sciences.
N. R. Loneragan, and I. C. Potter.
Marine Biology MBIOAJ, Vol. 106, No. 1, p 25-37, July 1990. 6 fig, 5 tab, 42 ref.

Descriptors: *Australia, *Estuaries, *Estuarine environment, *Fish, *Fish populations, *Life cycles, *Species composition, Population density, Salinity, Seasonal variation, Spawning, Swan Estuary, Water temperature.

Fish were collected at regular intervals over 5 yr (February 1977 to December 1981) from ten shallow water sites located throughout the lower, middle and upper regions of the large Swan Estuary in temperate southwestern Australia. Analysis of the catch data showed that the total number of species and total density of fishes were both influenced to a greater extent by site and season within the estuary than by year. The number of species and density of fishes within the whole system were greatest during the summer and autumn, when salinities and temperatures were at a maximum, and declined with distance from the estuary mouth. The density of marine estuarine-opportunists (species which enter estuaries regularly and in considerable numbers) was also correlated with temperature, reflecting the tendency for species of this category to congregate in the shallows during the summer and autumn. The similar seasonal aggregations of the single anadromous species and species that complete their whole life cycle in the estuary were frequently related to spawning. The density and number of species of the estuarine category were correlated neither with salinity nor with distance from the estuary mouth. The density of freshwater species was inversely correlated with salinity and positively correlated with distance from the estuary mouth. The composition of the fish fauna changed progressively through the estuary, with that of the lower estuary being the most discrete. The composition also changed seasonally, particularly in the upper estuary where, during the winter and spring, the volume of freshwater discharge increased greatly and as a consequence the salinity declined markedly. The species characteristic of the lower estuary were generally marine-opportunists, whereas those of the upper estuary typically belonged to either the estuarine or anadromous categories. (Author's abstract)
W91-02123

CARBON BUDGETS OF THE MICROBIAL FOOD WEB IN ESTUARINE ENCLOSURES.
Vandkvalitetsinstitutet, Hoersholm (Denmark).
B. Riemann, H. M. Sorensen, P. K. Bjornsen, S. J. Horsted, and L. M. Jensen.
Marine Ecology Progress Series MESEDT, Vol. 65, No. 2, p 159-170, 1990. 5 fig, 4 tab, 60 ref.

Descriptors: *Carbon cycle, *Estuarine environment, *Food chains, *Marine bacteria, Biomass, Carbon budgets, Microorganisms, Mussels, Nutrients, Phytoplankton, Primary productivity, Zooplankton.

During 9 to 25 June 1987, carbon budgets were established for estuarine enclosures manipulated by additions of nutrients and suspension-feeding bivalves. An intensive sampling program and a detailed examination of autotrophic and heterotrophic microorganisms enabled construction of carbon budgets of the microbial food web and comparison flow rates through a number of microbial components. Phytoplankton biomass and production covaried, and, as expected, lowest values were recorded in enclosures with added mussels, and highest values in enclosures with added nutrients. Bacteria and heterotrophic nanoflagellates peaked a few days after maxima in phytoplankton biomass and production. In enclosures with added mussels, biomasses were lower for bacteria and microzooplankton, and mesozooplankton, but slightly higher for heterotrophic nanoflagellates. Bacteria, flagellates, and microzooplankton, mostly ciliates, dominated heterotrophic processes, whereas larger mesozooplankton ingestion did not exceed 5% of phytoplankton primary production. Microzooplankton and flagellate clearances were higher in enclosures with added nutrients, whereas no such changes were found in the macrozooplankton, probably because the duration of the experiments did not allow full development of the macrozooplankton. The added mussels dominated heterotrophic consumption and controlled organisms >20 microns. Exclusion of mussels induced a primary dominance of microzooplankton followed by a subsequent increase of mesozooplankton. Additions of nutrients and filtration by suspension-feeding bivalves caused qualitative and quantitative changes at all levels in the microbial food web. These changes were measured from a large number of microbial components and allowed balances of the carbon budgets to be made as well as identification of factors controlling the structure and function of the pelagic carbon cycle. (Author's abstract)
W91-02125

TIDAL AND TURBIDITY EFFECTS ON THE SHALLOW-WATER FISH ASSEMBLAGE OF KUWAIT BAY.
Kuwait Univ., Safat. Dept. of Zoology.
F. Abou-Seedo, D. A. Clayton, and J. M. Wright.
Marine Ecology Progress Series MESEDT, Vol. 65, No. 3, p 213-223, 1990. 6 fig, 8 tab, 31 ref.
Kuwait University Grant SZ027.

Descriptors: *Diurnal distribution, *Fish, *Fish populations, *Kuwait, *Marine environment, *Tidal effects, *Turbidity, Biomass, Kuwait Bay, Mud flats, Population density, Sand, Seasonal variation, Shallow water, Species composition.

Effects of location, diel period, tidal condition and water clarity on the size and distribution of the shallow water fish assemblage of the non-estuarine Kuwait Bay were investigated using a beach seine and a small research trawl during spring and summer 1989. Total numbers, biomass and numbers of species differed markedly between Doha, a sandy shore environment, and Kazmah, an extensive intertidal mud flat. When fish were present in large numbers there was a marked diel effect at both locations with many more fish captured during the night. Tidal effects were influenced by turbidity and the age structure of the assemblage. In clear water during spring, very young Liza carinata from the seine catches formed shoals at the edge of the rising tide both day and night, while fish 2 mo older formed shoals only on daytime rising tides. At Kazmah during spring, high turbidity obscured any tidal effects in the seine catches. In slightly deeper water, sampled by trawl during spring, Leiognathus decorus showed an asymmetrical tidal migration. In summer, beach seine catches were much higher on the rising tide. Summer trawl catches did not show a consistent tidal effect. (Author's abstract)
W91-02126

CONTROL OF MEIOBENTHIC ABUNDANCE BY MACROEPIFAUNA IN A SUBTIDAL MUDDY HABITAT.
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Biological Sciences.
E. Olafsson, and C. G. Moore.
Marine Ecology Progress Series MESEDT, Vol. 65, No. 3, p 241-249, 1990. 7 fig, 62 ref.

Descriptors: *Fauna, *Marine animals, *Marine environment, Benthic environment, Benthic fauna, Copepods, Food chains, Loch Creran, Macrofauna, Marine sediments, Meiofauna, Microfauna, Nematodes, Population density, Scotland.

In order to assess the effects of microfauna in meiofaunal community structure, field investigations were performed in a low energy subtidal muddy sediment Loch Creran, a sea-loch on the west coast of Scotland. Meiofaunal colonization of azoic sediment in cages designed to exclude macrofauna to varying degrees was studied. After 1 mo, nematode density in all 15 cages was less than a third of ambient density. In none of the cages did the nematodes reach ambient densities within the experimental period. Copepods attained background levels in 3 mo in all cages and were in higher numbers in cages designed to exclude all macrofauna. Results indicate that small to medium sized macroepifauna control the densities of copepods at the study site. (Author's abstract)
W91-02127

ANTHROPOGENIC INFLUENCE ON THE INTERELEMENTAL CORRELATION IN DIFFERENT PHASES OF THE MARINE ENVIRONMENT.
Bulgarian Academy of Sciences, Varna. Inst. of Oceanography.
For primary bibliographic entry see Field 5B.
W91-02175

TRACE METALS IN THE WESTERN MEDITERRANEAN SEA.
Istituto di Biofisica, Pisa (Italy).
For primary bibliographic entry see Field 5B.
W91-02179

SURVIVAL OF STRIPED BASS LARVAE AND YEARLINGS IN RELATION TO CONTAMINANTS AND WATER QUALITY IN THE UPPER CHESAPEAKE BAY.
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
For primary bibliographic entry see Field 5C.
W91-02194

PREDICTING CONCENTRATIONS OF CONSUMER PRODUCT CHEMICALS IN ESTUARIES.
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-02211

SURFACE-WATER HYDROLOGY AND SALINITY OF THE ANCLOTE RIVER ESTUARY, FLORIDA.
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-02229

ELEVATED ATMOSPHERIC CO2 EFFECTS ON BELOWGROUND PROCESSES IN C3 AND C4 ESTUARINE MARSH COMMUNITIES.
Smithsonian Environmental Research Center, Edgewater, MD.
For primary bibliographic entry see Field 5C.
W91-02406

RELATIONSHIP BETWEEN MIXING PROCESS AND CONCENTRATIONS OF MAJOR IONS IN SPANISH MEDITERRANEAN BRACKISH WATERS.
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2K.
W91-02456

TIGRIS-EUPHRATES DELTA: A MAJOR SOURCE OF PESTICIDES TO THE SHATT AL-ARAB RIVER (IRAQ).
Basrah Univ. (Iraq). Dept. of Environmental Marine Chemistry.
For primary bibliographic entry see Field 5B.
W91-02463

NUTRIENTS, HEAVY METALS AND ORGANIC MICROPOLLUTANTS IN AN EUTROPHIC BRAZILIAN LAGOON.
Universidade Federal Fluminense, Niteroi (Brazil). Dept. de Geoquimica.
For primary bibliographic entry see Field 5B.
W91-02555

PERSISTENCE OF SPILLED CRUDE OIL IN A TROPICAL INTERTIDAL ENVIRONMENT.
Puerto Rico Univ., Mayaguez. Dept. of Marine Sciences.
For primary bibliographic entry see Field 5B.
W91-02556

TRACE METALS IN THE SEVERN ESTUARY: A REAPPRAISAL.
Water Research Centre, Medmenham (England).
For primary bibliographic entry see Field 5B.
W91-02557

HYDROCARBON CONCENTRATIONS IN SEDIMENTS AND ANIMAL TISSUES FROM THE COASTAL WATERS OF KARACHI.
Karachi Univ. (Pakistan). Inst. of Marine Biology.
For primary bibliographic entry see Field 5B.
W91-02558

OIL POLLUTION IN THE SOUTHERN ARABIAN GULF AND GULF OF OMAN.
Institute of Oceanography and Fisheries, Alexandria (Egypt).
For primary bibliographic entry see Field 5B.
W91-02559

DEPENDENCE OF ESTUARINE PRODUCTIVITY ON ANOMALIES IN MEAN SEA LEVEL.
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
J. T. Morris, B. Kjerfve, and J. M. Dean.
Limnology and Oceanography LIOCAH, Vol. 35, No. 4, p 926-930, June 1990. 4 fig, 1 tab, 25 ref. NSF Grants BSR 83-17407 and BSR 85-14326.

Descriptors: *Ecological effects, *Estuaries, *Primary productivity, *Salt marshes, *Sea level, Ecosystems, Fisheries, Intertidal areas, Menhaden, Salinity, Shrimp, Spartina.

The annual above ground productivity of Spartina alterniflora in a South Carolina salt marsh varies by a factor of two, and correlates positively (r sq = 0.99, P < 0.001) with anomalies in mean sea level during the growing season. The effect of sea level anomalies on the salinity of the intertidal sediments probably accounts for the observed changes in primary production. It has also been shown that commercial landings of shrimp and menhaden from the southeastern US Atlantic and central Gulf of Mexico are positively correlated with sea level anomalies. These species use salt marsh habitats as juveniles, and the authors attribute this correlation to effects of sea level anomalies on habitat availability or food production. (Author's abstract)
W91-02590

ANNUAL MEAN TRANSPORT IN PUGET SOUND.
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5B.
W91-02615

OIL SLICK SIZES AND LENGTH OF COASTLINE AFFECTED: A LITERATURE SURVEY AND STATISTICAL ANALYSIS--FINAL REPORT.
Minerals Management Service, Los Angeles, CA. Pacific OCS Region.
For primary bibliographic entry see Field 5B.
W91-02671

ANALYSIS OF LONG-TERM SALINITY PATTERNS IN THE LOUISIANA COASTAL ZONE.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
D. A. Fuller, R. E. Condrey, J. P. Geaghan, and B. B. Barrett.
Northeast Gulf Science NGSCDE, Vol. 11, No. 1, p 11-17, July 31, 1990. 2 fig, 2 tab, 13 ref.

Descriptors: *Coastal environment, *Hydrographic data collections, *Louisiana, *Marshes, *Saline water intrusion, *Salinity, *Wetlands, Brackish water, Coastal marshes, Coastal waters, Data collections, Fisheries, Hydrological regime, Salt marshes.

Saltwater intrusion is believed to be one of the greatest threats to Louisiana's fishery and wildlife resources. The Louisiana Department of Wildlife and Fisheries has maintained salinity recording stations throughout the state's coastal marshes since the 1960's. We applied several different analytical approaches to the salinity data from 17 stations to determine whether this data base could be used to detect and quantify long-term salinity trends in coastal Louisiana. We did not detect a large-scale, consistent trend over time in coastal salinities across the state. Problems that hindered the detection of long-term trends included short periods of record and the placement of the recording stations in salt and brackish marsh areas, where we would not expect to find great changes in salinity. For the data to be useful in monitoring salinity trends in coastal marshes, especially with respect to saltwater intrusion, stations should be added in fresh and intermediate marshes. In addition, the relationships our study revealed between short-and long-term data indicate that records covering less than a decade are insufficient to denote long-term salinity changes, barring some major modification of the hydrologic regime. (Author's abstract)
W91-02762

METHOD FOR THE QUANTITATIVE EVALUATION OF FISH MOVEMENTS IN SALT PONDS BY ACOUSTIC TELEMETRY.
Centre de Recherche en Ecologie Marine et Aquaculture, Nieul sur Mer (France).
For primary bibliographic entry see Field 7B.
W91-02782

CONTROLS AND EFFECTS OF CONTINENTAL BRINE FORMATION IN A SUPRATIDAL EPHEMERAL LAKE IN THE SEMI-ARID ENVIRONMENT OF SPENCER GULF, SOUTH AUSTRALIA.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 2H.
W91-02806

WITHDRAWAL OF SHELF WATER INTO AN ESTUARY: A BAROTROPIC MODEL.
Delaware Univ., Newark. Coll. of Marine Studies.
A. K. Masse.
Journal of Geophysical Research (C) Oceans JGRCEY, Vol. 95, No. 9, p 16,085-16,096, September 15, 1990. 12 fig, 27 ref. NSF Grant No. OCE87-11299.

Descriptors: *Barotropic models, *Delaware Bay, *Estuaries, *Estuarine environment, *Model studies, *Water circulation, Bottom circulation, Brackish water, Hydraulic models, Tidal hydraulics, Upwelling.

Coupled circulation between an estuary and the adjacent shelf is a new area of study. At low frequencies estuarine gravitational circulation requires landward flow of lower layer shelf water to balance the seaward flow of brackish estuarine water over the shelf. A clear description of the low frequency physical coupling between the estuary and shelf waters is developed through the use of a steady, linear, barotropic model. Complex bottom topography for the shelf is treated. The shelf adjacent to Delaware Bay, located on the east coast of the U.S. is used as an example. The results show that the landward flow field, driven only by withdrawal of flow through the estuary's entrance, is independent on the flow field otherwise present over the shelf. In the northern hemisphere this landward flow passes along the coast to the right of the estuary entrance, when viewed facing offshore, before it enters the estuary. Model results are supported by near bottom current observations collected on the shelf adjacent to the mouth of Delaware Bay. (Author's abstract)
W91-02831

SOME OBSERVATIONAL EVIDENCE ON THE EFFECT OF ATMOSPHERIC FORCING ON TIDAL VARIABILITY IN THE UPPER DELAWARE BAY.
Delaware Univ., Newark. Coll. of Marine Studies.
K. C. Wong, and J. H. Trowbridge.
Journal of Geophysical Research (C) Oceans JGRCEY, Vol. 95, No. 9, p 16,229-16,240, September 15, 1990. 11 fig, 29 ref. NSF Grant Nos. OCE-8515735 and OCE87-10768; NOAA Office of Sea Grant No. NA86AA-D-SG040.

Descriptors: *Atmospheric circulation, *Delaware Bay, *Estuaries, *Tidal hydraulics, *Tides, *Wind tides, Estuarine environment, Oceanography, Wind pressure.

Until recently, most oceanographic research relating to the tidal variability in an estuary has ignored the effect of atmospherically forced motions on tidal motions. Mechanisms exist through which high frequency wind waves and low frequency subtidal variability can interact nonlinearly with the tide, and modify the tidal response of an estuary significantly. A set of current and sea level observations in the upper Delaware Bay provides observational evidence which suggests that tidal variability in the interior of the bay was appreciably modified during two moderately strong atmospheric events. The observed order of magnitude of changes in tidal characteristics can be explained by interactions of the tide with surface waves and subtidal motions. The dominant mechanism in wave current interaction is the turbulent wave boundary layer, which enhances the frictional attenuation of the tide. Changes in propagation and attenuation characteristics due to subtidal depth changes have a smaller but still observable effect. (Lantz-PTT)
W91-02833

MONITORING AND ASSESSMENT OF MERCURY POLLUTION IN THE VICINITY OF A CHLORALKALI PLANT: I. DISTRIBUTION,

AVAILABILITY AND GENOTOXICITY OF SEDIMENT MERCURY IN THE RUSHIKULYA ESTUARY, INDIA.
Berhampur Univ. (India). Dept. of Botany.
For primary bibliographic entry see Field 5B.
W91-02932

STUDY ON THE HYDROLOGY AND PHYTOPLANKTON OF THE VARANO LAKE (ADRIATIC SEA) DURING AN ANNUAL CYCLE (MAY 1985-APRIL 1986). (ETUDE SUR LAC DE VARANO (MER ADRIATIQUE): MAI 1985-AVRIL 1986).
Padua Univ. (Italy). Dept. of Biology.
C. Tolomio, C. Andreoli, and M. Montanari.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 85, p 57-85, August 1990, 26 fig, 3 tab, 41 ref. English summary.

Descriptors: *Adriatic Sea, *Hydrology, *Italy, *Lagoons, *Lakes, *Multivariate analysis, *Phytoplankton, *Seasonal variation, Coastal environment, Diatoms, Dystrophic lakes, Lake Varano, Nanoplankton, Physicochemical properties, Picoplankton.

A 12-month study was made on the principal environmental factors affecting the physico-chemical properties and phytoplankton of Lake Varano. High levels of oxygenation, nitrates and phosphates with uniform levels of pH and salinity contributed to the high density of phytoplankton during the entire study period. Picoplankton, nanoplankton and diatoms were dominant especially during summer. Multivariate analysis of the data indicated that both the physico-chemical and biological conditions of this environment are greatly influenced by the seasons. Also, the two mouth canals are major factors that cause the dystrophic characteristics of this lake. Compared with other Italian coastal environments, this area is scarcely affected by anthropogenic factors. (Medina-PTT)
W91-02934

STATE OF THE CHESAPEAKE BAY.
For primary bibliographic entry see Field 5G.
W91-02956

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

RECOVERY OF MINERAL SALTS AND POTABLE WATER FROM DESALTING PLANT EFFLUENTS BY EVAPORATION. PART II. PROPOSED SIMULATION SYSTEM FOR SALT RECOVERY.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Chemical Engineering.
H. K. Abdel-Aal, K. M. Ba-Lubaid, A. A. Shaikh, and D. K. Al-Harbi.
Separation Science and Technology SSTEDS, Vol. 25, No. 4, p 437-461, April 1990. 11 fig, 7 tab, 11 ref.

Descriptors: *Desalination plants, *Desalination wastes, *Flash evaporation, *Separation techniques, *Waste recovery, *Water reuse, Brines, Magnesium compounds, Mathematical models, Potable water, Saudi Arabia, Simulation analysis, Sodium chloride.

Salt recovery from rejected brines of the Al-Khobar Water Desalination Plant, Saudi Arabia, is studied through the simulation of a modified multistage flash evaporator system. Two phases of concentration are planned: Phase I will concentrate the main effluent from 6.4 wt% total salt to 28.8%, while Phase II will use the effluents from Phase I as a feed to undergo further evaporation and cooling. NaCl and water are produced throughout this phase, while the end residue product will be essentially MgCl2, since it is the most soluble. A mathematical model is developed and used to perform stage-to-stage material and heat balance calculations. Concentrations of NaCl and MgCl2 in the streams entering and leaving a stage are determined by using the solubility correlation developed in Part I. Simulation results show that by using 5210 tons/h brine as a feed for Phase I, 4430 tons/h fresh water, 277 tons/h NaCl and 502 tons/h 'bittern' (in which the ratio of MgCl2/NaCl is increased to 12) are recovered as the very final products of the integrated scheme. This bittern provides 30 tons/h MgCl2 as an end product. (Author's abstract)
W91-02402

LEIGH CREEK TOWN WATER SUPPLY--A HISTORY.
For primary bibliographic entry see Field 5F.
W91-02528

3B. Water Yield Improvement

IMPROVED YIELD OF RURAL WATER WORKS THROUGH HYDRAULIC FRACTURING EXPERIMENTS (AMELIORATION DE LA PRODUCTIVITE DES OUVRAGES D'HYDRAULIQUE VILLAGEOISE PAR FRACTURATION HYDRAULIQUE EXPERIMENTATION).
Bureau de Recherches Geologiques et Minieres, Orleans (France). Water Resources Dept.
For primary bibliographic entry see Field 4B.
W91-02335

USE OF RUN OFF ON CULTIVATED FIELDS IN THE SUDAN-SAHELIAN AREA: BURKINA FASO, YATENGA PROVINCE, BIDI REGION (VALORISATION AGRICOLE DES EAUX DE RUISSELLEMENT EN ZONE SOUDANO SAHELIENNE: BURKINA FASO, PROVINCE DU YATENGA, REGION DE BIDI).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Ouagadougou (Burkina Faso). Centre ORSTOM a Ouagadougou.
For primary bibliographic entry see Field 3F.
W91-02365

TAPPING OF WATER HOLES FROM TEMPORARY SURFACES TO IMPROVE SAHELIAN PASTURELAND MANAGEMENT (EXPLOITATION DE POINTS D'EAU DE SURFACE TEMPORAIRES POUR L'AMELIORATION DE LA GESTION DES PATURAGES SAHELIENS).
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France). Lab. d'Hydrologie.
P. Chevallier, and J. Claude.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 946-956, 3 tab, 15 ref. English summary.

Descriptors: *Developing countries, *Sahel, *Water holes, *Water supply, *Water tanks, Cattle, Evapotranspiration, Groundwater, Management planning, Social aspects, Water conservation.

In the Sahelian cattle breeding areas, the exploration of natural resources must emphasize their fragility and must spread the sampling in space and time. The concentration of cattle around water points leads to the degradation of surrounding pastures. A study of water transfers made two main points clear: (1) loss of water by evapotranspiration can be higher than 2000 mm and (2) surface runoff constitutes an abundant water resource. To spread the water resource in time and space, small equipment is proposed (tanks, overdeepening of pools). By taking account of traditional breeding systems in this way, recourse to the exploitation of underground resources often can be avoided, thus eliminating the need for development of technical and sociological infrastructure that the society cannot support. (See also W91-02288) (Rochester-PTT)
W91-02366

HARVEST OF EPHEMERAL RUNOFF FOR ARTIFICIAL GROUNDWATER RECHARGE: FEASIBILITY EVALUATION USING HYDROLOGICAL AND HYDROGEOCHEMICAL MODELS.
Nevada Univ. System, Las Vegas. Water Resources Center.
G. F. Cochran, J. R. Barry, M. W. Dale, and P. R. Sones.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 471-485, 3 fig, 10 ref.

Descriptors: *Aquifer management, *Artificial recharge, *Groundwater management, *Groundwater resources, *Water harvesting, *Water resources management, *Water supply development, Drawdown, Economic aspects, Ephemeral streams, Groundwater recharge, Hydrologic budget, Hydrologic models, Model studies, Nevada, Runoff, Surface runoff, Watershed management.

The economic and technical feasibility of harvesting ephemeral runoff for artificial recharge of overdrafted aquifers in a topographically closed basin in western Nevada were investigated. Groundwater provides 80% of domestic water for the basin's 15,000 residents. Spring runoff, which is highly variable and of short duration, does not occur during peak demand periods thus precluding direct utilization. Because there are no surface storage reservoirs, the runoff is lost to evaporation from shallow, valley-bottom playas. Use of overdrafted aquifers to store harvested water and supplement supplies appears economically feasible compared to costs for alternate supplies. Donor area water balance and groundwater models which were developed indicate significant harvestable water. Groundwater simulation and geochemical models were used to select best recharge locations and study recharge effects. It was determined that, with this artificial recharge scenario, water levels in the central and northern portion of the valley would continue to decline but at a lower rate, experiencing up to 3 m less drawdown than without recharge operations. (See also W91-02672) (Author's abstract)
W91-02712

3C. Use Of Water Of Impaired Quality

RAPID EVALUATION OF SALT TOLERANCE OF MANGROVE-SWAMP RICE VARIETIES.
Regional Mangrove Swamp Rice Station, Rokupr (Sierra Leone).
M. P. Jones.
Tropical Agriculture TAGLA2, Vol. 67, No. 3, p 199-202, July 1990. 3 fig, 2 tab, 12 ref.

Descriptors: *Developing countries, *Mangrove swamps, *Plant water potential, *Rice, *Roots, *Salinity, *Salt tolerance, Physiological ecology, Plant growth, Resource conservation, West Africa.

In West Africa, an estimated 1,500,000 ha of cultivatable mangrove swamps are affected by salinity. The identification or development of salt-tolerant rice varieties could be of considerable benefit in the stabilization of rice production and expansion of cultivatable areas in mangrove swamps. Salinity tolerance of rice varieties was determined by comparative measurement of seedling root growth in saline and in non-saline conditions. A tolerance ratio (TR) of root growth after four days in 80 mM sodium chloride solution to root growth after four days in normal culture solution was calculated for each individual within a variety. The technique was used to screen 1058 varieties/advanced lines available at the WARDA-Rokupr Station and was found to be reliable, rapid and simple. Substantial variation in seedling tolerance to salinity was found within and between varieties and populations bearing the same variety name. The seedling TR was correlated with the visual scores ($r = 0.80$, $df = 1058$, $P < 0.001$) of salt symptoms and survival ($r = 0.75$, $df = 1058$, $P < 0.001$) at 80 mM sodium chloride solution. The scores after four weeks of plant exposure to 80 mM sodium chloride confirm the ranking of the varieties on the

basis of the TR. While visual scores can be subjective, the TRs were obtained from root length which is a quantitative characteristic. Humidity and temperature appeared to affect the germination and rate of root growth, thereby affecting the TR. The changes in TR due to seasonal drift were overcome by adjusting the TRs of all test varieties with the TR of the tolerant check. The method of comparing rate of root growth of one-week-old rice seedlings in normal and 80 mM sodium chloride solutions provided a quick, reliable and simple technique of screening rice varieties and breeding lines for salinity tolerances. (Author's abstract)
W91-02077

GUIDELINES FOR DEVELOPING A PROJECT.
Freese and Nichols, Inc., Fort Worth, TX.
For primary bibliographic entry see Field 6B.
W91-02567

GROUNDWATER MANAGEMENT STRATEGY FOR SALINITY MITIGATION IN THE VICTORIAN RIVERINE PLAIN, AUSTRALIA.
Rural Water Commission of Victoria, Armidale (Australia).
R. S. Evans, and J. Nolan.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 487-499, 5 fig, 2 ref.

Descriptors: *Aquifer management, *Groundwater management, *Groundwater resources, *Irrigation effects, *Irrigation water, *Saline groundwater, Saline soils, *Water resources management, Water supply development, Australia, Conjunctive use, Groundwater irrigation, Groundwater potential, Groundwater recharge, Land use, Resource allocation, Water allocation, Water table rise, Waterlogging.

Groundwater management for salinity purposes requires a significant change of thinking compared to management for 'stressed' aquifers. The recognition that groundwater quality decrease is a primary factor controlling groundwater quantity allocation represents a significant change of thinking compared to conventional management philosophies. The need for careful management of the re-used groundwater is paramount. The long-term viability of agriculture in the Riverine Plain of Northern Victoria, Australia, is now threatened by land salinization and waterlogging; a direct result of increased rates of recharge to groundwater in response to clearing of natural vegetation and intensive irrigation. Without large scale dewatering, the groundwater system is unable to dissipate the increased recharge, hence water tables will continue to rise and exacerbate the existing problem. A groundwater management strategy is based on encouraging groundwater development. The principle constraints on such development are the need for control of aquifer salinity and salt export, in the context of an overall conjunctive use policy. Specific strategy initiatives to encourage an appropriate and sustainable level of groundwater use include: integrated water allocation and management policy, definition of salt export criteria, and community education. (See also W91-02672) (Author's abstract)
W91-02713

3D. Conservation In Domestic and Municipal Use

WATER CONSERVATION IN DROUGHT-STRICKEN SANTA BARBARA COUNTY--RESPONSE IS SLOW.
Lawrance, Fish and McFarland, Inc., Santa Barbara, CA.
W. H. Lawrance.
Public Works PUWOAH, Vol. 121, No. 10, p 102-103, September 1990. 3 tab.

Descriptors: *California, *Domestic water, *Water conservation, *Water shortage, *Water use, Analytical methods, Biochemical oxygen demand, Conservation, Environmental protection, Municipal water, Water demand.

For several years, most of the public water supply agencies in Santa Barbara County, California have encouraged their customers to conserve water. The urgency for consumer conservation has increased since 1988, and has become critical for portions of Santa Barbara County that rely to a significant extent on surface water supply. Enlisting the cooperation of all municipal sewering agencies within Santa Barbara County, Lawrance, Fisk and McFarland, Inc. obtained and analyzed municipal wastewater treatment plant data for 1983 to 1989 in order to study interior water usage. Average dry-weather flow, estimated tributary population, and representative influent concentrations of 5-day biochemical oxygen demand and suspended solids were examined. The year 1983 was selected because is was the most recent very wet year in Santa Barbara County. Using the data submitted, per capita wastewater flows and organic contributions for each year were calculated. Results showed that only one community was experiencing significant effects of interior water conservation, as registered by a consistent decrease in average dry-weather flow and per capita wastewater flows and a corresponding increase in influent biological oxygen demand. The water purveyor serving this particular community had an unusually aggressive retrofit campaign for toilets and shower heads for a number of years. This activity apparently was paying off in terms of reduced interior water usage. (Mertz-PTT)
W91-02423

3E. Conservation In Industry

MODELS FOR A RATIONAL UTILIZATION OF HIGH QUALITY GROUNDWATER RESOURCES.
Dortmund Univ. (Germany, F.R.). Inst. for Environmental Protection.
I. Heinz.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 515-522, 1 tab, 3 ref.

Descriptors: *Germany, *Groundwater management, *Groundwater resources, *Industrial water, *Model studies, *Taxes, *Water conservation, *Water resources management, *Water use efficiency, Drinking water, Economic justification, Water allocation, Water demand, Water pollution.

Increasing demands are being placed on high grade quality drinking water, as a result of the continuing pollution in the Federal Republic of Germany. Consequently, the need has arisen for water utilization to become as efficient as possible. Approaches in this direction have already been made in industry where engineers have intensified the search for water-saving techniques in the manufacturing process. Optimal allocation of water resources may be achieved by introducing a groundwater intake levy in order to push industry in particular towards a maximally efficient water utilization. The starting point is a supply deficit of high quality groundwater in any given area due to increasingly higher drinking water needs and/or growing pollution of water by toxic substances. Using the example of a regional model, the conditions for an economically effective allocation of water resources for both industry and the public water supply, can be seen from an ecological standpoint. The optimal rate for a water intake levy is determined with the assistance of an iteration procedure. In 1988, a water intake levy was introduced in the State of Baden-Wurttemberg in the Federal Republic of Germany. The levying of this charge on all water users (on both groundwater and surface water) is now being retrospectively justified by the argument that a more efficient utilization of water has been created and that, in the future, the price of natural resources should no longer be fixed at zero. Such a levy can only bring about a more thrifty utilization of precious water supplies. (See also W91-02672) (Fish-PTT)
W91-02715

3F. Conservation In Agriculture

SCREENING FOR DROUGHT TOLERANCE: SOYBEAN GERMINATION AND ITS RELATIONSHIP TO SEEDLING RESPONSES.
Alabama A and M Univ., Normal. Dept. of Plant and Soil Science.
B. K. Kpoghomou, V. T. Sapra, and C. A. Beyl.
Journal of Agronomy and Crop Science ZAPFAR, Vol. 164, No. 3, p 153-159, April 1990. 4 fig, 1 tab, 14 ref. CSRS/USDA Grant No. 2-01-14-3151.

Descriptors: *Crops, *Drought resistance, *Soil-water-plant relationships, *Soybeans, Drought effects, Germination, Leaves, Osmoregulation, Plant growth, Plant water potential, Stress, Vegetable crops, Water use.

Soybean has a peak daily water use of 8.5 ml during the growing season and is very sensitive to water stress. Seventeen determinate soybean (Glycine max L.) cultivars from maturity groups V through VIII were screened for drought tolerance during germination and seedling stages. Ultimately, this information may be used to predict the field performance of selected varieties under actual drought conditions. Germinating seeds and hydroponically-grown seedlings were subjected to osmotic stresses of about 0.3 and 0.5 MPa using polyethylene glycol M.W. 8000. Genotypic variability was found among the cultivars for all the parameters analyzed in both germination and seedling tests. Germination stress index was lower for seeds exposed to about 0.5 MPa than for about 0.3 MPa osmotic stress. Lower osmotic potential in the treatment medium was also correlated with lower leaf water potential in seedlings. A significant relationship was found between fresh weight and height stress indices. The cultivars that grew taller under drought stress conditions had greater dry matter accumulation and higher germination stress indices, indicating the reliability of height to predict cultivar performance under such conditions. In the seedling tests, there was no strong relationship between the leaf water potential and the overall performance of the plant, suggesting no clear osmoregulatory mechanism. (Author's abstract)
W91-02074

INFLUENCE OF PLANT WATER STRESS ON NET PHOTOSYNTHESIS AND LEAF AREA OF TWO MAIZE (ZEA MAYS L.) CULTIVARS.
Orange Free State Univ., Bloemfontein (South Africa). Faculty of Agriculture.
J. J. Human, W. H. DuPreez, and L. P. DeBruyn.
Journal of Agronomy and Crop Science ZAPFAR, Vol. 164, No. 3, p 194-201, April 1990. 4 fig, 4 tab, 18 ref.

Descriptors: *Corn, *Crops, *Drought resistance, *Plant growth, *Plant water potential, *Soil-water-plant relationships, *Water stress, Absorption, Leaves, Photosynthesis, Vegetable crops.

Yield reduction caused by plant water stress can be attributed directly to inhibition of the carbon dioxide uptake rate. The effect of plant water stress on net photosynthesis and leaf growth were investigated in order to determine how much leaf water potential during vegetative growth and silking affects maize development. Two commercial maize hybrids grown in pots in a glasshouse were subjected to leaf water potentials of approximately 1300 and 1700 kPa during the eighth leaf stage and during silking to approximately -1700 and -2300 kPa to previously unstressed, moderately, and severely stressed plants. The effect of stress on inhibiting carbon dioxide uptake rates and leaf areas, as well as the recovery after alleviating stress, were compared to that of unstressed plants. No substantial differences in carbon dioxide uptake rates were found between medium and long seasoned cultivars. The carbon dioxide uptake rates per unit leaf area decreased to negative values under both moderate and severe stress conditions during both growth stages. During silking, the recovery of carbon dioxide uptake rate was much lower than during the eight leaf stage. Leaf area decreased

proportionally with increased stress but did not recover after alleviating stress on plants stressed during both the eighth leaf and silking stages. These findings indicate increased resistance to water stress with increased plant age. (Author's abstract)
W91-02075

RAPID EVALUATION OF SALT TOLERANCE OF MANGROVE-SWAMP RICE VARIETIES.
Regional Mangrove Swamp Rice Station, Rokupr (Sierra Leone).
For primary bibliographic entry see Field 3C.
W91-02077

WATER VAPOR TRANSPORT THROUGH A FLAIL-CHOPPED CORN RESIDUE.
Wisconsin Univ., Madison. Dept. of Soil Science.
C. B. Tanner, and Y. Shen.
Soil Science Society of America Journal SSSJD4, Vol. 54, No. 4, p 945-951, July/August 1990. 4 fig, 29 ref.

Descriptors: *Corn, *Evaporation, *Water transport, *Water vapor, Conductance, Convection, Crop residues, Crops, Evapotranspiration, Field tests, Flail-chopping, Regression analysis, Vapor pressure, Wind velocity.

Crop residue at the soil surface is known to decrease evaporation, and measurements have shown that wind increases evaporative loss through residues; however, measurements of water vapor flux through residues have not defined their vapor conductance. Water vapor transport through crop residues was measured in a wind tunnel and under natural wind in order to parameterize the vapor conductance in a way useful for modeling the energy balance of conservation-tillage systems. The vapor conductance of flail-chopped corn (Zea mays L.) residue laid over large vapor sources (0.15 by 1.2 m) at different vapor pressure gradients was measured in still air and under winds. In still air, the vapor conductance of 10 samples of residue (areal density, 0.4 kg/sq m; average thickness, 11 mm) averaged 2.2 mm/s at 20 C and was not significantly different than the conductance of a similar thickness of air. Error in the measurement (CV=13%) was sufficient that porosity and tortuosity effects could not be determined. Buoyancy-driven convection in the flail-chopped residue was negligible under much greater buoyancy instabilities than are likely to occur in the field. The vapor conductance of nine samples of residue measured in a wind tunnel increased linearly with wind speeds measured at 1 m above the residue. The regression coefficients of vapor conductance versus wind found in the wind tunnel and under natural winds did not differ. It is suggested that conductance measurements of other residues would be done much more easily in a suitable wind tunnel than in the field, and with the same results. (Author's abstract)
W91-02130

COUPLED WATER AND HEAT TRANSPORT IN RIDGED SOILS.
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W91-02133

POLYMER EFFECTS ON EROSION UNDER LABORATORY RAINFALL SIMULATOR CONDITIONS.
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
For primary bibliographic entry see Field 2J.
W91-02137

GUIDELINES AND INTEGRATED MEASURES FOR PUBLIC HEALTH PROTECTION IN AGRICULTURAL REUSE SYSTEMS.
World Health Organization, Geneva (Switzerland). Div. of Environmental Health.
For primary bibliographic entry see Field 5E.
W91-02142

IMPACT OF WATER CONTROL ON NAVAJO IRRIGATION PROJECTS.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. W. Leeper.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 165-174, 1 fig, 6 tab, 11 ref.

Descriptors: *Agricultural water, *Indian reservations, *Indian water rights, *Irrigation practices, *Water management, *Water resources management, Navajo Indians, Social aspects.

Navajo irrigation systems have been plagued with poor performance. Many theories have been proposed to explain this poor performance including: small economically non-viable farm size, lack of maintenance, lack of funding, institutional conflict, lack of extension/technology, lack of credit, lack of education, and/or irrigated agriculture is culturally unaccepted. Based on past experience with Navajo irrigation, many authorities do not believe that small-scale irrigated agriculture is culturally or economically viable. Based on system-wide data from 83 Navajo irrigation projects, farm data from over 600 Navajo farmers and comparisons with non-Navajo systems, one of the primary constraints on these systems is a lack of physical and organizational control over water. Resources expended on education, extension or exotic crops, will have little impact on farm performance if water control is lacking. On the Navajo Reservation, in spite of small farm size, because of no access to financing and insufficient extension services, farmers who have control of their water are using it. The farms at the head of the Fruitland system, for instance, have a cropping intensity of almost 80%. Even on the Fruitland system, although the water supply is adequate, it is not reliable, nor is it distributed equitably. Without water control, most of the farms experience crop threatening water shortages sometime during the water season. (See also W91-02262) (Lantz-PTT)
W91-02278

HYDRAULIC WORKING OF SHALLOW WATERS IN WEST AFRICA (FONCTIONNEMENT HYDROLOGIQUE DES BAS FONDS EN AFRIQUE DE L'OUEST).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Dakar (Senegal). Centre de Dakar.
For primary bibliographic entry see Field 4A.
W91-02314

IRRIGATION TRIALS: BASIS FOR THE DESIGN OF FURROW SYSTEMS.
Irrigation Development Authority, Accra (Ghana).
H. K. Nyaledzigbor.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 343-351, 5 fig, 2 tab, 2 ref.

Descriptors: *Agriculture, *Furrow irrigation, *Ghana, *Irrigation design, Design criteria, Developing countries, Economic aspects, Infiltration, Semiarid lands.

Applied research was carried out to investigate water intake, furrow lengths, and gradients for the design of a furrow irrigation system. The study aimed to develop well-designed fields with furrows of economical length and gradient and to investigate the operational parameters of lead stream size and duration to assist operational planning for the irrigation system. Furrow trials were established on the soils of an irrigation project during its design phase (semi-arid savanna zone of Ghana). The trials measured cumulative infiltration by furrow infiltration tests and investigated lead stream sizes for various furrow lengths and gradients. From the trial results it was possible to select an adequate furrow length and gradient for the layout design of the project. It also was possible to recommend the range of lead streams to achieve adequate water application, as follows: (1) the field layout of the upland areas of the project be approximately 200 m long at 1 in 500 gradient in the furrow direction; (2) furrows should have broad flat bases between ridges; (3) a lead stream of 2-2.3 l/sec should be adequate for furrows of 1-m spacing; and (4) an irrigation frequency of 4 days would be appropriate. (See also W91-02288) (Rochester-PTT)
W91-02315

QUANTIFYING THE WATER BALANCE OF DRYLAND MILLET IN NIGER USING STATE OF THE ART EVAPORATION TECHNIQUES.
Institute of Hydrology, Wallingford (England).
J. S. Wallace, J. H. C. Gash, D. D. McNeil, and M. V. K. Sivakumar.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 352-360, 4 fig, 8 ref.

Descriptors: *Data acquisition, *Dry farming, *Evaporation, *Hydrologic budget, *Measuring instruments, *Niger, *Semiarid lands, *Soil-water-plant relationships, Evapotranspiration, HYDRA, Lysimeters, Millet, Performance evaluation, Porometers, Soil moisture meters, Soil water.

Water use on sparse dryland crops is an important aspect of the hydrology of semi-arid zones because it is closely linked with crop yield. Information on the energy and water balance of Sahelian landscapes is needed to improve the accuracy of the output of global climate models that predict such phenomena as desertification. To improve the description of the energy balance and evaporation from sparse vegetation a collaborative project was undertaken between the Institute of Hydrology (IH), United Kingdom, and the ICRISAT Sahelian Center in Niger. The principal aim of the project was to make detailed measurements of plant, soil, and total evaporation in a sparse millet crop. Measurement techniques included the use of state-of-the-art eddy correlation devices ('The HYDRA') developed at IH, porometry to measure transpiration, and the use of microlysimeters to measure soil evaporation. Some preliminary results are presented showing how the energy balance and evaporation changed after rainfall and how the components of the total evaporation varied widely with soil wetness. The Hydra was able to provide routine measurements of evaporation and sensible heat flux to an accuracy of around 10%. The porometry and lysimeter techniques showed good agreement with the Hydra results and permitted the separation of soil from plant evaporation. The results demonstrated clearly the importance of soil evaporation in the water balance of areas covered by sparse vegetation. (See also W91-02288) (Rochester-PTT)
W91-02316

UTILIZATION OF THE LAW OF GAPS FOR THE DESCRIPTION OF THE PLUVIOMETRIC REGIME (L'UTILISATION DE LA LOI DES FUITES POUR LA DESCRIPTION DES REGIMES PLUVIOMETRIQUES).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Niamey (Niger). Mission ORSTOM au Niger.
For primary bibliographic entry see Field 2B.
W91-02345

USE OF RUN OFF ON CULTIVATED FIELDS IN THE SUDAN-SAHELIAN AREA: BURKINA FASO, YATENGA PROVINCE, BIDI REGION (VALORISATION AGRICOLE DES EAUX DE RUISSELLEMENT EN ZONE SOUDANO SAHELIENNE: BURKINA FASO, PROVINCE DU YATENGA, REGION DE BIDI).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Ouagadougou (Burkina Faso). Centre ORSTOM a Ouagadougou
J. Lamachere, and G. Serpantie.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas o

frica. Proceedings of the Sahel Forum, Ouagaougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illnois. 1990. p 933-945, 7 fig, 2 tab, 6 ref. English ummary.

escriptors: *Agricultural water, *Burkina Faso, Cultivated lands, *Erosion control, *Rainfall-unoff relationships, *Runoff, *Water harvesting, rop yield, Millet, Performance evaluation, Plant rowth, Seepage, Soil erosion, Soil moisture retenon, Soil water.

, Yatenga Province, northern Burkina Faso, the ultivated plots often are located at a lower level an relatively impermeable areas. The runoff on ese surfaces constitutes both a surface water reurce for agriculture and erosive force attacking e fine sandy soils, which are very vulnerable to ater erosion. To analyze the effect of a series of eping obstructions over the plowed and unowed plots on which millet grows, three experiental plots were established near the village of di in northern Yatenga. Rainfall, runoff, soil midity, and agricultural production data were served for 3 yr (1985, 1986, 1987). The runoff alysis shows the effect of the state of the soil face and of the moisture content. Stone ribbons more effective during heavy rains. They inase by 20% the amount of runoff absorbed, luce the flow, and prolong its period. This effect stone ribbons on the hydrographs suggests that improvement contributes to protection against erosion. During flow periods, the stone belts ourage the replenishment of the water reces of soil having good retention capacity. The let experiences a reduction in water deprivation iods and benefits from a better use of soil mineresources. During the 3-yr period an increase in matter was noted on the improved parcel. The ease in dry seed return, although very irregu- was about 40%. (See also W91-02288) (Au-'s abstract)
1-02365

PPING OF WATER HOLES FROM TEMPO-RY SURFACES TO IMPROVE SAHELIAN STURELAND MANAGEMENT (EXPLOITAN DE POINTS D'EAU DE SURFACE TEMRAIRES POUR L'AMELIORATION DE LA STION DES PATURAGES SAHELIENS).
ce de la Recherche Scientifique et Technique re-Mer, Montpellier (France). Lab. d'Hydrolo-

primary bibliographic entry see Field 3B.
-02366

TER ASSESSMENT OF SOILS AND TRADINAL AGRICULTURAL CALENDARS IN ER BORGOU (REP. POP. DU BENIN) ANS D'EAU DES SOLS ET CALENDRIERS ICOLES TRADITIONNELS DANS LE T BORGOU (R.P. BENIN)).
ersite Nationale du Benin, Cotonou. Dept. de graphie.
oko.
The State-of-the-Art of Hydrology and Hyeology in the Arid and Semi-Arid Areas of a. Proceedings of the Sahel Forum, Ouagaou, Burkina Faso, 18-23 February 1989. Internal Water Resources Association, Urbana, Il- 1990. p 957-963, 11 ref. English summary.

riptors: *Arid lands, *Benin, *Rainfall, *Soil , Agricultural water, Evapotranspiration, nal variation, Upper Borgou.

Upper Borgou is part of the subsahelian area. a dry tropical climate but with little variabil-5% over a long period). The annual rainfall is ge (900 mm) with a high seasonal concentra-Consequently, farmers must sow after the first tant rainfall. There are two types of soils, al and tropical ferruginous, very concretionvith a useful water reserve varying between nd 180 mm. The potential evapotranspiration) is very high between the end of the harmatriod and the beginning of the rainy season. water assessments of soils calculated for an ge year and for wet and dry years compared agricultural calendars. As a result of this comparison of the high variability of rainfall and the length of rainy seasons over the past 10 yr, farmers have adopted mobile agricultural calendars that begin with a useful water reserve approximately more than 50% of the total evapotranspiration. This empirical practice is based on the observation of depth of the moisture of soils and a very approximate evaluation of the quantities of rainfall. One question is whether it is risky that this estimation corresponds to a single measure of the recharge of the soil (50% of PET). This appears to be the result of the close knowledge farmers have of the hydrodynamic characteristics of the soils they cultivate. (See also W91-02288) (Rochester-PTT)
W91-02367

IDENTIFICATION AND INVENTORY OF PHILIPPINE FORESTED-WETLAND RESOURCE.
Philippines Dept. of Environment and Natural Resources, College. Coastal Zone and Freshwater Ecosystems Research Div.
For primary bibliographic entry see Field 2H.
W91-02473

MANGROVE FOREST RESOURCES IN INDONESIA.
Louisiana State Univ., Baton Rouge. School of Forestry, Wildlife and Fisheries.
For primary bibliographic entry see Field 2H.
W91-02474

MANGROVES IN KAMPUCHEA.
Humboldt State Univ., Arcata, CA. Dept. of Forest Economics.
For primary bibliographic entry see Field 2H.
W91-02475

INVENTORY AND MONITORING OF FORESTED-WETLAND RESOURCES OF ASEAN.
Pertanian Malaysia Univ., Serdang. Faculty of Forestry.
For primary bibliographic entry see Field 2H.
W91-02476

APPLICATION OF A DIGITAL GEOGRAPHIC DATA BASE TO IRRIGATION WATER RIGHTS MANAGEMENT.
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 6E.
W91-02598

AGRICULTURAL WATER USE MONITORING THROUGH LANDSAT SURVEILLANCE.
Earth Technology Corp., Long Beach, CA.
R. Kelly.
IN: Remote Sensing Applications for Consumptive Use (Evapotranspiration). Papers Presented at 21st Annual AWRA Conference and Symposium, August 11-16, 1985, Tucson, Arizona. AWRA Monograph Series No. 6, (1985). p 65-72, 5 fig, 3 ref.

Descriptors: *Agricultural water, *Arizona, *Consumptive use, *Landsat images, *Remote sensing, *Satellite technology, Geographic information systems, Water resources management, Water rights.

Arizona's massive water consuming economy is a paradox to its arid environment. Agriculture is the single greatest user of the limited water resources, yet the extent of water use can be difficult to ascertain. However, agriculture is readily detectable through Landsat data analysis. A water rights geographic information system (GIS) when combined with satellite surveillance can assist in water rights determinations, water law enforcement and water use estimates. The combination of Landsat and GIS is becoming a more familiar approach to natural resource management techniques. The contemporary nature of satellite data can accommodate surveillance purposes or other new real-time assessments of resource conditions. By recombining data sets and establishing Boolean relationships between Landsat and GIS data, a vast amount of synthetic information can be visually and statistically captured. As with many GIS based natural resource management programs, many supplemental programs can be supported with data designed for an initial purpose. (See also W91-02594) (Lantz-PTT)
W91-02600

ACCESS OF SMALL AND MARGINAL FARMERS TO GROUNDWATER--A FIELD STUDY.
Roorkee Univ. (India). Water Resources Development Training Center.
For primary bibliographic entry see Field 4B.
W91-02675

GROUNDWATER MANAGEMENT BY A DUAL-PIPE SUBIRRIGATION SYSTEM.
Iowa State Univ., Ames. Astronomy Program.
For primary bibliographic entry see Field 4B.
W91-02677

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

INFLUENCE OF THE HERBICIDE PARAQUAT 'GRAMAXON' ON GROWTH AND METABOLIC ACTIVITY OF THREE CHLOROPHYTES.
Institute of Oceanography and Fisheries, Cairo (Egypt). Lab. of Aquatic Plants.
E. A. Ibrahim.
Water, Air and Soil Pollution WAPLAC, Vol. 51, No. 1/2, p 89-93, May 1990. 1 fig, 21 ref.

Descriptors: *Algae, *Aquatic weed control, *Chlorophyta, *Herbicides, *Metabolism, *Paraquat, *Plant growth, Bioassay, Chlorophyll a.

The acute toxicity of the commercial herbicide, paraquat, commonly used in the control of aquatic weeds, was determined by 96 hour static bioassay on the freshwater chlorophytes Scenedesmus dimorphus, Scenedesmus quadricauda and Ankistrodesmus falcatus. The 96 hour EC50 values of paraquat for reducing growth and metabolic products of the three algae were determined. The number of days required for cell division increased with increasing paraquat concentration. The three algae and their test parameters respond differently to paraquat. Scenedesmus dimorphus was the most susceptible alga and the chlorophyll a was the most sensitive response parameter. On the other hand, the dry weight of the test algae was the most resistant parameter. The effective dose for controlling macrophytes is 1 mg/L. The results show that application of paraquat causes an inhibitory effect in primary producers. (Author's abstract)
W91-02085

POTENTIAL HAZARDS FROM FLOOD-FLOWS IN GRAPEVINE CANYON, DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA AND NEVADA.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-02230

IMPROVED METHODS FOR REGIONAL FLOOD FREQUENCY ANALYSIS.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-02243

FLOODS OF FEBRUARY 1989 IN TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
F. Quinones, and C. R. Gamble.

Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4207, 1990. 15p, 6 fig, 4 tab, 3 ref.

Descriptors: *Flood recurrence interval, *Floods, *Rainfall, *Storm runoff, *Tennessee, Flooding, Peak discharge, Streamflow.

Rainfall amounts of over 5 inches the night of February 13 and the morning of February 14, 1989, caused flooding in areas of Middle and West Tennessee. The towns of Lebanon in Middle Tennessee and Obion in West Tennessee were most severely affected. Most of the business district in Lebanon and many residential areas in Obion were flooded. Recurrence intervals for 24-hour rainfall totals were as high as 25 years at some sites but most peak discharges had recurrence intervals of less than 10 years. Rainfall amounts for the period February 13-20, 1989, peak stages and discharges for this flood, the peak of record, and a list of discharge measurements made during the flood are documented. (USGS)
W91-02260

IMPACT OF WATER CONTROL ON NAVAJO IRRIGATION PROJECTS.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W91-02278

HYDRAULIC WORKING OF SHALLOW WATERS IN WEST AFRICA (FONCTIONNEMENT HYDROLOGIQUE DES BAS FONDS EN AFRIQUE DE L'OUEST).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Dakar (Senegal). Centre de Dakar.
J. Albergel, and J. Claude.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 330-342, 4 fig, 16 ref. English summary.

Descriptors: *Agriculture, *Flood plain management, *Floods, *Land use, *Water resources development, *West Africa, Acidic soils, Casamance, Developing countries, Gambia, Guinea, Sahel, Saline soils, Sudan.

From the northern border of the Sahel to the forested areas in the south of Guinea, wet areas in Africa are being cultivated increasingly. The development of farming in the river beds is linked to constraints on rain farming on the slopes, drought in the north, exhaustion and erosion of the soil, or a shortage of arable land on the slopes in the areas with a more favorable climate. In the Sahel and the Sahelo-Sudan, drainage areas are usually spread out, rarely confined. Floods are sudden and large, and drainage in submerged areas often is slowed by topographical thresholds downstream. Temporary flooding feeds inter-flux expanses of water in the depressions. The relatively wooded flood plains are used as secondary pasture by shepherds in the north, whereas further south this is rivaled by agriculture (e.g., gardens and small rice fields). In the Sudano-Guinean region, the flood plains usually are more confined. The flood plains are affected by the rise or lateral flow from the expanses in depressions and the convergence of surface streams. Where the river bed has been transformed by human intervention, cash crops such as rice, cotton, and maize often are grown. The flood plains along tidal reaches of Gambia and Casamance and in coastal Guinea are the home of important development programs. These improvements should solve problems of acidification and salinity of the soil. (See also W91-02288) (Author's abstract)
W91-02314

WATER RESOURCES MANAGEMENT IN NIGERIA: THE RIVER BASIN APPROACH.
Ibadan Univ. (Nigeria). Dept. of Geography.
A. Faniran.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 836-845, 4 fig, 1 tab, 13 ref.

Descriptors: *Dams, *Nigeria, *River basin development, *Water resources development, Agriculture, Industry, Management planning, Monitoring, Reservoirs, Storage reservoirs, Water supply.

Nigeria's water resources are currently being developed for many purposes, including domestic, agricultural, and industrial uses. Irrigation activities in the north of the country have been widely reported, but more recent activities by river basin development authorities have not been so reported. Projects of the Upper Benue River Basin Authorities in the Gongola Basin (Kuri, Dadi Kowa, and Cham projects) are highlighted. Each river basin authority is currently engaged in 2-3 large-scale projects and numerous small-scale projects (earth dams, wells, boreholes, channel improvements, etc.). The Dadi Kowa scheme has the second largest storage, after Kainji Dam, in Nigeria. The Cham earth dam is one of many small-scale dams the authority has either constructed or proposed for construction. With persistent and well-guided efforts, the nation's water resources shortly will be fully controlled and ready to best serve the needs of the population. In the future, river basin authorities will need to be strengthened, both materially and in personnel, to perform other functions within the river systems, such as development of an efficient data management system and, perhaps more importantly, comprehensive planning, execution, and monitoring of the environmental impacts of development projects, as well as the observation and recording of natural processes. (See also W91-02288) (Rochester-PTT)
W91-02357

HYDROLOGY AND RIVER CONTROL ON THE NIGER AND SENEGAL.
Gibb (Alexander) and Partners Ltd., Reading (England).
For primary bibliographic entry see Field 2E.
W91-02358

SYSTEMS ENGINEERING APPROACH TO SOLUTIONS OF DROUGHT IN DEVELOPING COUNTRIES: THE CASE OF TANZANIA.
New Tech International Inst., Dar es Salaam (Tanzania).
For primary bibliographic entry see Field 2A.
W91-02361

POSSIBILITIES FOR REGENERATION OF FLOODPLAIN FORESTS WITHIN THE FRAMEWORK OF THE FLOOD-PROTECTION MEASURES ON THE UPPER RHINE, WEST GERMANY.
Institute for Floodplains Ecology, Rastatt (Germany, F.R.).
A. Zinke, and K. A. Gutzweiler.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 13-20, June 1990. 3 fig. 5 ref.

Descriptors: *Flood plain forests, *Flood plain management, *Forest management, *Germany, *Reforestation, *Regeneration, *Rhine River, *Soil-water-plant relationships, *Water resources management, Flood control, Flood plains, Forest watersheds, France, Management planning, Polders, Revegetation, Weirs.

The Upper Rhine valley in Germany is one of the most densely populated areas in Europe. As a result, human interference has significantly reduced both the original species diversity as well as the ecological function of the floodplain forests in the area. Furthermore, past mismanagement and potential flood danger necessitates the adoption of new management policies concerning this type of landscape. Among these measures, Germany and France have planned extensive specialized flood-protection strategies including the construction of polders and the utilization of weirs. In addition, the Institute for Floodplains Ecology has proposed the relocation of existing dams which would achieve a much more effective flood practice. It is concluded that with proper future planning and well-selected flood-protection procedures, the floodplain forests could potentially be regenerated. (D'Agostino-PTT)
W91-02472

POTENTIAL FOR ENHANCING RIPARIAN HABITATS IN THE SOUTHWESTERN UNITED STATES WITH WATERSHED PRACTICES.
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
L. F. Debano, and L. J. Schmidt.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 385-403, June 1990. 3 fig, 40 ref.

Descriptors: *Flow control, *Forest ecosystems, *Land management, *Riparian vegetation, *Riparian waters, *Streamflow, *Streams, *Watershed management, Channelization, Ephemeral streams, Hydrology, Stream discharge, Stream improvement.

Riparian communities are unique and sensitive habitats that are strongly interrelated with the surrounding watershed. Currently, since previous misuse has led to their extensive degradation, management of riparian areas is a critical issue in the southwestern United States. Potential opportunities for better management of existing ecosystems or for the re-establishment of new riparian communities generally exist where either the amount of water or the duration of streamflow, or both, can be increased. Various-sized channel structures, ranging from small gully check dams to large flood control structures, have been used successfully for both stabilizing erodible channels and lengthening streamflow duration. Such channel structures trap sediment in upstream deposits which store water and release it slowly over time, thereby producing perennial flow in previously ephemeral streams. In addition, the deposited sediment also provides a nutrient-rich medium which further favors plant establishment and growth. The amount and duration of streamflow through a riparian zone can also be increased by manipulating upslope vegetation where deep-rooted plants are replaced with more shallow-rooted species using less water. Such watershed practices may potentially improve the hydrologic conditions in southwestern streams as well as enhance establishment of riparian vegetation. (D'Agostino-PTT)
W91-02495

ENVIRONMENTAL RIVER ENGINEERING.
University of East Anglia, Norwich (England). School of Environmental Sciences.
R. D. Hey.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 4, p 335-340, August 1990. 4 fig, 17 ref.

Descriptors: *Channel flow, *Hydraulic engineering, *Regulated flow, *River channels, Canals, Channels, Flood control, Geomorphology, River mechanics, River systems.

River engineering works have often caused channel instability and adversely affected the river conservation and amenity value. Recent guidelines have advocated a more natural approach to river engineering practice, to retain a habitat diversity within the river system. While a more natural approach is desirable, a geomorphological guidance is required to ensure that the advocated changes are feasible and sustainable, both in the long and short term. The key requirement for sound environmental river engineering is a understanding of the natural processes controlling channel shape and dimensions. Examples are given in the paper to illustrate how such knowledge can be used to: (1) stabilize rivers, (2) design environmentally acceptable and stable flood alleviation schemes, and (3) restore previously canalized rivers. The basis of the geomorphological input to the assessment and design process is a river survey which determines the factors controlling ch

haracteristics and how it will respond to planned hanges. (Author's abstract)
/91-02845

LIMATIC INFLUENCES ON STREAMFLOW ARIABILITY: A COMPARISON BETWEEN OUTHEASTERN AUSTRALIA AND SOUTH-ASTERN UNITED STATES OF AMERICA.
elbourne Univ., Parkville (Australia). Dept. of vil and Agricultural Engineering.
or primary bibliographic entry see Field 2B.
91-02877

B. Groundwater Management

LTITUDE OF POTENTIOMETRIC SURFACE, LL 1985, AND HISTORIC WATER-LEVEL HANGES IN THE MEMPHIS AQUIFER IN ESTERN TENNESSEE.
ological Survey, Nashville, TN. Water Re-rces Div.
r primary bibliographic entry see Field 2F.
91-02224

OLOGY AND GROUND-WATER RE-URCES OF THE COCKFIELD FORMATION WESTERN TENNESSEE.
ological Survey, Nashville, TN. Water Re-rces Div.
primary bibliographic entry see Field 2F.
1-02225

LECTED GROUND-WATER INFORMA-ON FOR THE PASCO BASIN AND ADJA-NT AREAS, WASHINGTON, 1986-1989.
ological Survey, Tacoma, WA. Water Re-ces Div.
primary bibliographic entry see Field 2F.
1-02233

PROVED YIELD OF RURAL WATER RKS THROUGH HYDRAULIC FRACTUR-EXPERIMENTS (AMELIORATION DE LA ODUCTIVITE DES OUVRAGES D'HY-AULIQUE VILLAGEOISE PAR FRACTURA-N HYDRAULIQUE EXPERIMENTATION).
eau de Recherches Geologiques et Minieres, ans (France). Water Resources Dept.
Bonnet, H. Etienne, and P. Vaubourg.
The State-of-the-Art of Hydrology and Hy-eology in the Arid and Semi-Arid Areas of ca. Proceedings of the Sahel Forum, Ouaga-gou, Burkina Faso, 18-23 February 1989. Inter-nal Water Resources Association, Urbana, Il-s. 1990. p 562-573, 7 fig, 2 tab, 5 ref. English nary.

riptors: *Geologic fractures, *Groundwater ability, *Hydraulic fracturing, *Rural areas, ter yield improvement, *Well yield, Bore-, Brittany, France, Semiarid lands.

tical analysis of the discharge values for thou-of boreholes drilled in basement complex ations shows that about 30% of the wells have ductivity of less than 1 cu m/hr and 15% only 5 cu m/hr or more. Based on most of the cts, three features were apparent: (1) in a geneous hydrogeologic and climatic context, rly-sited wells have varied results; (2) the significant yields are produced by several res generally crossed at a depth of 50 m; and he 'dry' or very poorly producing wells ed no large fractures or only fractures ed or closed by the pressure of the ground. hydraulic fracturing technique was inspired idea that increased output could be obtained ificially enhancing the hydraulic connections en the borehole and the more productive l surrounding fracture network. The hydrau-cturing consists of isolating a borehole sec-ith packers and injecting water at a pressure than the natural constraints at the investi-depth. Generally, breaking or bursting s, which opens up fissures. The injected is charged with sand, which penetrates into ssures and remains there after pressure re-lease, thus keeping the fissures open. The first experiment was conducted on eight boreholes in the south of the crystalline massif of Brittany (France). The productivity of the wells was increased by at least 13%; on four of them, it increased by 50%. A similar experiment will be conducted on 25 boreholes drilled in the basement complex of Burkina Faso, with two objectives: (1) recovery of boreholes with productivities of less than 1 cu m/hr for village water supply and (2) increase in low-discharge wells (1-3 cu m/hr) to make possible small-scale irrigation and mini rural domestic water supplies. (See also W91-02288) (Author's abstract)
W91-02335

STATE OF THE ART HYDROLOGY FOR THE DEVELOPMENT OF SAHELIAN WATER RESOURCES.
Ohio Univ., Athens. Dept. of Hydrogeology.
For primary bibliographic entry see Field 2F.
W91-02355

ARTIFICIAL RECHARGE IN THE ANGAS-BREMER IRRIGATION AREA.
S. R. Howles.
Mines and Energy Review South Australia, No. 157, p 22-28, 1990. 17 fig, 3 tab, 19 ref, append.

Descriptors: *Artificial recharge, *Confined aquifers, *Groundwater management, *Irrigation effects, *Saline groundwater, Angas River, Aquifers, Australia, Bremer River, Drawdown, Groundwater recharge, Recharge wells, Saline water intrusion, Salinity.

Overdevelopment of the confined limestone aquifer underlying the Angas-Bremer irrigation area in South Australia has caused severe salinity problems. Annual water extraction in recent years has been about 16,000 ML, which has created a significant regional drawdown. This extraction has alos allowed saline waters to infiltrate from marginal areas of the groundwater basin, and induced the recirculation of irrigation water. Natural recharge is estimated to be only 25% of extraction. Artificial recharge wells are being used increasingly by irrigators to replenish the aquifer with flood waters having 500-1,500 mg/L total dissolved solids. In many places this has halved the ambient groundwater salinity. South Australia Department of Mines and Energy has developed an experimental recharge well in the area to assist irrigators in overcoming design problems with their own wells. (Author's abstract)
W91-02530

GROUNDWATER MANAGEMENT: QUANTITY AND QUALITY.
Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. 633p. Edited by A. Sahuquillo, J. Andreu, and T. O'Donnell.

Descriptors: *Aquifer management, *Groundwater management, *Symposium, *Water pollution control, *Water quality management, *Water resources management, Case studies, Decision making, Groundwater movement, Groundwater quality, Hydrologic models, Management planning, Model studies, Research priorities, Water quality control, Watershed management.

Increasing water needs, constraints imposed by quality for different uses, and the growing importance of contamination as a result of urban, industrial, and agricultural activities make it more and more necessary to consider aquifers as components of water resources systems to increase dependable water supplies and to preserve water quality. In order to obtain gains in efficiency, it is necessary to understand the flow and chemical processes involved in groundwater and to develop management models to simulate and optimize both quantity and quality. A symposium held in Spain 2-5 October 1989 contributed 53 papers from many different countries, addressing the following topics: the role of groundwater quantity in the decision-making process on water resources, the role of groundwater quality in the decision-making process in water resources, models for groundwater management, aquifers as components of water resources systems, and applications and case studies. These papers represent an important contribution that addresses groundwater management problems in their two crucial aspects of groundwater quantity and quality, and gives an excellent idea of the state of the art and of the direction this subject will take in the near future. (See W91-02673 thru W91-02724) (Fish-PTT)
W91-02672

ACCESS OF SMALL AND MARGINAL FARMERS TO GROUNDWATER--A FIELD STUDY.
Roorkee Univ. (India). Water Resources Development Training Center.
A. S. Chawla, C. S. Raghuvanshi, and S. A. Kumar.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 29-40, 9 tab.

Descriptors: *Agricultural water, *Farming, *Groundwater management, *India, *Irrigation water, *Supplemental irrigation, *Water resources development, Canals, Crop production, Cultivation, Economic evaluation, Horizontal wells, Pumping, Wells.

The importance of groundwater and its development has been greatly felt in India during the last few decades. Groundwater alone accounts for about 40% of the total irrigated area in the country. The most outstanding problem is that of raising the economic and social status of millions of marginal and small farmers. A large number of tubewells has been installed in alluvial areas to pump groundwater to supplement canal supplies in canal-commanded areas and to provide irrigation water outside the canal command areas. The accessibility of small and marginal farmers to groundwater was examined in western Uttar Pradesh, India, including an evaluation of the economics of various lifting devices, the water requirement of crops and the capacity of wells for different categories of farmers. An analysis of the data indicates that the small and marginal farmers constituting 62% of the sample farmers operate only 23.4% of cultivable land and own only 31% of private tubewells. Only 43% of these farmers have access to groundwater. Electrically operated tubewells are most economical. Small and marginal farmers should have a pumping capacity of 3.5-5.0 HP. (See also W91-02672) (Author's abstract)
W91-02675

GROUNDWATER MANAGEMENT BY A DUAL-PIPE SUBIRRIGATION SYSTEM.
Iowa State Univ., Ames. Astronomy Program.
D. Kirkham, and R. Horton.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 53-66, 5 fig, 1 tab, 13 ref.

Descriptors: *Drainage engineering, *Groundwater irrigation, *Groundwater management, *Irrigation design, *Model studies, *Subirrigation, *Water resources management, Boundary conditions, Evapotranspiration, Groundwater movement, Hydraulic conductivity, Hydraulic models, Laplace equation, Pipes, Saturation zone, Velocity head, Water table profiles.

Solutions to water flow problems form practical relationships useful to groundwater management. Determination of hydrological quantities for a dual-pipe subirrigation-drainage system has already been done where rectangular (slit) tubes were used. An analytical solution of Laplace's equation has been developed for appropriate boundary conditions associated with the problem of dual-pipe subirrigation and drainage extended to cylindrical tubes. The solution describes stream function and hydraulic head within the groundwater flow region and likewise the associated water table

shape. The solution is general and flexible. Response of the groundwater system can be studied relative to thickness of saturated zone, position of subirrigation and drainage pipes, crop evapotranspiration, fraction of inflowing subirrigation water that exits the drains, and the aquifer hydraulic conductivity. Calculations show how pipe spacing affects shape of water table. The general solution can also be used also to predict salt flow through the system as well as water flow. (See also W91-02672) (Author's abstract)
W91-02677

DISTRIBUTION OF AQUIFER RECHARGE FROM A CIRCULAR SPREADING BASIN UNDER TRANSIENT OPERATIONS.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux, C. Miracapillo, and M. J. Abdulrazzak.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 67-76, 5 fig, 6 ref.

Descriptors: *Aquifer characteristics, *Aquifer management, *Artificial recharge, *Flow models, *Groundwater management, *Model studies, *Water resources management, Groundwater basins, Groundwater movement, Groundwater recharge, Infiltration rate, Mathematical models, Numerical analysis, Recharge basins, Saturation zone, Three-dimensional model, Watershed management.

The process of aquifer recharge from a circular area has been investigated for management purposes. An approximate solution to the three-dimensional problem was obtained by matching two unidimensional flows, a vertical and a radial one. The mathematical formulation was obtained first for the case of a constant infiltration rate and then for a time-dependent rate through the unsaturated zone. The formulation led to an integro-differential equation whose solution was obtained numerically. In both cases, concrete examples illustrated the influence of the parameters on the discharge into the saturated zone and on the water table level. It was determined that anisotropy of the medium influences the mound elevation below the recharge zone and to a lesser degree the discharge. Numerical examples showed that the effect of a lower horizontal conductivity is partially compensated by a higher hydraulic head, due to a more rapid rise of the water table below the spreading basin. The lateral recharge efficiencies permit comparisons between different geometric designs. Between a rectangular and a circular basin having the same area and the same spreading perimeter the efficiency of the linear geometry is higher. The model can be used also to compare different operational schemes. (See also W91-02672) (Fish-PTT)
W91-02678

APPLICATION OF THE ANALYTIC ELEMENT METHOD FOR NATIONAL GROUNDWATER MANAGEMENT IN THE NETHERLANDS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
For primary bibliographic entry see Field 6A.
W91-02697

MANAGEMENT MODEL FOR AQUIFER RECHARGE WITH NON-CONSERVATIVE POLLUTANTS.
Baghdad Univ. (Iraq). Coll. of Engineering.
Q. N. Fattah, and H. M. Hamad.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 295-304, 10 fig, 4 ref.

Descriptors: *Groundwater management, *Hydrologic models, *Model studies, *Recharge, *Water quality management, *Water resources management, Confined aquifers, Convection, Dispersion, Groundwater pollution, Groundwater recharge, Hydrological models, Parametric hydrology, Partially penetrating wells, Path of pollutants, Plumes, Pollutant identification.

The management of aquifer recharge in conformity with particular environmental standards requires that contaminant concentration zones be identified. Theoretical solutions to the convective-dispersion equation have been examined for a substance injected by a partially-penetrating well into a confined isotropic homogeneous aquifer. A numerical solution for the concentration distribution of the substance in the aquifer was developed using an alternating-direction implicit method. The model was designed for conservative and non-conservative substances, and for different influent concentration distribution. A management model was developed combining the influent temporal concentration distribution with partial penetration ratios and extent of polluted zone in the aquifer. Various combinations of these parameters may be attempted in order to develop the appropriate concentration distribution for a given pollutant, thus enabling the engineer to perform recharge operations in accordance with environmental standards. (See also W91-02672) (Fish-PTT)
W91-02698

MODELING OF VARIABLE DENSITY FLOW, APPLICATION TO THE MANAGEMENT OF COASTAL AQUIFERS (MODELISATION DES ECOULEMENTS A DENSITE VARIABLE, APPLICATION A L'EXPLOITATION DES AQUIFERES COTIERS).
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 2F.
W91-02706

MODELLING OF FLOW AND CONTAMINANT TRANSPORT IN A CONJUNCTIVELY MANAGED GROUNDWATER BASIN: A CASE STUDY.
California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5B.
W91-02707

AQUIFERS AS COMPONENTS OF WATER RESOURCES SYSTEMS.
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
J. Schwarz.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 433-441, 11 ref.

Descriptors: *Aquifer management, *Groundwater management, *Groundwater resources, *Planning, *Water resources management, *Water supply development, Aquifer characteristics, Artificial recharge, Conjunctive use, Legal aspects, Management planning, Water quality management, Water treatment.

Aquifers function within water resources systems as water sources, media of storage, and means of water quality upgrading. The role of an aquifer depends on the properties of the aquifer itself and on the properties of the system as a whole. Conjunctive use of surface water and groundwater, and artificial recharge, are the most widespread uses of aquifers as components of water resources systems. Planning techniques are available to test management plans against a set of criteria including conservation of the resource and its environment, economic efficiency and financial viability. Knowledge gaps in the planning techniques and in aquifer properties fall into two main categories: (1) properties of the soil-aquifer system, of the water supply system and of the socio-economic system; and (2) techniques for evaluation of management plans in three systems. The objectives of future research and development should include regenerative small-farm agriculture; definitions of safe yield; remedial measures to improve quality by chemical processes such as demineralization, biological in situ treatment, or mixing with imported low salinity water; long distance transport of high quality water; and development of water uses that are tolerant. Emphasis will be placed in the future on conservation, regeneration, and remedial measures. (See also W91-02672) (Author's abstract) (Fish-PTT)
W91-02709

WASTE WATER, INFILTRATION-PERCOLATION FOR AQUIFER RECHARGE OR WATER RE-USE.
Montpellier-2 Univ. (France). Lab. d'Hydrologie et de Modelisation.
For primary bibliographic entry see Field 5D.
W91-02710

REGIONALIZATION SCHEMES FOR THE MANAGEMENT OF LARGE WATER RESOURCES SYSTEMS.
Universidad Politecnica de Cataluna, Barcelona (Spain). Escuela Tecnica Superior de Ingenieros de Caminos, Canales y Puertos.
J. Carrera, L. Vives, and J. Heredia.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held a Benidorm, Spain, October 2-9, 1989. Internationa Association of Hydrological Sciences, Washington, DC. 1989. p 457-470, 4 fig, 2 tab, 14 ref

Descriptors: *Aquifer management, *Groundwate management, *Groundwater resources, *Larg watersheds, *Management planning, *Planning *Regional planning, *Water resources manage ment, *Water supply development, Compute models, Conjunctive use, Reservoirs, Simulatio analysis, Surface-groundwater relations, Wate demand.

The large size of some water resources system may make classical management simulation metl ods unrealistic or unaffordably expensive for thos systems. This is particularly true in the case strongly interacting surface water and groundwa er and when a large number of demands are su plied by a large number of water sources (rese voirs and aquifers). Most management schem either ignore the topology of the distribution ne work, thus leading to unrealistic simulations, else consider an extremely large number of comb nations, thus becoming unaffordably expensiv The concept of demand region, which takes in account both network geometry and water ava ability, overcomes these limitations. Coupling th concept with a powerfully innovative method incorporate aquifer-river interaction has led to robust approach for the conjunctive use of lar systems. (See also W91-02672) (Author's abstra
W91-02711

HARVEST OF EPHEMERAL RUNOFF FC ARTIFICIAL GROUNDWATER RECHARG FEASIBILITY EVALUATION USING HYDR LOGICAL AND HYDROGEOCHEMIC MODELS.
Nevada Univ. System, Las Vegas. Water F sources Center.
For primary bibliographic entry see Field 3B.
W91-02712

GROUNDWATER MANAGEMENT STRATE FOR SALINITY MITIGATION IN THE VICT RIAN RIVERINE PLAIN, AUSTRALIA.
Rural Water Commission of Victoria, Armid (Australia).
For primary bibliographic entry see Field 3C.
W91-02713

ROLE OF GROUNDWATER IN ISRAEL'S TEGRATED WATER SYSTEM.
TAHAL-Water Planning for Israel Ltd., Tel-A D. Hamberg.
IN: Groundwater Management: Quantity Quality. Proceedings of the Symposium held Benidorm, Spain, October 2-9, 1989. Internati Association of Hydrological Sciences, Wash ton, DC. 1989. p 501-514, 9 fig, 2 tab.

Descriptors: *Aquifer management, *Groundw management, *Groundwater resources, *Isr

*Management planning, *Model studies, *Operating policies, *Planning, *Water resources management, *Water supply development, Drinking water, Finite difference methods, Groundwater potential, Groundwater recharge, Groundwater storage, Hydrologic models, Irrigation water, Rehabilitation, Saline water intrusion, Water demand.

Israel's national water system integrates water pumped from Lake Kinneret with two groundwater sources--the Karstic Aquifer and the Coastal Aquifer--supplying drinking water and irrigation water. In the rainy season irrigation demand drops and the surplus system capacity is used for aquifer recharge. Various multi-annual simulation techniques were used to plan an operating policy that would guarantee high reliability. The operating policy derived was based on decreasing the quantities supplied below the average potential of the sources, thus creating reserve storage in the aquifers. The Coastal Aquifer is today overexploited, which has led to seawater intrusion, salination of the fresh water wells and development of large craters in the water table. A rehabilitation program was planned by a schematic model that represents the aquifer as one 'black box.' The model was checked and detailed by a finite differences model of the aquifer. These tools are part of a hierarchic set of models and techniques used to build a new master plan for the water system of Israel. (See also W91-02672) (Author's abstract)
W91-02714

ODELS FOR A RATIONAL UTILIZATION F HIGH QUALITY GROUNDWATER RE-OURCES.
ortmund Univ. (Germany, F.R.). Inst. for Environmental Protection.
or primary bibliographic entry see Field 3E.
91-02715

RTIFICIAL RECHARGE PILOT PROJECTS GUJARAT, INDIA.
rmingham Univ. (England). Dept. of Civil Engineering.
R. Rushton, and P. N. Phadtare.
: Groundwater Management: Quantity and ality. Proceedings of the Symposium held at nidorm, Spain, October 2-9, 1989. International sociation of Hydrological Sciences, Washing-, DC. 1989. p 533-545, 5 fig, 1 tab, 6 ref.

scriptors: *Aquifer management, *Artificial rerge, *Groundwater management, *Groundwatresources, *India, *Irrigation effects, *Water ources management, *Water supply develop-nt, Alluvial aquifers, Alternative planning, Aqer characteristics, Economic aspects, Grounder depletion, Groundwater level, Groundwater harge, Injection wells, Irrigation water, Limee, Saline water intrusion.

ensive exploitation of an aquifer frequently leads deteriorating conditions, especially in highly gressive agricultural areas where the quantity vater withdrawn for irrigation purposes is usu- several times the recharge. This over-exploita- can lead to declining water levels, severe falls umping levels, and ingress of poor quality er. Artificial recharge is a possible means of viating the over-exploitation of aquifers, since it vides storage space free of cost, avoids evapo-n losses and allows the use of the stored water ng dry periods. Artificial recharge experiments oth alluvial and limestone aquifers in Gujarat, a, were performed using spreading channels, olation tanks, and injection wells. It was demrated that the first step in promoting an artifi- recharge scheme is to perform experiments ch can lead to an understanding of conditions e aquifer system. These pilots schemes provide rmation about the physical conditions in the fer and also indicate the economic and manent aspects which need to be considered. The ects in Gujarat showed that artificial recharge chnically feasible using a number of alternative tures but the results also indicated that the ts of overexploitation and saline intrusion h have occurred due to heavy irrigation deds cannot be overcome solely by artificial re-ge. (See also W91-02672) (Fish-PTT)
W91-02717

MADRID MIOCENE AQUIFER AS A COMPONENT OF THE METROPOLITAN WATER SUPPLY SYSTEM.
MOPU, Madrid (Spain). Servicio Geologico.
A. Sanchez, and M. Varela.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 547-556, 5 fig, 1 tab, 4 ref.

Descriptors: *Aquifer management, *Groundwater management, *Groundwater resources, *Madrid, *Metropolitan water management, *Model studies, *Water resources management, *Water supply development, Economic aspects, Operating policies, Pumping, Simulation analysis, Spain, Water demand, Water distribution.

The optimal operation scheme of the Madrid (Spain) aquifer has been analyzed from an economic point of view. A simulation model, including the whole system, reservoirs and aquifer, as well as the restrictions associated with the distribution network and some of the treatment plants, was constructed for the analysis. The results of the modeling efforts show that there are no significant differences, in economic terms, among various aquifer operation schemes. Nevertheless, a strategy based on intermittent high pumping rates is recommended; this would enable a more efficient utilization of an eventual groundwater concession and, at the same time, would provide the means to satisfy demand increases greater than those obtainable through any other operation rule. (See also W91-02672) (Author's abstract)
W91-02718

APPLICATION OF GROUNDWATER MODELLING IN WATER RESOURCES MANAGEMENT IN DENMARK.
Miljoestyrelsen, Copenhagen (Denmark).
For primary bibliographic entry see Field 5B.
W91-02719

FEASIBILITY STUDY ON THE GROUNDWATER DEVELOPMENT FOR THE WATER SUPPLY OF AN OIL SHALE PROCESSING PLANT IN CENTRAL JORDAN.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
H. Bender, W. Giesel, H. Klinge, R. M. Knoop, and K. Schelkes.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 571-579, 4 fig, 3 ref.

Descriptors: *Aquifer management, *Case studies, *Economic aspects, *Groundwater management, *Groundwater potential, *Groundwater resources, *Jordan, *Water resources management, Drilling, Geohydrology, Groundwater recharge, Model studies, Numerical analysis, Oil industry, Oil shale, Pumping, Water demand.

Oil shale is the only exploitable fossil energy resource of Jordan. Central Jordan's groundwater resources to the east of the Dead Sea were investigated in order to supply an oil shale plant with 22 million cu m/year of groundwater. The regional water balance for the two main aquifers based on hydrogeological investigations and on a numerical model indicates that the potential of the upper aquifer was previously overestimated. The present groundwater abstraction already exceeds the recoverable recharge, therefore only the minimum water demand of the plant of 5 million cu m/year can be withdrawn from this aquifer. An abstraction of the required quantity from the lower aquifer is feasible on a safe yield basis but technical aspects, i.e., deep drilling, excessively large pumping lifts as well as economic and ecological aspects have to be considered. (See also W91-02672) (Author's abstract)
W91-02720

WETLANDS AND GROUNDWATER: NEW CONSTRAINTS IN GROUNDWATER MANAGEMENT.
Universidad Complutense de Madrid (Spain). Dept. of Geodynamics.
For primary bibliographic entry see Field 6G.
W91-02722

MAYA UTILIZATION OF KARST GROUNDWATER RESOURCES.
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 6D.
W91-02813

HYDROGEOLOGICAL APPROACH TO INVESTIGATION IN KARST FOR POSSIBLE MODIFICATION OF GROUNDWATER REGIME AND INCREASE OF RECOVERABLE RESERVES.
GEOZAVOD, Belgrade (Yugoslavia).
M. Komatina.
Environmental Geology and Water Sciences EGWSEI, Vol. 16, No. 2, p 149-153, 1990. 7 fig, 5 ref.

Descriptors: *Aquifer management, *Aquifers, *Groundwater management, *Karst hydrology, *Water resources development, *Water resources management, Coastal areas, Flow control, Flow discharge, Geologic control, Groundwater movement, Groundwater reservoirs, Saline water intrusion, Saline-freshwater interfaces, Springs, Water yield.

An artificial contribution to groundwater reserves for water supply is a principal interest in modern hydrogeology. The fear of the inherent risk and uncertainty were invariably present wherever a resource was discovered in karst of a geosynclinal area; consequently progress has been limited. The reasons, however, for such a cautious approach are diminishing, because much knowledge has been obtained about these aquiferous rocks, especially through investigations in the regions of surface storage reservoirs. Better knowledge of karst features and the results achieved with surface reservoirs have indicated that large amounts of groundwater can be recovered. The conventional water investigation and recovery methods have made available only small safe yields equal to the lowest natural discharge (on the order of 100 L/sec). A reasonable use of a karst water resource and its better management cannot be considered without artificial control of the groundwater regime, i.e., without adjusting the regime to human demands. Artificial interventions in karst have generally been associated with overflow springs, which can be impounded easily and at a low cost to improve the water discharge regime. Some of the technical works in naked karst are: underground reservoirs, flow control through preferential paths, water recovery by lowering discharge level, and repumping springs. Isolation of fresh groundwater from hydrochemical sea encroachment in coastal karst districts is a difficult problem. However, water levels can be raised by damming a number of preferential waterways in certain localities, similar to those in the inland karst regions, for storage of some freshwater. This will result in a substantial decrease in saline water encroachment or in its elimination where large back water volume is involved. (Fish-PTT)
W91-02820

AQUIFER THERMAL ENERGY STORAGE: A NUMERICAL SIMULATION OF FIELD EXPERIMENTS IN CHINA.
Nanjing Univ. (China). Dept. of Earth Sciences.
Y. Xue, C. Xie, and Q. Li.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2365-2375, October 1990. 15 fig, 3 tab, 24 ref.

Descriptors: *Aquifers, *China, *Heat storage, *Injection-production wells, *Mathematical models, *Model studies, *Thermal energy, Heat transfer, Observation wells, Seasonal distribution, Water temperature.

Computer simulations for three seasonal aquifer thermal energy storage experiments were carried out in China. The flat-lying test site and its vicinity are covered with the Quaternary system. The test facility contains four injection-production wells, 34 observation wells and four special measuring wells at the test site. The governing equation of the mathematical model used to simulate the experiments contains convection, conduction and heat dispersion terms. For the mathematical model, the aquifer is assumed to be horizontal and of uniform thickness, with the cap rock and the rock bed above and below the aquifer are assumed impermeable to flow; aquifer properties are assumed to be isotropic and uniform in the vertical direction; flow is assumed to be steady; thermal equilibrium is considered to take place instantaneously between the water and the rock in the aquifer; and the effect of natural vertical convection due to the temperature difference between the cold and warm water is ignored. The simulated temperatures agree very well with the observed field data. Total mean values of the absolute errors are 0.5 C for the single-well experiment, 0.7 C for the double experiment and 0.4 C for the multiwell experiment; relative error ranges from 2.8% to 4.5%. The simulated production temperatures and energy recovery ratios also agree very well with the field data. The results strongly indicate the validity of the model and simulation parameters used. Heat transfer through the fluid phase by heat dispersion in the governing equation is considered. (Author's abstract)
W91-02866

4C. Effects On Water Of Man's Non-Water Activities

INFLUENCE OF SEDIMENT DISTURBANCE AND WATER FLOW ON THE GROWTH OF THE SOFT-SHELL CLAM, MYA ARENARIA L.

Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W91-02062

CHARACTERISTICS OF COARSE WOOD DEBRIS FOR SEVERAL COASTAL STREAMS OF SOUTHEAST ALASKA, USA.

Oregon State Univ., Corvallis. Forest Research Lab.
E. G. Robison, and R. L. Beschta.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1684-1693, September 1990. 7 fig, 3 tab, 28 ref.

Descriptors: *Alaska, *Detritus, *Land management, *Streams, Aquatic habitats, Fish, Fish behavior, Habitats, Resource management, Stream order, Streambeds.

Coarse woody debris (>0.2 mm in diameter and 1.5 m long) was measured along five undisturbed low-gradient stream reaches; volume, decay class, and horizontal orientation in relation to channel flow of first-order, second-order, third-order, and fourth-order coastal streams were determined. Debris were also classified into four influence zones based on stream hydraulics and fish habitats. Average debris length, diameter and volume per piece increased with stream size. Eighty percent of debris volume of the first-order and the smaller second-order streams was suspended above or lying outside the bankfull channel, while less than 40% was similarly positioned in the fourth-order stream. Approximately one-third of all debris was oriented perpendicular to stream flow, regardless of stream size. First-order, second-order, and third-order streams had a higher proportion of recent debris in the channel than the fourth-order stream, most new debris being attributable to a major 1984 windstorm. Tree blowdown had a major influence on debris distribution along the smaller storm reaches. Debris jams and accumulations in the largest stream were formed from floated debris. These characterizations are useful for evaluating the distribution and amount of woody debris associated with land-management activities. (Author's abstract)
W91-02063

ESTIMATING EROSION RISK ON FOREST LANDS USING IMPROVED METHODS OF DISCRIMINANT ANALYSIS.

Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
For primary bibliographic entry see Field 2J.
W91-02181

USE OF THE INDEX OF BIOTIC INTEGRITY TO ASSESS THE IMPACT OF LAND MANAGEMENT ACTIVITIES ON LOW ORDER STREAMS IN NORTHERN IDAHO.

Idaho Univ., Moscow. Dept. of Fish and Wildlife.
For primary bibliographic entry see Field 5G.
W91-02242

IMPACT OF SOIL SURFACE DETERIORATION ON RUNOFF PRODUCTION IN THE ARID AND SEMI-ARID ZONES OF WEST AFRICA.

Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lome (Togo). Centre ORSTOM du Togo.
C. Valentin, and A. Casenave.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 126-134, 5 fig, 8 ref.

Descriptors: *Africa, *Arid lands, *Rainfall-runoff relationships, *Semiarid lands, *Soil types, Burkina Faso, Infiltration, Mapping, Niger, Prediction.

The most ready way of diagnosing environmental damage in the arid and semi-arid zones of West Africa is to survey the field itself. However, a systematic method is needed to alleviate problems of definition and interpretation. A descriptive and genetic typology of surface crusts is proposed for characterizing typical unit surfaces. Also, an infiltration is established for each type of unit surface based on simulated rainfall experiments. Since each unit surface represents a part of a mapping unit, the total amount of runoff can be evaluated on the scale of a watershed. Good correlation between the measured and calculated runoff has been obtained on seven watersheds in Burkina Faso and Niger. This system provides a simple method to assess the degree of environmental (soil) degradation and to forecast the subsequent changes in hydrologic regimes. (See also W91-02288) (Author's abstract)
W91-02296

WAYS OF EVALUATING HUMAN-INDUCED IMPACTS ON THE FUNCTIONING OF WATERBODY ECOSYSTEMS.

Institute of Ecology of the Volga River Basin, Tolyatti (USSR).
S. M. Konovalov, V. N. Pautova, L. A. Vihristyuk, and V. S. Sarviro.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 921-932, 1990. 11 fig, 3 tab, 8 ref.

Descriptors: *Aquatic environment, *Ecosystems, *Environmental impact, *Reservoirs, *Water pollution effects, *Water quality, Economic aspects, Evaluation, Human impact, Population dynamics, Social aspects, Trophic level, Water pollution sources.

An examination of data obtained at the Kuibyshev Reservoir, intended for use in determining the self-purification potential of aquatic ecosystems, has provided an approach for estimating the human-induced pollution-ecosystem response relationships. At the same time, recent methodological investigations have established more precisely the methodology for studying the interaction of pollutants with aquatic ecosystems: (1) more detailed investigations of the structure of each particular trophic level with complete identification of all the organisms comprising this structure; (2) studying the ecosystem structure on a seasonal, annual and long-term basis with due regard to the population dynamics and ascertaining optimum conditions of functioning of mass and scarce species at all trophic levels; (3) establishing trophic relationships and flows of energy, matter and information within each particular trophic level and between them; estimation of the energy flow in the ecosystem and its alterations in the presence of the human-induced loading, based on the concept of spatial heterogeneity of the ecosystem, a unit of measure being a field of concentration of the pertinent species at different trophic levels as well as that of chemical components; (4) carrying out a complete inventory and an eco-technogene classification of the pollutant sources and establishing quantitative and qualitative characteristics of the flow and the pollution spectrum; (5) studying specific deformations of the ecosystem in the zone of modal sources of pollution relative to the background status; (6) estimating the total loading on the waterbody, working out the respective environmental protection measures and predicting the impacts of the socio-economic development on the water quality. (Author's abstract)
W91-02397

PRESENT SITUATION OF THE EUROPEAN FLOODPLAIN FORESTS.

Institute for Floodplains Ecology, Rastatt (Germany, F.R.).
E. L. Wenger, A. Zinke, and K. A. Gutzweiler.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 5-12, June 1990.

Descriptors: *Data acquisition, *Ecology, *Environment, *Flood plain forests, *Flood plain, *Forest ecosystems, *Forests, *Germany, *Limnology, Austria, Forest watersheds, Hungary, Information systems, Reservoirs, Switzerland.

Although the floodplain forests of Central Europe form an immensely important ecosystem, information concerning their function is scant and they are disappearing at an alarming rate. Consequently, the Institute for Floodplains Ecology in Rastatt, Germany was commissioned to construct an extensive database of the European floodplains. To date, the study has demonstrated that, with the exception of Switzerland and Germany, no country in Europe has obtained complete information about its most important floodplain areas, its forests and their types. Although some of the countries were able to provide some incomplete but practical information (Austria, Germany, Hungary), most of them, even those where relatively large undeveloped alluvial rivers exist (i.e. France, Poland, Yugoslavia), could only supply fragmentary knowledge about their floodplain forests. Recent evidence has also indicated that river impoundment, channelization, and drainage have caused rapid loss of these forests, particularly affecting the willow and poplar communities. It is concluded that a more complete understanding of floodplain function will aid in their future protection and management. (D'Agostino-PTT)
W91-02471

GEOGRAPHICAL ASPECTS OF FOREST WETLANDS IN THE LOWER UCAYALI, PERUVIAN AMAZONIA.

Instituto de Investigaciones de la Amazonia Peruana, Iquitos.
For primary bibliographic entry see Field 2H.
W91-02481

STATUS AND TRENDS OF U.S. WETLANDS AND DEEPWATER HABITATS.

National Wetlands Inventory, Washington, DC.
B. O. Wilen, and W. E. Frayer.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 181-192, June 1990. 5 ref.

Descriptors: *Ecological effects, *Forest watersheds, *Land use, *Wetlands, Agriculture, Data acquisition, Estuaries, Forest management, Resources management, Surveys, Urbanization.

Effective national management of U.S. wetlands requires current statistics on status and trends as well as detailed wetland maps for impact a

ment and site-specific decisions. The present study demonstrates that significant changes in the amounts of wetlands and deepwater habitats have occurred in the United States since the nation's first settlement. In the mid-1970's only 99 of the original 215 million acres of wetlands remained in the conterminous 48 states. These encompassed 93.7 million acres of palustrine wetlands of which 49.7 million were forested, and 5.2 million acres of estuarine wetlands of which 0.5 million were either shrubs, scrub trees or forested. Currently, wetlands cover a land surface area approximately the size of California, with half of this acreage existing as forests. Alarmingly, the annual losses have averaged 458,000 acres, an area about half the size of Rhode Island, of which 66% are forested. The most significant cause of this habitat destruction is the development of agriculture, which alone is responsible for 87% of all wetland degadation and 70% of the forested-wetland losses. In contrast, urban development accounts for only about 8% and 6% of the respective losses. It is concluded that there exists a pressing need for more intensive research and management of existing wetlands in order to maintain their current levels of fish and wildlife resources. (D'Agostino-PTT)
W91-02483

STIMATING THE FORESTED-WETLAND ESOURCE IN THE SOUTHEASTERN NITED STATES WITH FOREST SURVY ATA.
outheastern Forest Experiment Station, Asheille, NC.
B. Tansey, and N. D. Cost.
orest Ecology and Management FECMDW, Vol. 1/3, No. 1/4, p 193-213, June 1990. 6 fig, 5 tab, 17 f.

escriptors: *Ecological effects, *Forest ecosystms, *Land use, *Wetland forests, *Wetlands, Agculture, Data interpretation, Florida, Georgia, orth Carolina, Resources management, South arolina, Urbanization, Virginia.

dustrial expansion, residential development and ricultural activities have caused major changes forested-wetlands, significantly increasing their es of depletion. Data from the most recent forest rveys in the states of Virginia, North Carolina, uth Carolina, Georgia, and Florida were used to amine the wetland forest resources. Consistent imation of the forested wetland resource is diffit due to diverse species mixes and habitat types, ather cycles that influence hydroperiod, and the itrary timing of field visits. Using stand infortion collected on Forest Inventory and Analysis A) permanent plots, the area of wetland timberd in the southeastern United States was estimatand described. This method was comparable to classification method currently accepted by the A and the U.S. Army Corps of Engineers, ich routinely considers indicator species, soil a, and hydroperiod. Criteria also used in the A algorithm included overstory and understory cies occurrence, physiography, hydroperiod, cover type data. It was concluded that this is a sistent and repeatable method which is potenly useful for future wetland delineation and nagement. (Author's abstract)
1-02484

PROACH TO THE INVENTORY OF FORTED WETLANDS FOR TIMBER-HARVEST-G IMPACT ASSESSMENT.
rth Carolina State Univ. at Raleigh. School of est Resources.
M. Aust, S. F. Mader, L. J. Mitchell, and R.
est Ecology and Management FECMDW, Vol. 3, No. 1/4, p 215-225, June 1990. 1 fig, 3 tab, 36

criptors: *Ecological effects, *Forest ecosys-s, *Forest management, *Land use, *Manage-t planning, *Wetland forests, *Wetlands, Ala-a, Best management practices, Data interpreta-, Economic aspects, Ecosystems, Forestry, hydrology, Nutrients, Primary productivity, ources management, Sedimentation, Soil propes.

At present, available information describing the impact of forestry activities on forested-wetland functions is insufficient for use in planning optimal management strategies. A methodology has been developed to assess the impact of timber-harvesting in a tidal freshwater palustrine wetland in southwestern Alabama. Biophysical as well as socio-economic parameters were examined to estimate both stand timber stocks and the extent of disruption of ecosystem functions. Specifically, indices were chosen to detect changes in net primary productivity, plant nutrient assimilative capacity, soil nutrient retention and transformation, decomposition, sedimentation rate, hydrology, and wildlife habitat provision. Furthermore, methods were chosen for data collection efficiency, interpretive simplicity, and the ability to provide a relative index of both the integrity and recovery rates of a disturbed ecosystem. This assessment enables wetland managers to determine which parameters are sensitive to functional changes, as well as the relative effects of various harvesting methods for use in promoting best forest management practices. (Author's abstract)
W91-02485

STATE WETLAND PROTECTION LEGISLATION AFFECTING FORESTRY IN THE NORTHEASTERN UNITED STATES.
Southern Forest Experiment Station, New Orleans, LA.
For primary bibliographic entry see Field 6E.
W91-02487

FEDERAL LEGISLATION AND WETLANDS PROTECTION IN GEORGIA: LEGAL FOUNDATIONS, CLASSIFICATION SCHEMES, AND INDUSTRY IMPLICATIONS.
Georgia Univ., Athens. School of Forest Resources.
For primary bibliographic entry see Field 6E.
W91-02488

FLOODING AND SALTWATER INTRUSION: POTENTIAL EFFECTS ON SURVIVAL AND PRODUCTIVITY OF WETLAND FORESTS ALONG THE U.S. GULF COAST.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
S. R. Pezeshki, R. D. Delaune, and W. H. Patrick.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 287-301, June 1990. 4 fig, 3 tab, 64 ref. Supported by the Louisiana Educational Quality Support Fund, Contract No. LEQSF (1987-90)-RD-A-7.

Descriptors: *Floods, *Global warming, *Saline water intrusion, *Soil-water-plant relationships, *Swamps, *Wetland forests, *Wetlands, Coastal areas, Coastal zone management, Ecological effects, Flooding, Hardwood, Photosynthesis, Salinity, Stress, Sublethal effects, Trees.

The predicted global warming trend and resultant sea level rise will increase inundation and salinity along coastal regions worldwide. In addition, as water levels increase, saltwater will encroach farther inland in many areas. However, the resultant effects of these ecological changes on the major tree species of coastal forests are unknown. The present study, which evaluates tree-survival response to increased flooding and saltwater intrusion, demonstrates a substantial reduction of net photosynthesis in many bottomland hardwood and swamp-forest tree species on the U.S. Gulf Coast. The combination of flooding and salinity causes foliage damage and substantial reductions in carbon assimiliation. The morphological response and reductions in gas exchange rates are closely associated with increases in salt levels. Exposure to concentrations greater than 3 parts per thousand causes both leaf burning and decline (up to 84%) in carbon assimilation rates in seedlings, of some species. In addition, the sublethal stress can lead to weaker seedlings, and consequently, reduced survival rates of the susceptible species. (D'Agostino-PTT)
W91-02489

CAT ISLAND SWAMP: WINDOW TO A FADING LOUISIANA ECOLOGY.
Southern Forest Experiment Station, New Orleans, LA.
M. S. Devall.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 303-314, June 1990. 2 fig, 5 tab, 22 ref.

Descriptors: *Cat Island Swamp, *Forest ecosystems, *Land management, *Louisiana, *Swamps, *Wetland forests, Data acquisition, Ecological effects, Ecosystems, Species composition, Species diversity, Wetlands.

Currently, there is considerable awareness of the ecological importance of forested-wetlands, as well as an increasing concern over the long-term consequences of continued wetland losses. Future preservation of these habitats is predicated on understanding the topology of present swamp-forest communities, such as Cat Island swamp which borders the Mississippi River in Louisiana. In this tract, twenty species of trees were observed in six communities. Hadkberry (Celtis laevigata) had the highest importance value, followed by cypress (Taxodium distichum), green ash (Fraxinus pennsylvanica), and Tupelo gum (Nyssa aquatica). The understory was sparse, and saplings were not represented in the same frequency as mature trees. Of particular note is that no saplings of cypress, or of five other species, were present, suggesting an important future change in forest composition. Discriminant-function analysis indicated that of all the environmental variables considered, including soil conditions and nutrient status, changes due to human activities, such as lumbering, had the most significant influence on swamp tree survival and distribution. (D'Agostino-PTT)
W91-02490

POSSIBLE EFFECTS OF RESIDENTIAL DEVELOPMENT ON STREAMFLOW, RIPARIAN PLANT COMMUNITIES, AND FISHERIES ON SMALL MOUNTAIN STREAMS IN CENTRAL ARIZONA.
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
A. L. Medina.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 351-361, June 1990. 2 fig, 2 tab, 22 ref.

Descriptors: *Arizona, *Ecological effects, *Fisheries, *Forests, *Pine trees, *Regional development, *Streamflow, *Urbanization, Comparison studies, Ephemeral streams, Riparian vegetation.

Increased residential development along small mountain streams within the pine forests of central Arizona has surged within the last 20 years, presenting a potential threat to riparian plant communities due to the alteration of streamflow from perennial to ephemeral. This alteration significantly increases the water stress on plant populations. Measurements of tree densities and stand composition of Arizona alder (Alnus oblongifolia) and box elder (Acer negundo) showed that perennial stream reaches had greater tree densities in all diameter classes, compared with ephemeral stream reaches where small-diameter trees were absent. Xylem water potential measurements decreased more rapidly on trees occupying ephemeral stream reaches than on trees of comparable reaches of perennial streams over time during the summer. The increase in water stress in trees growing along ephemeral stream reaches may be responsible for both the lower plant densities and lack of seedling establishment observed. Trout populations also decline when perennial streamflow changed to ephemeral. (Author's abstract)
W91-02493

UTILITY OF STREAM HABITAT AND BIOTA FOR IDENTIFYING POTENTIAL CONFLICTING FOREST LAND USES: MONTANE RIPARIAN AREAS.
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
J. N. Rinne.

Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 363-383, June 1990. 6 fig, 91 ref.

Descriptors: *Forest ecosystems, *Forest watersheds, *Forests, *Land use, *Riparian vegetation, *Streams, *Wetlands, Data acquisition, Fish, Literature review, Macroinvertebrates, Particle size, Sediment distribution.

Since National Forest lands in the United States are managed through a multiple-resource approach, adopted practices often impose a conflict between two or more forest land uses. In addition, although many studies have assessed the impact of such land use practices on riparian stream areas, the practical usefulness of these approaches has not been clearly demonstrated. Through a review of the literature this study suggests the feasibility of using one physical feature of stream habitat, namely fine sediment, and two biological variables, aquatic macroinvertebrates and fish, to identify the effects of multiple use activities on riparian stream systems. Based on empirical data obtained from several southwestern montane streams, plus information derived from the existing literature, it was concluded that these three variables are valid indicators for detection of the effects of multiple use activities on riparian stream ecosystems. It was further concluded that multiple physical and biotic factors, such as solar radiation, water quality, water temperature, and type of vegetation, must also be considered for optimal management of the valuable forested wetlands. (D'Agostino-PTT)
W91-02494

LONG-TERM TRENDS IN THE BALD-CYPRESS (TAXODIUM DISTICHUM) RESOURCE IN LOUISIANA (U.S.A).
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2H.
W91-02501

EDUCATED GUESSES: HEALTH RISK ASSESSMENT IN ENVIRONMENTAL IMPACT STATEMENTS.
P. D. Harvey.
American Journal of Law & Medicine AJLMDN, Vol. 16, No. 3, p 399-427, 1990. 185 ref.

Descriptors: *Environmental impact, *Environmental impact statement, *Environmental policy, *Environmental quality, *Public health, *Risk assessment, Administrative agencies, Environmental effects, Federal jurisdiction, Project planning, Regulations, Uncertainty.

Efforts to protect the environment and public health from environmental pollution begin with describing potential adverse consequences of human activities and characterizing the predicted risk. The National Environmental Policy Act (NEPA) requires the preparation of environmental impact statements (EIS) to describe the effects of proposed federal projects and provide information for agency decision makers and the public. The scope of the EIS requirement has been delineated by regulations and frequent lawsuits and covers all federal agencies planning any major project, including construction, ongoing management programs, provision of funds, and approval of permits needed by state and local governments or private businesses. In 1978, the Council on Environmental Quality (CEQ) promulgated regulations binding on all federal agencies to provide uniform standards for the implementation of NEPA. A worst case analysis requirement continues in importance as an historical perspective on approaches to the problem of inadequate information. In 1986, CEQ rejected the worst case analysis requirement and replaced it with more clearly articulated and manageable requirements. Agencies must still evaluate catastrophic/low probability consequences, and there was little change in the framework for EIS expression of uncertainties. The methodologies for risk assessment are complex and vulnerable to bias from underlying assumptions and policy judgements. Components of a risk assessment methodology may include dose-response assessment, population exposure assessment, and risk characterization. Recommendations for use of risk assessment in EIS include clear statement of assumptions and scientific judgements, delineation of the nature and magnitude of uncertainties, separation of risk assessment and risk management, explanation of the choice of methodology, presentation of risk estimates, and specification of the role of risk assessment in decision making. (MacKeen-PTT)
W91-02508

NEW APPROACH FOR OPTIMIZATION OF URBAN DRAINAGE SYSTEMS.
Bradford Univ. (England). Dept. of Civil Engineering and Structural Engineering.
For primary bibliographic entry see Field 5D.
W91-02575

ROLE OF GROUNDWATER QUALITY IN THE DECISION-MAKING PROCESS FOR WATER RESOURCES.
Universidad Politecnica de Cataluna, Barcelona (Spain). Escuela Tecnica Superior de Ingenieros de Caminos, Canales y Puertos.
For primary bibliographic entry see Field 5G.
W91-02680

MANAGEMENT OF GROUNDWATER-INDUCED RIVER SALINITY DUE TO LAND CLEARING IN THE MURRAY BASIN, SOUTH-EASTERN AUSTRALIA.
South Australian Dept. of Mines and Energy, Adelaide.
For primary bibliographic entry see Field 5G.
W91-02681

ARTIFICIAL RECHARGE PILOT PROJECTS IN GUJARAT, INDIA.
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W91-02717

GRAVEL EXTRACTION AND WATER RESOURCES MANAGEMENT OF THE DENGE GRAVEL AQUIFER, KENT, ENGLAND.
Aspinwall and Co., Shrewsbury (England).
P. A. Marsland, and D. H. Hall.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 605-621, 6 fig, 1 tab, 4 ref.

Descriptors: *Aquifer management, *England, *Environmental impact, *Gravel mining, *Groundwater management, *Groundwater resources, *Water resources management, Case studies, Databases, Finite difference methods, Geohydrology, Groundwater level, Groundwater movement, Groundwater quality, Groundwater recharge, Habitat restoration, Model studies, Monitoring, Surface-groundwater relations, Water quality.

Denge Beach, on the southeastern coastline of England, is an 'environmentally sensitive' area that is under increasing pressure from a combination of man-made and natural forces, including gravel extraction, water abstraction and storm surges. Recent hydrogeological studies were conducted to assess the impact of gravel extraction on the resources of the Denge gravel aquifer. A finite difference model, that incorporates the findings of extensive investigations over the past 10-15 years, has been constructed; complex boundary conditions and anisotropy are integrated into the model. A scheme has been developed to reduce groundwater discharge to surface water courses by restoring gravel workings at the edge of the aquifer with less permeable silt. Modeling indicates that this scheme will maintain and increase water levels in the aquifer, compared with those predicted for the original restoration proposals. The model may also be used as a baseline against which actual monitoring data can be checked and as an assessment of the progress of the scheme made as development proceeds. The large volume of monitoring data has made it possible to develop a model that can be tested against a large range of environmental and man-made factors. The interaction of wet mineral workings on aquifer storage, recharge, and water quality can only be assessed with confidence by the use of modeling techniques. The ever-increasing pressure on mineral extractors to reduce the environmental impact of their workings, coupled with developmental pressures that look for progressively deeper and often sub-watertable workings, is likely to increase the need for this type of study. (See also W91-02672) (Fish-PTT)
W91-02723

ECOSYSTEM MODELLING: SCIENCE OR TECHNOLOGY.
Goettingen Univ. (Germany, F.R.). Abt. Bodenkunde und Waldernahrung.
For primary bibliographic entry see Field 2H.
W91-02736

EFFECTS OF VEGETATION TYPE ON THI BIOGEOCHEMISTRY OF SMALL CATCH MENTS (MONT LOZERE, FRANCE).
Orleans Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 2K.
W91-02742

PRECIPITATION, THROUGHFALL, SOIL SO LUTION AND STREAMWATER CHEMISTR IN A HOLM-OAK (QUERCUS ILEX) FOREST
Universidad Autonoma de Barcelona (Spain Centre de Recerca Ecologica i Aplicacions Fore tals.
For primary bibliographic entry see Field 2K.
W91-02744

HYDROGEOCHEMICAL VARIATIONS I HAFREN FOREST STREAM WATERS, MI WALES.
Institute of Hydrology, Wallingford (England).
C. Neal, C. J. Smith, J. Walls, P. Billingham, and S. Hill.
Journal of Hydrology JHYDA7, Vol. 116, No. 4, p 185-200, August 1990. 10 fig, 2 tab, 25 r

Descriptors: *Acid rain effects, *Forest hydrolo *Forest management, *Forest watersheds, *G chemistry, *Streams, *Wales, *Water chemist Bromides, Clear-cutting, Conifers, Groundwa Hydrogen ion concentration, Iodine, Model st ies, Nitrates, Nutrients, Organic carbon, Run Spruce trees, Storm water.

Results are presented for a study to assess effects of conifer planting/harvesting and aci oxide deposition on streamwater quality in a 2 45-year-old sitka spruce planation on acid m land. Hafren forest streamwater chemistry va for different components: nitrates, bromide, t iodine and total organic carbon show seas oscillations varying in phase and amplitude; alu num and hydrogen ion concentrations vary function of flow; manganese and cobalt re approximately constant except under dry co tions when concentrations reduce by up to 10 f Streamwater chemistry variations are determi primarily by hydrological and chemical react in the surface organic-rich soils and the underl inorganic soils/bedrock. Biologically medi breakdown processes determine, in part, the drochemical behavior of dissolved organic car the nutrients, bromine and iodine. Reactions i inorganic zones involve hydrogen ion consum and the release of calcium and magnesium. B bonate ions are generated by deprotonation of genically derived H_2CO_3 and the decompos of calcium carbonate in the bedrock. The i effects of forest clearfelling are demonstrate creases in nitrate and potassium occur. A si mixing model is presented to show that eitl large proportion of the storm water is de from non-hillslope, groundwater sources, sou or major modifications occur as soil water p rapidly to the stream; whichever process is o tive, it has not been identified directly withi catchment monitoring program. (Author's stract)
W91-02745

HYDROLOGICAL AND HYDROCHEMICAL FLUXES THROUGH VEGETATION AND SOIL N THE ALLT A'MHARCAIDH, WESTERN CAIRNGORMS, SCOTLAND: THEIR EFFECT ON STREAMWATER QUALITY.
Macaulay Land Use Research Inst., Aberdeen Scotland).
For primary bibliographic entry see Field 5B.
V91-02749

HORT-TERM IONIC RESPONSES AS INDI-CATORS OF HYDROCHEMICAL PROCESSES N THE ALLT A'MHARCAIDH CATCHMENT, VESTERN CAIRNGORMS, SCOTLAND.
reshwater Fisheries Lab., Pitlochry (Scotland).
or primary bibliographic entry see Field 5B.
V91-02750

FFECT OF CLEARFELLING A SITKA PRUCE (PICEA SITCHENSIS) PLANTATION N SOLUTE CONCENTRATIONS IN DRAIN-GE WATER.
stitute of Terrestrial Ecology, Grange over nds (England). Merlewood Research Station.
K. Adamson, and M. Hornung.
urnal of Hydrology JHYDA7, Vol. 116, No. 1/ p 287-297, August 1990. 2 fig, 2 tab, 20 ref.

escriptors: *Acid rain effects, *Clear-cutting, Forest management, *Forest watersheds, *Land e, Aluminum, Chlorides, Drainage systems, rainage water, England, Experimental basins, ydrogen ion concentration, Ion transport, Ions, trates, Phosphates, Potassium, Runoff, Sodium, lutes, Spruce trees, Sulfates, Sylviculture, Water emistry, Water sampling.

ater samples were collected from the drainage stem of a Sitka spruce plantation at weekly inter-ls for six years. The drainage system had been signed to divide the plantation into a series of ificial catchments, three of which were designat-experimental plots and clearfelled in the second ar of sampling while a fourth was the control ot which remained unfelled until the end of the dy. Prior to felling, solute concentrations were ilar for all plots. Concentrations of nitrate, po-sium, and phosphate all rose following felling. trate concentrations peaked one year after the d of felling and returned to levels similar to the trol plot in the fourth year after felling. Potassi-and phosphate peaked in the second year after ing but had not returned to control levels by end of the study, although seasonal patterns become established, with lower concentrations summer. Concentrations of sulphate, sodium, chloride declined as a result of felling and ained lower than the control at the end of the dy. There was a very slight fall of pH and minum concentration after felling, relative to control. The three experimental plots behaved similar way for all ions except phosphate and which were released in greatest quantities the least intensively drained plot. (Author's tract)
1-02751

OOD DYNAMICS OF A CONCRETE-LINED, BAN STREAM IN KANSAS CITY, MISSOU-

xsonville State Univ., AL. Dept. of Geography Geology.
M. Vaughn.
th Surface Processes and Landforms ESPLDB, 15, No. 6, p 525-537, September 1990. 6 fig, 3 16 ref.

criptors: *Flood channels, *Flood discharge, drodynamics, *Urban hydrology, *Watershed agement, Channel flow, Channel morphology, nnel scour, Flow velocity, Kansas, Missouri, ar stress.

sh Creek drains a 76.1 sq km watershed within n Kansas City, Missouri and eastern Kansas. A crete-lined reach trending 6.1 km through the a District of Kansas City, Missouri, has been Focus for several major floods over the past ten s. Channel geometry, slope, and floodwater ations were determined in the field for segments of the concrete-lined section of Brush Creek for a flood event that occurred on September 18, 1986. Discharge was computed by indirect methods and compared to a value determined from a rating curve established by the Water Resources Division of the U.S. Geological Survey. Boundary shear stress, unit stream power, and average velocity were also computed in order to establish a quantitative relationship between sediment distribution, volume, and size fractions; and flow dynamics operating throughout the channel during this event. Boundary shear stress ranged from 91-96 N/sq m, stream power was 528-557 W/sq m, while average velocity was 5.8 m/s. These values were sufficient to displace concrete slabs as large as 5 m long by 4.6 m wide by 0.23 m thick weighing an estimated 12,245 kg. As the channel was sediment-free and unscoured prior to the flood, the distribution of deposits and subsequent channel scour provide valuable evidence for potentially hazardous sections of this urban stream. (Author's abstract)
W91-02809

PREDICTING RUNOFF FROM RANGELAND CATCHMENTS: A COMPARISON OF TWO MODELS.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 2E.
W91-02869

CORRELATION OF EROSION MEASUREMENTS AND SOIL CAESIUM-137 CONTENT.
Soil Conservation Service, Gunnedah (Australia).
For primary bibliographic entry see Field 2J.
W91-02913

ANALYSIS OF HYDROLOGIC IMPACT OF QUARRYING SYSTEM BY 3-D FINITE ELEMENT MODEL.
Padua Univ. (Italy). Dipt. di Metodi e Modelli Matematici per le Scienze Applicate.
G. Gambolati, and G. Galeati.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 11, p 1388-1402, November 1990. 11 fig, 29 ref.

Descriptors: *Finite element method, *Groundwater movement, *Hydrological regime, *Model studies, *Quarries, *Water table fluctuations, Alluvial plains, Borrow pits, Design criteria, Environmental impact, Excavation, Italy, Nuclear powerplants, Numerical analysis, Three-dimensional model.

The excavation of an extensive quarrying system in alluvial plains to supply building material may induce water table modifications that are not compatible with the natural environment or with the existing activities (e.g., agricultural or recreational) in the area. The hydrologic impact of a set of borrow pits designed to provide the material needed for the construction of an electro-nuclear plant at Trino Vercellese, northwestern Italy, was analyzed with the aid of a 3-D finite element model of subsurface flow. The results from the simulations show that a single quarry induces water-table changes that are considered to be unacceptable from the environmental point of view. Close to the excavation boundary, the water level can rise more than 1 m, with possible flooding of nearby areas. Also, outside the electro-nuclear plant property an increase or decrease of 0.2 m is considered to be significant. The results also show that the groundwater regime is not altered either transversely or longitudinally if the excavation volume is fractioned into six distinct cavities and the downstream wall of each cavity is made impermeable through the deposition of a layer of fine sediments or the application of a thin plastic foil. (Fish-PTT)
W91-02921

IMPACT OF SYNTHETIC LEACHATE ON THE HYDRAULIC CONDUCTIVITY OF A SMECTITIC TILL UNDERLYING A LANDFILL NEAR SASKATOON, SASKATCHEWAN.
National Hydrology Research Inst., Saskatoon (Saskatchewan). Ground Water Div.
For primary bibliographic entry see Field 5E.
W91-02943

4D. Watershed Protection

MEASURING SOIL LOSS IN DIFFERENT LAND-USE SYSTEMS ON AN OXIC PALEUSTALF IN LUSITU, ZAMBIA.
Zambia Univ., Lusaka.
V. R. N. Chinene, D. Mbewe, and D. Lungu.
Tropical Agriculture TAGLA2, Vol. 67, No. 3, p 221-222, July 1990. 1 fig, 1 tab, 5 ref.

Descriptors: *Developing countries, *Erosion control, *Land use, *Soil erosion, Agriculture, Cowpeas, Crop yield, Groundnut, Millet, Productivity, Runoff, Zambia.

Erosion hazards in the Lusitu, Zambia area are one of the constraints limiting sustainable land productivity. Soil loss was measured using the runoff plot technique in five cropping systems (millet, bambara groundnuts, millet and bambara groundnuts, cowpeas, and millet and cowpeas) and a bare plot. Considerable variation in soil loss was apparent between different cropping systems. In the bare plot more than 12 tons soil per ha was lost. In millet and its intercrops, soil loss was nearly 50% lower than in the bare plot. Millet produced higher yields when intercropped with bambara groundnuts, and cowpea. Similarly, bambara groundnuts and cowpeas produced higher yields when intercropped with millet. Definite differences were demonstrated between cropping systems in controlling soil loss. Crop cover by itself has the capacity to reduce soil loss by nearly 50%. Crops such as bambara groundnuts and cowpeas which develop small leaf canopies should only be grown as intercrops to minimize soil loss and optimize productivity. (Brunone-PTT)
W91-02078

WATER DROPLET ENERGY AND SOIL AMENDMENTS: EFFECT ON INFILTRATION AND EROSION.
Soil and Irrigation Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 2G.
W91-02136

SLOPE, ASPECT, AND PHOSPHOGYPSUM EFFECTS ON RUNOFF AND EROSION.
Soil Erosion Research Station, Natanya (Israel).
For primary bibliographic entry see Field 2E.
W91-02139

USE OF RUN OFF ON CULTIVATED FIELDS IN THE SUDAN-SAHELIAN AREA: BURKINA FASO, YATENGA PROVINCE, BIDI REGION (VALORISATION AGRICOLE DES EAUX DE RUISSELLEMENT EN ZONE SOUDANO SAHELIENNE: BURKINA FASO, PROVINCE DU YATENGA, REGION DE BIDI).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Ouagadougou (Burkina Faso). Centre ORSTOM a Ouagadougou.
For primary bibliographic entry see Field 3F.
W91-02365

PREDICTION ON EUTROPHICATION OF RESERVOIR YUQIAO.
Tianjin Inst. of Environmental Protection and Sciences (China).
For primary bibliographic entry see Field 5G.
W91-02383

NOURISHMENT OF PERCHED SAND DUNES AND THE ISSUE OF EROSION CONTROL IN THE GREAT LAKES.
Michigan Univ.-Flint. Dept. of Resource Science.
For primary bibliographic entry see Field 2J.
W91-02821

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

EVALUATION OF THE SEA URCHIN ECHINOMETRA IUCUNTER AS AN INDICATOR OF HEAVY-METAL CONTAMINATION IN CUBA (EVALUACION DEL ERIZO DE MAR ECHINOMETRA IUCUNTER COMO INDICATOR DE CONTAMINACION POR METALES PESADOS, CUBA).
Instituto de Investigaciones del Transporte, Havana (Cuba). Unidad de Proteccion Ambiental.
N. Ablanedo, H. Gonzalez, M. Ramirez, and I. Torres.
Aquatic Living Resources ALREEA, Vol. 3, No. 2, p 113-120, 1990. 5 fig, 4 tab, 21 ref. (English summary).

Descriptors: *Bioindicators, *Cuba, *Echinoderms, *Heavy metals, *Marine pollution, *Path of pollutants, *Statistical analysis, Analysis of variance, Cluster analysis, Copper, Data interpretation, Havana, Iron, Manganese, Mercury, Pollutant identification, Tissue analysis, Water quality, Zinc.

Between March 1986 and June 1987, the content of iron, zinc and manganese in the hard parts, and the content of iron, copper, zinc and mercury in the gonads, of the sea urchin Echinometra Iucunter were studied. The specimens were collected from sites on the rocky shore of Havana, Cuba, which had different levels of heavy metal pollution. The sampling sites were Santa Cruz, Rincon de Guanabo, Alamar, Boca de la Bahia, Nautico and Santa Fe. Differences were found in the metal content of both the gonads and the hard parts. These differences were explained by the triglyceride content of the gonads and the higher organic content of the gonads, (> 90%), compared with 13% for the hard parts. The results were processed by analysis of variance (ANOVA) and cluster analysis. Seasonal variations were found by ANOVA. The differences between the sites that had been studied indicate that the gonads can act as an indicator of iron and mercury pollution and the hard parts as an indicator of iron, zinc and manganese pollution. (Author's abstract)
W91-02044

TOTAL HEAVY METAL CONCENTRATIONS CONTAINED ON THE SEDIMENT'S SURFACE OF ALGIERS BAY.
Laboratoire de Chemie Marine, Algiers (Algeria).
For primary bibliographic entry see Field 5B.
W91-02053

TOXICITY TEST FOR WATER AND WASTE WATER: ALDEHYDE DEHYDROGENASE INHIBITION TEST IN CUVETS AND MICROTITER PLATES (TOXIZITAETSTESTS FUER WASSER UND ABWASSER: KUEVETTEN- UND MIKROTITERPLATTENTEST MIT ALDEHYDDEHYDROGENASE).
Wasserforschung Mainz G.m.b.H. (Germany, F.R.).
M. Wiegand-Rosinus, K. Haberer, U. Obst, and A. Wild.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 23, No. 3, p 98-101, June 1990. 4 fig, 4 tab, 3 ref. English summary.

Descriptors: *Analytical techniques, *Laboratory methods, *Pesticides, *Toxicity, *Wastewater analysis, *Water analysis, Aldehyde dehydrogenase, Captafol, Dithiocarbamates, Fentinacetate, Maneb, Water quality.

Based on the inhibition of aldehyde dehydrogenase by pesticides, an enzymatic toxicity test is presented for testing water and wastewater. The test protocols are given for photometric measurement in cuvets and fluorometric measurement in microtiter plates. Using microtiter plates minimizes the costs by saving expensive reagents, and enables the testing of a higher quality of samples by rapid measurement of dilution series. The results of 17 tested pesticides are described: the dose-response curves of Maneb, Captafol and Fentinacetate are shown as examples. Dithiocarbamates inhibit aldehyde dehydrogenase in a low ppt range. The test in microtiter wells is more sensitive because of the lower concentration of substrate, enzyme and coenzyme in molecular rate. (Author's abstract)
W91-02056

COASTAL WATER POLLUTION: DISSOLVED HEAVY METALS AND SUSPENDED PARTICULATE MATTER.
Patras Univ. (Greece).
A. Koliadima, and G. Karaiskakis.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 23, No. 3, p 102-105, June 1990. 2 fig, 6 tab, 10 ref. International Atomic Energy Agency Contract 4621/EP.

Descriptors: *Greece, *Heavy metals, *Path of pollutants, *Pollutant identification, *Water pollution sources, Cadmium, Copper, Lead, Marine pollution, Particle size, Patras, Photosedimentation, Polarographic analysis, Suspended sediments, Water quality, Zinc.

Concentrations of the heavy metals, Zn, Cd, Pb, and Cu dissolved in coastal water samples collected from around the city of Patras, were measured over a period of one year, with a frequency of one sample per month, by polarographic methods. Lower annual mean concentrations of dissolved Zn and Cu were found in coastal locations close to the mouths of rivers, while the annual mean concentrations of dissolved Cd and Pb were found to be independent of the sampling location. The mean number diameter of the suspended particulate matter, as measured by photosedimentation, was found to increase with a decrease in the concentration of dissolved Zn, as well as an increase in the concentration of the dissolved Cu. (Author's abstract)
W91-02057

SORPTION LAYERS IMPREGNATED WITH AMMONIUM MOLYBDATE FOR THE THIN LAYER CHROMATOGRAPHY IN ORDER TO EVALUATE PHENOL CONTAMINATED WATERS (AMMONIUMMOLYBDATIMPAEGNIERTE SORPTIONSCHICHTEN FUER DIE DUENNSCHICHTCHROMATOGRAPHIE ZUR BEURTEILUNG PHENOLKONTAMINIERTER WAESSER).
Kreiskrankenhaus Treuenbrietzin (German D.R.).
H. Thielemann.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 23, No. 3, p 113-115, June 1990. 1 tab, 2 ref. English summary.

Descriptors: *Analytical techniques, *Chemical analysis, *Phenols, *Pollutant identification, *Thin layer chromatography, *Water analysis, Aromatic compounds, Benzenes, Dihydroxybenzene, Industrial wastewater, Laboratory methods, Trihydroxybenzene.

The application of thin layer chromatography to evaluate phenolic contamination in water is discussed. The mobile phase for separating bifunctional phenols is a mixture of: toluene; 49%; acetone, 35%; and chloroform, 25%. The mobile phase for the separation of polyfunctional phenolic compounds is composed of: benzene, 70%; and acetone, 30%. The stationary phase was composed of a wide-pore silica gel treated with a 5% solution of ammonium molybdate and air dried at 80-100 C. Phenolic compounds separated include 1,2-dihydroxybenzene, 1,3-dihydroxybenzene, 1,4-dihydroxybenzene, 1,2,3-trihydroxybenzene, 1,3,5-trihydroxybenzene, and 1,2,4-trihydroxybenzene. (King-PTT)
W91-02059

RESPONSE AND RECOVERY OF BRAIN ACETYLCHOLINESTERASE ACTIVITY IN ATLANTIC SALMON (SALMO SALAR) EXPOSED TO FENITROTHION.
Department of Fisheries and Oceans, St. John's (Newfoundland). Science Branch.
M. J. Morgan, L. L. Fancey, and J. W. Kiceniuk.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1652-1654, September 1990. 1 tab, 20 ref.

Descriptors: *Acetylcholinesterase, *Bioindicators, *Fenitrothion, *Fish physiology, *Insecticides, *Pesticides, *Salmon, *Water pollution effects, Enzyme activity, Marine pollution, Metabolism, Organophosphorus pesticides, Pesticide toxicity.

Exposure to organophosphorus insecticides is known to decrease the activity of brain acetylcholinesterase, and a 20% decrease in the enzyme's activity relative to controls is taken as evidence that animals have been in contact with an organophosphorus pesticide. Atlantic salmon (Salmo salar) parr were exposed to a number of concentrations of either technical grade fenitrothion or an operational formulation of the pesticide for 7 days or to the operational formulation for two, 24 hour periods separated by seven days. Brain acetylcholinesterase (AChE) activity decreased as concentration of fenitrothion increased. Recovery period was directly related to amount of depression, with recovery of AChE from exposure to 0.004 microl/L fenitrothion taking less than one week. Samples must be taken soon after spray operation to detect exposure to such low levels of fenitrothion through AChE monitoring. The use of AChE activity measurements as a monitoring tool in aquatic systems should reliably detect exposure to dangerous levels of fenitrothion which might produce significant population changes. (Brunone-PTT)
W91-02061

PRECONCENTRATION OF COPPER ON ALGAE AND DETERMINATION BY SLURRY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY.
Texas Univ. at Austin. Dept. of Chemistry and Biochemistry.
M. Shengjun, and J. A. Holcombe.
Analytical Chemistry ANCHAM, Vol. 62, No. 18, p 1994-1997, September 15, 1990. 4 fig, 4 tab, 8 ref.
Robert A. Welch Foundation Grant F1108.

Descriptors: *Atomic absorption spectrophotometry, *Chemical analysis, *Chlorella, *Copper, *Laboratory methods, *Pollutant identification, *Preconcentration, *Water analysis, *Water treatment, Adsorption, Freshwater, Heavy metals, Hydrogen ion concentration, Seawater.

Unicellular green algae (Chlorella) were utilized to preconcentrate Cu ions from seawater and riverine water samples. Studies show that after the algae are rinsed with 1% HCl, Cu adsorption on the algae is improved. The addition of sodium citrate and dodecyl sulfate can also improve Cu adsorption. The algae weight and the solution pH are not critical. The seawater matrix does not affect the adsorption efficiency for Cu. Cu preconcentration can be achieved by mixing 6 mg of algae with 100 ml of sample and subsequently separating by centrifugation. The algae pellet is then resuspended in 1 ml of 0.5% HNO3 and analyzed as a slurry by graphite furnace atomic adsorption spectrometry. The determined values of Cu in riverine (SLRS-1) and seawater (CASS-1) standard reference materials are within the limits of certification. (Author abstract)
W91-02191

ENZYME-LINKED IMMUNOSORBENT ASSAY COMPARED WITH GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR THE DETERMINATION OF TRIAZINE HERBICIDES IN WATER.
Geological Survey, Lawrence, KS. Water Resources Div.
E. M. Thurman, M. Meyer, M. Pomes, C. A. Perry, and A. P. Schwab.
Analytical Chemistry ANCHAM, Vol. 62, No. 1, p 2043-2048, September 15, 1990. 4 fig, 4 tab, 2 ref.

Descriptors: *Chemical analysis, *Gas chromatography, *Herbicides, *Immunoassay, *Laboratory methods, *Mass spectrometry, *Pollutant identi

tion, *Triazine herbicides, *Triazines, *Water alysis, Comparison studies, ELISA, Enzymes, etabolites, Organic compounds.

n enzyme-linked immunosorbent assay (ELISA) as compared to a gas chromatography/mass ectrometry (GC/MS) procedure for the analysis triazine herbicides and their metabolites in sur- e water and groundwater. Apparent recoveries m natural water and spiked water by both meth- s were comparable at 0.2-2 micrograms/L. lid-phase extraction (SPE) was examined also, d recoveries were determined for a suite of zine herbicides. A significant correlation was ained between the ELISA and GC/MS method natural water samples that were extracted by E. Because ELISA was developed with an atra- e-like compound as the hapten with conjugation he 2-position, it was selective for triazines that tained both ethyl and isopropyl side chains. ncentrations for 50% inhibition (IC50) were as ows: atrazine, 0.4 micrograms/L; ametryne, 5 micrograms/L; prometryn and propazine, 0.5 rograms/L; prometon, 0.7 micrograms/L; si- zine and terbutryn, 2.5 micrograms/L; hydrox- razine, 28 micrograms/L; deethylatrazine and sopropylatrazine, 30 micrograms/L; cyanazine, micrograms/L; didealkylatrazine had no re- nse. The combination of screening analysis by ISA, which requires no sample preparation and rks on 160 microliters of sample, and confirma- by GC/MS was designed for rapid, inexpen- analysis of triazine herbicides in water. (Au- 's abstract)
1-02192

ORT-TERM EXPOSURE OF ZOOPLANK- N TO THE SYNTHETIC PYRETHROID, IVALERATE, AND ITS EFFECTS ON TES OF FILTRATION AND ASSIMILA- N OF THE ALGA, CHLAMYDOMONAS NHARDII.
lph Univ. (Ontario). Dept. of Environmental ogy.
primary bibliographic entry see Field 5C.
-02195

IFICIALLY INDUCED METAMORPHOSIS TONE IN ACRIS GRYLLUS.
essee State Univ., Nashville. Dept. of Biologi- ciences.
primary bibliographic entry see Field 5C.
-02201

ECTS OF ATRAZINE ON FRESHWATER ROBIAL COMMUNITIES.
sylvania State Univ., University Park. School orest Resources.
primary bibliographic entry see Field 5C.
-02202

PONSES OF ZOOPLANKTON AND OBORUS TO TEMEPHOS IN A NATURAL D AND IN THE LABORATORY.
Olaf Coll., Northfield, MN. Dept. of Biol-

rimary bibliographic entry see Field 5C.
02203

SSING DETOXIFICATION OF A COM- X HAZARDOUS WASTE, USING THE MI- TOX BIOASSAY.
State Univ., Logan. Div. of Environmental eering.
rimary bibliographic entry see Field 5E.
02204

HODS FOR ASSESSING FERTILIZATION EMBRYONIC/LARVAL DEVELOPMENT OXICITY TESTS USING THE CALIFOR- MUSSEL (MYTILUS CALIFORNIANUS).
rnia Univ., Bodega Bay. Bodega Marine

Cherr, J. Shoffner-McGee, and J. M. er.
onmental Toxicology and Chemistry CDK, Vol. 9, No. 9, p 1137-1145, September 1990. 9 fig, 2 tab, 20 ref.

Descriptors: *Analytical methods, *Bioassay, *Bioindicators, *Embryonic growth stage, *Mytilus, *Toxicity, *Toxicology, DNA, Fertilization, Fluorescence, Larvae, Microscopy, Mussels, Polarization, Pollutant identification.

The fertilized eggs, embryos and larvae of the California mussel (Mytilus californianus) were used to develop methods for assessing fertilization and larval development rates, and for conducting toxicity tests in standard exposure chambers and small volume (3 ml) chambers. Because the sperm/egg ratio resulting in high monospermic fertilization rates varied among females, the 'optimal' ratio for each female was predetermined in an aliquot of eggs prior to fertilizing the entire batch for bioassay use. The fluorescent DNA probe Hoechst 33342 was used to rapidly differentiate unfertilized, monospermic and polyspermic eggs. Following fertilization of entire batches of eggs based on the predetermined sperm/egg ratio, monospermic fertilization rates of >90% were readily achieved. Fertilized embryos were then used in bioassays conducted in beakers of tissue-culture chamber slides (mini chambers), which could be viewed directly on the microscope. The response of the embryos and larvae to the metabolic inhibitor sodium azide was assessed in both types of test chambers. At 96 h postinsemination at 12 degrees, veliger or nonveliger larvae were assessed using polarization microscopy to determine the presence or absence of a complete shell. No significant difference in the response to sodium azide was detected between the beakers and mini chambers. M. californianus is suitable for static embryo/larval toxicity tests, and small volume chambers allow successful larval development and eliminate the need for subsampling of larger test chambers. The value of assessing fertilization rates prior to conducting the bioassay, and an improved method for examining larval shell development using polarization microscopy were demonstrated. (Author's abstract)
W91-02212

POPULATION-SPECIFIC TOXICITY RESPONSES BY THE FRESHWATER OLIGOCHAETE, STYLODRILUS HERINGIANUS, IN NATURAL LAKE MICHIGAN SEDIMENTS.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W91-02213

RAINBOW TROUT LIVER ACTIVATION SYSTEMS WITH THE AMES MUTAGENICITY TEST.
National Fisheries Contaminant Research Center, Columbia, MO.
B. T. Johnson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 9, p 1183-1192, September 1990. 3 fig, 6 tab, 41 ref.

Descriptors: *Ames test, *Genotoxicity, *Liver, *Mutagenicity, *Pollutant identification, *Toxicology, *Trout, Animal metabolism, Bioassay, Cytochromes, Enzymes, Laboratory methods, Metabolites, Mutagens, Salmonella, Temperature effects.

A poikilothermic metabolic activation system developed from liver homogenate of rainbow trout (Oncorhynchus mykiss, formerly Salmo gairdneri) was used in the Ames Salmonella/Mammalian Microsome Mutagenicity Test. Postmitochondrial fractions (S9) mediated four model promutagens: 2-aminoanthracene (2AA), 2-aminofluorene (2AF), benzo(alpha)pyrene (BaP), and 3-methylcholanthrene (3MC). These promutagens require two different exogenous metabolic activation routes to form mutagens with Salmonella TA98 and TA100. The enzymatic activity of trout S9 was cytochrome P-450-like; it was heat labile and oxygen-dependent and cofactor-dependent. Preincubation temperature significantly influenced the sensitivity of the fish-activated Ames test. Bacterial mutagenesis with trout activation significantly decreased as preincubation temperature increased; the optimum S9 activation temperature range for trout was 10 to 15 degrees compared with 37 degrees for the rat. The liquid-preincubation test was best adapted to the trout poikilothermic activation system; it was significantly more sensitive than the plate-incorporation test in detecting histidine revertants. The S9 activity of trout and rat was qualitatively similar in the Ames test; that is, both fractions metabolically activated 2AA, 2AF, BaP and 3MC to produce bacterial mutagenesis with Salmonella TA98 and TA100. The use of this ecologically relevant exogenous activation system in the short-term predictive genotoxicity testing of freshwater ecosystems is helpful in the assessment of potential hazards of chemical contaminants on fishery resources. (Author's abstract)
W91-02217

COMPARATIVE EVALUATION OF FIVE TOXICITY TESTS WITH SEDIMENTS FROM SAN FRANCISCO BAY AND TOMALES BAY, CALIFORNIA.
National Ocean Service, Seattle, WA. Ocean Assessments Div.
E. R. Long, M. F. Buchman, S. M. Bay, R. J. Breteler, and R. S. Carr.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 9, p 1193-1214, September 1990. 13 tab, 38 ref.

Descriptors: *Mutagenicity, *San Francisco Bay, *Sediment contamination, *Toxicity, *Toxicology, *Water pollution effects, Amphipods, Chemical analysis, Coastal environment, Comparison studies, Echinoderms, Embryonic growth stage, Genotoxicity, Hydrocarbons, Marine environment, Mussels, Mytilus, Organic carbon, Pollutant identification, Polychaetes, Sediment analysis, Trace metals.

The relative sensitivity, analytical precision, discriminatory power and concordance among endpoints with sediment chemistry were compared among five sediment toxicity tests. The tests were performed with aliquots of 15 composited, homogenized sediment samples. Survival and a variety of sublethal endpoints were determined in tests performed with the amphipods Rhepoxynius abronius and Ampelisca abdita, embryos of the mussel Mytilus edulis, embryos of the urchin Strongylocentrotus purpuratus and the polychaete Dinophilus gyrociliatus. Each sample was also tested for trace metal and organic compound concentrations, organic carbon content and texture. Two of the five tests (survival among M. edulis and survival among R. abronius) were highly sensitive to the samples and had relatively high precision, but the results were correlated most highly with sedimentological variables. One of the tests (survival among A. abdita) was relatively insensitive, but the results were highly correlated with only the concentrations of toxic chemicals. The test with S. purpuratus indicated mutagenicity in several samples that had high hydrocarbon concentrations. The test of pore water with D. gyrociliatus was intermediate in sensitivity and precision and not correlated highly with the results from other tests. (Author's abstract)
W91-02218

COMPARISON OF QUARTER-HOURLY ON-LINE DYNAMIC HEADSPACE ANALYSIS TO PURGE-AND-TRAP ANALYSIS OF VARYING VOLATILE ORGANIC COMPOUNDS IN DRINKING WATER SOURCES.
Drexel Univ., Philadelphia, PA. Dept. of Chemistry.
J. G. Schnable, B. Dussert, I. H. Suffet, and C. D. Hertz.
Journal of Chromatography JOCRAM, Vol. 513, p 47-54, July 27, 1990. 6 fig, 1 tab, 7 ref.

Descriptors: *Analytical methods, *Monitoring, *Pollutant identification, *Volatile organic compounds, *Water supply, Chemical analysis, Comparison studies, Electronic equipment, Gas chromatography, Water conveyance.

The temporal monitoring of volatile organic compounds (VOCs) in water sources is important be-

cause of contamination and the transport of contaminants. This project was the first application of quarter-hourly on-line headspace analysis for monitoring VOC concentrations in surface and ground waters, for extended periods of time. A Siemens P101 dynamic headspace analyzer was refined, and quality assurance was developed for quarter-hourly analyses. Hourly comparisons were made to on-line purge-and-trap analysis and to purge-and-trap analysis after sample preservation and storage. Variations in VOC concentrations of 6047% biweekly, 222% daily, 97% hourly, and 35% quarter-hourly were observable, with the 15-min cycle of the dynamic headspace analysis. The headspace analyzer had superior retention time stability, required less maintenance, and had 1/4 the analysis time as a typical purge-and-trap-gas chromatography system used for hourly comparisons. (Author's abstract)
W91-02219

PERIPHYTON AS INDICATOR OF THE RESERVOIR WATER QUALITY: III. BIOMONITORING TECHNIQUES.
Prague Dept. of Water Technology and Environmental Engineering (Czechoslovakia).
A. Sladeckova.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 775-782, 1990. 2 fig, 30 ref.

Descriptors: *Analytical methods, *Bioassay, *Bioindicators, *Limnology, *Monitoring, *Periphyton, *Reservoirs, *Water quality, Algae, Ciliates, Diatoms, Organic compounds, Protozoa, Trace metals.

Periphyton bioassays on species, community, and microcosm levels conducted in situ or in the laboratory using field-collected water can be used for the biomonitoring of pollution, eutrophication, and toxic effects of the water quality of reservoirs and their tributaries. Such assays measure important environmental stress factors in natural localities. (1) On the species level, the algae Stigeoclonium subsecundum and Cladophora glomerata and the ciliate Vorticella convallaria have been shown to be good biological monitors of water pollution. (2) On the community level, diatoms have been used as representatives of the algal components of the periphyton community, mostly for the monitoring of organic pollution, nutrient enrichment, and bioaccumulation of trace metals. Protozoan community structure and colonization dynamics have also been used for testing water pollutants. The majority of procedures using the entire periphyton community to monitor water quality are based on the exposure of artificial substrates. The aim is to provide comparable conditions for periphyton colonization in localities with variable or nonexistent natural substrata. (3) At the microcosm level, experimental units are used to contain important components and to exhibit important processes occurring in a whole ecosystem. Designed mostly for simulating the conditions in flowing water, they are also appropriate for testing water quality in reservoir tributaries. The choice of an appropriate bioassay technique or of the best combination of several methods will be dictated by the specific data requirements of the study, by the level of environmental control desired and by the investigator's resources and equipment. (Sand-PTT)
W91-02382

WATER QUALITY IN CZECHOSLOVAK WATER-SUPPLY IMPOUNDMENTS.
Prague Dept. of Water Technology and Environmental Engineering (Czechoslovakia).
For primary bibliographic entry see Field 2H.
W91-02386

CLASSIFICATION OF SOME RESERVOIRS IN SR SERBIA (SFR YUGOSLAVIA) BASED ON ANALYSIS OF PLANKTON SPECIES AS INDICATORS OF TROPHIC CONDITIONS.
Institute for Biological Research, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 2H.
W91-02388

WATER QUALITY OF SOME RESERVOIRS.
Vyzkumny Ustav Vodohospodarsky, Prague (Czechoslovakia).
D. Matulova.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 861-867, 1990. 1 fig, 3 tab, 4 ref.

Descriptors: *Algae, *Bacteria, *Bioassay, *Pollution index, *Reservoirs, *Water quality, Chlamydomonas, Czechoslovakia, Escherichia coli, Nitrates, Phosphates, Scenedesmus, Serratia.

In evaluating the water quality of reservoirs, in addition to physical and chemical analyses biological methods have become increasingly important. Several biological procedures were used in a study of the water quality of six Czechoslovakian reservoirs. The results were compared with physical and chemical data to determine the water quality at the chosen localities and to evaluate the results obtained from the methodological points of view and the importance of individual factors which affect the water quality. The ecological procedures included saprobity zones determination, based on biological analyses, and determination of total numbers of bacteria multiplying at 37 C and 20 C and the number of coliforms. Experimental biological procedures (physiological tests) included bioassays with algae (Scenedesmus quadricauda and Chlamydomonas eugametos) and bioassays with bacteria (Escherichia coli and Serratia marcescens). The following results were obtained: (1) the physiological tests with both algae species had a very similar course; (2) the results with both algae depended on the contents of phosphates in the samples examined; (3) phosphorus was proved as the limiting factor at the investigated localities; (4) the results of the physiological tests with algae were not closely related to the contents of nitrates in the samples; (5) the mutual relationship between the results of bioassays with algae and bacteria was not significant; (6) the results of the physiological tests with both bacteria were very similar and were in good conformity with the contents of nitrates; (7) the saprobic index according to Sladecek at the investigated localities compared with the chemical and physical data, and the results of physiological tests applied varied less. (Sand-PTT)
W91-02391

SOLVENT SUBLATION OF HEXACHLOROBUTADIENE AND 2,4,6-TRICHLOROPHENOL.
National Tsing Hua Univ., Hsinchu (Taiwan). Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W91-02403

SIMPLE MEMBRANE FILTER METHOD TO CONCENTRATE AND ENUMERATE MALE-SPECIFIC RNA COLIPHAGES.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
M. D. Sobsey, K. J. Schwab, and T. R. Handzel.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 9, p 52-59, September 1990. 2 fig, 7 tab, 25 ref.

Descriptors: *Bacteriophage, *Bioindicators, *Enteroviruses, *Laboratory methods, *Membrane filters, *Pollutant identification, *Water treatment, Disinfection, Groundwater, RNA coliphages, Surface Water Treatment Rule, Viruses, Water quality, Water quality standards.

Because of concerns about viruses and other microbial contaminants in drinking water, the US EPA recently promulgated the Surface Water Treatment Rule, which requires filtration and disinfection to achieve a 99.99% virus reduction. A groundwater disinfection rule targeted at controlling viruses and other microbial pathogens through disinfection is now in preparation. The development of treatment requirements to control viruses in drinking water is based, in part, on the inability to define a practical virus standard or develop a technically feasible, reliable, inexpensive, and rapid virus monitoring strategy or virus indicator system. Recent research suggests that male-specific (F-specific) RNA coliphages, a group of small, icosahedral bacteriophages infecting male strains of Escherichia coli, may fulfill many of the essential requirements of a viral indicator. A simpl membrane filter method for concentrating and enu merating F-specific coliphages in raw and finishe drinking water was developed with a view to usin these phages as a viral indicator. F-specific col phages were enumerated by plaque assays on specially constructed host of Salmonella typhimu ium that is resistant to nalidixic acid and kanam cin and contains an E. coli plasmid responsible fo E. coli pili production and, thus, susceptibility infection by F-specific coliphages. The metho developed was field-tested by determining the co centrations of F-specific coliphages in sever source waters and comparing them with concen trations of fecal indicator bacteria. The resul suggest that the new membrane filter method fo enumerating F-specific coliphages should be usef for assessing fecal contamination of natural an treated waters. Additional studies are needed determine whether these coliphages are reliab indicators of enteric viruses in water. (Mertz-PTT
W91-02416

LIQUID CHROMATOGRAPHY-MASS SPE TROMETRY: AN EMERGING TECHNOLOG FOR NONVOLATILE COMPOUNDS.
Environmental Protection Agency, Cincinna OH. Chemistry Research Div.
W. L. Budde, T. D. Behymer, T. A. Bellar, and J S. Ho.
Journal of the American Water Works Associati JAWWA5, Vol. 82, No. 9, p 60-65, Septemb 1990. 10 fig, 1 tab, 18 ref.

Descriptors: *Analytical techniques, *Chemi analysis, *High performance liquid chromatogr phy, *Liquid chromatography, *Mass spectrom try, *Organic compounds, *Pollutant identifi tion, *Water analysis, Detection limits, Drinki water, Particle beam, Regulations, Separation tec niques.

Most currently regulated organic compoun found in drinking water are amenable to separati and measurement by gas chromatography. A n generation of compounds being proposed for re lation includes some that are not amenable to se ration and measurement with this technique. T emerging analytical technology of liquid chrom tography-mass spectometry is considered a lik candidate for the separation and measurement nonvolatile compounds in drinking water. Hi pressure liquid chromatography-particle-bea mass spectrometry shows promise as broad-sp trum analytical technique applicable to the det mination of a variety of nonvolatile compounds drinking water and other environmental samp The combination of precise retention times, el tron ionization mass spectra, and isotope distri tion patterns from compounds containing natura occurring isotopes gives excellent information the unequivocal identification of target and un pected analytes. The precision, calibration, instrument detection limits obtained with h pressure liquid chromatography-particle-bea mass spectrometry are encouraging and sugg that it will be possible to develop a broad-spectr analytical method. Particle-beam liquid chro tography-mass spectrometry technology is r tively new, and substantial improvements in tems and performance are expected during early 1990s. (Mertz-PTT)
W91-02417

COMPARISON OF THE ZINC SULFATE A IMMUNOFLUORESCENCE TECHNIQU FOR DETECTING GIARDIA AND CRYP SPORIDIUM.
American Water Works Service Co., Inc., Be ville, IL. Belleville Lab.
M. W. LeChevallier, T. M. Trok, M. O. Burns, R. G. Lee.
Journal of the American Water Works Associa JAWWA5, Vol. 82, No. 9, p 75-82, Septen 1990. 7 tab, 45 ref.

Descriptors: *Analytical techniques, *Cryptosp dium, *Giardia, *Human pathogens, *Paras *Pollutant identification, *Protozoa, *Water t ment, Fluorescence, Immunofluorescence, Sur

/ater Treatment Rule, Water quality control, /ater quality standards, Zinc sulfate method.

pidemiological studies have shown that Giardia mblia is widespread, with infection rates among dividuals in North America ranging from 1.5-%. Giardia has been reported to be present in -28% of lakes, rivers, and creeks tested. The ccidian protozoan, Cryptosporidium, was not cognized in humans until 1976. In recent years s parasite has been isolated in stools at a rate of to 23%. Cryptosporidium appears to be widely tributed in the aquatic environment. An immun-uorescence method for the simultaneous detec-n of Giardia and Cryptosporidium in water was mpared with the zinc sulfate flotation and gol's iodine method in surface water samples lected in western Pennsylvania. The results owed that the immunofluorescence technique ected approximately 12 times more Giardia ts in surface water samples than the zinc sulfate thod. In addition, Cryptosporidium was detect-in several samples. Application of the immuno-orescence procedure for surface waters detected rdia at levels as high as 690 cysts/100 gallon at level, utilization of the 99% filtration criteria posed in the Surface Water Treatment Rule ld still result in about 7 Giardia cysts/100 on of filtered water. The results are significant use they represent levels not detected using zinc sulfate flotation technique. These data gest that operators of treatment plants with r source-water quality should pay special atten-to flocculation, coagulation, and filtration esses to optimize parasite removal. (Mertz-)
-02419

ESSING DEFINED-SUBSTRATE TECH-LOGY FOR MEETING MONITORING RE-REMENTS OF THE TOTAL COLIFORM E.
ois State Environmental Protection Agency, gfield.
. Katamay.
al of the American Water Works Association WA5, Vol. 82, No. 9, p 83-87, September 2 tab, 23 ref.

riptors: *Analytical techniques, *Coliforms, utant identification, *Water quality manage-*Water quality standards, *Water treatment, ria, Defined-substrate technology, Drinking standards, Illinois, Membrane filter proce-Water analysis, Water law, Water sampling.

Illinois Environmental Protection Agency is nsible for drinking water analyses for ap-nately 2,200 public water utilities serving than half the state's population. The recently oped defined-substrate technology (commer-known as Colilert), which simultaneously rates both total coliforms and Escherichia nd does not require confirmatory tests, was red in this geographic area with the mem-filter procedure from Standard Methods. l, there were no differences between mem-filter and defined-substrate technology. Sub-es of positive defined-substrate technology demonstrated this technology's specificity. (total coliform-positive) tubes yielded spe-nsistent with total coliforms, and fluorescent -positive) tubes contained E. coli. The de-ubstrate system was easy to use and is com-with new drinking water regulations that crease monitoring and resampling require-mandate a fecal indicator (either an E. coli i coliform analysis), and use a maximum inant level in the frequency-of-occurrence Defined-substrate technology also has sev-portant advantages for state regulators, in-its ability to help utilities comply with new rtation and storage requirements. (Author's)
420

ITY TEST PROCEDURES FOR HYA-AZTECA, AND CHRONIC TOXICITY CADMIUM AND PENTACHLORO-OL TO H. AZTECA, GAMMARUS FAS-S, AND DAPHNIA MAGNA.
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
U. Borgmann, K. M. Ralph, and W. P. Norwood.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 5, p 756-764, September 1989. 4 fig, 6 tab, 34 ref.

Descriptors: *Amphipods, *Bioindicators, *Cadmium, *Chronic toxicity, *Pentachlorophenol, *Toxicity, *Toxicology, *Water pollution effects, *Waterfleas, Aquatic animals, Aquatic environment, Benthic environment, Cultures, Culturing techniques, Daphnia, Gammarus, Great Lakes, Growth, Hyalella, Life cycles, Mortality, Substrates, Survival.

Survival, growth, and reproduction of Hyalella azteca were determined under various test conditions. Reproduction by a cohort begins when the amphipods are 5 to 6 weeks old, peaks at 8 to 12 weeks, and then declines due to continuing adult mortality. Full life-cycle tests can be completed in 12 to 14 weeks at 25 C. Reproduction is poor when only artificial plastic substrate is provided. A substrate of cotton gauge results in dramatic improvements in both reproduction and growth. Better reproduction can be obtained by culturing the amphipods in some sediments, but this makes weekly enumeration difficult. Increased mortality during chronic exposure to cadmium was observed at 1 microgram/L for H. azteca and 3.2 microgram/L for Gammarus fasciatus. Reproduction during longer exposure was not reduced at concentrations lower than those causing increased mortality within six weeks. Chronic toxicity of pentachlorophenol was observed at 100 micrograms/L for both species. Chronic toxicity to Daphnia magna was similar to that of the amphipods for cadmium, but lower for pentachlorophenol. Amphipods are at least as sensitive as Daphnia to a variety of toxicants during chronic exposure. (Author's abstract)
W91-02444

ACUTE TOXICITY OF INDUSTRIAL SURFACTANTS TO MYSIDOPSIS BAHIA.
AWARE, Inc., Nashville, TN.
For primary bibliographic entry see Field 5C.
W91-02445

BINDING OF TRIAZINE HERBICIDES TO ANTIBODIES IN ANHYDROUS ORGANIC SOLVENTS.
Gesellschaft fuer Biotechnologische Forschung m.b.H., Brunswick (Germany, F.R.). Dept. of Enzyme Technology.
W. Stocklein, A. Gebbert, and R. D. Schmid.
Analytical Letters ANALBP, Vol. 23, No. 8, p 1465-1476, August 1990. 1 fig, 2 tab, 13 ref.

Descriptors: *Analytical methods, *Drinking water, *Immunoassay, *Pesticides, *Pollutant identification, *Water analysis, Antibodies, Atrazine, Detection limits, Organic solvents, Propazine, Simazine, Toluene, Triazine herbicides.

Preconcentration of pesticides in drinking water by extraction or elution from columns with organic solvents has been used to improve detection limits in various analytical methods. To assess the applicability of preconcentration in organic solvents to immunochemical techniques, the binding of atrazine and an atrazine derivative dissolved in various nonpolar organic solvents to immobilized polyclonal antibodies was studied. The antibodies immobilized onto immunodyne membranes were stable in chloroform and in buffer for at least 65 h at room temperature. The apparent binding affinity was lower in the five solvents tested than in buffer, and showed a correlation with the polarities of the solvents and with the solubilities of the haptens in the solvents. An increase in the antibody-hapten binding specificity by the use of toluene as the solvent for atrazine, propazine and simazine was observed. (Mackeen-PTT)
W91-02512

DETERMINATION OF COBALT BY ADSORPTIVE STRIPPING VOLTAMMETRY USING COBALT(II)-NIOXIME-NITRITE CATALYTIC SYSTEM.
Academy of Mining and Metallurgy, Krakow (Poland). Inst. of Material Science.
A. Bobrowski.
Analytical Letters ANALBP, Vol. 23, No. 8, p 1487-1503, August 1990. 4 fig, 1 tab, 35 ref.

Descriptors: *Analytical methods, *Cobalt, *Pollutant identification, *Water analysis, Adsorption, Detection limits, Drinking water, Natural waters, Nickel, Voltammetry, Water pollution, Water sampling, Zinc.

A differential pulse adsorptive voltammetric method was developed for cobalt determination with a detection limit of 120 pM (100 sec preconcentration). The preconcentration of Co(II)-nioxime complex during the adsorption step and the utilization of catalytic effect during the reduction of Co(II)-nioxime complex provide great enhancement of cobalt voltammetric response. The ammonia buffer solution containing nioxime and nitrite is suitable for the adsorptive voltammetric determination of nanomolar cobalt concentrations in the presence of 1000-fold excess of nickel and 10,000-fold excess of zinc. The sensitivity and selectivity of the proposed method are significantly higher than those of the well-known adsorptive voltammetric method with dimethylglyoxime. The method has been tested for the determination of Co in river, canal and tap water samples. (Author's abstract)
W91-02513

SAFETY AND EFFICACY OF FOOD PROCESSING SLUDGES AS ANIMAL FEED: CHEMICAL CHARACTERIZATION.
For primary bibliographic entry see Field 5E.
W91-02542

FAST DETERMINATION OF THE BIODEGRADABILITY OF ORGANIC COMPOUNDS IN A LABORATORY-TRICKLING-FILTER (RASCHE BESTIMMUNG DES BIOABBAUS ORGANISCHER STOFFE IN EINEM LABOR-TROPFKORPER).
Eidgenoessische Materialpruefungs- und Versuchsanstalt fuer Industrie, Bauwesen und Gewerbe, St. Gall (Switzerland).
For primary bibliographic entry see Field 5D.
W91-02544

ANALYTICAL PROPERTIES OF 4,4'-BIAZOBENZENEDIAZOAMINOBENZENE AND ITS APPLICATIONS IN SPECTROPHOTOMETRY.
China National Environmental Monitoring Centre, Beijing.
F. Wei, W. Jiang, E. Teng, Y. Zhu, and J. Liu.
Analytical Letters ANALBP, Vol. 23, No. 7, p 1181-1190, July 1990. 4 fig, 3 tab, 7 ref.

Descriptors: *Azo dyes, *Chelating agents, *Chemical analysis, *Colorimetry, *Heavy metals, *Metal complexes, *Pollutant identification, *Spectrophotometry, *Water analysis, Analytical methods, Cadmium, Chemical properties, Reagents, Water pollution.

In the past, chelating ligands with auxochromic groups at the para-position of benzenediazoaminoazobenzene have been studied as agents for the spectrophotometric determination of transition metal ions. In this study, 4,4'-biazobenzene diazoamino benzene was synthesized from para-aminoazobenzene reacted in nitroso-sulfuric acid medium. Due to the existence of a strong auxochromic group (p-benzeneazo) in the molecule, the reagent has intense color reactions with some transition metal ions. The reagent is insoluble in water, soluble in organic solvents such as acetone, chloroform, benzene, carbon tetrachloride, and ethanol. In neutral and alkaline media, the reagent solution is yellow and stable for at least a month. In the presence of Triton X-100 and sodium tetraborate solution, the reagent reacted with mercury(II), nickel(II), cadmium(II), copper(II), zinc(II), cobalt(II), palladium(II) and silver(I) to form stable, highly sensitive complexes, exhibiting a red

color. Other metal ions were complexed, but these did not generate a detectable color. Molar absorptivities were 180,000 L/mol/cm at 515 nm for mercury, 200,000 L/mol/cm at 540 nm for nickel, and 180,000 L/mol/cm at 526 nm for cadmium. The reagent was used for spectrophotometric determination of cadmium in industrial waste waters from a smelter, battery works, and an alkali works. Results agree well with those of atomic absorption spectrophotometry. Interference from other metal ions can be eliminated by extraction separation. (VerNooy-PTT)
W91-02548

DETERMINATION OF TRACE AMOUNTS OF ACETALDEHYDE USING A NOVEL CHEMILUMINESCENCE REACTION.
University of Science and Technology of China, Hefei. Dept. of Applied Chemistry.
For primary bibliographic entry see Field 7B.
W91-02549

STRUCTURE OF AN ANHYDRIDE RELATED TO A MUTAGENIC COMPONENT OF DRINKING WATER, 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE.
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
R. T. LaLonde, H. Perakyla, Y. Ishiguro, J. Clardy, and L. S. Brinen.
Chemical Research in Toxicology CRTOEC, Vol. 3, No. 6, p 404-405, September/October 1990. 1 fig, 1 tab, 12 ref. USGS Award 14-08-0001-G1498.

Descriptors: *Crystallography, *Disinfection, *Genotoxicity, *Molecular structure, *Mutagens, *Pollutant identification, *Structure-activity relationships, *Water treatment, Chemical interactions, Chemical properties, Chlorination, Pulp wastes, Wastewater pollution.

3-Chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) is the most potent member of a family of genotoxins resulting from the disinfection of drinking water and the bleaching of wood pulp by chlorination. MX is often a major contributor to the mutagenic activity of drinking waters. It as a direct-acting bacterial mutagen and a mammalian cell clastogen and forms an adduct with DNA. Unexpectedly, crystals of an MX anhydride were formed, in the course of unsuccessful attempts to obtain MX in a form appropriate for X-ray crystallography. A crude sample of MX was flash-chromatographed twice and the colorless oil obtained stored at -18 C for 6 months. The resulting crystalline solid was recrystallized from n-hexane-ether at room temperature. Crystals were examined by thin layer chromatography, infrared analysis, and (1)H NMR (nuclear magnetic resonance). From a computer-generated perspective drawing of the final X-ray model (one enantiomer of the racemic mixture), comparison of the anomeric torsion angles revealed that the crystal lacked the expected molecular of a dl diastereomer. A space-filling molecular model of the X-ray structure illustrated there is essentially an oxygen-dominated surface, and an opposite, chlorine-dominated surface. There is little doubt that MX's genotoxicity is a manifestation of the compound's electrophilicity; each of the five carbons is an electrophilic site. The anhydride's structure information anticipates a mode of reactivity that could account for MX's mutagenic potency. (VerNooy-PTT)
W91-02551

ANALYTICAL APPROACH TO ASSESSMENT OF LONG-TERM EFFECTS OF LOW LEVELS OF CONTAMINANTS IN THE MARINE ENVIRONMENT.
Cambridge Univ. (England). Dept. of Zoology.
G. Howells, D. Calamari, J. Gray, and P. G. Wells.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 8, p 371-375, August 1990. 1 fig, 3 tab.

Descriptors: *Chronic toxicity, *Coastal waters, *Environmental effects, *Hazard assessment, *Marine pollution, *Monitoring, *Pollutant identification, *Water pollution effects, Baseline studies, Case studies, Indicators, Long-term planning, Marine environment, Pollutants, Water pollution control.

Detection of long-term changes due to low level contamination in the coastal and inshore marine environment is very difficult, both because of the complexity and interactive nature of ecosystems, of their variability in time and space, and the absence in most situations of a norm or baseline representing the pristine, or even the previous state of a particular ecosystem or community. There is also the problem of identifying the nature and source of contamination and the type of exposure. An analytical approach to assessment is proposed and its validity tested by reference to a few cases where there is judged to be strong evidence of biological change in response to a persistent but low level of contamination. A few examples of contaminants have been identified and selected, including nutrients, chlorinated hydrocarbons, tributyl tin, and hydrocarbons. In these four examples there is a sufficient body of quantitative and qualitative data where the cause of damage is indisputable and where the agent is present in low and persistent concentrations. They represent a diversity of causal agents and of biological responses, i.e., primary productivity, reproduction, growth and non-specific biological responses. These examples illustrate the kinds of information needed for assessment leading to control and monitoring, and where early warning signals can be identified and included in a monitoring program. A major challenge is to be able to document contaminant induced change against the highly variable and complex pattern of natural conditions. A second challenge is to detect change in an imperfectly understood marine ecosystem. In addition, improvement and calibration of ecotoxicological methods for detecting chemically inducted changes is needed. A detailed evaluation of a wider range of data to substantiate and verify the thesis that long-term biological changes can be attributed to low-levels of contamination is also required. (VerNooy-PTT)
W91-02554

FUCUS VESICULOSUS AS AN INDICATOR OF HEAVY METAL AVAILABILITY IN A FISH FARM RECIPIENT IN THE NORTHERN BALTIC SEA.
Abo Akademi, Turku (Finland). Dept. of Biology.
O. Ronnberg, K. Adjers, C. Ruokolahti, and M. Bondestam.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 8, p 388-392, August 1990. 5 fig, 20 ref.

Descriptors: *Algae, *Baltic Sea, *Bioindicators, *Coastal waters, *Finland, *Fish farming, *Fucus, *Heavy metals, *Path of pollutants, *Water pollution sources, Aquaculture, Copper, Iron, Manganese, Marine pollution, Seasonal variation, Trout, Zinc.

In recent years, cage farming of rainbow trout has been a strongly expanding industry in Finnish coastal waters, with 1988 production exceeding 12,700 tons. Contents of zinc (Zn), manganese (Mn), and copper (Cu) in the brown seaweed Fucus vesiculosus L. were studied between May 1987 and April 1988 near a fish farm in the Aland archipelago, southwest Finland. Measurements were made on samples from naturally growing Fucus specimens from an unaffected reference locality and from specimens transplanted to the vicinity of the farm (50, 200 and 700 m away). At the unaffected locality there was a clear seasonal variation in contents of the studied metals in growing tips of Fucus specimens. Significantly higher content of Fe and Cu were measured in autumn and winter in specimens transplanted close to the farm. In summer, the contents of Mn and Zn showed an increasing tendency with decreasing distance to the farm. Results indicate marked seasonal variations in metal contents and the applicability of Fucus vesiculosus as an indicator of the availability of Zn, Mn and Cu in fish farm recipients in the Baltic Sea. The irregular variation in the concentration of iron makes Fucus less useable as an indicator of iron availability. (VerNooy-PTT)
W91-02560

INFORMATION COLLECTION REQUEST FOR: NATIONAL PRIMARY DRINKING WATER REGULATIONS FOR INORGANI CHEMICALS.
Miller (Wade) Associates, Inc., Arlington, V
For primary bibliographic entry see Field 7B.
W91-02602

GUIDELINES FOR PHYSICAL AND BIOLOG CAL MONITORING OF AQUATIC DREDGE MATERIAL DISPOSAL SITES.
Army Engineer Waterways Experiment Stati Vicksburg, MS. Environmental Lab.
T. J. Fredette, D. A. Nelson, J. E. Clausner, and J. Anders.
Available from the National Technical Informat Service, Springfield, VA 22161. Technical Rep No. D-90-12. September, 1990. 46 p, 7 fig, 2 tab, ref.

Descriptors: *Data acquisition, *Disposal si *Dredging wastes, *Monitoring, *Standar *Waste disposal, *Water quality, Bioassay, M uring instruments, Satellite technology, W quality control.

A preliminary set of guidelines are given for m toring aquatic, uncontaminated dredged mat disposal sites, and are intended to serve as a 'w ing' document that can be periodically improve experience dictates. Emphasis is placed on: (1) establishment of concise objectives and hyp eses; (2) the use of multidisciplinary approache developing monitoring programs; and (3) and provision of results that are relevant and usefi site managers. A 'tiered' step-wise proce which can be used when developing a monitc program is presented, along with a summary o basic tools and techniques for biological (suc bioassays with fish, shellfish, benthic infauna, submergent vegetation) and physical ana (such as satellites, bathymeters, fathometers, ment samplers, sediment-profiling cameras, wave meters). Ideally, monitoring of open dredged material disposal sites should be pro tive. Observations or measurements are tak determine if site conditions conform to de conditions. Monitoring can then focus on th tection of changes in specific conditions r than identifying any or all detectable chang monitoring program should be multi-tiered, each level having its own predetermined en mental threshold, hypothesis, sampling desig management options should the threshold b ceeded. (Lantz-PTT)
W91-02607

APPLICATION OF A SIMPLE SHORT-T BIOASSAY FOR THE IDENTIFICATIO GENOTOXINS FROM HAZARDOUS WA
Environmental Health Research and Testing Research Triangle Park, NC.
S. S. Sandhu, and G. N. Acedo.
Available from the National Technical Inform Service, Springfield, VA 22161, as PB89-2 Price codes: AO3 in paper copy, AO1 in fiche. Report No. EPA/600/D-89/099. 198 2 fig, 4 tab.

Descriptors: *Aquatic plants, *Bioassay, *B cators, *Mutagenicity, *Pollutant identifi *Toxicity, *Water pollution effects, Arabi Economic aspects, Industrial wastes, Moni Testing procedures, Tradescantia, Zea.

The proper disposal of hazardous wastes cu generated and clean up of waste disposal the past are challenges facing regulatory a in the industrialized nations. The estima levels of toxicity is an essential step in pric industrial effluents and solid wastes for tr and disposal. A number of short-term bioas been developed to supplement informatic chemical analysis for evaluating the pote chemical complex mixtures to induce human health effects and environmental c nation. Among these bioassays, plant test provide simple, inexpensive, and rapid m evaluating toxic effects of industrial wast on multimedia exposure. Two such assays, cantia paludosa and Zea mays, have been monitoring the genotoxic effects of amb

municipal wastes, industrial effluents, solid wastes, water sediments, and pesticides. The Arabidopsis embryo assay was used to evaluate the mutagenicity of complex environmental mixtures including industrial effluents and sludges. The industrial waste samples were tested as either unextracted or as dichloromethane aqueous extracts. All methylene chloride-extracted samples were positive for mutagenicity; however, dose-related response was not observed for these extracts. For the aqueous extracts the NP3 and N-Hg recovery sludge samples showed dose-related mutagenic response although the mutagenicity values were much lower than that of NP2. The primary advantages of the plant bioassays are their simplicity, cost effectiveness, and utility in assessing simultaneous multimedia exposure. (Author's abstract)
W91-02665

NSTALLATION OF A MULTIPORT ROUND-WATER SAMPLING SYSTEM IN HE 300 AREA.
attelle Pacific Northwest Labs., Richland, WA.
J. Gilmore.
vailable from the National Technical Information ervice, Springfield, VA 22161, as DE89-014794. ice codes: A03 in paper copy, A01 in microfiche. ne 1989. 34p, 8 fig, 1 tab, 4 ref, append. DOE ontract No. DE-AC06-76RLO-1830.

escriptors: *Groundwater pollution, *Groundater sampling, *Monitoring, *Path of pollutants, ampling, *Water sampling, Design criteria, Hanrd Site, Hydrogeology, Wells.

1988, the Pacific Northwest Laboratory inlled a multiport groundwater sampling system in ll 399-1-2, drilled north of the 300 Area on the nford Site in southeastern Washington State. e purpose of installing the multiport system is to luate methods of determining the vertical distriion of contaminants and hydraulic heads in undwater. Well 399-1-20 is adjacent to a cluster our Resource Conservation and Recovery Act CRA) groundwater monitoring wells. This ximity makes it possible to compare sampling rvals and head measurements between the mulort sytem and the RCRA monitoring wells. lling and installation of the multiport system k 42 working days. Six sampling ports were alled in the upper unconfined aquifer at depths pproximately 120, 103, 86, 74, 56, and 44 feet. locations of the sampling ports were detered by the hydrogeology of the area and the ened intervals of adjacent groundwater moniig wells. The system was installed by backig sand around the sampling ports and isolating ports with bentonite seals. The method proved luate. For future installations, however, develent and evaluation of an alternative method is mmended. In the alternative method suggestthe multiport sytem would be placed inside a d and screened well, using packers to isolate ampling zones. (Author's abstract)
-02670

MBINING SURFACE GEOELECTRICS AND EHOLE MEASUREMENTS FOR CONINATION CONTROL.
raska Univ., Lincoln. Dept. of Civil Engineer-
. Kelly, I. Bogardi, W. Woldt, and A.
ossy.
Groundwater Management: Quantity and ity. Proceedings of the Symposium held at dorm, Spain, October 2-9, 1989. International ciation of Hydrological Sciences, Washing-DC. 1989. p 143-152, 7 fig, 13 ref. USGS t No. 14-08-0001-G1133.

riptors: *Borehole geophysics, *Electrical logging, *Geophysical surveys, *Geostatis-Groundwater pollution, *Groundwater qualKriging, *Water pollution control, *Water y management, Geophysical methods, ndwater management, Mapping, Monitoring, ork design, Plumes, Pollutant identification, active wastes, Rhode Island, Specific conity, Water resources management.

diation of polluted groundwater starts with curate evaluation of the degree and extent of the contamination. This evaluation requires a monitoring network and the network commonly increases in sophistication as the study progresses from preliminary evaluation to design of the remedial action. Surface geoelectrics have been combined with borehole information to define a plume of contaminated groundwater. The methodology allows for the uncertainty of the monitoring network to be quantified and for the design of the most effective expansion of a network. The methodology was applied to a plume at a low-level radioactive site in Rhode Island. Variograms for specific conductance were obtained from the direct borehole data, and were used with kriging techniques to estimate the areal distribution of specific conductance characterizing the extent and intensity of pollution. An accuracy analysis revealed the irregular pattern of well locations manifested by the reduced error estimates near monitoring wells. Mapping the interpreted electromagnetic data closely paralleled the direct data methodology. A variogram of the vertical dipole data was computed and used in the kriging process to map the electromagnetic data. Comparison shows a large degree of correlation between the location of high contamination levels. It is this correlation that can be employed to combine the two types of data (direct and geoelectric). The combination of data does reduce the estimation error and the reduction is measurable. (See also W91-02672) (Fish-PTT)
W91-02685

ADAPTATION OF A LEAD-TESTING PROGRAM.

Hackensack Water Co., Harrington Park, NJ.
D. Hoven, B. Dietel, and V. Leiby.
Water Engineering and Management WENMD2, Vol. 137, No. 9, p 46-48, September 1990. 1 fig.

Descriptors: *Drinking water, *Lead, *Pollutant identification, *Schools, *Testing procedures, New Jersey, Public relations, Regulations, Water analysis, Water sampling.

In 1989, the Hackensack Water Company (HWC), Harrington Park, NJ, developed a lead-testing program for area schools. The program includes a one and one-half hour slide show and seminar that covers the following: (1) pertinent federal legislation and regulations, such as the Lead Contamination Control Act, the Lead Ban, and the Lead and Copper Rule; (2) the various sources of lead contamination, such as industries, lead-based paints and lead plumbing; (3) the sources of lead in drinking water, including source water contamination and contamination due to corrosion of fixtures, interior plumbing and service connections; (4) health effects of lead contamination, especially as it relates to children; (5) the HWC's sampling program; and (6) the types of remediation available to schools, such as removal of lead contaminated coolers, flushing, and replacing lead solder and pipes. Although the Environmental Protection Agency (EPA) guidance manual for lead in schools was used as the basis for the HWC program, a number of changes were made to decrease the burden on schools both from a cost and a manpower perspective. To avoid the necessity of developing a plumbing profile, which the EPA uses as a screening device to limit the number of samples collected and therefore the analysis costs, HWC decided to test all drinking water taps. No profiles are required unless a problem shows up. The HWC sampling program also maintains a consistent sampling protocol across all types of drinking water taps. The actual sampling scheme consists of two sampling rounds. The first step consists of first-draw samples collected from all sources of drinking water in the school, as well as from the service connection. Any sites yielding samples containing 20 parts per billion or more of lead are resampled in the second round. Round 2 sampling consists of a first draw for verification of the first-round sample result, a short flush of 30 seconds, and a longer flush of 3 minutes. Samples are then returned to the HWC laboratory where they are logged in and analyzed. In most cases, schools opt to flush the taps rather than investigate the causes. (Korn-PTT)
W91-02765

APPLICATION OF DIRECT PLAQUE ASSAY FOR DETECTION AND ENUMERATION OF BACTERIOPHAGES OF BACTEROIDES FRAGILIS FROM CONTAMINATED-WATER SAMPLES.

Malaga Univ. (Spain). Dept. of Microbiology.
R. Cornax, M. A. Morinigo, I. G. Paez, M. A. Munoz, and J. J. Borrego.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 10, p 3170-3173, October 1990. 2 fig, 3 tab, 18 ref.

Descriptors: *Bacteriophage, *Bioassay, *Laboratory methods, *Monitoring, *Pollutant identification, Bacteria, Bioindicators, Fecal coliforms, Microbiological studies, Population density.

Bacteriophages of Escherichia coli are considered reliable indicators of the fecal pollution of natural waters. The direct double-agar-layer plaque assay for the detection and enumeration of specific bacteriophages of Bacteroides fragilis from contaminated-water samples was performed. Several factors that affect the methods, such as conditions of the bacterial culture, composition of the assay medium, addition of divalent cations, and decontamination techniques applied to the sample, were evaluated. The results obtained show that the direct assay technique is more efficient than the most-probable-number technique. The direct assay technique involves cells of the host bacteria being cultured with an atmosphere of 20% carbon dioxide and 80% nitrogen. Sample decontamination is performed by using membrane filtration (0.45 microm pore size) with membranes previously treated with 10 ml of 3% beef extract (pH 9.5). In the case of samples with a high degree of pollution, the medium should be supplemented with vancomycin and kanamycin. A higher recovery of bacteriophages was obtained from 17 of 24 samples with the direct assay. The two methods only showed similar results from samples with a low degree of pollution. (Brunone-PTT)
W91-02770

STABILITIES OF CARBOXYLIC ACIDS AND PHENOLS IN LOS ANGELES RAINWATERS DURING STORAGE.

California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
K. Kawamura, and I. R. Kaplan.
Water Research WATRAG, Vol. 24, No. 11, p 1419-1423, November 1990. 4 fig, 18 ref.

Descriptors: *Carboxylic acids, *Chemistry of precipitation, *Phenols, *Pollutant identification, *Precipitation, *Sample preservation, *Water analysis, Acetic acid, Aromatic acids, Benzoic acid, Fatty acids, Formic acid, Hydrogen ion concentration, Los Angeles, Microbial degradation, Volatile aliphatic acids.

Organic compounds in rainfall may originate from biogenic or anthropogenic sources, or from photochemical reactions in the atmosphere. Concentration changes of acidic organic compounds (volatile aliphatic acids, fatty acids, aromatic acids and phenols) in rainwaters collected in Los Angeles, CA, were studied during storage experiments (up to 45 days). Carboxylic acids decreased with time in the order: benzoic acid < fatty acids < volatile acids. Although the observed losses have not been shown to result from microbial degradation, such a process is highly likely. Degradation of these acids, especially formic and acetic acids which are major components may result in a pH increase, during storage of rain. By contrast, toluic acids and phenols did not show a decrease in concentration after 2 weeks of storage indicating that these toxic compounds are resistant to microbial degradation in urban rainwater. (Author's abstract)
W91-02800

MECHANISM OF ENRICHMENT OF TRACE METALS ON FINE SLUDGES COLLECTED FROM FILTRATION PLANTS.

Kansei Kogyo K.K., Sakata (Japan). Inst. for Environmental Measurement.
H. Teraoka, and S. Nakashima.
Environmental Geology and Water Sciences

Group 5A—Identification Of Pollutants

EGWSEI, Vol. 16, No. 2, p 143-148, 1990. 4 fig, 1 tab, 7 ref.

Descriptors: *Analytical techniques, *Sludge analysis, *Suspended solids, *Trace metals, *Water treatment, Cadmium, Cobalt, Copper, Ion exchange, Iron, Japan, Leachates, Leaching, Lead, Manganese, Nickel, Organic matter, Oxides, River sediments, Silver, Sludge solids, Sulfides, Tin, Zinc.

In the analysis of natural water, it is of interest to determine quantities of trace metals in potable water sludges, since these trace metals, derived from yearly averages of suspended solids from the river, not only influence the environment, but will also help in investigating the mechanism of trace metals on solids suspended in river water. Fine sludges were collected from five filtration plants in Japan, and the partitioning of ten metals (Ag, Cd, Mn, Zn, Pb, Cu, Sn, Co, Ni, and Fe) in them was determined by selective leaching techniques. It was found that the available amounts, which show the total of each metal leached between 1 M CH3COONH4 and 30% H2O2, for Ag, Cd, and Mn, ranged from 51% to 98% for five sludges. The available amounts for Zn, Pb, Cu, and Sn were 47% to 92% for five sludges. The most important fraction for Co, Ni, and Fe, except the sludge from the Inagawa filtration plant which is markedly polluted by organic matter, was the crystalline particle. Therefore, the above metals, except Co, Ni, and Fe, are thought to be enriched on ion-exchangeable sites, organic matter, hydrous Fe/Mn oxides, and sulfides in fine sludges. (Author's abstract)
W91-02819

DETERMINATION OF PHOTOCHEMICALLY PRODUCED HYDROXYL RADICALS IN SEAWATER AND FRESHWATER.
Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Marine and Atmospheric Chemistry.
X. Zhou, and K. Mopper.
Marine Chemistry MRCHBD, Vol. 30, No. 1/3, p 71-88, 1990. 4 fig, 3 tab, 37 ref.

Descriptors: *Chemical interactions, *Fate of pollutants, *Freshwater, *Photochemistry, *Pollutant identification, *Seawater, Chemical analysis, Degradation, Laboratory methods.

A variety of short-lived, reactive chemical species (free radicals and excited state species) are known to be photochemically produced in natural waters. Some of these transients may strongly affect chemical and biological processes, and they have been implicated in the degradation of organic pollutants and natural organic compounds in aqueous environments. Previous studies demonstrated that the highly reactive hydroxyl radical (OH) is photochemically formed in seawater. However, the quantitative importance of this key species in the sea has not been previously studied because of past analytical limitations. By using a highly sensitive probe based on alpha-hydrogen abstraction from methanol, production rates were measured of steady state concentrations of photochemically produced OH radicals in coastal and open ocean seawater and freshwaters. The validity of the method was tested by intercalibrating with an independent, OH-specific reaction, hydroxylation of benzoic acid, and also by competition kinetics experiments. OH production rates and steady state concentrations for freshwaters are in excellent agreement with those measured by previous investigators for similar waters. In contrast, for seawater, the values measured are 1-3 orders of magnitude higher than previously predicted by models, indicating that there is a major unknown photochemical OH source(s) in seawater. (Author's abstract)
W91-02852

HYDROCARBON POLLUTION IN PARTICLE-RICH WATERS (GULF OF FOS-SUR-MER): COMPARATIVE STUDY OF EXTRACTION PROCEDURES.
Centre d'Oceanologie de Marseille (France).
R. Siron, and G. Giusti.
Marine Chemistry MRCHBD, Vol. 30, No. 1/3, p 379-388, 1990. 1 fig, 2 tab, 30 ref. French Ministry of Science and Technology Grant No. DGRST 82-217.

Descriptors: *Chromatography, *Gulf of Fos-sur-mer, *Hydrocarbons, *Oil pollution, *Pollutant identification, *Water pollution sources, Alkanes, Chemical treatment, Coastal areas, Extraction, France, Lipids, Organic compounds, Particulate matter, Path of pollutants, Physical treatment.

The direct liquid-liquid extraction of hydrocarbons, without filtration of water supplies, can not be used for particle rich waters because of low yields and the selectivity towards particulate lipid classes. The ratios of hydrocarbons/total extractable matter and n-alkane/total hydrocarbons--as pollution indices--are altered in unfiltered water samples. The separation of dissolved and particulate phases and their specific extraction are indispensable for the complete recovery of the total hydrocarbons and alkanes from the water. Likewise, the n-alkane distribution and related Carbon Preference Index are influenced by the incomplete extraction of high molecular weight compounds in unfiltered samples. Conversely, the n-C17/pristane (Pr), n-C18/phytane (Phy) and Pr/Phy ratios are not significantly affected by direct extraction. However, these indices sometimes are strongly influenced by biological contributions. The Pr/Phy ratio generally seems to be convenient for characterization of the anthropogenic origin of hydrocarbons. (Author's abstract)
W91-02854

COMPARATIVE SURVEY OF IMPOSEX IN NORTHEAST PACIFIC NEOGASTROPODS (PROSOBRANCHIA) RELATED TO TRIBUTYLTIN CONTAMINATION, AND CHOICE OF A SUITABLE BIOINDICATOR.
Victoria Univ. (British Columbia). Dept. of Biology.
D. A. Bright, and D. V. Ellis.
Canadian Journal of Zoology CJZOAG, Vol. 68, No. 9, p 1915-1924, September 1990. 10 fig, 3 tab, 14 ref.

Descriptors: *Bioindicators, *Gastropods, *Organotin compounds, *Water pollution effects, Animal physiology, British Columbia, Comparison studies, Ecotoxicology, Field tests, Surveys.

Imposex, the manifestation of male morphological sex characteristics in females of functionally dioecious neogastropod taxa, is an abnormal response to tri-n-butyltin (TBT) contamination introduced to the marine environment in antifouling paints. Since the phenomenon has been thoroughly described only in Atlantic species, a comparative survey of field populations from British Columbia was undertaken, and field studies were carried out to assess the relative value as bioindicators of species in the genus Nucella from the Pacific coast. The majority of neogastropods studied to date have demonstrable signs of imposex, although this leads to sterilization of females in only a few species, depending on differences in the development in females of a pallial vas deferens. Within the Nucella species complex, N. lamellosa, N. canaliculata, and N. emarginata show promise as TBT bioindicators. Only the response of N. emarginata, however, was related to TBT bioaccumulation, based on measurements of a limited number of samples. This is attributed to the apparent irreversibility of imposex, the temporal variability of both environmental levels and tissue burdens of TBT, and considerably shorter life span of N. emarginata relative to that of N. lamellosa and N. canaliculata. The geographic distribution of imposex in Nucella spp. suggests that waterborne concentrations of TBT sufficiently high to induce imposex occur over large areas within British Columbia where exchange with oceanic water is limited. (Author's abstract)
W91-02894

COMPUTER-CONTROLLED AUTOMATED RAIN SAMPLER (CCARS) FOR RAINFALL MEASUREMENT AND SEQUENTIAL SAMPLING.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 7B.
W91-02914

ASIATIC CLAM, CORBICULA SPP., AS A BIOLOGICAL MONITOR IN FRESHWATER ENVIRONMENTS.
Syracuse Research Corp., NY. Aquatic Toxicology Lab.
F. G. Doherty.
Environmental Monitoring and Assessmen
EMASDH, Vol. 15, No. 2, p 143-181, Septembe 1990. 3 tab, 87 ref.

Descriptors: *Aquatic habitats, *Bioaccumulatio *Bioindicators, *Clams, *Literature review, *Mo lusks, *Organic pollutants, Drainage systems, Ec logical distribution, Ecological effects, Populatio growth.

Asiatic clams, Corbicula ssp., are filter-feedin freshwater bivalves that are widely distribute abundant, and fast growing with a lifespan of l years. A review of the existing literature demo strates that Asiatic clams can concentrate organ pollutants from both water and sediment a heavy metals from water. In conjunction wi these traits, they exhibit a high tolerance for t effects resulting from exposure to toxic substanc While an organism must possess these traits serve as an effective biological monitor, they ha also permitted the Asiatic clam to rapidly coloni natural and industrial environments resulting purported ecological disturbances and severe ec nomic repercussions, respectively. Its invasive b fouling attributes therefore restrict the use of t clam for biomonitoring purposes from Corbicu free drainage systems. (Author's abstract)
W91-02944

5B. Sources Of Pollution

TOTAL HEAVY METAL CONCENTRATIO CONTAINED ON THE SEDIMENT'S SURFA OF ALGIERS BAY.
Laboratoire de Chemie Marine, Algiers (Alge
A. Chouikhi, B. Sellali, and M. Azzouz.
Pelagos, Vol. 7, No. 1, p 5-7, 1989. 1 fig, 2 ta ref.

Descriptors: *Algiers Bay, *Heavy metals, * of pollutants, *Pollutant identification, *Sedin contamination, Atomic absorption spectroph metry, Cadmium, Copper, El-Harrach, Indus wastes, Lead, Mercury, Water pollution sou Zinc.

Sediment samples from seven sites in Algiers were analyzed for Zn, Cu, Hg, Cd and Pb. samples were dissolved in Aqua Regia and lyzed by atomic absorption spectrophotom High concentrations of heavy metals were f near the mouth of the El-Harrach sampling re These concentrations fall to a lower level distance of 1 km from the El-Harrach site. Ho er, the concentrations of Pb and Hg increased the mouth of the El-Harrach up to the parts These high levels were probably due to factor and around Algiers and the operation of mot the region. (King-PTT)
W91-02053

MACROBENTHIC POPULATION OF PORT OF ALGIERS (LES PEUPLEM MACRO BENTHIQUES DU PORT D'AL
Laboratoire de Chemie Marine, Algiers (Alg
A. Bakalem, C. Rebzani, J. C. L. Roman, and Tahar.
Pelagos, Vol. 7, No. 1, p 35-40, 1989. 1 fig, 2 ref. English summary.

Descriptors: *Benthic environment, *Marine ronment, *Path of pollutants, *Port of A Benthic fauna, Benthic flora, Bottom san Hydrogen ion concentration, Oxygen, Pl properties, Suspended solids, Water quality, temperature.

The southern part of the Port of Algiers i polluted than the northern part of the port

ng to results from 28 stations. Physical and chemi-
al parameters such as dissolved oxygen, pH, tem-
erature and suspended matter were measured, and
he benthic populations were analyzed at the sta-
ons in order to determine the condition of the
ater at the sites. The benthic population indicated
at the southern region port was more polluted
an the northern region of the port. There was an
zoic region in the south and a diversified popula-
on in the north. However the northern popula-
on is still subnormal. An intermediately polluted
gion exists in the between these two regions.
King-PTT)
91-02054

ROBLEMS OF GROUND WATER TREAT-
ENT IN AN AREA OF DEPRESSION (ZUR
ROBLEMATIK DER GRUNDWASSERAUF-
EREITUNG IN EINEM ABSENKUNGSGE-
ET).
reiskrankenhaus Treuenbrietzin (German D.R.).
Thielemann.
itschrift fuer Wasser - und Abwasser Forschung
VABAQ, Vol. 23, No. 3, p 116-118, June 1990. 1
. English summary.

scriptors: *Groundwater quality, *Water treat-
nt, *Wells, Carbon dioxide, Filtration, Germa-
Halle-Neustadt, Hydrogen ion concentration,
n, Manganese, Water quality.

perimental chemical, chemical-physical and bio-
ical tests were conducted to study the problem
he formation of chemical compounds contain-
Fe and Mn in wells connected with the treat-
t of groundwater in the settling area or depres-
of Halle-Neustadt. The effects of de-acidifica-
, softening, removal of iron and manganese,
treatment with activated carbon were studied
a laboratory-scale and a semi-industrial scale.
pH of the raw water was 7.2 and the amount
ree CO2 was 75 mg/L. After aeration and
ring through a porous carbon filter bed for 20
utes, the pH was 8.2 and the free CO2 was 0
L. The results show that at present the chemi-
ormation of Fe and Mn compounds has not yet
ed in the wells which were tested. The begin-
of the formation of chemical compounds con-
ng Fe and Mn is regarded as representative
use samples were taken along the entire length
ie well. Although positive redox potentials
determined, further conditions for acute pre-
re ageing of the wells do no exist. (King-PTT)
-02060

RCE, COMPOSITION AND FLUX OF PO-
YCLIC AROMATIC HYDROCARBONS IN
MENTS OF THE RIVER DERWENT,
BYSHIRE, U.K.
yshire Coll. of Higher Education, Derby
and). Div. of Biology.
Evans, R. A. Gill, and P. W. J. Robotham.
, Air and Soil Pollution WAPLAC, Vol. 51,
/2, p 1-12, May 1990. 3 fig, 1 tab, 41 ref.

iptors: *Nonpoint pollution sources, *Path of
ants, *Polycyclic aromatic hydrocarbons,
nent analysis, *Sediment contamination,
r pollution sources, England, Fluorescence,
performance liquid chromatography, High-
Mass spectrometry, Rainfall-runoff relation-
Storm runoff, Storms.

water surface sediments from eleven sites on
ver Derwent (Derbyshire, England) were
d monthly during the period of June 1987 to
988. Samples were extracted and separated
e polycyclic aromatic hydrocarbon (PAH)
was analyzed using high performance
chromatography with a fluorescence detec-
entity of the peaks was confirmed by co-
n and gas chromatography-mass spectrome-
anges in total levels of nine parent PAH
unds were compared with rainfall data ob-
for the study area. The time lag between
ncorporation into sediments and preceding
vents varied between a minimum of 4 and a
m of 30 days. All sites were affected by
PAH pollution. At certain sites and at times
y rainfall this contamination is overlaid by a
input of PAH to the sediment from point
sources. Road runoff was identified as a major diffuse source underlying atmospheric and point sources at particular sites. Small industrial areas had a greater influence on sediment PAH than the larger commercial or residential areas. Pyrene and fluoranthene were the dominant parent compounds, explained by their availability and relative solubility. (Author's abstract)
W91-02079

PAH AND ORGANIC CONTENT OF SEDIMENT PARTICLE SIZE FRACTIONS.
Derbyshire Coll. of Higher Education, Derby (England). Div. of Biology.
K. M. Evans, R. A. Gill, and P. W. J. Robotham.
Water, Air and Soil Pollution WAPLAC, Vol. 51, No. 1/2, p 13-21, May 1990. 5 fig, 2 tab, 40 ref.

Descriptors: *Particle size, *Path of pollutants, *Polycyclic aromatic hydrocarbons, *Sediment contamination, Adsorption, Organic matter, Regression analysis.

The organic matter content of aquatic sediments has been shown to be very important in complexing hydrophobic toxic pollutants. The relationship of nine polycyclic aromatic hydrocarbons (PAH) with organic matter present in various Derwent River (Derby, England) sediment size fractions, from 63 microm to 1.0 to 2.0 mm, has been investigated. PAH and organic matter have bimodal distributions through the sediment size fractions which may be explained by the presence of two types of organic material in the sediment. Maxima in both factors are found in the two largest and the smallest size fractions. A positive linear relationship between PAH concentration and organic matter has been demonstrated and the slope of this relationship has been used to identify sites where PAH pollution is generally high. The relative proportion of each PAH compound in the sediment remains relatively constant regardless of temporal and spatial differences in total PAH concentration and organic matter content and certain PAH compounds may be grouped together depending on their association with organic matter. Differing PAH compound availabilities, competition for adsorption sites and the reactivity of PAH compounds may all result in the unchanging sediment PAH profile seen in each size fraction. The organic material present in the sediment may have a similar affinity for all PAH's in a particular group. (Author's abstract)
W91-02080

LEAD, ZINC, CADMIUM, AND FLUORIDE IN SMALL MAMMALS FROM CONTAMINATED GRASSLAND ESTABLISHED ON FLUOROSPAR TAILINGS.
Sunderland Polytechnic (England). School of Biology.
J. A. Cooke, S. M. Andrews, and M. S. Johnson.
Water, Air and Soil Pollution WAPLAC, Vol. 51, No. 1/2, p 43-54, May 1990. 6 tab, 29 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Industrial wastes, *Mine wastes, *Path of pollutants, Cadmium, Fluorides, Lead, Metabolism, Waste disposal.

Waste materials produced by the fluorospar extraction industry contain high concentrations of a number of potentially toxic elements normally found only in trace amounts. These wastes are deposited in tailings lagoons or dams, which can be revegetated after dewatering. The total body concentrations of lead, cadmium, and fluoride were higher at such a site compared to an uncontaminated control site for three species of small mammals, Apodemus sylvaticus, Microtus agrestis, and Sorex araneus. Zinc was also higher in M. agrestis and S. araneus, but in A. sylvaticus it significantly decreased. There was evidence of homeostatic control of zinc in all three species even at the higher dietary intakes at the tailings dam. Accumulation in kidney, liver and bone (femur) showed the expected pattern with lead and fluoride highest in bone and cadmium in the kidney for both the control and the contaminated sites. The only exception was S. araneus at the contaminated site where cadmium was highest in the liver, not the kidney. The accumulation of lead, cadmium, and fluoride at the contaminated site was in the decreasing species order S. araneus > M. agrestis > A. sylvaticus in terms of total body concentrations or target organ concentration. This order probably reflects the decreasing dietary intake rates of the three species although physiological interspecific differences may be of significance. For example, S. araneus showed considerable capability to bioconcentrate cadmium to much higher body concentrations than present at the contaminated site. The lack of any consistent pattern of correlation for the tissue concentrations of lead, zinc, cadmium and fluoride is unexpected, but the small sample size may have prevented any significant correlations from being made. (Author's abstract)
W91-02082

TRACE ELEMENT ACCUMULATION IN THE TISSUE OF FISH FROM LAKES WITH DIFFERENT PH VALUES.
Department of Energy, New York. Environmental Measurements Lab.
R. A. Stripp, M. Heit, D. C. Bogen, J. Bidanset, and L. Trombetta.
Water, Air and Soil Pollution WAPLAC, Vol. 51, No. 1/2, p 75-87, May 1990. 7 tab, 37 ref.

Descriptors: *Acid lakes, *Acid rain effects, *Bioaccumulation, *Fish physiology, *Hydrogen ion concentration, *Path of pollutants, *Trace elements, Aluminum, Selenium, Spectrophotometry, Tissue analysis, Water chemistry.

Two species of fish, omnivorous Catostomus commersoni (white suckers) and carnivorous Perca flavescens (yellow perch) were collected from natural lakes with different pH ranges (circumneutral, pH 6.5 to 6.8; variable, pH 5.8 to 6.7; and acidic, pH 4.9 to 5.4). The lakes are located in the North Branch of the Big Moose River drainage system in the New York State Adirondack Park Preserve. Concentrations of potentially toxic elements (aluminum, cadmium, copper, lead, and selenium) were measured by electrothermal atomic absorption spectrophotometry in water, sediment, and fish (bone, gill, kidney, liver, and muscle) from each lake. The results showed that concentrations of lead and cadmium were significantly higher ($P < 0.05$) in some of the tissues of the fish collected from the acidic lake. Also, the yellow perch from the acidic lake had significantly higher ($P < 0.05$) selenium concentrations in their muscles and livers than fish from the other lakes. The concentrations of aluminum were elevated in the gill tissues of both fish species from the acidic lake relative to fish from the other lakes. (Author's abstract)
W91-02084

SPECIATION AND BEHAVIOR OF ARSENIC IN THE NILE DELTA LAKES.
Alexandria Univ. (Egypt). Dept. of Oceanography.
A. R. Abdel-Moati.
Water, Air and Soil Pollution WAPLAC, Vol. 51, No. 1/2, p 117-132, May 1990. 4 fig, 3 tab, 31 ref.

Descriptors: *Arsenic, *Nile Delta, *Nonpoint pollution sources, *Path of pollutants, *Water pollution sources, Agricultural runoff, Coastal waters, Detergents, Fertilizers, Flushing, Herbicides, Mediterranean Sea, Phosphates, Retention time, Speciation, Wastewater pollution.

Dissolved and particulate arsenic species were measured in three Nile River coastal lakes in Egypt. Apart from input sources, arsenic levels lie within the range 1.2 to 18.2 microg/L (dissolved) and between 1.2 and 8.7 microg/g (particulate). Arsenic (V) is the predominant dissolved arsenic species constituting between 85% and 95% of total dissolved arsenic (TDA). Opposite to local sewage discharge points, arsenic (III) appeared, constituting between 14% and 33% of TDA at low and high water discharge periods, respectively. Dimethylarsenic is the dominant organic arsenic form, reaching 22% of TDA while the maximum concentration of monomethylarsenic (1.0 microg/L) constituted about 8% of TDA. Particulate arsenic is mostly partitioned among reducible and detrital phases while the organic phase appeared

dominant in eutrophic areas (> 30% of particulate arsenic). About 413 tons/year arsenic entered the northern delta lakes via agricultural drains and wastewater discharge. Phosphate fertilizers, detergents, herbicides, and loamy Nile deposits are the main arsenic sources to the drainage system. Fifty-two percent of the total arsenic deposited in the Nile delta lakes is transported to the Mediterranean coastal seawater through the lakes outlets. This amount is potentially hazardous to the coastal environment. (Author's abstract)
W91-02087

TRACE METAL ANALYSIS OF SEWAGE SLUDGE AND SOILS IN BAHRAIN.
Bahrain Univ., Manama. Dept. of Chemistry.
For primary bibliographic entry see Field 5E.
W91-02088

EFFECT OF SOLID-PHASE SPECIATION ON METAL MOBILITY AND PHYTOAVAILABILITY IN SLUDGE-AMENDED SOIL.
Instytut Uprawy, Nawozenia i Gleboznawstwa, Pulawy (Poland). Trace Element Lab.
For primary bibliographic entry see Field 5E.
W91-02089

SOLUTE TRANSPORT THROUGH SATURATED SOILS: A STUDY OF THE PHYSICAL NON-EQUILIBRIUM MODEL.
Claremont Graduate School, CA. Dept. of Mathematics.
G. Mahinthakumar, and S. Vigneswaran.
Water, Air and Soil Pollution WAPLAC, Vol. 51, No. 1/2, p 161-180, May 1990. 10 fig, 3 tab, 17 ref, 2 append.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Model studies, *Path of pollutants, *Saturated soils, *Soil contamination, *Solute transport, Adsorption, Equilibrium, Mass transfer, Soil physical properties, Solutes.

A two-region physical non-equilibrium transport model incorporating mobile and immobile regions (Van Genuchten and Wieringa model) was used to predict the movement of solutes through saturated soils. Freundlich's nonlinear isotherms were coupled with this transport model to account for the adsorption phenomena. A CSMP III (Continuous System Modeling Program) program was used to solve this problem numerically. The model was tested for 3 sets of experimental data having different soil and solute properties. The experimental curves were fitted by adjusting the 3 parameters, mass transfer coefficients, distribution factor for sorption sites in the mobile region, and the fraction of mobile water content. The model predicted well only for fairly conservative solutes. To predict the movement of highly reactive solutes, such as cadmium, the model needs further modification. Effects of dispersion coefficient, mass transfer coefficients, distribution factor for sorption sites in the mobile region, and the fraction of mobile water content on the breakthrough curves were studied for highly reactive solutes (a term used for solutes with high adsorption coefficient and high mass transfer coefficient), although these effects were significant for mild solutes. Solute concentration profiles for a semi-infinite column (as in the field situation) were predicted for 3 different cases and the penetration depths were compared with those obtained from Green and Ampt profiles. A Green and Ampt profile was a good approximation for finding the penetration depths in environmental impact assessment studies for mildly reactive solutes exhibiting fairly sharp solute fronts. (Author's abstract)
W91-02090

UPTAKE OF CADMIUM AND NICKEL IN BANANA PRAWN (PENAEUS MERGUIENSIS DE MAN).
Balai Penelitian Veteriner, Bogor (Indonesia). Toxicology Section.
D. Darmono.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 3, p 320-328, September 1990. 9 fig, 16 ref.

Descriptors: *Bioaccumulation, *Bioindicators, *Cadmium, *Marine animals, *Nickel, *Path of pollutants, *Shrimp, *Water pollution effects, Animal tissues, Dose-response relationships, Experimental data, Heavy metals.

The patterns of nickel and cadmium accumulation were measured in juvenile banana prawns (Penaeus merguiensis de Man). Prawns were exposed to the test metals (0-0.5 mg/L Cd or 0-2.0 mg/L Ni) for up to 30 d with replacement of the metal solutions every 3 d. At all experimental levels of exposure, Cd was most concentrated by the hepatopancreas and least concentrated by muscle over the 30 d period. Ni was accumulated to the greatest extent by the hepatopancreas followed by the gills and then the muscle. For both Cd and Ni, the rates of uptake were linearly related to the metal concentration in the seawater over the concentration ranges studied. For Ni in all tissues, the relationship approximated one of direct proportionality, implying little metabolic control over uptake at the levels tested. A similar trend was observed for Cd in muscle tissue. The accumulation of Cd in all tissues was greater than for Ni, despite lower Cd test concentrations used. This suggests that the cell membranes are more permeable to Cd than to Ni which may account for the greater toxicity of Cd to these organisms. The limited ability of prawns to control uptake of either metal against changes in external concentrations suggests that they may have potential as bioindicators of pollution by Ni and Cd. (MacKeen-PTT)
W91-02093

BARIUM BIOACCUMULATION IN CLAMS COLLECTED FROM DIFFERENT SALINITY REGIMES ALONG THE SAUDI COAST OF THE ARABIAN GULF.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
M. Sadiq, T. H. Zaidi, and H. Al-Mohana.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 3, p 329-335, September 1990. 1 fig, 2 tab, 7 ref.

Descriptors: *Barium, *Bioaccumulation, *Mollusks, *Path of pollutants, *Persian Gulf, *Salinity, *Saudi Arabia, Clams, Marine pollution, Oil industry, Sediment contamination.

Barium bioaccumulation by clams (Maritrix maritrix) as a function of sediment concentration and seawater salinity was investigated along the Saudi coast of the Arabian Gulf. Samples of clams, seawater and sediment were obtained quarterly from each of 12 stations between March 1985 and April 1986. The maximum concentrations of Ba were found in sediments from Stations 8 and 12, both of which were probably affected by the drilling muds during the development of Beri and Manifa oil fields, respectively. The maximum Ba concentrations in clams were found in those from Station 12. No significant correlation between Ba concentrations in sediments and mean clam concentrations were found when all the data were considered. Removing the data for Stations 1 and 12 resulted in a significant linear correlation. No effect of salinity on Ba bioaccumulation by clams was found. (MacKeen-PTT)
W91-02094

FATE OF PARATHION IN GROUND WATER IN COMMERCIAL CRANBERRY CULTURE IN THE NEW JERSEY PINELANDS.
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
G. Winnett, P. Marucci, S. Reduker, and C. G. Uchrin.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 3, p 382-388, September 1990. 2 fig, 2 tab, 14 ref.

Descriptors: *Agricultural chemicals, *Agriculture, *Cranberries, *Groundwater pollution, *New Jersey, *Parathion, *Path of pollutants, *Pesticides, Aquifer testing, Bogs, Cohansey aquifer, Risk assessment, Soil contamination, Surface water, Surface-groundwater relations.

The possible contamination of groundwater resulting from the recent use of parathion (O,O-diethyl O-4 nitrophenyl phosphorothioate) and its horizontal and vertical movement in the bog soil of the Cohansey aquifer, New Jersey, were examined. Parathion was applied by spray boom at 1 pound per acre three times per growing season. Surface waters and groundwaters were sampled weekly or biweekly for one year for the parathion-treated bog and a control bog. In general, parathion which was the New Jersey Agricultural Station's recommendation to the cranberry growers of New Jersey, showed no discernible vertical movemen in the experimental bog from the surface water t the groundwater. There appears to be no correla tion between the residues found in the surfac water and soil with those few found in the ground water. Where residues of parathion are found i the soil, concentrations are highest in the uppe stratum. It thus appears that there is little danger c parathion pollution from applications made i normal cranberry culture at these sites. (MacKeer PTT)
W91-02098

RESIDUES OF DDT AND HCH IN MAJO SOURCES OF DRINKING WATER I BHOPAL, INDIA.
Industrial Toxicology Research Centre, Luckno (India). Pesticide Toxicology Lab.
T. S. S. Dikshith, R. B. Raizada, S. N. Kumar, M K. Srivastava, and S. K. Kulshrestha.
Bulletin of Environmental Contamination a Toxicology BECTA6, Vol. 45, No. 3, p 389-39 September 1990. 1 tab, 15 ref.

Descriptors: *Chlorinated aromatic compoun *Chlorinated hydrocarbons, *DDT, *Drinki water, *Groundwater pollution, *India, *Inse cides, *Path of pollutants, Benzene hexachlori Bhopal, Gas liquid chromatography, Halogena pesticides, Metabolites, Pesticide residues, Wa pollution, Water quality monitoring.

The presence of residual organochlorine inse cides (OCIs) such as HCH and DDT was stud in different sources of drinking water in around Bhopal, India. A total of sixty sam from different wells, handpumps and ponds w analyzed for OCIs by gas-liquid chromatogra and thin layer chromatography. HCH and D were detected in all samples tested. Water sam from wells had mean residual contents of 4.7 p HCH and 5.8 ppm DDT. Samples obtained fi handpumps had on average 6.1 ppm residual H and 14.5 ppm residual DDT. Mean residual H and DDT contents of 9.9 ppm and 16.1 ppm v detected in pond water samples. The alpha iso of HCH was most prevalent in all three w sources (52-53%), followed by beta (33-37%) gamma (10-14%). pp'-DDT and its metabo such as pp'-DDE and pp'-DDD were also four almost all the water samples, possibly indica metabolic conversion and dehydrochlorina Due to the carcinogenic and esterogenic pote of OCIs and their metabolites, regular monito of the drinking water on a national basis is rec mended. (MacKeen-PTT)
W91-02099

RESIDUES OF ORGANOCHLORINE INSE CIDES IN FISH FROM MAHALA WATER R ERVOIR, JAIPUR, INDIA.
Rajasthan Univ., Jaipur (India). Dept. of Zoo P. P. Bakre, V. Misra, and P. Bhatnagar.
Bulletin of Environmental Contamination Toxicology BECTA6, Vol. 45, No. 3, p 39 September 1990. 1 tab, 15 ref.

Descriptors: *Chlorinated hydrocarbons, *India, *Insecticides, *Path of pollutants, cide residues, Aldrin, Benzene hexachloride, Fish diets, Halogenated pesticides, Jaipur, Reservoir, Metabolites.

The levels of organochlorine insecticide (OC dues were measured in different fish species the Mahala Reservoir, a freshwater lake situa km from Jaipur, India. Pesticides used in the ment area (220 sq miles) are carried in agric

runoff from land to water where they are adsorbed on bottom sediments and may move to other components of the aquatic system. Sixty-four fish of four species were collected between November 1986 and September 1987 (12 Puntius sarana, 24 Channa punctatus, 12 Wallago attu, and 16 Labeo bata) and tested for residues of alpha-, beta-, and gamma-HCH, aldrin, p,p'-DDT, DDE, and DDD. The highest OC residue quantities were detected in L. bata, a bottom feeder, the lowest in C. punctatus, which has a diversified diet with a large plankton share. A comparison of OC residue levels in various tissues indicated that the lowest levels were found in muscle, probably due to the low fat content and lack of active metabolic role for OC in muscle tissue. (MacKeen-PTT)
W91-02100

OXICITY EVALUATION OF THE PROOSED SECONDARY AND THE PRIMARY FFLUENTS DISCHARGED TO MASSACHUETTS BAY.
oringborn Labs., Inc., Wareham, MA.
. M. Jop, J. W. Williams, and R. B. Foster.
ulletin of Environmental Contamination and oxicology BECTA6, Vol. 45, No. 3, p 399-407, eptember 1990. 4 tab, 1 fig, 15 ref.

escriptors: *Bioindicators, *Effluents, *Massausetts Bay, *Municipal wastewater, *Path of llutants, *Toxicity, *Toxicology, *Wastewater sposal, *Wastewater treatment, *Water quality ndards, Chlorination, Deer Island, Marine pollun, Nut Island, Primary wastewater treatment, condary wastewater, Water pollution sources, ater quality monitoring.

mary effluents from the Deer Island and Nut and wastewater treatment plants discharged to ssachusetts Bay and proposed secondary efents were tested for toxicity. The average conntrations of dissolved oxygen in unchlorinated d chlorinated samples were 2.8 and 6.5 mg/L, pectively. Total residual chlorine (TRC) conntrations in secondary effluents were similar for h samples and ranged between 1.0 and 1.12 mg/ The results of the 7 day toxicity renewal test cated that the survival of sheepshead minnows unchlorinated effluent samples collected from n plants was significantly reduced compared n survival in chlorinated effluents. The results he 96 h static acute toxicity tests indicated that rival of mysids in the chlorinated effluents was ced when compared with survival in unchlored effluents; however, mysid response to chlo- was not substantial. Sea urchin sperm cell city tests showed that toxicity of each effluent ed throughout the program. Generally, the rinated primary effluents were more toxic than unchlorinated, and Nut Island effluents desed sperm viability more than Deer Island ents. The unchlorinated and chlorinated secary effluents were minimally toxic to sea in. Overall, the results of the study indicated the wastewaters currently discharged to on Harbor are toxic, however the source of oxicity is unknown. The chlorination treatcurrently used at both treatment facilities ases the TRC concentration in the primary ents and exaggerates the toxicity of the ewaters. Biological monitoring conducted in uture on effluent discharged from the new ndary treatment plant should include assess of the short-term and long-term biological s of the discharged wastewaters. For short- biomonitoring, the sea urchin fertilization test ommended because it includes the evaluation production potential, is conducted in minutes, s sensitive and simple to conduct. (MacKeen-
02101

CHED AND FREE-LIVING DIVIDING TERIA IN TWO AQUATIC SYSTEMS.
rsidad del Pais Vasco, Bilbao (Spain). Dept. crobiologia e Inmunologia.
rimary bibliographic entry see Field 2H.
02121

UENCE OF PHYSIOLOGICAL CONDI- ON CADMIUM TRANSPORT FROM HAEMOLYMPH TO HEPATOPANCREAS IN CARCINUS MAENAS.
Odense Univ. (Denmark). Biological Inst.
P. Bjerregaard.
Marine Biology MBIOAJ, Vol. 106, No. 2, p 199-209, 1990. 10 fig, 3 tab, 43 ref.

Descriptors: *Bioaccumulation, *Cadmium, *Crabs, *Dose-response relationships, *Marine animals, *Path of pollutants, Absorption, Crustacea, Heavy metals, Hemolymph, Hepatopancreas, Ion transport, Proteins.

Accumulation and binding of cadmium in the tissues of the shore crab Carcinus maenas (L.) were investigated in a series of laboratory experiments. Cadmium was removed from the hemolymph with a half-life of approximately 10 h, and half of the cadmium removed from the hemolymph was taken up in the hepatopancreas. The efficiency with which individual crabs transported cadmium from the hemolymph to the hepatopancreas was strongly related to physiological parameters, such as concentrations of calcium and magnesium in the hepatopancreas, hemolymph volume and hemolymph protein concentration. The transport of cadmium from the hemolymph to the hepatopancreas was saturated in crabs exposed to more than 2-4 mg/L of cadmium in the seawater. In the hepatopancreas of unexposed crabs, cadmium was bound mainly in the insoluble tissue fraction (40%) and in the protein fraction with a molecular weight of approximately 6,000 D (50%). Exposure to 0.25-1.5 mg/L cadmium for 2 w led to dose-dependent increases in the amounts of cadmium bound in the high-molecular weight protein fraction and in the insoluble tissue fraction. Cadmium may be transported from hemolymph either as free ions (actively or passively), transported with hemocyanin in a pinocytotic process or transported with amoebocytes. (Author's abstract)
W91-02124

APPLICATION OF TWO-SITE/TWO-REGION MODELS FOR STUDYING SIMULTANEOUS NONEQUILIBRIUM TRANSPORT AND DEGRADATION OF PESTICIDES.
Florida Univ., Gainesville. Dept. of Soil Science.
A. P. Gamerdinger, R. J. Wagenet, and M. T. van Genuchten.
Soil Science Society of America Journal SSSJD4, Vol. 54, No. 4, p 957-963, July/August 1990. 5 fig, 4 tab, 21 ref.

Descriptors: *Degradation, *Fate of pollutants, *Mathematical models, *Path of pollutants, *Pesticides, *Sorption, Atrazine, Computer programs, Equilibrium, Isotherms, Organic compounds, Pore water, Soil columns, Soil contamination, Solute transport.

Quantitative laboratory study of pesticide sorption and degradation during transport can provide insight into the basic processes affecting pesticide fate in field soils. Accordingly, the application of analytical solutions of two-site/two-region transport models useful in studying simultaneous pesticide sorption and degradation, were demonstrated. Soil column displacement experiments involving tritiated water, Cl and atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine) were conducted during steady-state water flow at two pore water velocities and two pesticide concentrations. The soil used was a Valois silty loam (coarse-loamy, mixed, mesic Typic Dystrichrept). Effluent data from these experiments were used to demonstrate the application of these analytical solutions, as well as a parameter estimation computer program based on these solutions. The ability to use laboratory-derived estimates of equilibrium sorption parameters to describe sorption under flowing conditions was evaluated at each flow velocity. Significant correlation between soil sorption partitioning and degradation prevents the simultaneous determination of both processes using these solutions. However, estimates of degradation obtained from mass balances of the column data were useful in identifying the equilibrium sorption parameters. Data collected elsewhere for 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) herbicide transport were used as an additional example of the application of the model with degradation. These techniques are applicable to other organic chemical contaminants. (Author's abstract)
W91-02132

ORGANIC SELENIUM DISTRIBUTION IN SELECTED CALIFORNIA SOILS.
Oregon Graduate Inst. of Science and Technology, Beaverton. Dept. of Environmental Science and Engineering.
M. M. Abrams, R. G. Burau, and R. J. Zasoski.
Soil Science Society of America Journal SSSJD4, Vol. 54, No. 4, p 979-982, July/August 1990. 3 fig, 2 tab, 21 ref.

Descriptors: *Agricultural runoff, *California, *Kesterson Reservoir, *Organic compounds, *Path of pollutants, *Selenium, *Soil chemistry, *Subsurface drainage, *Water pollution sources, Fulvic acids, Gas chromatography, Humic acids, Mass spectrometry, Organic matter, Soil types, Topography.

The distribution of organic Se was determined in seven soils from central California. Six of these soils (one Typic Pelloxerert, three Typic Torriorthents, one Vertic Torriorthent, and one Entic Chromoxerert) were in a toposequence from an area thought to be relatively high (>1000 microg total Se/kg) in native Se, because of the high Se levels in the subsurface agricultural drainage water pumped into the Kesterson Reservoir (California). The seventh soil, Yolo (a Typic Xerorthent), thought to be low in native Se, was included for comparison. Three of the soils in the toposequence had total Se levels less than 1000 microg/kg; the basin soil (Tachi; Typic Pelloxerert) had less than the Yolo soil. A solution of 0.1 M NaOH/0.1 M alkaline pyrophosphate extracted an average of 12% of the total Se, ranging from 5 to 32%. Organic Se accounted for 50% or more of the NaOH/alkaline pyrophosphate extractable Se in all but the poorly drained Ciervo clay (Typic Torriorthent), which had about 40% in an organic form. Extracted organic Se compounds were fractionated into humates and hydrophobic fulvates. Selenium associated with hydrophobic fulvates was high in the soils of intermediate toposequence elevation. Selenomethionine was identified by gas chromatography/mass spectrometry in the hydrophilic fulvate fraction of the Yolo soil and in three soils from the toposequence. The high percentage of extractable Se associated with organic matter in these soils represents a pool of Se potentially available to plants. (Author's abstract)
W91-02134

TRITIUM, OXYGEN-18, AND DEUTERIUM DIFFUSION AT THE CONFEDERATION ROAD LANDFILL SITE, SARNIA, ONTARIO, CANADA.
University of Western Ontario, London. Faculty of Engineering Science.
E. K. Yanful, and R. M. QR. M. Quigley.
Canadian Geotechnical Journal CGJOAH, Vol. 27, No. 3, p 271-275, June 1990. 4 fig, 1 tab, 19 ref.

Descriptors: *Deuterium, *Diffusion, *Landfills, *Leachates, *Ontario, *Oxygen isotopes, *Path of pollutants, *Tracers, *Tritium, Biodegradation, Chemical interactions, Chemical reactions, Chlorides, Clay liners, Clays, Diffusion coefficient, Ficks Law, Infiltration, Isotopes, Sodium.

The Confederation Road Landfill is a closed municipal landfill situated about 6.4 km east-southeast of Sarnia, Ontario. The isotopes tritium, oxygen-18, and deuterium, which appear to have been concentrated in the leachate at the site, are shown to have migrated into the underlying natural clay barrier by molecular diffusion. The theoretical best-fits to the observed concentration profiles, using the error function solution to the transient diffusion equation (analogous to Fick's second law), give diffusion coefficients (in square centimeters per second) of 0.000013 for both oxygen-18 and deuterium, and 0.0000085 for tritium. Field concentration profiles for Cl(-) and Na(+) yielded diffusion coefficients of 0.0000064 for chloride and 0.0000033 for sodium (also square cm/s). Tritium and chloride appear to have migrated a similar

distance of approximately 2.0 m from the clay-waste interface, compared with only 1.2 m for sodium, which has probably been retarded by adsorption onto clay exchange sites. Oxygen-18 and deuterium appear to have migrated the furthest at approximately 2.3 m. The tritium profile indicates that post-1953 rainwater entered the landfill site, probably mostly in 1967 when the landfill trench was excavated. High delta O18 and delta deuterium values, especially near the clay-waste interface, suggest mixing of 1967 rainwater with an isotopically enriched water, probably produced in the landfill either directly from enriched organic wastes such as leaves or by biodegradation processes. (Author's abstract)
W91-02146

HYDROGEOCHEMICAL PROCESSES CONTROLLING THE TRANSPORT OF DISSOLVED ORGANIC CARBON THROUGH A FORESTED HILLSLOPE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
P. M. Jardine, G. V. Wilson, J. F. McCarthy, R. J. Luxmoore, and D. L. Taylor.
Journal of Contaminant Hydrology JCOHE6, Vol. 6, No. 1, p 3-19, July 1990. 11 fig, 37 ref.

Descriptors: *Dissolved organic carbon, *Forest watersheds, *Organic carbon, *Path of pollutants, *Radioactive waste disposal, *Solute transport, *Storm runoff, *Waste disposal, Carbon cycle, Hydrographs, Pollutants, Precipitation, Rainfall, Rainstorms, Soil chemistry, Soil horizons, Soil profiles, Soil water, Tennessee, Underground waste disposal, Water pollution sources.

The subsurface transport of dissolved organic carbon (DOC) through a proposed waste burial site during rain events was investigated in order to assess the role of colloid-mediated contaminant mobility. A sub-watershed (0.45 ha) located on a forested hillslope in eastern Tennessee was instrumented with an isolated soil pedon for one-dimensional transport studies, and a subsurface weir monitoring system for three-dimensional transport studies. The source of DOC in the soils resulted from dissolution of organic matter in the surface horizon during and between rain events, as well as from a highly reactive B horizon which stored significant quantities of DOC in small pores. During large storms, the concentration of DOC was similar on ascending and descending limbs of the subsurface hydrograph, with a maximum concentration occurring at peak flow. During small storms chemical interactions with soil solution SO4(--) caused DOC concentrations to be greater on the ascending limb of the hydrograph, with maximum DOC concentrations occurring before peak flow. Because subsurface lateral flow through preferential paths predominated in the Bt2 and Bt3 horizons of the soil during storm events, the total cumulative flux of DOC downslope was generally much greater through the lower soil horizons. A significant component of mobile DOC consisted of hydrophobic organic solutes, even though this material was selectively adsorbed with soil depth relative to hydrophilic organic solutes. The significant mobility of hydrophilic DOC may enhance the environmental transport of contaminants. (Author's abstract)
W91-02159

PERSISTENCE OF ALDICARB RESIDUES IN THE SANDSTONE AQUIFER OF PRINCE EDWARD ISLAND, CANADA.
Canada Centre for Mineral and Energy Technology, Elliot Lake (Ontario). Elliot Lake Lab.
R. E. Jackson, J. P. Mutch, and M. W. Priddle.
Journal of Contaminant Hydrology JCOHE6, Vol. 6, No. 1, p 21-35, July 1990. 10 fig, 1 tab, 16 ref.

Descriptors: *Agricultural chemicals, *Aldicarb, *Carbamate pesticides, *Groundwater, *Groundwater pollution, *Path of pollutants, *Pesticide residues, *Pesticides, *Prince Edward Island, Aquifer characteristics, Glacial sediments, Groundwater movement, Groundwater quality, Half-life, Hydrogen ion concentration, Sandstones, Sorption.

Aldicarb residues were found in the shallow groundwaters of the fractured sandstone aquifer of Prince Edward Island more than two years after the last application of the pesticide. Concentrations of aldicarb measured were relatively constant with time. It is deduced that the detoxifying abiotic transformation (hydrolysis) of aldicarb is inhibited by the low pH and temperature of the soil and groundwater, the former being partly due to the pH-buffering effects of ammonium fertilizer oxidation. Aldicarb residues remain constant and relatively high because their storage within the sandstone matrix and subsequent diffusion back into the fractures of this dual porosity system. Attempts to simulate the observed persistence of aldicarb in this hydrogeologic environment using a one-dimensional, solute transport simulation code were unsuccessful, probably because of the three-dimensional nature of the matrix diffusion process. The simulation suggested that the overall half-life for aldicarb in the till-sandstone system approaches 150 days. These results indicate that aldicarb is not readily degraded in the hydrologic system, and that some insitu storage mechanism is retaining undegraded aldicarb species and slowly releasing them over time. Mechanisms possibly playing a role include sorption of aldicarb and its slow release, downslope migration of aldicarb within the flow system, inhibition of degradation, slow infiltration through the unsaturated till overlying the sandstone, and matrix diffusion within the sandstone and slow release. (Tappert-PTT)
W91-02160

MODELING THE MASS-TRANSFER RATE OF RADIOACTIVE COBALT FROM A SYNTHETIC GROUNDWATER TO VOLCANIC TUFF MEDIA.
Howard Univ., Washington, DC. Dept. of Chemical Engineering.
M. G. Rao, H. R. Fuentes, W. L. Polzer, and E. H. Essington.
Journal of Contaminant Hydrology JCOHE6, Vol. 6, No. 1, p 69-84, July 1990. 6 fig, 3 tab, 14 ref. U. S. Nuclear Regulatory Commission Grant No. NRC/FIN/A7150.

Descriptors: *Cobalt radioisotopes, *Groundwater pollution, *Mass transfer, *Model studies, *Path of pollutants, *Radioactive waste disposal, *Tuff, Adsorption kinetics, Diffusion, Radioactive wastes, Radiochemical analysis, Radioisotopes.

A factor affecting the retention of ions by solids is diffusion from the bulk of a solution to the inner portion of solid particles and the rate-determining step is either film or particle diffusion or both. The application of a shrinking-core model controlled by macroporous diffusion has been validated for the adsorption kinetics of radioactive Co from a 0.01N CaCl2 solution to Bandelier Tuff. This tuff has served as a natural barrier in the disposal of low-level radioactive waste at Los Alamos National Laboratory. The model is validated for duplicate experiments and also in binary and ternary combinations with Sr and Cs. The sorbates were initially in solution at 20 mg/L and were contacted with the tuff in bottles agitated in the batch mode at 25C. Co adsorbs irreversibly to the particle and is not available for transfer to the nonreacted portion or inner core of the particle. Unlike traditional models of rate control such as chemical reaction, film and particle diffusion, the shrinking-core model predicts increased mass-transfer rates with an increase in the concentration of Co in the liquid phase. The results have direct implications in the understanding and modeling of the fate and transport of radioactive Co in volcanic tuffs. Volcanic tuff is also being considered as a medium for the location of a high level nuclear waste repository in the state of Nevada. (Tappert-PTT)
W91-02163

ADSORPTIVE SOLUTE TRANSPORT IN FRACTURED ROCK: ANALYTICAL SOLUTIONS FOR DELTA-TYPE SOURCE CONDITIONS.
Kyoto Univ., Osaka (Japan). Research Reactor Inst.
Y. Fujikawa, and M. Fukui.
Journal of Contaminant Hydrology JCOHE6, Vol. 6, No. 1, p 85-102, July 1990. 6 fig, 3 tab, 15 ref, 2 append.

Descriptors: *Adsorption kinetics, *Fracture permeability, *Mathematical models, *Path of pollutants, *Radioactive waste disposal, *Solute transport, Analytical models, Breakthrough curves, Geologic fractures, Tracers.

Solutions for adsorptive solute transport equations in a single fracture-rock system were derived under two different delta-type source conditions. One was the delta-type, flux injection condition. The correspondent solution can be used for the analysis of experimental column breakthrough curves obtained by injecting the tracer into the rock fracture. The other was the delta-type, resident fluid injection condition. The solution can be used for the crude estimation of pollutant migration from the underground radioactive waste repository. In formalizing the resident fluid injection an initial distribution of solute between solution and solid phase was assumed in order to satisfy the mass balance between injected and detected solute. Each of the two solutions was also expressed in two ways reflecting the flux and the resident fluid detection. Solutions expressed in terms of the fluid detection correspond to the effluent concentration measured experimentally by a fraction collector system. On the other hand, solutions expressed in terms of the resident fluid detection describe spatial distribution of the solute in the fluid. Since considerably long tailings of breakthrough curves are often observed in column tracer experiments using fractured rocks, effects of some parameter values on the tailing were also investigated. It was shown that the adsorption of solute to rock matrix caused longer tailing. It was also shown that the resident fluid injection caused longer tailing in breakthrough curves than the flux injection condition. (Author's abstract)
W91-02164

ELECTRON MICROSCOPY DOCUMENTIN THE CELLULAR METABOLIC FATE OF H IONS.
University of Science, Penang (Malaysia). Sch of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-02171

ELECTRON MICROSCOPY DOCUMENTI THE CELLULAR METABOLIC FATE OF IONS.
University of Science, Penang (Malaysia). Sch of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-02172

ENVIRONMENTAL CHEMISTRY AND B LOGICAL EFFECTS OF CADMIUM CO POUNDS.
International Association of Environmental A lytical Chemistry, Therwil (Switzerland).
E. Merian.
Toxicological and Environmental Chemi TXECBP, Vol. 26, No. 1/4, p 27-44, 1990. 1 fig tab, 58 ref.

Descriptors: *Cadmium, *Heavy metals, *Path pollutants, *Reviews, *Toxicology, *Water p tion effects, Air pollution effects, Analytical m ods, Bioaccumulation, Pathology, Population posure.

The toxic metal cadmium and its compounds distributed ubiquitously in the earth's crust. Ca um uptake occurs by ingestion and inhala Smoking also plays a role, since tobacco con cadmium. Cadmium commonly occurs as v soluble bivalent compounds and can be anal by atomic absorption, isotope dilution mass trometry, and neutron activation analytical m ods. Most of the world production of cadmi used in the electroplating of iron and steel manufacture of nickel-cadmium batteries; addi al uses include pigments, soaps, alloys for cells, and neutron absorbers in nuclear p plants. In the environment, cadmium is taken plants much more readily than other heavy m High cadmium concentrations in compost, se sludge, and upper soil layers may reduce the

ers of microorganisms necessary for rapid decomposition of organic material, and nitrogen fixation ay also be reduced. Plants and fish bioaccumulate admium. Measurements of particulate airborne admium intake via the respiratory tract indicate tention rates of 10 to 40%, with broad variations nong mammals in lung deposition and biological lf-life. Detoxification is performed by cytosolic oteins such as metallothioneins. Symptoms of dmium uptake in plants include chloroses and croses with characteristic color changes. Inease of salinity and/or calcium content and dimition of temperature in aquatic environments deease cadmium toxicity. Terrestrial animals are commonly exposed to doses that produce toxic ects. In humans, ingestion of cadmium levels gher than 15 ml/L causes vomiting. Inhalation of dmium at levels greater than 1 mg/cu meter can oduce shortness of breath, weakness, and fever. vels of 5 mg/cu meter may be lethal after eight urs exposure. There is no clear evidence for tagenesis. Data from animal experiments sugt cadmium may have the potential to be a cinogen, although epidemiological data is conng and requires further study. Studies on reprotive effects and teratogenicity have mainly n conducted on rodents, and the evidence is not r. Relatively high single cadmium doses may treated with chelators. Threshold values are stantly being revised as more data becomes ilable. (Tappert-PTT)
1-02173

AMS 2: EXPOSURE ANALYSIS MODELING TEM.
reuth Univ. (Germany, F.R.). Chair of Ecolog-Chemistry and Geochemistry.
primary bibliographic entry see Field 7B.
-02174

THROPOGENIC INFLUENCE ON THE IN-ELEMENTAL CORRELATION IN DIF-ENT PHASES OF THE MARINE ENVI-MENT.
arian Academy of Sciences, Varna. Inst. of nography.
ndreev, and V. Simeonov.
cological and Environmental Chemistry CBP, Vol. 26, No. 1/4, p 91-98, 1990. 4 fig, 3 ref.

riptors: *Black Sea, *Correlation analysis, ine environment, *Path of pollutants, *Statismethods, *Water pollution sources, Chemical sis, Metals, Sediments, Suspended load.

valuation of anthropogenic pollutants is usased upon direct comparison of their absolute ntrations in different environmental compart-. Recent studies indicate that additional facould be taken into account. A simple correstrategy can be applied to obtain information anthropogenic influence in different coments (e.g., water, sediment, thin surface layer) marine environment. Seven chemical coms (As, Se, Li, Rb, Fe, Cu, Zn) plus organic and salinity were analyzed in 2200 samples ed from 21 sampling locations in the Black amples were collected from various depths, es from the coast, and environmental comnts. Nine of the sampling locations were known pollution source. The remaining s were located from 3 to 20 miles offshore. ical data for water, suspended matter, sediand thin surface layer samples were ob-Two approaches were used to establish ogenic effects: (1) comparison of concen-(traditional approach), and (2) checking of mental correlation changes near the pollurce. The data show that the most substanriation for the polluted region compared to an region is the increase in correlation (i.e., the percentage of significant correlefficients). In clean areas the correlation m for water samples is found in the bottom while in polluted areas the correlation maxifound in the thin surface layer; in suspendr the reverse is true, and in sediments the m for both regions is the surface layer. t-PTT)
175

MESIP: MODELLING ENVIRONMENTAL SCENARIOS IN PONDS.
Bayreuth Univ. (Germany, F.R.). Chair of Ecological Chemistry and Geochemistry.
For primary bibliographic entry see Field 7C.
W91-02176

SEPTIC TANK AND AGRICULTURAL NON-POINT SOURCE POLLUTION WITHIN A RURAL WATERSHED.
Texas Christian Univ., Fort Worth. Environmental Sciences Program.
S. Hayes, L. Newland, K. Morgan, and K. Dean.
Toxicological and Environmental Chemistry TXECBP, Vol. 26, No. 1/4, p 137-155, 1990. 2 fig, 7 tab, 65 ref.

Descriptors: *Agricultural runoff, *Agricultural watersheds, *Ammonia, *Coliforms, *Nonpoint pollution sources, *Rural areas, *Septic tanks, *Water pollution effects, Rainfall, Soil conservation, Water pollution sources.

An increased interest in water quality improvement has resulted in the creation of special programs to promote the adoption of soil conservation practices. Non-point source (NPS) pollution derived from sediment infusion is specifically addressed in the latest version of the Clean Water Act. The Lake Weatherford reservoir in Parker County, Texas is the primary municipal water supply for the City of Weatherford, Texas. The principal method of wastewater disposal is the on-site system or septic tanks for the small residential areas surrounding the reservoir. Sources of NPS pollution of interest in this watershed include agricultural operations as well as the residential areas. These sites were identified with the aid of aerial photography and field investigation. Suspected NPS problems were substantiated through a sampling program involving chemical and biological testing of the reservoir. Results indicate that there is significant NPS pollution contamination of Lake Weatherford from agricultural sources and seepage from on-site wastewater disposal systems. Excessive fecal coliform and fecal streptococcus counts were generally associated with rainfall events, and several samples showed values greater than 100,000 bacteria per 100 ml. The fecal coliform/fecal streptococcus ratios indicated contamination from human sources, animal sources, and a combination of both. Nutrient concentrations fluctuated from quite low to high with ammonia as the most consistent problem. High ammonia values were also associated with rainfall events. (Author's abstract)
W91-02177

TRACE METALS IN THE WESTERN MEDITERRANEAN SEA.
Istituto di Biofisica, Pisa (Italy).
A. Seritti, E. Morelli, L. Nannicini, and G. Scarano.
Toxicological and Environmental Chemistry TXECBP, Vol. 26, No. 2/3, p 87-93, 1990.

Descriptors: *Cadmium, *Copper, *Lead, *Mediterranean Sea, *Path of pollutants, *Trace metals, *Water pollution sources, Data collections, Distribution patterns, Particulate matter, Seawater, Water sampling.

Data on Cd, Pb, and Cu concentrations in seawater were determined from samples collected during five years of field studies in the western Mediterranean Sea. The data present a space and time integrated status of the levels of these metals. Sampling locations included areas near known sources of industrial discharges. Surface total metal concentrations present rather homogeneous distributions over the different areas considered, including the Tyrrhenian Sea (off Italy in the eastern part of the study area). The metal concentrations in three areas affected by natural and industrial wastes are not significantly different from data reported from other areas of the Mediterranean. Averages and ranges of metal concentrations found in particulate matter in the Tyrrhenian Sea seem to be rather low, although the ranges are larger than those in the dissolved fraction, particularly for Pb and Cu. The data indicate the high affinity of metals for particulate matter. The vertical distribution of dissolved Cd, Pb, and Cu in the Alboran Sea (in the western part of the study area, between Spain and North Africa) seems to be rather homogeneous, both vertically and along a series of stations between the Strait of Gibraltar and the island of Alboran. (Tappert-PTT)
W91-02179

MODELING OF MULTICOMPONENT TRANSPORT WITH MICROBIAL TRANSFORMATION IN GROUNDWATER: THE FUHRBERG CASE.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
E. O. Frind, W. H. M. Duynisveld, O. Strobel, and J. Boettcher.
Water Resources Research WRERAQ, Vol. 26, No. 8, p 1707-1719, August 1990. 16 fig, 26 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Groundwater pollution, *Microbial degradation, *Model studies, *Path of pollutants, *Solute transport, Aquifer characteristics, Finite element method, Groundwater management, Nitrates, Water resource management.

A numerical technique has been developed that appears to have potential in studies of nonlinear reactive transport problems, and it is applied to a case study where the implications of reactive transport processes are profound. The case study relates to the Fuhrberger Feld aquifer in northern Germany, which provides the bulk of the water supply for the half-million people living in the city of Hannover. Part of the aquifer receives a strong influx of nitrate from agricultural activities. The nitrate in the aquifer is microbially transformed into sulfate, the transformation depending on the availability of reduced sulfur compounds present in the sediment. The individual transformations occur within distinct reaction zones in the aquifer. The relevant dynamic processes can be formulated as a nonlinear transport problem involving multiple interacting species in dissolved or solid form. The system is simulated using a finite element-based technique that generates a symmetric coefficient matrix for the transport equation, while providing second-order accuracy in time. The form of the matrix allows the use of a highly efficient and robust symmetric conjugate gradient solver. The technique provides an ample spatial resolution capacity at reasonable cost, and handles grids with irregular geometry in two or three dimensions. The convenience and versatility of conventional finite elements is retained. A vertical-section simulation identifies different reaction zones in the aquifer and gives insight into the effect of the controlling parameters. The simulation study is a first step in the development of a prognosis for the fate of the groundwater resource. (Author's abstract)
W91-02180

THREE-DIMENSIONAL STATISTICAL MOMENT ANALYSIS OF THE STANFORD/WATERLOO BORDEN TRACER DATA.
Western Australia Univ., Nedlands. Centre for Water Research.
D. A. Barry, and G. Sposito.
Water Resources Research WRERAQ, Vol. 26, No. 8, p 1735-1747, August 1990. 4 fig, 3 tab, 50 ref. NSF Grant ECE-8513726.

Descriptors: *Groundwater pollution, *Ontario, *Path of pollutants, *Statistical analysis, *Tracers, Bromine, Canada, Military reservations, Plumes, Statistical methods, Stochastic models.

The bromide plume at the Borden site (Ontario, Canada) has been extensively investigated by researchers from Stanford University and the University of Waterloo. Seven solutes, including Br and Cl, were injected into the Borden aquifer in 1982. Chemical data was collected at varying intervals up to an elapsed time of 1038 days. The data has been used to estimate the mass, mean position vector, and covariance tensor of the bromide plume. A number of interpretive steps was necessary to compute these plume moments. First, the spatially scattered data were interpolated onto a

regular grid, with the interpolator selected on the basis of a cross-validation criterion. The moment estimates then could be calculated readily, although it was recognized that the interpolation procedure can lead to bias in the moment estimates. For this reason, reduced-bias, jackknifed estimates of the moments, as well as confidence intervals for these estimates, were derived. The total plume variance also was estimated with the jackknife method. The latter results were compared with the prediction of a recent stochastic model developed by Dagan (1988). When this model was applied in a completely predictive mode, a remarkably good estimate of the total plume variance resulted. (Author's abstract)
W91-02182

UNIVERSAL SCALING OF HYDRAULIC CONDUCTIVITIES AND DISPERSIVITIES IN GEOLOGIC MEDIA.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2F.
W91-02183

VARIABILITY IN CONCENTRATIONS OF SELECTED TRACE ELEMENTS IN WATER AND SEDIMENT OF SIX ACIDIC LAKES.
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
M. Sprenger, A. McIntosh, and T. Lewis.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 4, p 383-390, July 1987. 4 fig, 5 tab, 19 ref.

Descriptors: *Acid lakes, *Acid rain effects, *Aluminum, *Cadmium, *Lead, *Manganese, *Water pollution sources, *Zinc, Chemical analysis, Heavy metals, Hydrogen ion concentration, Lake sediments, New Jersey, Pollutant identification, Seasonal variation, Sediment analysis, Sediment contamination, Trace metals.

Concentrations of the trace elements Al, Cd, Pb, Mn and Zn were determined in water and sediments of six acidic clear-water lakes (pH 3.6-6.2) in northwestern New Jersey. Levels of Al, Pb and Zn in the water column were sharply elevated in the most acidic lakes, with values similar to acidified systems elsewhere. Seasonal fluctuations occurred, with Pb displaying peak concentrations in all lakes during the fall sampling period. Analyses of core samples of lake sediment indicated that while Pb concentrations exhibited a typical sharp increase in most recent sediments, Cd and Zn levels in the upper layers were substantially lower than values reported for similar systems elsewhere. As expected, Mn concentrations generally decreased in the upper sediment layers in the acidic lakes, while Al varied dramatically between systems. (Author's abstract)
W91-02193

RESIDUE LEVELS OF ORGANOCHLORINE CHEMICALS AND POLYCHLORINATED BIPHENYLS IN FISH FROM THE ALEXANDRIA REGION, EGYPT.
Institute of Oceanography and Fisheries, Alexandria (Egypt). Dept. of Marine Pollution Research.
A. El Nabawi, B. Heinzow, and H. Kruse.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 6, p 689-696, November 1987. 3 fig, 6 tab, 25 ref.

Descriptors: *Chlorinated hydrocarbons, *Fish, *Path of pollutants, *Pesticide residues, *Polychlorinated biphenyls, Abu Qir Bay, Chemical analysis, Coastal waters, DDD, DDE, DDT, Egypt, Endosulfan, Fate of pollutants, Gas chromatography, Lake Idku, Lake Maryut, Lakes, Marine environment, Methoxychlor, Tilapia, Tissue analysis.

Residues of polychlorinated biphyenyls (PCBs) and organochlorine chemicals were analyzed by capillary gas chromatography in five fish species (Pagellus erythrinus, Sargus vulgarius, Siganus rivulatus, Sphyraena sphyraena and Trigia hirundo) from Abu Qir Bay as well as in Tilapia species from Idku and Maryut lakes in Alexandria, Egypt. Total DDT and PCBs were the most predominant contaminants occurring in the muscle tissue of all fish samples. Remarkable variations in the concentrations of PCBs were noted among the species, and the concentrations of total DDT were higher than that of PCBs in all fish species. Elevated PCB concentrations were observed in muscle tissue of S. vulgarius from Abu Qir Bay, and in Tilapia zillii from Forn El-Gieraia, Maryut lake. Also, variations were found in the relative proportions of p,p'-DDT, p,p'-DDD and p,p'-DDE in all fish samples. The results revealed an increase in chlorinated hydrocarbons with increase in body size and fat content. Neither alpha-endosulfan nor beta-endosulfan was detected in fish from Abu Qir Bay; however, only alpha-endosulfan was detected in trace amounts in Tilapia species from Idku and Maryut lakes. With the exception of S. vulgarius, mirex and methoxychlor occurred in low levels in all other fish species. From a public health standpoint, residue levels of organochlorines and PCBs in all fish samples analyzed are considerably lower than known tolerance levels; however, there is an increasing need for monitoring of these contaminants to insure the protection of food sources. (Author's abstract)
W91-02197

EFFECTS OF ENVIRONMENTAL PARAMETERS ON THE ELIMINATION OF CADMIUM BY EASTERN OYSTERS, CRASSOSTREA VIRGINICA.
National Marine Fisheries Service, Charleston, SC. Southeast Fisheries Center.
F. M . Van Dolah, T. C. Siewicki, G. W. Collins, and J. S. Logan.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 6, p 733-743, November 1987. 2 fig, 6 tab, 27 ref.

Descriptors: *Cadmium, *Heavy metals, *Humic acids, *Oysters, *Path of pollutants, *Salinity, *Temperature effects, *Toxicology, Animal metabolism, Cadmium radioisotopes, Chelating agents, Chemical analysis, Copper, Fate of pollutants, Iron, Laboratory methods, Magnesium, Trace metals, Zinc.

Laboratory studies were conducted to test the effects of salinity, humic acid and temperature on the rate of elimination of Cd109 from laboratory-dosed juvenile oysters, Crassostrea virginica. After 140 days, oysters maintained at 34 parts per thousand (ppt) salinity retained 67% of the Cd109 dose (CPM), oysters in 20 ppt salinity retained 72% and those in 6 ppt salinity retained 80%. The presence of humic acid in 14 ppt salinity water enhanced the amount of Cd109 eliminated in 140 days relative to oysters in control tanks without humic acid; oysters exposed to 10 parts per million (ppm) humic acid retained 65%, oysters exposed to 1 ppm humic acid retained 67%, controls retained 72%. Temperature had a significant effect on the rate of Cd elimination. Oysters held at 28 degrees and 20 ppt for 28 days retained 75%, oysters at 20 degrees and 20 ppt retained 81% and those at 12 degrees and 20 ppt retained 88% of Cd109 dose. The effects of a strong Cd-chelator, ethylenediamine tetraacetic acid-sodium salt (EDTA) were compared with those of the relatively weaker chelator, humic acid, on the rate of Cd elimination by oysters. No difference was observed between the two chelators over a 28 day depuration period. Cadmium concentrations were monitored in the water and Cd, Cu, Zn, Mg and Fe concentrations were determined in the animals on the final day of the studies. Tissue Zn concentrations behaved similarly to tissue Cd concentrations, while Cu and Fe behaved oppositely from those of Cd and Zn. Mg correlated with salinity. Particle clearance assays were performed to determine if the rate of filtration by the oysters held in each of the test treatments correlated with the rates of Cd depuration. No direct correlation was observed. (Author's abstract)
W91-02198

SHORT-TERM LETHALITY AND SEDIMENT AVOIDANCE ASSAYS WITH ENDRIN-CONTAMINATED SEDIMENT AND TWO OLIGOCHAETES FROM LAKE MICHIGAN.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W91-02199

DETECTION OF ORGANOPHOSPHORU PESTICIDE DETOXIFYING BACTERIA COLONIES, USING UV-PHOTOGRAPHY C PARATHION-IMPREGNATED FILTERS.
Texas A and M Univ., College Station. Dept. Biochemistry and Biophysics.
C. S. McDaniel, and J. R. Wild.
Archives of Environmental Contamination a Toxicology AECTCV, Vol. 17, No. 2, p 189-19 March 1988. 3 fig, 1 tab, 13 ref.

Descriptors: *Biodegradation, *Detoxificati *Fate of pollutants, *Laboratory methods, *Mic bial degradation, *Organophosphorus pesticid *Parathion, *Pesticides, Bacterial physiology, I tration, Microbiological studies, Photograp Plasmids, Pseudomonas, Ultraviolet radiation.

A rapid filter-lift assay was developed for identification of bacteria capable of degrading ganophosphorus pesticides. Filter pads impregn ed with parathion were applied to the surface plates containing potential parathion-degrad colonies. Positive colonies capable of convert parathion to 4-nitrophenol attain a visible yell coloration after 30 min of exposure; however, identification of selected individuals was diffi when large numbers of colonies were screened a single plate. An enhancement of this screer method was achieved with the use of UV-pho raphy, which allowed for the detection of a su mutant or cured colony among 500 parath degrading colonies per plate. In addition, it possible to detect a single parathion-degra colony among 10000 non-degrading colonies plate. The efficiency of the technique was vali ed with a parathion-degrading strain of Pse monas diminuta from which phenotypically n tive isolates were selected, subjected to pla isolation, evaluated for detoxifying activity, tested by a battery of microbiological criteri confirm the parental strain phenotype. All productive colonies were identical to the par strain except for the lack of detoxifying capal and the loss of a large plasmid found in the p tal strain. (Author's abstract)
W91-02200

SLOWLY REVERSIBLE SORPTION OF PHATIC HALOCARBONS IN SOILS. I. MATION OF RESIDUAL FRACTIONS.
Connecticut Agricultural Experiment St New Haven. Dept. of Soil and Water.
J. J. Pignatello.
Environmental Toxicology and Chem ETOCDK, Vol. 9, No. 9, p 1107-1115, Septe 1990. 3 fig, 5 tab, 22 ref.

Descriptors: *Adsorption-desorption, *Fate o lutants, *Halogenated hydrocarbons, *Path o lutants, *Soil contamination, Chemical an Desorption, Laboratory methods, Loam, Soil ysis, Soil physics, Soil types.

The formation of slowly reversible sorbed tions of various halogenated alkanes and alke two surface soils (Cheshire fine sandy loa Agawam fine sandy loam) was studied. Aft initial sorption equilibration period, the comp were desorbed by one of two methods. Th used repetitive batch extraction with water. 16 extractions of 24 to 72 h each, concentrat the aqueous phase reached low values and desorbing, residual fraction remained in th The residual fraction in the soil was dete independently after extraction with hot a whose efficacy was demonstrated. During tion, apparent soil-water distribution coef increased progressively to as much as 20 greater than equilibrium sorption coefficien obtained separately from sorption isotherm increasing sorption equilibration time, the became greater in magnitude and less mobi second desorption method simulated desor infinite dilution over a 96 h period by using GC polymeric adsorbent beads included

suspension as a sink for desorbed chemical. Control experiments proved the usefulness of Tenax and showed that desorption from the soil was rate limiting. All compounds studied formed slowly reversible fractions in the soils. This fraction amounted to several percent of the total sorbed from solution. The results indicate that formation of slowly reversible fractions is probably typical of nonpolar organic compounds, including those with weak sorbing tendencies. (See also W91-02210) (Author's abstract)
W91-02209

LOWLY REVERSIBLE SORPTION OF ALIHATIC HALOCARBONS IN SOILS. II. ECHANISTIC ASPECTS.
onnecticut Agricultural Experiment Station, ew Haven. Dept. of Soil and Water.
J. Pignatello.
ivironmental Toxicology and Chemistry OCDK, Vol. 9, No. 9, p 1117-1126, September 90. 6 fig, 4 tab, 27 ref.

escriptors: *Adsorption-desorption, *Fate of pollants, *Halogenated hydrocarbons, *Path of pollants, *Soil contamination, Chemical analysis, sorption, Laboratory methods, Loam, Sediment alysis, Sediment chemistry, Soil analysis, Soil ganic matter, Soil physics, Soil types.

e mechanism of formation and release of highly nobilized residues of some small nonpolar haloated hydrocarbons in two surface soils (Cheshfine sandy loam and Agawam fine sandy loam), tream sediment and an aquifer sediment was estigated. The labile sorbed fractions of the ipounds were removed from treated soils by ging to infinite dilution in aqueous suspensions 96 h. The remaining slowly reversible (residucompound fraction in the soil was quantitated function of prepurge sorption conditions. The dual increased nonlinearly with sorption equilion time and applied concentration. Residuals whole soils and whole soils pretreated with 02 were correlated with soil organic carbon. ong wet-sieved particle size fractions, howevthe organic carbon-based concentrations fold the order sand > silt >> clay. Also, some ual was associated with undecomposed plant er. Release of the residual into water was ly increased by pulverization of the soil and cidification of the soil suspension. The results ate that the slow release of the residual fracis caused by molecular diffusion from remote in the soil organic matter matrix. Mineral ce and clay interlayer adsorption were ruled y the finding of low residuals in the clay-sized cles. However, the mineral fraction plays an rtant role by shielding some of the organic r in interstitial pores of particle aggregates equilibrium with bulk solution. (See also 02209) (Author's abstract)
02210

DICTING CONCENTRATIONS OF CONER PRODUCT CHEMICALS IN ESTUS.
nia Univ., Charlottesville. Dept. of Civil Eng.
Lung, R. A. Rapaport, and A. C. Franco.
onmental Toxicology and Chemistry CDK, Vol. 9, No. 9, p 1127-1136, September 10 fig, 23 ref.

ptors: *Computer models, *Estuaries, *Estuenvironment, *Expert systems, *Fate of pol, *Path of pollutants, *Solute transport, Alns, Alkylbenzene sulfonates, Biochemical demand, Computers, Flow models, Industastes, Low flow, Mathematical models, Muwastes, Organic carbon, Salinity, Seasonal on.

25 to 30% of all United States publicly-treatment works (POTW) discharges enter s and coastal waters. An expert system has eveloped to model the fate and transport of als discharged from POTWs into estuaries. POTW has been classified as one of four primary, trickling filter, lagoon and activsludge in terms of treatment level. The system is designed to calculate concentrations under 7-d 10-year low flow, summer low flow and annual mean flow conditions. To account for varying mixing characteristics and salinity distributions observed in a given estuary, the system includes one-dimensional and two-dimensional (longitudinal and vertical) mass transport algorithms. To date, the modeling framework has been applied to nine estuaries. For validation purposes, biochemical oxygen demand (BOD) concentrations are also predicted based on industrial as well as municipal organic carbon loads. In several estuaries, predicted in-stream BOD levels have been compared to measured BOD data resulting in successful model validation. The validated models are then used to predict linear alkylbenzene sulfonate (LAS) concentrations in estuaries. These LAS concentrations are found to be less than 20 micrograms/L in these estuaries under the three flow conditions. (Author's abstract)
W91-02211

GEOCHEMISTRY OF BATCH-EXTRACT WATERS DERIVED FROM SPOIL MATERIAL COLLECTED AT THE CORDERO COAL MINE, POWDER RIVER BASIN, WYOMING.
Geological Survey, Cheyenne, WY. Water Resources Div.
D. L. Naftz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4200, 1990. 58p, 21 fig, 14 tab, 26 ref.

Descriptors: *Geochemistry, *Mine wastes, *Model studies, *Powder River Basin, *Water pollution effects, *Water pollution sources, *Water quality, *Wyoming, Coal mining, Mineralogy.

Batch-mixing experiments to evaluate postmining water quality at the Cordero Mine were conducted by the U.S. Geological Survey during 1984 to 1985. Contact of groundwater from the spoil aquifer with fresh spoil material caused only small changes in major-element concentrations and in pH, unless sulfide oxidation or contact with soluble salts, such as epsomite, occurred. In contrast, large changes in major-element concentration resulted when water from the coal aquifer contacted the spoil material. Only three of seven reaction models considered to explain the water quality changes during the batch-mixing experiments were consistent with the thermodynamic and mineralogical data. The three models used to account for the observed water quality changes derived potassium from potassium feldspar; magnesium from chlorite or epsomite or both; sodium from cation exchange and halite; chloride from halite; silica from potassium feldspar and chlorite; sulfate from gypsum, or epsomite or both, and carbon from carbon dioxide. In general, water quality samples obtained from the batch-mixing experiments using water from the coal aquifer had smaller major-ion concentrations than the actual water quality in the spoil aquifer. These differences can be explained by the limited amount of efflorescent salt dissolution and volume of water used in the experiments. Correction ratios calculated for these experiments may be applied to batch-mixing experiments at other mines in the area, to predict postmining water quality. (USGS)
W91-02222

HYDROLOGY OF GOAT LAKE WATERSHED, SNOHOMISH COUNTY, WASHINGTON, 1982-87.
Geological Survey, Tacoma, WA. Water Resources Div.
N. P. Dion, J. C. Ebbert, J. E. Poole, and B. S. Peck.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4235, 1989. 44p, 11 fig, 8 tab, 36 ref.

Descriptors: *Acid rain, *Goat Lake, *Mountain lakes, *Washington, *Water quality, Acid rain effects, Acidification, Alkalinity, Water pollution sources, Watersheds, Yield.

The Goat Lake watershed in Snohomish County, Washington, functions as an 'experimental watershed' for long-term studies to determine the effects of acidic precipitation on water resources. Data have been collected there by the U.S. Geological Survey since 1982. The watershed is in a wilderness area of the Cascade Range and is downwind of an industrial and urban area that produces chemical compounds found in acidic precipitation. The lake is considered sensitive to acidic inputs from atmospheric deposition and streamflow. The mean annual discharge of the Goat Lake outflow is 35 cu ft/sec; precipitation on the watershed is calculated to be about 170 in/yr. The inflow to Goat Lake is sufficient to replace the entire contents of the lake basin on an average every 21.5 days, or 17 times/year. Water in Goat Lake, and that of the inlet and outlet, is of low ionic strength and of calcium-bicarbonate type. The lake, although considered oligotrophic, is sufficiently deep to stratify thermally, and summer dissolved-oxygen concentrations in the hypolimnion are depressed. Even though alkalinity and specific conductance at Goat Lake are in the range considered sensitive to acidic inputs, the pH of water in the lake has consistently ranged from 6.1 to 7.2, indicating that the lake is not acidified at this time. (USGS)
W91-02227

U. S. GEOLOGICAL SURVEY APPLIED RESEARCH STUDIES OF THE CHEYENNE RIVER SYSTEM, SOUTH DAKOTA: DESCRIPTION AND COLLATION OF DATA, WATER YEARS 1987-88.
Geological Survey, Rapid City, SD. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-580, 1990. 145p, 9 fig, 52 tab.

Descriptors: *Cheyenne River, *Hydrologic data, *Mine wastes, *Path of pollutants, *South Dakota, *Water pollution sources, *Water quality, Adsorption-desorption, Analytical techniques, Biology, Sediment chemistry.

The Cheyenne River System in western South Dakota has been impacted by the discharge of about 100 million metric tons of gold-mill tailings to Whitewood Creek near Lead, South Dakota. In April 1985, the U.S. Geological Survey initiated an extensive series of research studies to investigate the magnitude of the impact and to define important processes acting on the contaminated sediments present in the system. The report presents all data collected during the 1987 and 1988 water years for these research studies. Some of the data included have been published previously. Data collected in the 1985 and 1986 water years have been published in a companion report (U.S. Geological Survey Open-File Report 88-484). Hydrologic, geochemical, and biologic data are available for sites on Whitewood Creek, and the Belle Fourche and Cheyenne Rivers. Data complexity varies from routine discharge and water-quality to very complex energy-dispersive x-ray analysis. Methods for sample collection, handling and preservation, and laboratory analysis are also presented. No interpretations or complex statistical summaries are included. (See also W89-08390) (USGS)
W91-02235

WATER-QUALITY, WELL CONSTRUCTION, AND GROUNDWATER LEVEL DATA FOR AN INVESTIGATION OF RADIONUCLIDES IN GROUND WATER, HICKMAN AND MAURY COUNTIES, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02238

AGRICULTURAL PESTICIDES AND GROUNDWATER IN NORTH CAROLINA: IDENTIFICATION OF THE MOST VULNERABLE AREAS.
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 5G.
W91-02245

Group 5B—Sources Of Pollution

HYDROGEOLOGIC RECONNAISSANCE OF THE SWOPE OIL SUPERFUND SITE AND VICINITY, CAMDEN AND BURLINGTON COUNTIES, NEW JERSEY.
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02249

SOURCE, EXTENT, AND DEGRADATION OF HERBICIDES IN A SHALLOW AQUIFER NEAR HESSTON, KANSAS.
Geological Survey, Lawrence, KS. Water Resources Div.
C. A. Perry.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4019, 1990. 24p, 10 fig, 7 tab, 14 ref. USGS Project No. KS151.

Descriptors: *Degradation, *Fate of pollutants, *Groundwater pollution, *Herbicides, *Kansas, *Path of pollutants, *Water pollution sources.

Atrazine, alachlor, cyanazine, metolachlor, and metribuzin were detected in water from a domestic well completed in a shallow aquifer underlying the Harvey County Experiment Field near Hesston, Kansas. The study described in this report investigated the source, extent, and degradation of these five herbicides. Hydrogeologic analysis of the site enabled estimation of the degradation half-lives of the herbicides in the saturated zone. The most probable source of the contamination was backsiphonage or spillage of herbicides from a sprayer tank into a trench backfilled with sand. The herbicides moved downgradient to the domestic well and then moved into the aquifer via the annular space in the well. Once in the aquifer, the contaminants remained nearly stationary with very little lateral movement away from the point of injection. Decreases in herbicide concentrations were caused mainly by degradation of the parent compounds and to a lesser degree, by extensive pumping of the well. Estimated herbicide degradation half-lives in the saturated environment were 1,000 days for atrazine, 400 days for alachlor, 250 days for cyanazine, 350 days for metolachlor, and 350 days for metribuzin. The herbicides will likely be eliminated from the soil and groundwater at the experiment field by continued natural degradation at the land surface and by degradation in and continued pumping of water from the aquifer. Pumping will remove any degradation products as well as the remaining parent compounds. (USGS)
W91-02252

GEOHYDROLOGY AND GROUNDWATER GEOCHEMISTRY AT A SUB-ARCTIC LANDFILL, FAIRBANKS, ALASKA.
Geological Survey, Anchorage, AK. Water Resources Div.
J. S. Downey, and P. O. Sinton.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4022, 1990. 25p, 21 fig, 2 tab, 11 ref.

Descriptors: *Alaska, *Geohydrology, *Landfills, *Path of pollutants, *Water pollution sources, Biological processes, Cold regions, Water chemistry.

The Fairbanks-North Star Borough, Alaska, landfill is located on silt, sand, and gravel deposits of the Tanana River flood plain, about 3 miles south of the city of Fairbanks water supply wells. The landfill has been in operation for about 25 years in this sub-arctic region of discontinuous permafrost. The cold climate limits biological activity within the landfill with corresponding low gas and leachate production. Chloride concentrations, specific conductance, water temperature, and earth conductivity measurements indicate a small plume of leachate flowing to the northwest from the landfill. The leachate remains near the water table as it flows northwestward toward a drainage ditch. Results of computer modeling of this local hydrologic system indicate that some of the leachate may be discharging to the ditch. Chemical data show that higher-than-background concentrations of several ions are present in the plume. However, the concentrations appear to be reduced to background levels within a short distance along the path of groundwater flow from the landfill, and thus the leachate is not expected to affect the water supply wells. (USGS)
W91-02253

GROUNDWATER QUALITY IN RURAL AREAS IN WESTERN AFRICA.
International Bank for Reconstruction and Development, Abidjan (Ivory Coast). Regional Water and Sanitation Group.
For primary bibliographic entry see Field 2F.
W91-02336

VULNERABILITY OF THE BRAZZAVILLE AQUIFER AND THE RISK OF CONTAMINATION WITH DOMESTIC WASTES (PROBLEMES DE VULNERABILITE DE LA NAPPE DE BRAZZAVILLE ET RISQUES DE CONTAMINATION PAR LES REJETS DOMESTIQUES).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Brazzaville (Congo). Centre ORSTOM de Brazzaville.
N. Moukolo.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 605-626, 11 ref, append. English summary.

Descriptors: *Congo, *Developing countries, *Domestic wastes, *Groundwater pollution, *Human diseases, *Wastewater pollution, *Water pollution sources, Aquifer characteristics, Path of pollutants, Sanitation, Water supply, Wells.

Sanitary and social conditions prevailing in the outskirts of Brazzaville (Congo) are a cause of concern and are linked to the poor quality of drinking water. In areas not fitted with a water supply system, waterborne diseases such as amoebiasis, bacillary dysentery, and diarrhea are the prime causes of morbidity. A fact-finding operation was initiated in 1985 to determine the effects of pollution on the underground water surrounding Brazzaville. Thirty water wells (sources and fountains included) were selected and checked. Type of well, location of well, design parameters, past and present use of the well, and the possibility of obtaining data were determined in a preliminary phase of the project. These wells are regularly checked and physical, chemical, and bacteriological analyses of their water are conducted. Industrial waste is unknown around Brazzaville; agriculture is confined to non-intensive gardening and chemical fertilizers and pesticides are used rarely. Pollution of domestic origin is the most important source and accounts for 70% of the cases of contamination of the aquifer as revealed by the preliminary results of this study. (See also W91-02288) (Author's abstract)
W91-02339

PROBLEMS OF MAINTENANCE OF WATER QUALITY IN ARID AND SEMI-ARID REGIONS OF WEST AFRICA.
Ghana Univ., Legon. Dept. of Botany.
For primary bibliographic entry see Field 5G.
W91-02348

IMPACTS OF URBAN WASTE ON SURFACE WATER IN OUAGADOUGOU AND BOBO-DIOULASSO (BURKINA FASO) (IMPACTS DES REJETS URBAINS SUR LES EAUX DE SURFACE A OUAGADOUGOU ET BOB-DIOULASSO (BURKINA FASO)).
Centre National de la Recherche Scientifique et Technologique, Ouagadougou (Burkina Faso).
J. N. Poda.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 976-986, 1 fig, 3 tab, 8 ref. English summary.

Descriptors: *Burkina Faso, *Human diseases, *Public health, *Urban, *Wastewater pollution, *Water pollution effects, *Water pollution sources, Developing countries, Domestic water, Hydrogen ion concentration, Monitoring, Municipal wastes, Municipal water, Path of pollutants, River We Sanitation, Water chemistry, Water quality trends

Water presents a crucial problem in Burkina Fas for two reasons: its scarcity and its unsanitar condition in both the towns and the countrysid One of the consequences of development of urba centers is the significant production of water fc domestic and industrial consumption. The contam nation of aquatic systems that results from this indicated by modification of physical, chemica and biological characteristics and by the frequenc of illnesses resulting from poor water quality. Th phenomenon was studied in Burkina Faso throug observations of the evolution of pH in the Riv We in Bobo-Dioulasso, its ionic composition, ar the productivity of reservoir waters in Ouagado gou. Overall, the mineral and organic contributic of wastes in the surface waters in Ouagdougou ar Bobo-Dioulasso seems to favor development aquatic life and because of it, a certain self-purific tion of these waters occurs. In the long term. Th concentration of pollution would endanger the bi logical equilibrium. The surface waters in tow could become a favorable medium for concentr tion and expansion of serious microbial illness because these waters are often used directly f domestic consumption. (See also W91-02288) (A thor's abstract)
W91-02369

BIOLOGICALLY AVAILABLE PHOSPHOR RETENTION BY THE KIS-BALATON RESE VOIR.
Ulster Univ., Coleraine (Northern Ireland). Li nology Lab.
For primary bibliographic entry see Field 2H.
W91-02375

WATER QUALITY IN RESERVOIRS: T EFFECT OF INFLOWING POLLUTION.
Vyzkumny Ustav Vodohospodarsky, Pra (Czechoslovakia).
E. Kockova.
Ergebnisse der Limnologie ERLIA6, Vol. 33, 3, p 827-829, 1990. 2 tab, 3 ref.

Descriptors: *Czechoslovakia, *Limnology, *R ervoirs, *Water pollution sources, *Water qua Ammonium, Biological oxygen demand, Dissol oxygen, Lentic environment, Organic matter, P toplankton.

In the Brno Water Research Institute, Czecho vakia, research in surface water pollution has b directed towards two localities. The first syste reservoirs is that of Nove Mlyny situated at confluence of the Dyje, Jihlava and Svratka ri in the South Moravian region. The inflow water of the Dyje is contaminated with high le of organic compounds as indicated by BOD5, also with mineral components. The water c contains minimal concentrations of disso oxygen (DO) or even no oxygen at all. P contamination is responsible for the constant ence of ammonium ion. The BOD5 value aver 23 mg/L in 1986; in the last 5 years the loa inflowing water fluctuated between 15 an tons/day BOD5. The oxygen regime is influe by many other factors such as the intensive gr of phytoplankton, resulting in the oversaturati water during the summer days. Overnight a the morning the phytoplankton draws on oxygen until its concentration reaches zero. O to the small depth the stagnant water ha oxygen at all in the bottom zone, and in r years this has often led to fish kills. The inco contamination, sedimentation of the or matter, and other effects have a negative imp the upper third of the reservoir, which is dor ed by the decrease in DO. In the second loc the Dalesice reservoir, the inflowing water

river Jihlava contains high concentrations of DO, with an average BOD5 of 10 mg/L; during 1980-83 the load of the inflow-profile fluctuated between 3.35 and 9.32 tons/day BOD5. Although this reservoir is substantially less contaminated than the Nove Mlyny reservoir, the general trend of the water quality has not been satisfactory, especially in relation to the oxygen regime. Neither the motion of the water surface nor turbine and pumping operations have substantially affected the oxygen balance of the whole water column. Consequently, in this reservoir, especially in the summer, the surface water is oversaturated (owing to biological activity) in the vertical direction; at the same time bottom water at depths of 5 m to 74 m contain less than 4 mg/L of DO. The low DO concentrations are documented by average values of the yearly measurement of vertical layers in both reservoirs. (Sand-PTT)
W91-02387

KEY FACTORS IN TASTE AND ODOUR PROBLEMS FOR MUNICIPAL WATER WORKS USING SURFACE WATER SOURCES.
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-02394

ORGANIC SOLVENT-SOLUBLE CONTENTS OF NICKEL AND COBALT IN SOME ALGAE.
Mainz Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie und Analytische Chemie.
R. Pfarr, and R. Neeb.
Naturwissenschaften NATWAY, Vol. 77, No. 8, p 383-384, August 1990. 1 tab, 5 ref.

Descriptors: *Algae, *Chemical analysis, *Chemical speciation, *Laboratory methods, *Nickel, *Path of pollutants, *Solvents, Chlorophyta, Cobalt, Germany, Heavy metals, Organic solvents, Trace metals.

Heavy metal speciation studies have gained increased importance, especially in view of the need to assess the biological behavior of these metals. Algae samples, mostly Cladophora and Ulothrix, were collected in the Rheinhessen region near Mainz and the total amounts of Ni and Co were determined by adsorption voltammetry with dimethylglyoxime. The solvent-soluble amounts of Ni and Co were measured for a non-polar solvent (hexane) as well as a weakly polar one (chloroform). About 0.1-1.7% of the total Ni and 0.1-2.0% of the total Co are extracted into the solvents with the fraction of metal soluble in the weakly polar solvent higher than the fraction soluble in the nonpolar solvent. A correlation between the total amount present and that extracted was not found. Treatment of the algae prior to the analytical procedure, e.g., with 0.02 molar EDTA per 1 or 0.1 molar HCl/L, decreased the total metal content to a degree which varied from sample to sample, but did not noticeably influence the fraction of metal which dissolved in the organic solvents. (Hoskin-PTT)
W91-02401

USE OF CLUSTER ANALYSIS TO DEFINE PERIODS OF SIMILAR METEOROLOGY AND PRECIPITATION CHEMISTRY IN EASTERN NORTH AMERICA: PART I. TRANSPORT PATTERNS.
Michigan Univ., Ann Arbor. Dept. of Atmospheric, Oceanic and Space Sciences.
M. E. Fernau, and P. J. Samson.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 8, p 735-750, August 1990. 12 fig, 3 tab, 23 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Cluster analysis, *Meteorology, *North America, *Path of pollutants, *Regional Acid Deposition Model, *Weather patterns, Climatology, Computer programs, Model studies, Rainfall distribution, Synoptic analysis, Weather data collections.

An aggregation approach is desirable in order to use results from the Regional Acid Deposition Model to determine seasonal or annual deposition loads in eastern North America. The complexity and number of computations involved in the Regional Acid Deposition Model make it costly to directly model long-term deposition by repeated simulation of episodes of several days duration. Cluster analysis has been used sparingly in synoptic climatological and air pollution applications. Cluster analysis was applied to transport vectors, derived from three years of daily backwards trajectories, in order to define a synoptic climatology of representative three-day periods of air mass movement. The resulting clusters represent groups whose mean air mass transport fields were statistically different from one another and corresponded to the types of high and low pressure patterns seen on daily weather maps. Seasonal differences were evident in the frequency of occurrence of each cluster. The clusters were relatively insensitive to changes in number of sites or years used; however, different clustering methods yielded somewhat different clusters. Ward's hierarchical grouping method yielded clusters with more or less equal numbers while other methods tended to produce one large cluster and a series of outlier clusters. Cluster analysis was useful in the computer-assisted classification of spatial patterns of weather data and should be considered for use along with more widely used synoptic climatological tools such as principal component analysis. (See also W91-02410) (Mertz-PTT)
W91-02409

USE OF CLUSTER ANALYSIS TO DEFINE PERIODS OF SIMILAR METEOROLOGY AND PRECIPITATION CHEMISTRY IN EASTERN NORTH AMERICA: PART II. PRECIPITATION PATTERNS AND POLLUTION DEPOSITION.
Michigan Univ., Ann Arbor. Dept. of Atmospheric, Oceanic and Space Sciences.
M. E. Fernau, and P. J. Samson.
Journal of Applied Meteorology JAMOAX, Vol. 29, No. 8, p 751-761, August 1990. 8 fig, 5 tab, 19 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Cluster analysis, *Meteorology, *North America, *Path of pollutants, *Weather patterns, Climatology, Computer models, Deposition, Model studies, Rainfall distribution, Regional Acid Deposition Model, Synoptic analysis, Water pollution sources, Weather data collections.

The spatial precipitation patterns and wet deposition chemistry associated with transport-derived clusters were examined to determine whether representative meteorological events conducive to high acid deposition could be identified. These representative events could be used in aggregation schemes to extend the results of the episode-based Regional Acid Deposition Model to determine seasonal or annual deposition loads in eastern North America. Cluster analysis has been little used in synoptic climatological and air pollution applications to date. Cluster analysis was applied to transport vectors, derived from three years of daily trajectories arriving at monitoring sites, in order to define a synoptic climatology of representative three-day periods of air mass movement. The resulting clusters were successful in defining wet, dry, polluted and nonpolluted clusters, as shown by the spatial patterns of median deposition and by statistical testing. The highest pollutant depositions over the widest areas resulted from mean transport patterns with large areas of slow air mass movement over the regions of high sulfur emissions and which were frequently persistent over several periods or followed persistent clusters. There was a large amount of overlap among the chemistry distributions and large variation within most of the clusters. Seasonal differences exist within each cluster, with sulfur deposition within a given cluster generally being higher in the warmer months. Cluster analysis was shown to be useful in the computer-assisted classification of spatial patterns of weather and pollution data. (See also W91-02409) (Mertz-PTT)
W91-02410

GROUNDWATER MONITORING: VOLATILE ORGANIC CHEMICALS BENEATH UNSEWERED SUBDIVISION.
Wisconsin Univ.-Eau Claire. Dept. of Geology.
J. R. Tinker.
Journal of Environmental Health JEVHAH, Vol. 53, No. 2, p 26-28, September/October 1990. 5 fig, 12 ref.

Descriptors: *Drinking water, *Groundwater pollution, *Path of pollutants, *Public health, *Volatile organic compounds, *Water pollution sources, Septic wastewater, Tetrachloroethylene, Water quality standards, Well data, Well water, Wisconsin.

Water supply wells in Mill Run Subdivision, Eau Claire County, Wisconsin were sampled for volatile organic chemicals. Mill Run was selected because on-site septic-tank, soil-absorption systems within the subdivision had increased the nitrate-nitrogen levels in the water supply wells to an average of 11.1 mg/L and volatile organic chemicals occur in septic system cleaners and other household products. Fifty-nine water samples from 26 water-supply wells in and adjacent to the unsewered subdivision were analyzed. Three samples from two wells had 1.3 to 3.1 micrograms/L of tetrachloroethylene, but the source of the tetrachloroethylene could not be determined from available data. The enforcement standard in Wisconsin for tetrachloroethylene is 1 microgram/L. The Wisconsin Department of Natural Resources notified in writing the residents of the duplexes served by Wells 21 and 18 of the results of the volatile organic chemicals sampling and the enforcement standard for tetrachloroethylene. Residents were warned not to drink the water. (Mertz-PTT)
W91-02413

MERCURY ACCUMULATION IN RELATION TO SIZE AND AGE OF ATLANTIC HERRING (CLUPEA HARENGUS HARENGUS) FROM THE SOUTHWESTERN BAY OF FUNDY, CANADA.
Guelph Univ. (Ontario). Dept. of Zoology.
B. M. Braune.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 3, p 311-320, May 1987. 3 fig, 7 tab, 46 ref. Natural Sciences and Engineering Research Council of Canada Strategic Grant No. G0304 (1980-83).

Descriptors: *Bioaccumulation, *Canada, *Fish, *Herring, *Mercury, *Path of pollutants, *Water pollution effects, Aquatic environment, Bay of Fundy, Chemical analysis, Correlation analysis, Data interpretation, Fate of pollutants, Marine animals, Marine environment, Marine pollution, Metabolism, Model studies, Muscle, Water analysis, Zooplankton.

Relationships between weight, length or age, and total mercury concentration in Atlantic herring were investigated. In addition, the applicability a model for total mercury accumulation developed for freshwater fish to a sampled population of marine fish, specifically Atlantic herring, was also determined. Measured muscle and whole fish total mercury concentrations showed significant positive correlations with age, weight and length, in order of decreasing correlation. Within herring age classes, however, muscle and whole fish mercury concentrations showed significant negative correlations with weight and length due to a growth dilution effect in 1 and 2 year old herring. However, a positive correlations with weight and length was demonstrated in 3 to 5 year old fish. A bioenergetic-based pollutant accumulation model was used to describe total mercury accumulation for the commercially valuable Atlantic herring aged 3 to 5 years. The predicted values fell within one standard deviation of the measured annual body burdens for the herring. (Author's abstract)
W91-02433

TOXICITY OF CHLORINATED BORNANE (TOXAPHENE) RESIDUES ISOLATED FROM GREAT LAKES LAKE TROUT (SALVELINUS NAMAYCUSH).
Michigan State Univ., East Lansing. Pesticide Research Center.

For primary bibliographic entry see Field 5C.
W91-02435

EFFECTS OF CHLORINATED BENZENES ON DIATOM FATTY ACID COMPOSITION AND QUANTITATIVE MORPHOLOGY: I. 1,2,4-TRICHLOROBENZENE.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W91-02436

EFFECTS OF CHLORINATED BENZENES ON DIATOM FATTY ACID COMPOSITION AND QUANTITATIVE MORPHOLOGY: II. 1,3,5-TRICHLOROBENZENE.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W91-02437

EFFECTS OF CHLORINATED BENZENES ON DIATOM FATTY ACID COMPOSITION AND QUANTITATIVE MORPHOLOGY: III. 1,2,3-TRICHLOROBENZENE.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W91-02438

EFFECTS OF CHLORINATED BENZENES ON DIATOM FATTY ACID COMPOSITION AND QUANTITATIVE MORPHOLOGY: IV. PENTACHLOROBENZENE AND COMPARISON WITH TRICHLOROBENZENE ISOMERS.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W91-02439

DDT CONTAMINATION OF BENTHIC MACROINVERTEBRATES AND SEDIMENTS FROM TRIBUTARIES OF WHEELER RESERVOIR, ALABAMA.
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
E. C. Webber, D. R. Bayne, and W. C. Seesock.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 5, p 728-733, September 1989. 1 fig, 4 tab, 18 ref.

Descriptors: *Alabama, *Benthic environment, *Benthic fauna, *Bottom sediments, *DDT, *Food chains, *Macroinvertebrates, *Path of pollutants, *Reservoirs, *Sediment analysis, *Sediment contamination, *Streams, Benthos, Bottom sampling, Ecosystems, Trophic level, Water pollution sources.

Residues of 1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane (DDT) were measured quarterly during 1983-1984 in bottom sediments and benthic macroinvertebrates from heavily contaminated sections of Huntsville Spring Branch (HSB) and Indian Creek (IC), backwater streams on Wheeler Reservoir (Alabama). Bottom muds from both channel and overbank locations contained mean concentrations of DDTR (DDT and its metabolites) ranging from 12 to 2,730 ppm (dry weight). Sediment DDTR were highest in HSB at stations closest to the original DDT source. Stations in IC, downstream from HSB, had progressively lower DDTR as distance from the DDT source increased. Macroinvertebrate DDTR measured from several stations suggested bioaccumulation of residues mainly through food webs. However, at the most contaminated locations, substrate and mode of life appeared to override trophic level effects in determining DDTR in the benthos. There is apparently an upper limit to the amount of DDTR these organisms usually accumulate. For example, detritivore DDTR from channel sediments at two stations just downstream from the DDT source averaged 2,370 ppm and 96 ppm, respectively. Benthic macroinvertebrates in the highly contaminated sediments of HSB and IC apparently acquire DDTR from water, sediments, and food. (Author's abstract)
W91-02442

SEASONAL DELIVERY OF THE PARTICULATE FORMS OF PHOSPHORUS TO LAKE GENEVA FROM THE UPPER RHONE RIVER.
Geneva Univ. (Switzerland). Inst. F.-A. Forel.
For primary bibliographic entry see Field 2H.
W91-02448

PERSISTENCE OF DDT IN THE YAKIMA RIVER DRAINAGE, WASHINGTON.
Washington State Dept. of Ecology, Olympia.
A. Johnson, D. Norton, and B. Yake.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 3, p 289-297, May 1988. 3 fig, 4 tab, 34 ref.

Descriptors: *DDD, *DDE, *DDT, *Fate of pollutants, *Fish, *Nonpoint pollution sources, *Path of pollutants, *Pesticide residues, *River sediments, Environmental quality, Halogenated pesticides, Pollutant identification, Seasonal variation, Washington, Water pollution, Yakima River.

DDT compounds (p,p' and o,p' isomers of DDT and metabnolites DDE and DDD were studied in fish, water, and bed sediments from the Yakima River drainage in Washington State. p,p'-DDE was the predominant compound in fish and the only DDT compound detected in water from the main stem of the river. However, concentrations of p,p'-DDT predominated in water and bed sediments from Yakima tributaries identified as current sources of DDT compounds. These data suggest DDT is extremely persistent in Yakima basin soils. Data compiled by the U.S Geological Survey and U.S. Fish and Wildlife Service illustrated a historical trend toward decreasing concentrations of DDT compounds in water and fish from the main stem of the Yakima River. A positive correlation between runoff and water concentrations of chlorinated pesticides has been demonstrated in a number of investigations. Results from this study showed DDT compounds were routinely detectable in several Yakima River tributaries during the irrigation season, but could not be detected in any tributary after diversions for irrigation ceased. (Mertz-PTT)
W91-02457

EFFECT OF URANIUM MINE TAILINGS ON RADIONUCLIDE CONCENTRATIONS IN LANGLEY BAY, SASKATCHEWAN, CANADA.
Environmental Protection Service, Regina (Saskatchewan).
D. T. Waite, S. R. Joshi, and H. Sommerstad.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 3, p 373-380, May 1988. 1 fig, 5 tab, 28 ref.

Descriptors: *Lake Athabasca, *Mine wastes, *Path of pollutants, *Radioisotopes, *Uranium radioisotopes, *Water pollution sources, Acid mine drainage, Bioaccumulation, Calcium, Canada, Conductivity, Ions, Langley Bay, Magnesium, Sulfates, Water chemistry, Water pollution.

From 1955 to 1964 the Gunnar Uranium Mine (Canada) produced approximately 8000 tons of uranium oxide and about 5,000,000 tons of waste rock tailings. Large quantities of fine tailings material washed into Langley Bay, a shallow bay opening onto Lake Athabasca. The initial movement of tailings into Langley Bay occurred suddenly, as a result of the demolition of a retaining dam. This material consisted of a slurry of untreated, acidic wastes produced by the sulfuric acid extraction process used by the mine. Following this initial event, effluent from the process continued to transport materials in the bay until mine closure in 1964. Runoff from the uphill tailings continues to move various metals into Langley Bay. The sediment data showed concentrations of radionuclides and some heavy metals to be much higher in Langley Bay than in the uncontaminated control area. The tailings content of the sediments in Langley Bay had significantly affected the water chemistry. The water of the two control sites was of low conductivity, Ca(2+), HCO3(-) type, typical of shield areas. Sites overlying tailings showed marked differences in both major and minor components. Conductivities were higher as a result of increases in Ca(2+), Mg(2+) and SO4(2-), probably derived from the CaSO4 and MgSO4 precipitates reported to be in the tailings. Concentrations of uranium found in Langley Bay water fell within the 0.5-200 microgram/L range reported for American rivers. Concentrations of 226Ra and 210Pb at some sites were higher than those reported for other northern Canadian waters above contaminated sediments. These radionuclides were available for uptake by the resident biota. The northern pike and whitefish populations of Langley Bay contained higher body burdens of radionuclides than those from uncontaminated control areas. (Mertz-PTT)
W91-02460

TOXICITY TESTING OF SUBLETHAL EFFECTS OF DREDGED MATERIALS.
Old Dominion Univ., Norfolk, VA. Applied Marine Research Lab.
For primary bibliographic entry see Field 5C.
W91-02461

INORGANIC POLLUTION OF THE MAN-MADE LAKES OF WADI EL-RAIYAN AND ITS IMPACT ON AQUACULTURE AND WILDLIFE OF THE SURROUNDING EGYPTIAN DESERT.
Cairo Univ., Giza (Egypt). Faculty of Agriculture.
M. A. Saleh, M. A. Saleh, M. M. Fouda, M. A. Saleh, and M. S. A. Abdel Lattif.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 3, p 391-403, May 1988. 4 fig, 8 tab, 45 ref.

Descriptors: *Aquaculture, *Deserts, *Reservoirs, *Water pollution effects, *Water pollution sources, Agricultural runoff, Ammonia, Bioaccumulation, Cadmium, Carbonates, Copper, Cyanide, Egypt, Halogens, Heavy metals, Iron, Lead, Manganese, Mercury, Nitrates, Nitrites, Phosphates, Selenium, Silicates, Sulfates, Sulfites, Thiocyanate, Water pollution, Zinc.

El-Raiyan lakes were created as a reservoir for agricultural drainage wastewater in the Western Desert of Egypt. The project was started in 1968 and has been operating since 1973. Physical and chemical properties of water from 17 sampling stations in the lakes and in the springs of the surrounding deserts were monitored every three months during the years 1984 and 1985. Concentrations of metals (cadmium, copper, iron, lead, manganese, mercury, selenium, and zinc) and of inorganic anions (sulfate, sulfite, sulfide, nitrate, nitrite, ammonia, cyanide, thiocyanate, halogens, carbonate, silicate, and phosphate) were generally lower than those reported for other lakes of Egypt which are used as wastewater reservoirs. The concentrations of metals and inorganic anions in water varied according to the distance from the origin of the lakes, depth, and seasons of the year. Concentrations of heavy metals in fish and in selected wildlife fauna and flora of the surrounding deserts were also determined. Animals living near the lakes had much higher concentration of heavy metals, particularly lead, mercury, and cadmium than animals of the same species collected further away from the lakes. High rate of evaporation may cause concentrations of heavy metals to soon reach dangerous levels. This may effect the utilization of the lake for fish production and may also pollute groundwater of the nearby springs and be transferred through the food chain to wildlife of the area. The use of biological filters and/or growing grass on the sand dunes may be used to clean up heavy metals from the water. (Mertz-PTT)
W91-02462

TIGRIS-EUPHRATES DELTA: A MAJOR SOURCE OF PESTICIDES TO THE SHATT AL ARAB RIVER (IRAQ).
Basrah Univ. (Iraq). Dept. of Environmental Marine Chemistry.
A. A. DouAbul, H. T. Al-Saad, A. A. Al-Timari, and H. N. Al-Rekabi.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 3, p 405-41

May 1988. 4 fig, 5 tab, 33 ref.

Descriptors: *Bioaccumulation, *Chlordane, *DDD, *DDE, *DDT, *Deltas, *Endrin, *Halogenated pesticides, *Heptachlor, *Path of pollutants, *Shatt Al-Arab River, *Water pollution sources, Arid lands, Euphrates River, Iraq, Mussels, Pesticide residues, Pesticides, River sediments, Tigris River, Water pollution.

Organochlorine pesticides were determined in the Tigris-Euphrates-Shatt al-Arab Delta by high resolution gas chromatography. Mean concentrations of pesticides in the dissolved form were 98 ng/L p,p'-DDE (2,2-bis(p-chlorophenyl)-1,1-dichloroethylene); 8 ng/L o,p'-DDD (2,2-bis(p-chlorophenyl)-1,1-dichloroethane); 28 ng/L p,p'-DDD; 16 p,p'-DDT (2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane); 30 mg/L aldrin; 66 ng/L dieldrin; 57 ng/L cis-chlordane; 15 ng/L trans-chlordane and 10 ng/L heptachlor. Mean particulate concentrations were 76 microgram/kg dry weight for p,p'-DDE; 67 microgram/kg p,p'-DDT; 154 microgram/kg endrin; 11 microgram/kg cis-chlordane; and 68 microgram/kg heptachlor. Partitioning of dissolved pesticides was evident along the Shatt al-Arab River, which was reflected by significantly higher levels of particulate species down river. Residues of p,p'-DDE; p,p'-DDD; p,p'-DDT; endrin and dieldrin were confirmed in sediments from this river; however, DDD was confined to the anoxic sub-surface layers only. Absorbing pesticides from both water and suspended particulate matter, Shatt al-Arab mussels had mean residue concentrations of 43 microgram/kg wet weight p,p'-DDD; 12 microgram/kg aldrin; 24 microgram/kg dieldrin; 6 microgram/kg cis-chlordane and 5 microgram/kg trans-chlordane. The euphrates River was the major source of pesticides in the dissolved form, while the Tigris River contributed pesticides mainly in the particulate form to the Shatt al-Arab River. The sediment of this river was the largest reservoir of organochlorine pesticides, where more than 80% of the studied contaminants reside. (Author's abstract)
W91-02463

LONG-TERM MONITORING OF POLYCHLORINATED BIPHENYLS IN THE HUDSON RIVER (NEW YORK) USING CADDISFLY LARVAE AND OTHER MACROINVERTEBRATES.
New York State Dept. of Environmental Conservation, Albany. Div. of Water.
M. A. Novak, A. A. Reilly, and S. J. Jackling.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 6, p 699-710, November 1988. 6 fig, 5 tab, 11 ref.

Descriptors: *Bioassay, *Bioindicators, *Hudson River, *Monitoring, *Polychlorinated biphenyls, *Water pollution sources, Caddisflies, New York, Water pollution.

Polychlorinated biphenyl (PCB) contamination of the Hudson River occurred over a period of nearly 50 years, via discharges by capacitor manufacturing plants in Hudson Falls and Fort Edward, New York. Concentrations of PCBs in the Hudson River were monitored from 1978 through 1985, by chromatographic analysis of the tissue residues of hydropsychid caddisflies and the contents of artificial substrate samplers. For both means of assessment, levels of Aroclor 1016 and Aroclor 1254 were positively correlated. Temporally, PCB concentrations decreased at all sampling stations from 1978 to 1980, but increased and remained stable from 1981 through 1985. Spatially, PCB levels as measured by artificial substrate samplers, decreased along the length of the river. Spatial trends in caddisflies were not as consistent as those of the artificial substrate samplers; in 6 of the 8 years sampled, there was no significant decrease in PCB concentrations in caddisflies from the point of discharge of the contaminant to the most downstream sampling site. (Mertz-PTT)
W91-02464

POLYCHLORINATED BIPHENYL CONGENERS IN SEDIMENTS, PLANKTON, MOLLUSCS, CRUSTACEANS, AND EEL IN A FRESHWATER LAKE: IMPLICATIONS OF USING REFERENCE CHEMICALS AND INDICATOR ORGANISMS IN BIOACCUMULATION STUDIES.
Amsterdam City Environmental Health Research Lab. (Netherlands).
R. van der Oost, H. Heida, and A. Opperhuizen.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 6, p 721-729, November 1988. 3 fig, 5 tab, 36 ref.

Descriptors: *Bioaccumulation, *Biological magnification, *Food chains, *Monitoring, *Path of pollutants, *Polychlorinated biphenyls, Fish, Lakes, Macroinvertebrates, Plankton, The Netherlands, Water pollution.

The concentrations of six polychlorinated biphenyl (PCB) congeners in sediments and four classes of biota species of the aquatic food chain were investigated in a freshwater lake near Amsterdam, The Netherlands. Despite the low concentrations of the contaminants in the sediment, significant amounts of PCBs were found in plankton, macro-invertebrates and fish. The composition of the PCB mixtures found in the various organisms cannot be explained in terms of simple partitioning of the PCB congeners between sediment, water, and organisms. In addition to bioconcentrations, it is likely that biomagnification via consumption of contaminated food also contributed significantly to the total PCB concentrations. This is most pronounced for the higher trophic food-chain organisms. Studying bioaccumulation processes by monitoring just one type of organism is probably not very suitable, due to the pronounced differences in accumulation patterns demonstrated for the different organisms. In addition, significant differences were found in the accumulation of the six PCBs in the various biotic samples. This indicates that the fate of the mixtures of PCBs is determined by the fate of the individual congeners and therefore cannot be monitored in terms of total PCBs concentrations. (Author's abstract)
W91-02465

SPATIAL DIFFERENCES AND TEMPORAL TRENDS OF ORGANOCHLORINE COMPOUNDS IN BIOTA FROM THE NORTHWESTERN HEMISPHERE.
Statens Livsmedelsverk, Uppsala (Sweden). Food Research Dept.
O. Andersson, C. E. Linder, M. Olsson, L. Reutergardh, and U. B. Uvemo.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 6, p 755-765, November 1988. 4 fig, 3 tab, 37 ref.

Descriptors: *Biological magnification, *DDD, *DDE, *DDT, *Halogenated pesticides, *Path of pollutants, *Pesticide residues, *Polychlorinated biphenyls, *Spatial distribution, *Temporal distribution, Animals, Arctic zone, Baltic region, Birds, Chlordane, Fate of pollutants, Fish, Polychlorinated camphenes, Seals.

Tissues of animal species from various trophic levels in the northwestern hemisphere were collected and analyzed for the presence of polychlorinated camphenes (PCC, for example toxaphene), DDT and its metabolites DDD and DDE and PCB (polychlorinated biphenyl) to elucidate differences in geographical distribution, biomagnification and temporal trends. Many of the samples were also analyzed for the presence of chlordane. The previously achieved knowledge of DDT and PCB contamination was used as a yardstick for characterizing the exposure regime of the other organochlorine compounds. No pronounced geographical differences were found for polychlorinated camphenes when comparing animals from the Arctic region with corresponding species in the Baltic, while PCB, DDD and DDE showed definite spatial differences. The highest concentrations of DDD, DDE and PCB were found in fish predators, such as raptorial birds and seals, from the Baltic. Polychlorinated camphenes levels in fish exceeded levels of DDD, DDE and PCB in the North Atlantic and the polychlorinated camphenes levels in Swedish fish were as high or higher than the DDD and DDE levels. While the DDD, DDE, and PCB levels for all trophic levels ranged from 0.14-990 mg/Kg fat, the corresponding range for polychlorinated camphenes was only 0.33-17 mg/kg. This indicated less biomagnification of polychlorinated camphenes and/or a more effective metabolism of polychlorinated camphenes, compared with DDD, DDE, and PCB, at high trophic levels. The levels of DDD, DDE, and PCB is Swedish fish and birds showed a decrease during the late seventies and the beginning of the eighties. For the polychlorinated camphene levels, however, no distinct trends could be discerned during the same period in any of the areas studied. (Author's abstract)
W91-02467

EVALUATING THE IMPACT OF MUNICIPAL WATER FLUORIDATION ON THE AQUATIC ENVIRONMENT.
Lakeshore General Hospital, Pointe Claire (Quebec). Community Health Dept.
For primary bibliographic entry see Field 5C.
W91-02510

DIFFUSION AND DISPERSION IN COASTAL WATERS.
California Inst. of Tech., Pasadena. Dept. of Environmental Engineering Science.
E. J. List, G. Gartrell, and C. D. Winant.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 10, p 1158-1179, October 1990. 17 fig, 1 tab, 15 ref.

Descriptors: *Coastal waters, *Diffusion, *Dispersion, *Ocean dumping, *Path of pollutants, *Water currents, California, Eddy diffusion, Oceanography, Outfall, Theoretical analysis, Tides, Turbulent flow, Waste disposal.

Oceanographic drogue and current meter studies were performed in the coastal waters of southern California. The transport and dispersing properties of the oceanographic currents were evaluated over diurnal periods and related to extant theories of diffusion and dispersion in coastal waters. The measurements provided useful results concerning Lagrangian and Eulerian estimates of turbulent diffusivity. In particular, they show the importance of regarding diffusivity as an ensemble average property of the turbulent flow field, and that great care is necessary in applying the concept to single realization studies. It was shown that under some tide conditions significant negative diffusivities are possible. Furthermore, coastal motions at this location were very coherent up to scales of 4-5 km, at which point they become rapidly dispersive. The results provide information of value in the design of ocean disposal systems. (Author's abstract)
W91-02521

ESTIMATION OF FLOW THROUGH AND OVER ARMORED SLOPES.
Nuclear Regulatory Commission, Washington, DC. Div. of Waste Management.
For primary bibliographic entry see Field 5E.
W91-02526

FREE AMMONIA AND TOXICITY CRITERIA IN A POLLUTED URBAN LAKE.
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, C. M. Brooks, M. T. Auer, and S. M. Doerr.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 6, p 771-779, September/October 1990. 7 fig, 3 tab, 40 ref.

Descriptors: *Ammonia, *Eutrophication, *Lake restoration, *Path of pollutants, *Urban areas, *Water pollution control, *Water quality, Algal growth, Hydrogen ion concentration, Monitoring, New York, Onondaga Lake, Seasonal variation, Toxicity, Wastewater pollution.

The distribution of free ammonia in Onondaga Lake, New York, a polluted urban lake, was documented for the spring-to-fall interval of 1988. Free ammonia levels were compared with national criteria set to protect fish from toxic effects. Nearly continuous contravention of the national chronic

toxicity criteria for free ammonia for salmonid and nonsalmonid fish, at all depths, and infrequent contravention of the national acute toxicity criterion for nonsalmonids in the upper waters was documented. The occurrence of particularly high concentrations of free ammonia was associated with increases in pH, driven by high levels of algal growth. A major reduction (>60%) in the concentration of total ammonia in the epilimnion of the lake is necessary to remediate the lake's free ammonia problem. This would require a major reduction (>50%) in the load presently received from the adjoining wastewater treatment plant. This remediation effort should be integrated with ongoing programs, focusing on the lake's problem of excessive algal growth, because of the impact of algal photosynthetic activity on levels of free and total ammonia in the lake. (Author's abstract)
W91-02536

TOTAL TRIHALOMETHANE FORMATION DURING TARGETED AND CONVENTIONAL CHLORINATION OF SEAWATER FOR BIOFOULING CONTROL.
For primary bibliographic entry see Field 5F.
W91-02538

SUPERCOMPUTERS AND THEIR USE IN MODELING SUBSURFACE SOLUTE TRANSPORT.
Western Australia Univ., Nedlands. Centre for Water Research.
For primary bibliographic entry see Field 7C.
W91-02543

REVISION OF THE SAPROBIC SYSTEM (EINE REVISION DES SAPROBIENSYSTEMS).
Landesamt fuer Wasser und Abfall Nordrhein-Westfalen, Duesseldorf (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W91-02546

S-OXYGENATION OF THIOBENCARB (BOLERO) IN HEPATIC PREPARATIONS FROM STRIPED BASS (MORONE SAXATILIS) AND MAMMALIAN SYSTEMS.
California Univ., San Francisco. School of Pharmacy.
For primary bibliographic entry see Field 5C.
W91-02552

NUTRIENTS, HEAVY METALS AND ORGANIC MICROPOLLUTANTS IN AN EUTROPHIC BRAZILIAN LAGOON.
Universidade Federal Fluminense, Niteroi (Brazil). Dept. de Geoquimica.
B. A. Knoppers, L. D. Lacerda, and S. R. Patchineelam.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 8, p 381-384, August 1990. 5 tab, 30 ref.

Descriptors: *Brazil, *Coastal lagoons, *Effluents, *Eutrophic lakes, *Eutrophication, *Heavy metals, *Nutrients, *Organic pollutants, *Urbanization, *Water quality, Environmental quality, Path of pollutants, Sediment contamination, Trace metals, Water pollution, Water sampling.

The Fluminense coastline between the cities of Rio de Janeiro and Cabo Frio includes numerous eutrophic lagoons. A recent increase in urbanization has resulted in uncontrolled effluent discharges into some of these lagoons. An evaluation was made of the environmental quality with respect to nutrients, heavy metals, and organic micropollutants at Lagoa de Guarapina, a tropical eutrophic lagoon of Rio de Janeiro State, Brazil. Sampling for dissolved inorganic nitrogen species was conducted over an annual cycle (winter 1985 to 1986) at four stations in the lagoon. In addition, samples for particulate organic carbon and nitrogen were collected at the central station in the lagoon. Trace metal analyses were performed on surficial sediments at five stations and their vertical distribution was assessed on a separate sediment core from the central lagoon station. The cations exchange capacity, organic matter content and heavy metals manganese, chromium, zinc and lead generally decrease from the fluvial to the lower estuarine station, with maximum values at the central lagoon station and decrease sharply towards the lower portion, close to the tidal inlet. Nickel and copper, however, remained fairly constant. Concentrations of nutrients and heavy metals in the lagoon and its tributaries were low, closely resembling natural conditions. However, lead formed the exception, and its presence in conjunction with detectable concentrations of organic micropollutants suggest that minor pollution effects are occurring via atmospheric inputs. (VerNooy-PTT)
W91-02555

PERSISTENCE OF SPILLED CRUDE OIL IN A TROPICAL INTERTIDAL ENVIRONMENT.
Puerto Rico Univ., Mayaguez. Dept. of Marine Sciences.
J. E. Corredor, J. M. Morell, and C. E. Del Castillo.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 8, p 385-388, August 1990. 2 fig, 2 tab, 15 ref.

Descriptors: *Degradation, *Fate of pollutants, *Mangrove swamps, *Marine pollution, *Oil spills, *Path of pollutants, *Puerto Rico, *Sediment contamination, Biodegradation, Hydrocarbons, Intertidal areas, Oil, Oil pollution, Sediment analysis, Tropical regions.

In the last few decades, two major tanker spills of crude oil have occurred off the southern coast of Puerto Rico; that of the Argea Prima in 1962 and the Zoe Colocotronis in 1977. As a contribution to the CARIPOL program for petroleum pollution research and monitoring in the Caribbean region, the vertical distribution of hydrocarbons in a core from sediments was documented. Intertidal sediments at Bahia Sucia, on the southwest coast of Puerto Rico contain discreet subsurface layers of petrogenic hydrocarbons. The uppermost of these layers contains petroleum contaminants in concentrations above 100 mg/g and is most probably attributable to the 1977 spill. A deeper layer containing a less concentrated load of petroleum hydrocarbons may correspond to the spill of 1962. Sediments above, between and below these two layers present low concentrations of typically biogenic hydrocarbons. Although petroleum released to the sea in tropical environments generally suffers rapid degradation, petroleum contaminants reaching intertidal sediments may exhibit long-term persistence. In the case of mangrove-lined intertidal environments, rapid burial coupled to the well-documented bacteriostatic nature of mangrove tannins result in a dramatic decrease in degradation rates of petroleum hydrocarbons in these environments. Persistence of these substances may well have subsequent long-term deleterious effects upon the mangroves themselves as well as the complex plant and animal communities associated with the mangroves. (VerNooy-PTT)
W91-02556

TRACE METALS IN THE SEVERN ESTUARY: A REAPPRAISAL.
Water Research Centre, Medmenham (England).
S. C. Apte, J. M. Gardner, A. M. Gunn, J. E. Ravenscroft, and J. Vale.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 8, p 393-396, August 1990. 2 fig, 2 tab, 10 ref.

Descriptors: *England, *Estuarine environment, *Heavy metals, *Path of pollutants, *Trace metals, *Water pollution sources, Arsenic, Cadmium, Chromium, Copper, Distribution patterns, Lead, Nickel, Salinity, Severn River Estuary, Water quality, Zinc.

The Severn estuary is the largest estuary in the United Kingdom. The salinity/concentration profiles of seven dissolved trace metals, i.e., copper (Cu), nickel (Ni), cadmium (Cd), lead (Pb), chromium (Cr), zinc (Zn), and arsenic (As), in the Severn estuary were reported. The metal concentrations observed in this study were considerably lower than those reported in previous work. Despite known inputs of metals through industrial and waste discharges, river inputs play an important part in the estuarine profiles. For Cu, Ni and Zn, riverine inputs appear to be the main source of metals. The profiles of Cd, Cr and As appear to be dominated by point source discharges in mid-estuary. Lateral heterogeneity is small, except in the vicinity of industrial outfalls. In spite of this, quite large between-day variations in dissolved metal concentrations were observed in the upper estuary. Chromium was the only metal not showing between-day variability. Saline end member concentrations were consistent with ranges quoted for the European coastal shelf area. This survey suggests that atmospheric deposition is far less important, at least as a contributor to concentrations of dissolved metal, though its influence on particulate metal may still be significant. (VerNooy-PTT)
W91-02557

HYDROCARBON CONCENTRATIONS IN SEDIMENTS AND ANIMAL TISSUES FROM THE COASTAL WATERS OF KARACHI.
Karachi Univ. (Pakistan). Inst. of Marine Biology.
S. Durrani, and S. A. Siddiqui.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 8, p 397-399, August 1990. 2 fig, 1 tab, 9 ref.

Descriptors: *Coastal waters, *Marine pollution, *Oil pollution, *Pakistan, *Path of pollutants, *Water quality, Fish, Hydrocarbons, Oil, Oil refineries, Oil spills, Oysters, Sediment analysis, Sediment contamination, Tissue analysis.

Preliminary data is presented on the present levels of petroleum hydrocarbon contamination in coastal waters of Karachi (Pakistan) resulting from the exploitation, refining and routine handling of petroleum. Surface sediment samples in triplicate and subtidal samples were collected from the intertidal zone during low tide from Korangi Creek and Hawks Bay and from Manora Channel. Oysters (Crassostrea rivularis and Perna viridis) and fish (Mugil sp. and Acanthopagurus sp.) were also collected. Extracted aliphatic hydrocarbons were analyzed by gas chromatography. In marine sediment a range of hydrocarbons (n-C7 to n-C19) were detected. Levels found in the sediments were 0.0 to 0.16 ng/g for n-C19 and 0 to 0.24 ng/g for n-C16. Hydrocarbon peaks were not observed in the tissues of Perna viridis and fish from any locality. The coastal waters of Karachi seem to discourage persistence of oil pollution due to the availability of light, temperatures characteristic of tropical areas, and well oxygenated water. (VerNooy-PTT)
W91-02558

OIL POLLUTION IN THE SOUTHERN ARABIAN GULF AND GULF OF OMAN.
Institute of Oceanography and Fisheries, Alexandria (Egypt).
H. I. Emara.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 8, p 399-401, August 1990. 6 fig, 2 tab, 11 ref.

Descriptors: *Arabian Gulf, *Data collection, *Marine pollution, *Oil pollution, *Water quality, *Water sampling, Distribution patterns, Hydrocarbons, Oil, Oil spills, Path of pollutants.

Results are presented from the winter cruise (February to 3 March, 1987) carried out in the southern Arabian (Persian) Gulf and the gulf of Oman, as well as previous work in the Northwestern Arabian Gulf in 1984 to 1986. Surface and subsurface (10 to 200 m) samples were taken. Kuwait crude oil was used as standard with detection limits of 1 microgram/L. Petroleum hydrocarbons in surface water varied from 4.6 to 2 micrograms/L in the southern Arabian Gulf compared with 4.4 to 63 micrograms/L in the Gulf of Oman. 54% of the analyzed samples contained less than 16 micrograms/L. Starting from the Qatar waters, the petroleum levels generally showed decrease in an eastward direction until Sharjah the United Arab Emirates water. The vertical profile of petroleum hydrocarbons was nearly homogeneous due to vertical mixing characteristic of winter season. Data from 1984 to 1987 were examined. Excluding the highly polluted stations, 1987 levels of petroleum hydrocarbons are exceptionally high in comparison with other areas in the world oceans. When the concentrations all stations including the highly contaminated

were considered, the mean values decrease from 1984 to 1987 indicating that during 1984 to 1985 the Gulf water was affected by oil spills due to the Iraq-Iran war. The average concentration of petroleum hydrocarbons in the Gulf area varied from 15 to 65.2 micrograms/L during the years 1987 and 1984, respectively. The annual contribution of petroleum hydrocarbons that fluxed from the Arabian Gulf to the Gulf of Oman during 2987 is 23% of the annual fluxes recorded in 1984. (VerNooy-PTT)
W91-02559

FUCUS VESICULOSUS AS AN INDICATOR OF HEAVY METAL AVAILABILITY IN A FISH FARM RECIPIENT IN THE NORTHERN BALTIC SEA.
Åbo Akademi, Turku (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W91-02560

TOXIC-SUBSTANCE CONTROL FOR THE OHIO RIVER.
Ohio River Valley Water Sanitation Commission, Cincinnati.
For primary bibliographic entry see Field 5G.
W91-02564

LOADING OF WATER AND SOIL BY POLLUTANTS IN SHELBY COUNTY.
Christian Brothers Univ., Memphis, TN.
K. Madhavan.
Journal of the Tennessee Academy of Science TASAG, Vol. 65, No. 4, p 121-128, 1990. 2 fig, 7 tab, 5 ref.

Descriptors: *Path of pollutants, *Pesticides, *Pollutant load, *Soil contamination, *Water pollution sources, Air pollution, Aldrin, Atrazine, Bacteria, DDT, Heptachlor, Herbicides, Memphis, Organic compounds, Pollutant identification, Shelby County, Surface runoff, Suspended solids, Tennessee, Wet deposition.

A study was undertaken to indicate the possible extent of pollution of the surface soil in and near Memphis. Since rain carries surface and atmospheric pollutants into the runoff, water samples were collected and analyzed for pollutants at different times during and between rainfall events. Only one site was studied in a residential area and only one site was studied near a chemical plant, to give an idea of the extent of pollution under differing environmental conditions. The results presented are site specific and vary with other factors such as weather, rainfall rate, rainfall intensity, previous rainfall conditions, and number of household pets in the neighborhood. For the residential site, the amounts of various chemicals present were below the surface water criteria for pesticides in public water supplies. Results obtained in the industrial site are also site specific since the extent of pollution mainly depends on the proximity of the study site from the chemical industries. (Lantz-PTT)
W91-02583

QUANTITATIVE ASSESSMENT OF THE SOURCES AND GENERAL DYNAMICS OF TRACE METALS IN A SOFT-WATER LAKE.
Lancaster Univ. (England). Inst. of Environmental and Biological Sciences.
D. Hamilton-Taylor, and M. Willis.
Limnology and Oceanography LIOCAH, Vol. 35, No. 4, p 840-851, June 1990. 1 fig, 9 tab, 39 ref. Natural Environmental Research Council Grant GR3/4029.

Descriptors: *Chemical analysis, *Heavy metals, *Lakes, *Path of pollutants, *Trace metals, *Water pollution sources, Air pollution, Aluminum, Copper, England, Iron, Lead, Manganese, Pollution load, Wastewater disposal, Wet deposition, Windermere, Zinc.

Dissolved (<0.45 microm) and particulate concentrations of Fe, Mn, Al, Cu, Pb, and Zn were measured at intervals of 2-6 weeks in rivers, sewage effluents, atmospheric deposition, and surface lake waters within the Windermere (U.K.) catchment, over a two year period. Factor analysis revealed a number of geochemical associations: a large proportion of the particulate Fe, Al, Pb, and Cu appears to be associated with detrital minerals and organic materials in the rivers, sewage effluents, and atmospheric deposition; redox processes, probably occurring higher in the catchment, have an appreciable influence on the riverine concentrations of dissolved Fe and Mn, particulate Mn, and to a lesser extent particulate Fe and Zn; pollution terms account for most of the variance of dissolved Fe, Cu, Pb, and Zn, and particulate Cu, Pb, and Zn in the sewage effluent and atmospheric deposition data sets; and an association in the rivers of dissolved Al and Zn concentrations with discharge is probably related to catchment soil processes. Mass balances were determined for the metals, including a detailed assessment of the errors involved. An imbalance was apparent between the inputs and the outputs (flushing and sedimentation), probably due to the underestimation of particulate loads in the rivers. Fe, Mn, and Al were predominantly (> 90%) supplied by rivers, while Cu, Pb, and Zn received significant inputs from direct atmospheric deposition and sewage discharges. The residence times of the dissolved metals in Windermere were in the order: Cu > Zn > Pb, Fe, a sequence consistent with observations in various alpine lakes. More than 50% of the dissolved inputs of each metal was retained in the lake, except for Cu, which appeared to show a small net loss from the lake. (Author's abstract)
W91-02587

SULFUR STORAGE AND ALKALINITY GENERATION IN NEW ENGLAND LAKE SEDIMENTS.
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2H.
W91-02588

ANNUAL MEAN TRANSPORT IN PUGET SOUND.
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
E. D. Cokelet, R. J. Stewart, and C. C. Ebbesmeyer.
Available from the National Technical Information Service, Springfield, VA 22161. NOAA Technical Memorandum ERL PMEL-92, July 1990. 59 p, 12 fig, 15 tab, 55 ref, append.

Descriptors: *Estuaries, *Model studies, *Path of pollutants, *Puget Sound, Data interpretation, Hydrologic models, Runoff, Salinity, Strait of Juan de Fuca.

The increasing urbanization of the Puget Sound region is resulting in concern about the long-term circulation of the Sound and its relationship to the transport and dispersal of pollutants. As part of a study of this problem, a project was undertaken to calculate systematically the annual mean runoff, salinity and transport of the Sound. Puget Sound was modeled as a branched system of two-layered advective reaches separated by mixing zones. Fresh-water and salt-water provide convenient tracers to calculate the annual mean layer transports. The technique used historical records (1951-1956) of runoff and salinity which were analyzed with the aid of modern (principally in the 1970s) current meter records to provide the appropriate mass conserving landward-flowing and seaward-flowing layer salinities for each reach. For the first time long-term transports have been estimated simultaneously for the entire Strait of Juan de Fuca/Puget Sound system. With few exceptions the inferred transports agree well with estimates derived from scattered, shorter duration current observations. Uncertainties in the transports are estimated from uncertainties in the runoff, velocity profiles and salinities. The analyzed runoff and salinity data sets and the inferred transports provide a foundation for applying the reflux theory to Puget Sound. (Lantz-PTT)
W91-02615

CHARACTERIZATION OF YEAR-ROUND SENSITIVITY OF CALIFORNIA'S MONTANE LAKES TO ACIDIC DEPOSITION.
California Univ., Santa Barbara. Marine Science Inst.
J. O. Sickman, and J. M. Melack.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-215552. Price codes: A04 in paper copy, A01 in microfiche. Final Report, June 1989. 104 p, 44 fig, 19 tab, 25 ref. California Air Resources Board Contract A5-203-32.

Descriptors: *Acid rain, *California, *Mountain lakes, *Path of pollutants, *Water pollution sources, Acetates, Ammonium, Crystal Lake, Hydrogen, Hydrogen ion concentration, Nitrates, Pear Lake, Ruby Lake, Seasonal variation, Sierra Lake, Snow, Sulfates, Topaz Lake.

Four high elevation lake watersheds in the Sierra Nevada were studied from October 1986 through June 1988. Researchers measured wet deposition, lake outflow, and lake chemistry and physics at these sites using the mass balance approach to relate the effect of wet deposition on lake and stream water chemistry. Crystal and Ruby Lakes, located on the eastern slope of the Sierra, and Topaz and Pear Lakes, located on the western slope in Sequoia National Park, were found to be dimictic. Major solute concentrations in the subsurface reached a minima during the latter part of snowmelt. Near-bottom concentrations of these solutes generally had less seasonal variation and were generally higher than subsurface values. Mean snow depth and chemical concentrations were similar for the winters of 1986-87 and 1987-88 at all watersheds. Volume-weighted mean pH ranged from 5.3 to 5.5, with the dominant ions being hydrogen, ammonium, acetate, nitrate and sulfate. Wet deposition as mixed rain and snow occurring between May and October can deliver more solutes to the watersheds than winter snows. (Author's abstract)
W91-02619

WETLAND AREAS: NATURAL WATER TREATMENT SYSTEM (JAN 78 - AUG 89). CITATIONS FROM THE POLLUTION ABSTRACTS DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5D.
W91-02642

SUMMARY OF RISK ASSESSMENT METHODOLOGIES FOR MUNICIPAL SLUDGE REUSE OR DISPOSAL OPTIONS.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
For primary bibliographic entry see Field 5E.
W91-02666

SEDIMENT-WATER-EQUILIBRIA: THE SORPTION OF VOLATILE CHLORINATED HYDROCARBONS AND DICHLORO BENZENES BY SEDIMENTS. (SEDIMENT-WASSER-GLEICHGEWICHTE: VERHALTEN FLUCHTIGER CHLORKOHLENWASSERSTOFFE UND DER DICHLORBENZOLE AN GEWASSERSEDIMENTEN).
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
R. Weinberg, U. Forstner, T. Haug, and W. Kienz.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-764537. Price codes: A06 in paper copy, A01 in microfiche. Report No. NP-9764537. December 1987. 113p, 46 fig, 20 tab, 132 ref. English summary.

Descriptors: *Fate of pollutants, *Organic pollutants, *Path of pollutants, *Sediment chemistry, *Sediment-water interfaces, *Sorption, Anions, Benzene, Cations, Chlorinated hydrocarbons, Germany, Hydrogen ion concentration, Methane, Temperature effects.

Sorption of selected organic contaminants by aquatic sediments was examined. The sorbates used were dichloro methane, trichloro methane, 1,1,1-

trichloro ethane, trichloro ethene, tetrachloro ethene and 1,2-, 1,3-, as well as 1,4-dichloro benzene. For comparison parathion and hexachloro benzene were also used in the experiments. The sediments were taken from a freshwater tidal marsh of the Elbe river near the city of Hamburg. Sorption equilibria were reached in less than one hour. Sorption was generally reversible and was adequately described by linear partition coefficients. Sorption increased with increasing organic carbon content of the sediments. The sorption coefficients of a compound based on the organic carbon fraction, Koc, however, were almost equal for all sediments tested. Sorption experiments under varied conditions had the following results: (1) Sorption decreased with increasing temperature. The sorption enthalpies are about 8.6 kJ/mol for all sediments and dichlorobenzenes; (2) The pH has no effect on the sorption of the dichlorobenzenes; (3) Increasing the salinity enhances the sorption; (4) Acetic acid, NTA, as well as methanol introduced to concentrations up to some g/L, showed no effect; and (5) Detergents caused a marked desorption at concentrations above their critical micelle concentrations. The anionic compound TBS, however, enhanced the sorption of an acidic sediment (pH 3.5), when the concentration of the detergent was increased. The cationic TCAB exhibited at concentrations somewhat below the critical micelle concentration a marked increase of the sorption of DCB, Parathion and HCB. These phenomena can be explained by the surface charge characteristics of the sediment particles. (Author's abstract)
W91-02668

OIL SLICK SIZES AND LENGTH OF COASTLINE AFFECTED: A LITERATURE SURVEY AND STATISTICAL ANALYSIS--FINAL REPORT.
Minerals Management Service, Los Angeles, CA. Pacific OCS Region.
G. G. Ford.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-204648/AS. Price codes: A03 in paper copy, A01 in microfiche. Report No. MMS 85-0105, October 1985. 37p, 7 fig, 5 tab, 68 ref.

Descriptors: *Coastal waters, *Oil pollution, *Oil spills, *Path of pollutants, *Statistical analysis, Mathematical equations, Model studies, Prediction, Regression analysis.

An historical and statistical analysis of the size of oil slicks at sea and the length of coastline affected by oil slicks which come ashore was undertaken. A total of 21 incidents which included descriptions of slick sizes at sea, and 39 incidents which included descriptions of the amount of coastline oiled were located in the literature. Only incidents for which estimates of oil outflow were available were accepted. Stepwise multiple linear regression was used to determine which factors were the most accurate predictors of slick size and coastline affected. A regression model was developed which could account for 90.1% of the variation in slick size based on spill volume, age of spill, wind speed, and wave height. A simplified equation based only on spill volume and age--assuming the average wind and wave conditions in the Southern California Bight--was presented. The variation in slick sizes which was not explained by the regression model was used to construct a model to estimate the probability that a spill of a given volume and age would reach a particular size. Stepwise regression was also used to build a predictive model of the length of coastline affected by a spill which comes ashore. Only two variables, spill volume and latitude, contributed significantly to the prediction of coastal oiling. These two variable accounted for 64.8% of the variation in the length of coastline affected. As with slick sizes, a model based on the unexplained variance in length of coastline affected was constructed to estimate the probability that a spill of a given volume would affect a given length of coastline. (Author's abstract)
W91-02671

TEMPORAL VARIABILITY OF WATER QUALITY AND THE IMPLICATIONS FOR MONITORING PROGRAMMES IN IRISH LIMESTONE AQUIFERS.
Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
For primary bibliographic entry see Field 7A.
W91-02682

EFFECT OF FIELD-SCALE SOLUTE INFILTRATION INTO GROUNDWATER ON SURFACE WATER QUALITY.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering.
C. S. Kung, G. Destouni, and V. Cvetkovic.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 121-129, 6 fig, 12 ref.

Descriptors: *Agricultural runoff, *Groundwater quality, *Nonpoint pollution sources, *Path of pollutants, *Surface-groundwater relations, *Water pollution sources, Adsorption-desorption, Advection, Aeration zone, Groundwater management, Groundwater movement, Infiltration, Solute transport, Solutes, Water quality management, Water resources management.

The impact of agricultural activities on water quality is a problem of growing interest. Different substances that are soluble in water are spread over large areas and may leach through the unsaturated zone into the groundwater, following groundwater movement, eventually reaching surface water and public supply wells. Decisions on appropriate administrative and technical measures are based on the assessment of potential hazards that may arise due to groundwater quality changes. In order for the potential hazard to be assessed in an objective manner, the uncertainty in predictions of regional solute transport needs to be quantified. The effect of field-scale infiltration on surface water quality was analyzed. A hypothetical example, where solute leaches from a heterogeneous field and is transported through the aquifer to surface water, was examined. Both conservative and reactive solutes were considered, where the assumed reaction was first order non-equilibrium sorption-desorption. The influence of variability in the parameters that control advection in the unsaturated zone decreases with the distance from the source area. This effect is more pronounced for a conservative than for a reactive solute. The effect of sorption-desorption in the unsaturated zone on regional movement of solute is to decrease the expected peak concentration and reduce the influence of field heterogeneity. The results on regional solute transport are primarily qualitative and provide an indication of the uncertainty that may be expected in field applications. (See also W91-02672) (Fish-PTT)
W91-02683

PREDICTION OF THE CONCENTRATION DISTRIBUTION OF GROUNDWATER POLLUTANTS.
Kyushu Univ., Fukuoka (Japan). Dept. of Civil Engineering.
K. Jinno, A. Kawamura, T. Ueda, and H. Yoshinaga.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 131-142, 7 fig, 7 ref.

Descriptors: *Decision making, *Groundwater pollution, *Groundwater quality, *Model studies, *Path of pollutants, Aquifer characteristics, Convection, Dispersion, Fourier analysis, Groundwater management, Groundwater movement, Mathematical models, Stochastic models, Water quality management, Water resources management.

When a convective-dispersive phenomenon of groundwater pollutants is analyzed, its mechanism should be regarded as stochastic, because of many uncertainties in the interaction between pollutant and flow. A method based on the Fourier series expansion and the extended Kalman filter has been developed to identify the parameters of a one-dimensional constant coefficient stochastic convective-dispersive equation and to predict the concentration distribution of groundwater pollutants. This method was compared with two synthetically generated concentration distributions: one with constant physical parameters and the other with spatial change in the physical parameters. The results obtained showed that the proposed method would be able to predict the concentration distribution and identify the parameters accurately. (See also W91-02672) (Fish-PTT)
W91-02684

INFLUENCE OF PRECIPITATION ON THE QUALITY OF KARST GROUNDWATER IN INDUSTRIAL ZONES.
Belgrade Univ. (Yugoslavia). Faculty of Mining and Geology.
N. Kresic, P. Papic, and R. Golubovic.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 153-159, 4 fig, 2 tab, 3 ref.

Descriptors: *Acid rain effects, *Air pollution effects, *Groundwater quality, *Karst hydrology, *Water pollution sources, Acid rain, Correlation analysis, Geohydrology, Groundwater management, Hydrogen ion concentration, Industrial wastes, Mineralization, Nitrates, Precipitation, Regression analysis, Serbia, Spring water, Sulfates, Water quality management, Water resources management, Yugoslavia.

Complex hydrogeological researches on karst aquifers in western Serbia, Yugoslavia, conducted for water supply purposes, found an increased content of some hydrochemical components in groundwater. The groundwater quality in an important karst aquifer in the vicinity of Valjevo, a large industrial center in western Serbia, has worsened during the last few years. An increased content of nitrates and sulfates is caused by acid rain. Its influence was analyzed daily for two years, with particular attention being paid to the regimes of nitrates, sulfates, pH values, and mineralization both in precipitation and spring discharge, depth of precipitation, and spring discharge. Connections between these elements were established through correlation and regression analysis. It was concluded that further industrialization without preventing the emission of pollutants might cause an exceedance of the permitted limits in the near future. (See also W91-02672) (Author's abstract)
W91-02686

THREAT TO GROUNDWATER QUALITY BY PESTICIDES IN THE NETHERLANDS.
Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands).
P. Lagas, B. Verdam, and J. P. G. Loch.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 171-180, 3 fig, 4 tab, 4 ref.

Descriptors: *Groundwater pollution, *Groundwater quality, *Nonpoint pollution sources, *Path of pollutants, *Pesticides, *The Netherlands, *Water pollution sources, Agricultural chemicals, Decomposition, Drinking water, Groundwater management, Leaching, Monitoring, Organic pollutants, Water quality management, Water quality standards, Water resources management, Water sampling.

Since the early 1980s, monitoring studies for pesticide residues in groundwater have been conducted in several countries. In the Netherlands, pesticide admission requires the estimation of their leaching potential to groundwater. To assess the risk of groundwater pollution by pesticides in the Netherlands, the occurrence and behavior of selected pesticides in the upper groundwater was investigated. On land with potatoes, maize, and flower bulb culture, and on uncropped land, filter tubes were placed for periodic sampling and analysis. So far, 21 different organic compounds have been

letected in groundwater as a consequence of the pplication of pesticides. The highest concentra- ions found involve persistent admixtures and de- omposition products, which are more polar and hus more mobile in the soil than the parent com- ound. Apart from the pesticides, decomposition roducts and admixtures are a threat to ground- vater quality and drinking water supply. (See also V91-02672) (Author's abstract)
V91-02688

ITRATE IN GROUNDWATER.
lanover Univ. (Germany, F.R.). Inst. fuer Wasser- irtschaft, Hydrologie und Landwirtschaftlichen /asserbau.
/. Meier, and R. Mull.
N: Groundwater Management: Quantity and uality. Proceedings of the Symposium held at enidorm, Spain, October 2-9, 1989. International ssociation of Hydrological Sciences, Washing- n, DC. 1989. p 181-190, 6 fig, 2 tab, 6 ref.

escriptors: *Groundwater management, Groundwater quality, *Nitrates, *Water pollution revention, *Water quality management, *Water sources management, Animal wastes, Cattle, Fer- izers, Forecasting, Germany, Groundwater pol- tion, Hydrologic models, Model studies, Path of llutants, Pump wells, Waste disposal, Water ality standards, Watershed management, Well nstruction, Wells.

n intensive intrusion of nitrate into many aquifers s occurred in the last 20 years. Measures are ing taken to prevent high concentrations of this llutant in pumping wells. In the long run a less ensive use of mineral fertilizers and a diminished sposal of livestock wastes in the catchment areas pumping wells are the prerequisitions for an ceptable concentration of nitrate in groundwat- Before these measures take effect, hydraulic easures are convenient to avoid the pollution of tracted groundwater: pumping wells have to be ced at locations with low nitrate concentrations d pumping strategies must be applied to keep the rate concentration below the tolerable standard 50 mg/L NO3. Groundwater modeling was plied to forecast the effects of different meas- s, such as the installation of new pumping wells, per screens, or special pumping strategies, on a in northern Germany. Such solutions are effec- e in decreasing the concentrations of the con- inant in the discharged groundwater within the erable standard. (See also W91-02672) (Author's tract)
1-02689

ARACTERIZING THE HYDROGEOLOGI- L VARIABILITY OF A SAND AQUIFER IN E REGION OF A DOMESTIC WASTE DIS- SAL SITE.
mmonwealth Scientific and Industrial Research ganization, Wembley (Australia). Div. of Water ources.
B. Salama, G. B. Davis, and C. Barber.
Groundwater Management: Quantity and lity. Proceedings of the Symposium held at idorm, Spain, October 2-9, 1989. International ociation of Hydrological Sciences, Washing- DC. 1989. p 215-225, 7 fig, 17 ref.

criptors: *Geohydrology, *Groundwater vement, *Groundwater pollution, *Groundwat- quality, *Path of pollutants, *Sand aquifers, ater pollution sources, Aquifer characteristics, mestic wastes, Flow velocity, Geophysical sur- s, Groundwater management, Hydraulic con- tivity, Landfills, Plumes, Solute transport, cers, Waste disposal, Water chemistry, Water ity management, Water resources manage- t.

multidisciplinary approach was adopted to ne pollution plume development in a sand aqui- at a landfill site. Aquifer parameters, water ity changes, and plume development were de- ined through detailed hydrogeological investi- ons and regular hydrochemical monitoring and physical surveys. Hydraulic conductivities esti- d from grain size analyses were confirmed by nates obtained from a tracer test and gave groundwater velocities in the range 60-100 m/year. This is in agreement with the rate of plume advancement. Data collected from the field studies were used in a groundwater flow and solute transport model to predict the rate of pollution plume development and provide a basis for aquifer management in the vicinity of the site. Further work is in progress to integrate the microscale variations of the hydraulic conductivity, as indicated by the tracer test, to estimate better the critical parameters of the plume scale dispersivity. Although apparently a uniform sand, the aquifer underlying the landfill shows significant microscale variability, particularly of the hydraulic conductivity, which suggests variable pollution velocities. It is, therefore, critical to appraise properly the likelihood of such variability in any remedial work at a landfill site. (See also W91-02672) (Fish-PTT)
W91-02692

DECOMPOSITION AND ELIMINATION OF TYPICAL POLLUTANTS FROM SANITARY LANDFILLS IN POROUS AQUIFERS.
Technische Univ. Braunschweig (Germany, F.R.). Leichtweiss-Inst. fuer Wasserbau und Grundbau.
P. Spillmann.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 227-233, 3 fig, 2 ref.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Groundwater quality, *Landfills, *Path of pollutants, *Sanitary landfills, Aquifers, Atrazine, Bacteria, Chemical oxygen demand, Decomposition, Germany, Groundwater management, Landfill covers, Leachates, Leaching, Lindane, Loam, Pathogens, Pesticides, Sand, Simazine, Solute transport, Water quality management, Water resources management.

In the past, sanitary landfills were not sealed or drained and it is not absolutely certain that a modern sealing would be completely impermeable today and in the future. Groundwater pollutants caused by sanitary landfills are currently being investigated in defined artificial aquifers in an interdisciplinary research project in Germany. In order to measure the transport and the elimination of the substances polluting the groundwater, the following method was selected: a defined quantity of leachate from a refuse dump is added to an artificial aquifer where there is a definite flow path. The load of the added leachate is then compared to the load of the outflow. The leachate both from a freshly built landfill and from an old, biologically decomposed dump is investigated under parallel conditions. In the same way, the effect of a porous covering layer of sand is compared with a barely permeable covering layer of compacted loam. This gives a total of four parallel artificial aquifers, each of which permits investigations to be made concerning the transport and decomposition of pollutants from dumps and sanitary landfills. In addition to the leachate, germs, 2-3-dichlorphenol, Simazine, Atrazine, Lindane, and Coli bacteria are added. Initial results of the research show that the remaining load-constant chemical oxygen demand is converted further into substances similar to natural substances and that the organic substances of the leachate from refuse encourage the decomposition of various synthetic organic compounds. (See also W91-02672) (Fish-PTT)
W91-02693

COUPLING OF CHEMISTRY AND TRANSPORT.
Gesamthochschule Kassel (Germany, F.R.).
W. Kinzelbach, and W. Schafer.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 237-259, 16 fig, 20 ref.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Hydrologic models, *Model studies, *Path of pollutants, *Solute transport, Cations, Chemical interactions, Groundwater management, Heterogeneity, In situ treatment, Mathematical models, Model testing, Nitrates, Numerical analysis, Water quality management, Water resources management.

There is virtually no pollutant or solute in groundwater which will not eventually undergo chemical transformation including adsorption, reaction, speciation, complexation, etc. A correct interpretation of concentration data in groundwater requires a coupled model of transport and chemical processes. Coupling of non-trivial chemical models to transport models results in systems of non-linear partial differential equations and algebraic equations. The split-operator method has been used in their numerical solution. Two applications of chemical models coupled to transport were examined: a cation (heterogeneous fast reaction) and a nitrate system (a heterogeneous slow reaction). For field applications there is a competition between transport and chemistry which can only be evaluated with three-dimensional or horizontally two-dimensional models: a breakthrough of nitrate in a well can be caused either by nitrate passing by the spill or by nitrate being no longer used up by microbial activity in the spill itself. Coupled models allow these effects to be considered and can therefore be useful in the design of an in situ remediation. Ambiguity in identifying the model parameters can be diminished if the parallel transport of several components is observed and interpreted. These models may well be used for purposes such as testing of hypotheses, gaining insight into system behavior, and interpretation of column experiments. (See also W91-02672) (Fish-PTT)
W91-02694

IDENTIFICATION OF UNSATURATED SOLUTE TRANSPORT PARAMETERS.
Pontificia Univ. Catolica de Chile, Santiago. Faculty of Engineering.
R. Abeliuk.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 261-270, 1 fig, 3 tab, 14 ref.

Descriptors: *Hydrologic models, *Model studies, *Path of pollutants, *Solute transport, Algorithms, Convection, Dispersion, Flow models, Groundwater management, Hydrodynamics, Hydrologic data, Numerical analysis, Optimization, Parametric hydrology, Soil contamination, Soil moisture, Unsaturated flow, Water quality management, Water resources management.

Although a number of analytical solutions of partial differential equations have been developed to describe one-dimensional solute transport, these solutions are only applicable to specific cases where simplifying assumptions can be made. A general model of solute transport must include the equations for flow and solute transport, with terms included as appropriate to account for physical, chemical, or biological interactions of the solute with the soil environment. The problem of parameter identification is probably the major restriction on the practical application of comprehensive numerical models of unsaturated solute transport. An optimization algorithm with two different forms of the objective function was used to estimate the parameters governing the convection-dispersion equation for the transport of solutes under unsaturated flow conditions. The results show that at least two forms of the coefficient of hydrodynamic dispersion produce identical performance when used to simulate the transient transport of a nonreactive solute in a column of unsaturated soil, confirming that the form of this coefficient is ambiguous when identified from transient moisture content/solute profiles, and hence indicating that interpretation of analytical forms from experimental data must be carried out with great caution. When a large number of parameters are estimated the optimization technique generates various parameter sets that reproduce the calibration data adequately for both types of objective function. However, when the number of parameters decreases, the technique identifies unique parameter values. In all cases, however, the estimated param-

eter sets are robust in prediction. (See also W91-02672) (Fish-PTT)
W91-02695

STOCHASTIC CONTROL OF CONTAMINANT TRANSPORT PROBLEMS.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 5G.
W91-02696

RELEVANCE OF THE TRANSPORT PARAMETERS IN PREDICTIVE MODELLING OF GROUNDWATER CONTAMINATION.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
E. O. Frind, and J. W. H. Molson.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 331-347, 11 fig, 8 ref.

Descriptors: *Groundwater movement, *Groundwater pollution, *Hydrologic models, *Model studies, *Path of pollutants, *Water quality management, *Water resources management, Aquifer characteristics, Canada, Decision making, Dispersion, Flow equations, Flow models, Flow system, Groundwater management, Groundwater quality, Plumes, Three-dimensional model.

To protect groundwater quality, it must be understood how contaminants migrate in groundwater systems, and it must be known what and how much information is needed to predict such migration. In real situations under irregular aquifer geometry, the controlling factors on the propagation of a plume may not be the dispersion parameters, but the flow field. A three-stage modeling approach that produces a fully three-dimensional plume was developed to compare the effects due to dispersion to those due to the flow field. The propagation of the well-monitored Borden (Toronto, Canada) contaminant plume was simulated in three dimensions. The results show that plume propagation is strongly controlled by the three-dimensional flow field. The most relevant parameters for the simulation were found to be those that govern the three-dimensional flow field, namely the stratigraphy, the aquifer geometry, the hydraulic conductivity, and the flow boundary conditions. To verify the prediction of asymmetry, the aquifer stratigraphy and recharge pattern should be confirmed by independent measurements. Dispersion, although important, plays a less controlling role. The implication on the decision-making process in groundwater resource investigations is that primary data acquisition should focus on defining the three-dimensional groundwater flow system. (See also W91-02672) (Fish-PTT)
W91-02701

LOCALIZED ADJOINT METHODS: APPLICATION TO ADVECTION DOMINATED FLOWS.
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Geofisica.
For primary bibliographic entry see Field 2F.
W91-02702

FINITE ELEMENT GROUNDWATER MODEL AS ESSENTIAL PLANNING TOOL: MICROBIOLOGICAL DENITRIFICATION OF A WELL FIELD AT BROICHHOF.
Lahmeyer International G.m.b.H., Frankfurt am Main (Germany, F.R.).
For primary bibliographic entry see Field 5F.
W91-02703

NUMERICAL MODEL FOR SIMULATING THE IN-SITU VOLATILIZATION OF HYDROCARBON CONTAMINANTS IN SOILS.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
G. P. Sabadell, D. K. Sunada, and N. S. Grigg.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 381-391, 4 fig, 13 ref.

Descriptors: *Fate of pollutants, *Hydrocarbons, *Hydrologic models, *Model studies, *Oil spills, *Path of pollutants, *Petroleum products, *Pollutant transport, *Soil contamination, *Volatile organic compounds, *Volatilization, *Water resources management, Advection, Aeration zone, Free water, Groundwater management, Groundwater pollution, In situ treatment, Soil treatment, Soil water, Solute transport, Three-dimensional model, Volatility, Water quality management.

In recent years contamination of groundwater by industrial chemicals, especially petroleum products and halogenated solvents, has become a problem of major concern. A three-dimensional model of the advective transport of volatile organic contaminants in the gaseous phase of the unsaturated zone has been developed and tested against selected analytical solutions. The model accounts for the evaporation of contaminants from a pure liquid surface, partitioning of a contaminant from an aqueous solution and the adsorption/desorption of organics with soil particle surfaces. The results predict the concentrations of volatile organics throughout the soil profile allowing the user to estimate the amounts of hydrocarbons leaving the soil via volatilization. The model can aid the analysis, design, and operation of remediation efforts using an In Situ Volatilization (ISV) system. The ISV is used to prevent volatile organic compounds from migrating with infiltrating water through the vadose zone to the underlying groundwater table. (See also W91-02672) (Author's abstract)
W91-02705

MODELLING OF FLOW AND CONTAMINANT TRANSPORT IN A CONJUNCTIVELY MANAGED GROUNDWATER BASIN: A CASE STUDY.
California Univ., Davis. Dept. of Agricultural Economics.
S. A. Taghavi, M. A. Marino, and R. E. Howitt.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 405-418, 8 fig, 16 ref. University of California Water Resources Center Project UCAL-WRC-W-692.

Descriptors: *Artificial recharge, *Conjunctive use, *Flow models, *Groundwater management, *Groundwater movement, *Hydrologic models, *Pollutant transport, *Water quality management, *Water resources management, California, Farm wastes, Fate of pollutants, Groundwater basins, Groundwater pollution, Nitrates, Numerical analysis, Overdraft, Path of pollutants, Recharge basins, Watershed management.

Groundwater quality and quantity in the Chino basin, California, have been seriously affected by agricultural, industrial, and municipal developments during the past few decades. Increasing water demands have caused overdraft of the groundwater while indiscriminate disposal of agricultural and dairy wastes have contributed to the downgrading of the quality of the groundwater. To remedy the overdraft problem, imported water from the State Water Project is to be used in conjunction with the local groundwater through artificial recharge. However, there is currently no plan for controlling and reducing high levels of nitrate in the aquifer. A numerical simulation model was used to study the hydraulic response of the aquifer to the recharge program and to analyze the feasibility of recharge basins. The model simulates two-dimensional regional changes in the water table over time. Also, a mass transport model was used to simulate the movement and fate of nitrate in the aquifer considering the recharge program with the existing rate of waste disposal. Results of the water quality model show that the recharge program using the proposed recharge facilities would not alter the nitrate levels. However, if the existing recharge basins in the southern portion of the Chino basin were to be used, the nitrate levels would be expected to decrease considerably or not increase at the current rate over the next 15-20 years. (See also W91-02672) (Author's abstract)
W91-02707

APPLICATION OF GROUNDWATER MODELLING IN WATER RESOURCES MANAGEMENT IN DENMARK.
Miljoestyrelsen, Copenhagen (Denmark).
M. Dyhr-Nielsen.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 559-570, 6 ref.

Descriptors: *Aquifer management, *Denmark, *Groundwater management, *Groundwater resources, *Irrigation effects, *Model studies, *Streamflow depletion, *Surface-groundwater relations, *Water resources management, *Water supply development, Agricultural chemicals, Case studies, Environmental policy, Groundwater pollution, Hydrologic models, Leachates, Management planning, Minimum flow, Nitrates, Path of pollutants, Research priorities, Water pollution control.

With a water supply almost entirely dependent on groundwater, Denmark has extensive experience in management and control of groundwater resources. Natural recharge is mostly sufficient to satisfy the water supply needs except in the most populated areas around major cities like Copenhagen. However, a policy of water resource management based on environmental impacts has made stream depletion the most important constraint for water development. To achieve rational estimates of the potential effects of groundwater developments on streamflow, extensive investigations and model tools have been developed on the initiative of the National Agency of Environmental Protection. Also the more recent water resources problems associated with agricultural nitrate pollution and leaching of chemical wastes has led to the initiation of major interdisciplinary research programs. Developments in Danish water resource management have progressed from a case-by-case basis to comprehensive pollutant control programs. Some major research projects initiated in connection with important management issues include the determination of streamflow depletion, nitrate pollution from agriculture, and reclamation of groundwater polluted by chemical wastes. (See also W91-02672) (Author's abstract)
W91-02719

ORIGINS OF ACID RUNOFF IN A HILLSLOPE DURING STORM EVENTS.
Sveriges Lantbruksuniversitet, Umea. Dept. of Forest Site Research.
For primary bibliographic entry see Field 5C.
W91-02737

EVIDENCE FOR LONG-TERM DETERIORATION OF STREAMWATER CHEMISTRY AND SOIL ACIDIFICATION AT THE BIRKENES CATCHMENT, SOUTHERN NORWAY.
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5C.
W91-02738

REVERSAL OF STREAM ACIDIFICATION AT THE BIRKENES CATCHMENT, SOUTHERN NORWAY: PREDICTIONS BASED ON POTENTIAL ANC CHANGES.
Senter for Industriforskning, Oslo (Norway).
N. Christophersen, C. Neal, and J. Mulder.
Journal of Hydrology JHYDA7, Vol. 116, No. 4, p 77-84, August 1990. 1 fig, 2 tab, 18 ref.

Descriptors: *Acid neutralizing capacity, *Acid rain effects, *Acid streams, *Acidification, *Fish stocking, *Norway, *Soil chemistry, *Streams, *Sulfur, *Water quality trends, Acid rain, Acidic soils, Air pollution effects, Cations, Emission control, Fish, Fish establishment, Soil water, Sulfur oxides, Trout.

As western European sulfur emissions continue to decline following peak levels in the 1970's, interest is now focusing on the reversibility of freshwater acidification. Streamwater and soilwater data from the Birkenes catchment in southern Norway were considered in an attempt to estimate the minimum reductions of sulfur deposition required to reintroduce brown trout to the stream. The approach taken was to derive a lower bound for the required reduction based on a suitable definition of the acid-neutralization capacity (ANC). The results demonstrate that, for present soil conditions and atmospheric base cation inputs, a decrease of sulfate deposition of more than 85%, from 1985-1987 levels, is needed to allow successful restocking of brown trout. Since this is a minimum estimate, it is possible to envisage several mechanisms by which streamwater acidification would not be sufficiently reversible for fish survival even at 100% reduction in sulfur deposition. (Author's abstract)
W91-02739

ELEMENT BUDGETS OF TWO CONTRASTING CATCHMENTS IN THE BLACK FOREST (FEDERAL REPUBLIC OF GERMANY).
Freiburg Univ. (Germany, F.R.). Inst. of Soil Science and Forest Nutrition.
K. H. Feger, G. Brahmer, and H. W. Zottl.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 85-99, August 1990. 5 fig, 5 tab, 29 ref. Nuclear Research Center Karlsruhe Grant 86/012/1A.

Descriptors: *Acid rain, *Black Forest, *Forest hydrology, *Forest watersheds, *Geochemistry, *Germany, *Rainfall-runoff relationships, Drainage patterns, Dry deposition, Forest management, Geochemical cycles, Hydrologic budget, Ion transport, Nitrogen, Precipitation, Rainfall, Runoff, Soil organisms, Soil types, Soil water, Stream discharge, Sulfur, Throughfall, Topography.

Rainfall and throughfall inputs of all major cations and anions, via open-field bulk precipitation and canopy throughfall, are compared with streamwater outputs in two forested catchments at higher altitudes of the Black Forest. The sites differ considerably in terms of bedrock geology, soil type, soilwater characteristics, topography, and forest management history. Chemical deposition at both sites is almost equal and, in contrast to other forest areas in Central Europe, of a low-to-moderate level. Dry deposition does not seem to play an important role. Distinct differences in the elemental output emerge owing to the differing site conditions. At Villingen, deposited nitrogen is almost totally retained, whereas at Schluchsee, nitrogen output and input are of the same order of magnitude. This is consistent with the different nitrogen nutrition level of the stands, microbial turnover in the soil, and former management practices (change of tree species, excessive nutrient export). Sulfur is not retained in either of the catchments. At Schluchsee, sulfur export exceeds input from canopy throughfall by a factor of 2.5. The higher output rates, both of nitrogen and sulfur at Schluchsee, are due to the much higher microbial mineralization of organic matter as shown by previous incubation tests. Differences in cation and proton export are mainly caused by a difference in drainage pattern. In contrast to the Schluchsee catchment, where vertical water pathways prevail, the streamwater solute output at Villingen is dominated by a shallow subsurface runoff. Atmospheric deposition is a contributing, but not the dominant factor in the biogeochemical cycling at these sites. Hence, a generally applicable quantitative definition of critical loads, especially for nitrogen, is illusory and the use of such numbers will be misleading. (Author's abstract)
W91-02740

INFLUENCE OF ACID ATMOSPHERIC INPUTS ON SURFACE WATER CHEMISTRY AND MINERAL FLUXES IN A DECLINING SPRUCE STAND WITHIN A SMALL CATCHMENT (VOSGES MASSIF, FRANCE).
Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
A. Probst, E. Dambrine, D. Viville, and B. Fritz.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 101-124, August 1990. 8 fig, 7 tab, 36 ref.

Descriptors: *Acid rain, *Acid rain effects, *Air pollution effects, *Forest hydrology, *Forest watersheds, *France, *Geochemistry, *Path of pollutants, *Rainfall-runoff relationships, *Vosges Mountains, *Water chemistry, Acidification, Ion transport, Nitrogen, Precipitation, Springs, Spruce trees, Streams, Sulfur, Throughfall, Weathering.

The characteristics of surface and soil waters draining an old declining spruce stand, and their chemical behavior under acid input influence within a small catchment are described using open field precipitation, throughfalls, soil solutions, and spring and streamwater data. Precipitation is characterized by a rather low pH, resulting from a moderate global pollution climate. However, pollution peaks associated with easterly winds cause, during winter and spring, a strong increase of pollutant concentrations in open field precipitation and throughfall waters. Inputs of protons, sulfur and nitrogen, which originate mainly from dry and occult deposition, are approximately 1.8, 31, and 17 kg/hectare/year, respectively. Such inputs strongly influence the inorganic mass transfer within the ecosystem. This influence results from the low base content and coarse texture of the soils. These inputs have led to an acidification of soil solutions, an increase of their aluminum content and a decrease of exchangeable base cations, particularly for calcium; this process might be one of the fundamental causes of the deficiencies which characterize the forest decline phenomenon. In the regolith, the acid inputs strongly enhance silicate mineral weathering. However, stream waters and spring waters are not yet acidified owing to the neutralization of acid inputs by weathering in the regolith. Nevertheless, streamwater chemistry is dominated by strong acid anions which are not characteristics of waters draining bedrock in pristine areas. (Korn-PTT)
W91-02741

EFFECTS OF VEGETATION TYPE ON THE BIOGEOCHEMISTRY OF SMALL CATCHMENTS (MONT LOZERE, FRANCE).
Orleans Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 2K.
W91-02742

LONGITUDINAL PATTERNS OF CONCENTRATION-DISCHARGE RELATIONSHIPS IN STREAM WATER DRAINING THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE.
Maine Univ. at Orono. Dept. of Plant and Soil Sciences.
G. B. Lawrence, and C. T. Driscoll.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 147-165, August 1990. 8 fig, 2 tab, 22 ref. National Science Foundation Grant No. BSR-8406634.

Descriptors: *Acid rain effects, *Aluminum, *Geochemistry, *Ion transport, *New Hampshire, *Streams, Acidification, Dissolved organic carbon, Experimental basins, Hydrogen ion concentration, Neutralization, Silicon.

Longitudinal variations of concentration-discharge relationships and chemical fluxes were evaluated in two headwater streams at the Hubbard Brook Experimental Forest, New Hampshire. At high elevations changes in subsurface flow paths explained variations in H(+), inorganic Al and Si concentrations, whereas variations of dissolved organic carbon concentration were inconsistent with this mechanism. Flow responses of middle and low elevation subcatchments were influenced by variable contributions of hydrologic source areas and the elevational concentration gradient which exists in these catchments, but in most cases were not consistent with responses predicted by changes in flow paths. Spatial patterns of chemical fluxes indicate that, in general, catchment neutralization processes increased in effectiveness in the downslope direction. However, this pattern can be interrupted by secondary tributaries, both ephemeral and persistent, which originate in variable source areas that contribute acidic surface runoff during high flow conditions. Current models of catchment acidification need to incorporate spatial variations of biogeochemical processes and flow responses to improve predictions of short-term variations in surface water chemistry. (Author's abstract)
W91-02743

HYDROGEOCHEMICAL VARIATIONS IN HAFREN FOREST STREAM WATERS, MID-WALES.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4C.
W91-02745

PRELIMINARY ANALYSIS OF WATER AND SOLUTE MOVEMENT BENEATH A CONIFEROUS HILLSLOPE IN MID-WALES, U. K.
Polytechnic South West, Plymouth (England). Dept. of Geographical Sciences.
For primary bibliographic entry see Field 2E.
W91-02746

HYDROLOGICAL AND HYDROCHEMICAL FLUXES THROUGH VEGETATION AND SOIL IN THE ALLT A'MHARCAIDH, WESTERN CAIRNGORMS, SCOTLAND: THEIR EFFECT ON STREAMWATER QUALITY.
Macaulay Land Use Research Inst., Aberdeen (Scotland).
R. C. Ferrier, T. A. B. Walker, R. Harriman, J. D. Miller, and H. A. Anderson.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 251-266, August 1990. 9 fig, 2 tab, 18 ref.

Descriptors: *Acid rain effects, *Acidification, *Cairngorm Mountains, *Geochemistry, *Scotland, *Soil water, *Soil-water-plant relationships, *Water chemistry, *Water quality, Air pollution effects, Base flow, Neutralization, Nitrogen, Soil chemistry, Streams, Sulfates, Vegetation effects.

A detailed investigation of the hydrochemical alteration of input water by vegetation and soils was undertaken in an upland catchment in the Cairngorm Mountain region of Scotland. The composition of the catchment outflow water reflects the hydrological routing of water through different soil horizons and the importance of long residence time water. There is uptake of nitrogen and neutralization of incoming anthropogenic acidity by the vegetation, and sulfate adsorption in the mineral soils. Streamwater quality is dominated by the contribution of long residence time water, especially during base flow. Sulfate retention and cation release are the major neutralization mechanisms buffering outflow chemistry at this site. (Author's abstract)
W91-02749

SHORT-TERM IONIC RESPONSES AS INDICATORS OF HYDROCHEMICAL PROCESSES IN THE ALLT A'MHARCAIDH CATCHMENT, WESTERN CAIRNGORMS, SCOTLAND.
Freshwater Fisheries Lab., Pitlochry (Scotland).
R. Harriman, E. Gillespie, D. King, A. W. Watt, and A. E. G. Christie.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 267-285, August 1990. 10 fig, 1 tab, 12 ref.

Descriptors: *Acid rain effects, *Acidification, *Cairngorm Mountains, *Geochemistry, *Ion transport, *Scotland, *Water chemistry, Alkalinity, Flow profiles, High flow, Hydrographs, Hydrologic data, Low flow, Organic compounds, Streamflow, Sulfates.

An attempt to identify chemical controls in a transitional catchment in the Cairngorm region of Scotland was made using data from two distinct sampling regimes. Annual mean data from spot samples provided general information on alkalinity sources and acidification status, and flow/ion relationships suggested a three-phase chemical response within the flow profile. Alkalinity and organics appeared to show the greatest response to flow and sulfate the smallest. Information collected from time series sampling showed significant dif-

ferences in the chemical response on the rising limb of the hydrograph compared with that on the falling limb, particularly for pH and alkalinity. In the first, low flow, response phase, the chemical changes are attributed to a simple dilution process with little or no influence form surface soil horizons. During the second and more complex intermediate flow phase, the chemical response is compatible with wetting and mixing processes in the soil horizons resulting in a more variable relationship between flow and pH/alkalinity. The delayed return of alkalinity, base cations and organics, during flow recession, to pre-event levels, indicates a reservoir of acid/organic-rich water which, until depleted, contributes a major fraction of the output water. In the third, high-flow phase, a state of chemical equilibrium appears with little or no change in ion concentrations for large changes in flow. This insensitivity reflects a relatively saturated system with establishment of major hydrological pathways which produce water of a similar chemistry. (Author's abstract)
W91-02750

EFFECT OF CLEARFELLING A SITKA SPRUCE (PICEA SITCHENSIS) PLANTATION ON SOLUTE CONCENTRATIONS IN DRAINAGE WATER.
Institute of Terrestrial Ecology, Grange over Sands (England). Merlewood Research Station.
For primary bibliographic entry see Field 4C.
W91-02751

GEOCHEMICAL CONTROL OF ALUMINIUM CONCENTRATIONS IN ACIDIFIED SURFACE WATERS.
Oslo Univ. (Norway). Dept. of Chemistry.
H. M. Seip, S. Andersen, and A. Henriksen.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 299-305, August 1990. 4 fig, 21 ref.

Descriptors: *Acid rain effects, *Acidic water, *Acidification, *Aluminum, *Geochemistry, *Groundwater chemistry, *Lakes, *Soil chemistry, *Solute transport, *Streams, *Surface-groundwater relations, *Water chemistry, Equilibrium, Geomorphology, Hydrogen ion concentration, Ion transport, Kinetics, Model studies, Norway, Vegetation effects.

The relationship between concentrations of aluminum and hydrogen ions in surface waters was investigated on the basis of various studies, including a regional survey of more than a thousand Norwegian lakes. It was concluded that equilibrium with a single aluminum hydroxide phase cannot account for observed aluminum concentrations and that water pathways play an important role in determining the concentrations in lake and stream water. Three interactive aspects of these factors were identified: (1) hydrological phenomena which control the proportions of waters entering the lake or stream from the upper soil zone (often highly acidic), from the lower soil zone (less acidic and higher in inorganic aluminum content), and from deeper zones such as groundwater areas (even less acidic waters that are low in inorganic aluminum); (2) individual chemical signatures--differing from site to site in response to mineralogical, geomorphological, and vegetational factors--of these soil water and groundwater components; (3) non-equilibrium kinetic processes which control aluminum mobilization and precipitation. Whatever their relative influence, it is clear that any attempt to model regional water acidification must take these factors into account. One of the major processes studied in acidification research which is still not accounted for, and is still little understood, is the mechanism which mobilizes and precipitates aluminum in both soil and streams. (Korn-PTT)
W91-02752

MODELLING STREAMWATER CHEMISTRY AS A MIXTURE OF SOILWATER END-MEMBERS--A STEP TOWARDS SECOND-GENERATION ACIDIFICATION MODELS.
Senter for Industriforskning, Oslo (Norway).
N. Christophersen, C. Neal, R. P. Hooper, R. D. Vogt, and S. Andersen.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 307-320, August 1990. 4 fig, 1 tab, 26 ref.

Descriptors: *Acid rain effects, *Acidification, *Geochemistry, *Model studies, *Soil water, *Streams, *Water chemistry, Data analysis, Data collections, Data interpretation, Hydrologic models, Least squares method, Mixing, Norway, Prediction, Soil chemistry, Whales.

In present acidification models, soilwater characteristics, though modelled, are seldom checked against field observations. Given that such data are now collected as part of many catchment studies, a technique is developed whereby stream water can be predicted as a mixture of the observed soilwater classes or end-members. Provided that a sufficient set of end-members has been identified, a least-squares technique can be used to estimate the contribution to the stream from each end-member, whenever streamwater samples have been taken. For two catchments, Birkenes in southern Norway and Plynlimon in Mid-Wales, the analysis indicates that the soilwater end-members observed to date are insufficient to explain streamwater chemistry. However, properties of the missing soil waters have been identified, thus facilitating future field work. When an adequate set of soilwater end-members have been established, long-term predictions of changes in streamwater chemistry reduce to the problem of predicting the fate of each end-member. Thus, a separate hydrological submodel is not needed, since the mixing patterns are derived from the end-member analysis. (See also W91-02754) (Author's abstract)
W91-02753

MODELLING STREAMWATER CHEMISTRY AS A MIXTURE OF SOILWATER END-MEMBERS-AN APPLICATION TO THE PANOLA MOUNTAIN CATCHMENT, GEORGIA, U. S. A.
Geological Survey, Doraville, GA. Water Resources Div.
R. P. Hooper, N. Christophersen, and N. E. Peters.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 321-343, August 1990. 10 fig, 3 tab, 24 ref.

Descriptors: *Acid rain effects, *Acidification, *Geochemistry, *Georgia, *Model studies, *Soil water, *Water chemistry, Alkalinity, Calcium, Data analysis, Data interpretation, End-member mixing analysis, Experimental basins, Hydrographs, Magnesium, Mixing, Prediction, Rainfall, Silica, Sodium, Soil chemistry, Solute transport, Streams, Sulfates.

Streamwater chemistry at Panola Mountain research catchment, Georgia, is explained as a mixture of representative soilwater solutions that are considered to be temporally invariant to a first approximation. The selection of three end-members from all sampled soil waters is evaluated by comparing the observed and predicted streamwater concentrations of six solutes (alkalinity, sulfate, sodium, magnesium, calcium, and dissolved silica), which are assumed to mix conservatively, and by assessing the consistence of the implied hydrograph separation with the hydrological mechanisms that are believed to be operating in this catchment. The percentage of variation in the streamwater solute concentrations explained by the end-member mixing analysis (EMMA) ranges from 82 to >97%, and the hydrograph separation is, intuitively, physically reasonable. If the correct end-members have been identified, the streamwater chemical response to different levels of acidic deposition can be predicted by examining the change in each end-member under different loads; no hydrological model is required. If a traditional hydrochemical model, which is driven by rainfall quantity and quality, is desired, this analysis provides an indication of the model structure that would be necessary to reproduce both streamwater and soilwater chemistry. (See also W91-02753) (Author's abstract)
W91-02754

HYDROGRAPH SEPARATION USING CHEMICAL TECHNIQUES: AN APPLICATION TO CATCHMENTS IN MID-WALES.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2K.
W91-02755

METHOD FOR PREDICTING THE EXTREMES OF STREAM ACIDITY AND OTHER WATER QUALITY VARIABLES.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
A. J. Jakeman, P. G. Whitehead, A. Robson, A. Jenkins, and J. A. Taylor.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 375-390, August 1990. 7 fig, 4 tab, 21 ref.

Descriptors: *Acid rain effects, *Acid streams, *Geochemistry, *Streams, *Water quality, Acidification, Acidity, MAGIC model, Model studies, Prediction, Scotland, Statistical models, Water chemistry.

A hybrid deterministic-statistical approach is proposed for modeling the extremes of water quality in catchments subjected to long-term acidification. In the area of acidification modeling, long-term models such as MAGIC (Model of Acidification of Groundwater In Catchments) have been developed to simulate long-term trends and have been applied to a wide range of catchments. The approach used in this study is based on process models describing the long-term variations in mean chemistry. Superimposed on these mean projections are distributions providing information on the extremes of water quality which are fitted to catchment data using maximum likelihood techniques. The approach is general and can be applied to the prediction of other water quality variables where samples can be regarded as belonging to a parametric probability distribution. A simple implementation of the approach using chemical data and a calibrated deterministic model for the Allt a'Mharcaidh catchment is used as an illustrative method. Data from the catchment was analyzed and a preliminary form for the distribution was chosen. The mean values produced by the MAGIC model were combined with this knowledge of the distribution and estimates of the extremes were derived. The approach is general and can be applied to the prediction of other water quality variables where samples can be regarded as belonging to a parametric probability distribution. (Korn-PTT)
W91-02757

TOWARDS DEVELOPING A NEW SHORT-TERM MODEL FOR THE BIRKENES CATCHMENT--LESSONS LEARNED.
Norges Vassdrags- og Elektrisitetsvesen, Oslo.
For primary bibliographic entry see Field 2K.
W91-02758

REGIONAL MODEL OF ACIDIFICATION IN WALES.
Institute of Hydrology, Wallingford (England).
A. Jenkins, P. G. Whitehead, T. J. Musgrove, and B. J. Cosby.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 403-406, August 1990.

Descriptors: *Acid rain effects, *Acidification, *Model studies, *Wales, *Water quality, *Water quality trends, Air pollution control, Hydrogen ion concentration, Lakes, MAGIC model, Monte Carlo method, Streams.

A regional assessment of streamwater quality in Wales is presented which reconstructs the historical trend for acidification and predicts the effect of several pollutant deposition reduction policies, using the Model of Acidification of Groundwater in Catchments (MAGIC). The regional methodology used is a two-stage coupling of Monte Carlo simulations with a calibration procedure designed to produce a coarse fit to the joint distribution of the key streamwater quality variables. The regional model is based on data from the Welsh Water Authority Survey of 1983-1984 during which streams and lakes were sampled weekly for one year. The modeling results reveal a significant decline of water quality across the region since industrialization. The model indicates that 40% of the streams and lakes within the region have suf-

fered a decline of mean annual pH of >0.5 pH units. Predictions indicate that a 30% reduction of deposition would maintain present-day stream quality levels. Reductions of the order of 60% are required to ensure a significant recovery at most sites across the region. (Author's abstract)
W91-02759

DEGRADATION OF VINYL ACETATE BY SOIL, SEWAGE, SLUDGE, AND THE NEWLY ISOLATED AEROBIC BACTERIUM V2.
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Mikrobiologie.
For primary bibliographic entry see Field 5D.
W91-02769

REMOBILIZATION OF TOXIC HEAVY METALS ADSORBED TO BACTERIAL WALL-CLAY COMPOSITES.
Guelph Univ. (Ontario). Dept. of Microbiology.
C. A. Flemming, F. G. Ferris, T. J. Beveridge, and G. W. Bailey.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 10, p 3191-3203, October 1990. 7 fig, 4 tab, 46 ref. EPA Grant CR813605-01-1.

Descriptors: *Bacterial physiology, *Clays, *Heavy metals, *Path of pollutants, *Soil chemistry, Biochemistry, Chemical analysis, Chromium, Copper, Fate of pollutants, Geochemistry, Industrialization, Leaching, Organic matter, Silver, Toxicity, Urbanization.

Rapid industrialization and urbanization have caused elevated levels of toxic heavy metals to enter the biosphere. Significant quantities of silver, copper, and chromium were bound to isolated Bacillus subtilis 168 walls, Escherichia coli K-12 envelopes, kaolinite and smectite clays, and the corresponding organic material-clay aggregates (1:1, wt/wt). These sorbed metals were leached with nitric acid, calcium nitrate, EDTA, fulvic acid, and lysozyme at several concentrations over 48 h at room temperature. The remobilization of the sorbed metals depended on the physical properties of the organic and clay surfaces and on the character and concentration of the leaching agents. In general, the remobilization of the metals was chromium < silver < copper. Chromium was very stable in the wall, clay, and composite systems; pH 3.0, 500 microM EDTA, 120-ppm (mg/L) fulvic acid, and 160-ppm calcium remobilized less than 32% of sorbed chromium. Silver (45 to 87%) and copper (up to 100%) were readily removed by these agents. Although each leaching agent was effective at mobilizing certain metals, elevated calcium or acidic pH produced the greatest overall mobility. The organic chelators were less effective. Lysozyme digestion of Bacillus walls remobilized copper from walls and copper-wall-kaolinite composites, but silver, chromium, and smectite partially inhibited enzyme activity, and the metals remained insoluble. The extent of metal remobilization was not always dependent on increasing concentrations of leaching agents. Sometimes the organic material-clay composites reacted in a manner distinctly different from that of their individual components. The particle size of the deposited metal may account for some of the stability changes; those metals that formed large, compact aggregates as seen by transmission electron microscopy were less likely to be remobilized. Remobilization of toxic heavy metals in sediments, soils, and the vadose zone is a complicated issue, with predictions based on single inorganic or organic component systems being too simplistic. (Author's abstract)
W91-02771

PATHOGENIC MARINE VIBRIO SPECIES IN SELECTED NOVA SCOTIAN RECREATIONAL COASTAL WATERS.
Dalhousie Univ., Halifax (Nova Scotia). Faculty of Medicine.
A. Badley, B. Phillips, D. J. M. Haldane, and M. T. Dalton.
Canadian Journal of Public Health CJPEA4, Vol. 81, No. 4, p 263-267, 1990. 2 fig, 3 tab, 11 ref.

Descriptors: *Coastal waters, *Nova Scotia, *Path of pollutants, *Recreation, *Vibrio, *Water pollution effects, Coliforms, Estuaries, Fecal pollution, Marine bacteria, Mollusks, Pathogens, Public health, Water birds.

Seven heavily frequented coastal recreation sites serving metropolitan Halifax and Dartmouth were investigated to determine the numbers and species of pathogenic marine vibrios (PMV) present. Seawater, mussels and sea gull feces were cultured using quantitative methods and the effects of temperature and fecal pollution noted. Emergency rooms serving the sites under surveillance were monitored for PMV-related infections. All 11 recognized species of PMV were recovered from the seven sites. Estuarine sites yielded a greater variety of species and greater numbers of PMV than non-estuarine sites. Culture of hand washings after immersion in seawater did not demonstrate contamination of skin by PMV. No cases of PMV infection in the seven surveillance sites were demonstrated. PMV contamination of marine recreational waters does not frequently result in superficial infections. (Author's abstract)
W91-02780

OUTBREAK OF CAMPYLOBACTER ENTERITIS ASSOCIATED WITH A COMMUNITY WATER SUPPLY.
Centre Hospitalier Regional de la Beauce, Beauceville East (Quebec). Dept. de Sante Communautaire.
For primary bibliographic entry see Field 5C.
W91-02781

POLYCHLORINATED BIPHENYLS PARTITIONING IN WATERS FROM RIVER, FILTRATION PLANT AND WASTEWATER PLANT: THE CASE FOR PARIS (FRANCE).
Paris-6 Univ. (France). Inst. d'Hydrologie et de Climatologie.
M. Chevreuil, L. Granier, A. Chesterikoff, and R. Letolle.
Water Research WATRAG, Vol. 24, No. 11, p 1325-1333, November 1990. 8 fig,1 tab, 25 ref.

Descriptors: *France, *Paris, *Path of pollutants, *Polychlorinated biphenyls, *Wastewater analysis, *Water analysis, *Water pollution sources, *Water treatment, Drinking water, Organic carbon, Partition coefficient, Seine River, Suspended matter, Wastewater, Water pollution.

The partitioning of PCBs between the aqueous and particulate phases was studied from January to December 1987 in the Seine river at Paris, as well as the quality of the drinking water produced in the Orly plant. The concentrations in the influent and the effluent of the wastewater plant of Acheres were also measured. Mean concentration in the Seine river at Paris was 115 ng/L in 1986 and 130 ng/L at Orly (upstream from Paris) in 1987, which corresponds to the heavily polluted class of the World Health Organization (WHO). Evolution of PCB concentration and speciation in waters were studied following the hydrological cycle, the suspended matter content, its mineralogy, and particulate organic carbon content. In contrast to accepted opinion, about three quarters of PCBs (73%) in the Seine were carried by the aqueous phase, with no notable influence of the hydrological cycle: suspended matters were insufficient (25 mg/L mean value) to adsorb the majority of the PCBs and their adsorption capacity varied inversely with their concentration. Therefore 67% of the PCBs of the source water were not retained by the treatment plant, and the mean concentration of the drinking water was 79 ng/L. However, in most samples the concentration of PCBs was below the 100 ng/L norm of the European Economic Community. In wastewaters the proportion of particulate PCBs was only 55%, probably due to their dissolution in greases and oils. The removal rate varied from 18 to 83% (mean 54%). Mean concentrations were 650 in wastewaters and 280 ng/L ate the outlet of the secondary settling basin. The annual estimated flux was 95 mg per capita. (Author's abstract)
W91-02786

PROBABILITY MODEL FOR ACID RAIN DATA.
Canada Centre for Inland Waters, Burlington (Ontario).
A. H. El-Shaarawi, and A. Naderi.
Water Research WATRAG, Vol. 24, No. 11, p 1335-1339, November 1990. 10 fig, 2 tab, 6 ref.

Descriptors: *Acid rain, *Acid rain effects, *Alkalinity, *Model studies, *Probability distribution, Box-Cox Power Transformation, Color, Data collections, Hydrogen ion concentration, Lognormal distribution.

A probability model to represent lake alkalinity distributions based on the Box-Cox power transformations and covering the family of lognormal distributions was developed. The adequacy of the lognormal distribution was assessed by testing the significance of a single parameter in the proposed model. It was shown that the three-parameter lognormal does not fit the majority of data sets from Eastern Canada. The pH-alkalinity relationship developed by Small and Sutton was previously used to yield a class of probability models representing the derived distributions for pH. The distributional model developed in this study allows more flexibility and extends the scope of applications to a wider class of distributions than what has been available. Furthermore, when the pH-Alk relationship does not hold for a particular data set, the data set (if possible) may be divided into groups so that those groups for which the pH-Alk relationship is adequate are identified. This was illustrated by dividing the data from Nova Scotia into two groups according to water color. The results indicate an improved agreement between the pH-Alk relationship and the observations when water color is =/< 30 Hazen units. (White-Reimer-PTT)
W91-02787

USE OF KINETIC BIOASSAY PROCEDURE TO ESTIMATE SULFATE AND CYSTEINE CONCENTRATIONS IN SEDIMENT.
Portland State Univ., OR. Environmental Sciences and Resources.
For primary bibliographic entry see Field 2H.
W91-02796

ACCUMULATION FROM WATER AND DEPURATION OF 110MAG BY A FRESHWATER FISH, SALMO TRUTTA L.
CEA Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-les-Durance (France). Lab. de Radioecologie des Eaux Continentales.
J. Garnier, J. P. Baudin, and L. Foulquier.
Water Research WATRAG, Vol. 24, No. 11, p 1407-1414, November 1990. 2 fig, 5 tab, 42 ref.

Descriptors: *Bioaccumulation, *Fish physiology, *Nuclear reactors, *Path of pollutants, *Radioactive wastes, *Silver, *Trout, Kinetics, Liver, Radionuclides, Tissues, Tracers.

The radioactive isotope 110mAg, which contributes to total gamma radioactivity in low-level liquid wastes from some pressurized-water nuclear reactors, has been detected in fish living in the zones affected by waste discharges from such facilities. Accumulation kinetics were followed on a group of 20 brown trout maintained for 85 days in spring water contaminated with 30 Bq/ml of 110mAg. Because of a very significant radionuclide adsorption on all available surfaces, and in order to allow investigation of uptake under chronic exposure, the contaminated water was completely renewed three times a week. The development of radionuclide concentration in the trout followed slow uptake kinetics; the maximum contamination level would not be reached until about 900 days of exposure. The concentration factor, calculated from the ratio of the integrals of the curves representing the radionuclide concentration variations in the unfiltered water and in the fish, reached a maximum value of 9 (w/w). At the end of the 57-day exposure phase, the 110mAg organotropism, investigated on 10 individuals, showed a very high concentration in the liver, amounting to 70% of the total radioactivity in the fish. Immediately following the accumulation

period (57 days), the remaining specimens were placed in non-radioactive water. After 28 days, their radioactivity level and the 110mAg distribution in the tissues were the same as at the end of the uptake phase. (White-Reimer-PTT)
W91-02798

HYDROLOGIC HYDROCHEMICAL CHARACTERIZATION OF TEXAS FRIO FORMATION USED FOR DEEP-WELL INJECTION OF CHEMICAL WASTES.
Texas Univ., Austin. Bureau of Economic Geology.
C. W. Kreitler, M. S. Akhter, and A. C. A. Donnelly.
Environmental Geology and Water Sciences EGWSEI, Vol. 16, No. 2, p 107-120, 1990. 15 fig, 17 ref.

Descriptors: *Groundwater movement, *Groundwater pollution, *Hazardous waste disposal, *Injection wells, *Path of pollutants, *Texas, *Waste disposal wells, Artesian pressure, Biodegradation, Brines, Groundwater recharge, Injection, Microbial degradation, Oil fields, Saline-freshwater interfaces, Water chemistry.

Hydrologic hydrochemical investigations were conducted to determine the long-term fate of hazardous chemical waste disposed in the Texas Gulf Coast Tertiary Frio Formation by deep-well injection. Three hydrologic regimes exist within the Frio Formation: a shallow fresh to moderately saline water section in the upper 3000-4000 ft; an underlying 4000-5000 ft section with moderate to high salinities; and a deeper overpressured section with moderate to high salinities. The complexity of the hydrologic environment is enhanced due to extensive depressurization in the 4000-8000 ft depth interval, which presumably results from the estimated production of over 10 billion barrels of oil equivalent and associated brines from the Frio in the past 50 years. Because of the higher fluid density and general depressurization in the brine hydrostatic section, upward migration of these brines to shallow fresh groundwater should not occur. Depressured oil and gas fields, however, may become sinks for the injected chemical wastes. Water samples appear to be in approximate oxygen isotopic equilibrium with the rock matrix, suggesting that active recharge by continental waters is not occurring. In the northern Texas Gulf Coast region salt dome dissolution controls water chemistry. In the central and southern Frio Formation, brines from the deeper geopressured section may be leaking into the hydrostatic section. The lack of organic acids and the alteration of Frio oils from samples collected from depths shallower than approximately 7000 ft suggest microbial degradation of organic material. This has useful implications for degradation of injected chemical wastes and needs to be investigated further. (Author's abstract)
W91-02814

GAMMA EMITTERS IN HONG KONG WATER.
Hong Kong Polytechnic, Kowloon. Dept. of Applied Physics.
L. Shun-Yin, M. Chung-Keung, N. Wai-Kwok, and A. Shui-Chun.
Environmental Geology and Water Sciences EGWSEI, Vol. 16, No. 2, p 129-131, 1990. 3 tab, 1 ref.

Descriptors: *Baseline studies, *Gamma radiation, *Groundwater pollution, *Hong Kong, *Nuclear powerplants, *Path of pollutants, *Radioactive wastes, *Water pollution sources, Drinking water, Groundwater, Radioactivity effects, Reservoirs, Rivers, Seawater, Spectral analysis.

Radioactivity in water originates from natural and artificial sources. The development of a nuclear powerplant near Hong Kong necessitates that attention be given to formulating techniques to assess the possible resultant environmental radioactive contamination. Water samples collected from various sites in Hong Kong in the spring and summer of 1987, representing seawater, river water, reservoir water, drinking water, and underground water were studied through gamma-ray spectral analysis. Only gamma emitters in the U238 and Th232 series and K40 were detected. No fission product was detected with specific activity above 0.1 Bq/kg. The data could be the baseline for future monitoring of the radioactivity released from a nuclear plant being built at a 50-km distance from Hong Kong. The variation of detected specific activities may be due to geological differences and the effect of plants. (Author's abstract) (Fish-PTT)
W91-02816

TRANSFORMATION OF MONOAROMATIC HYDROCARBONS TO ORGANIC ACIDS IN ANOXIC GROUNDWATER ENVIRONMENT.
Geological Survey, Reston, VA.
I. M. Cozzarelli, R. P. Eganhouse, and M. J. Baedecker.
Environmental Geology and Water Sciences EGWSEI, Vol. 16, No. 2, p 135-141, 1990. 4 fig, 21 ref.

Descriptors: *Benzenes, *Biodegradation, *Biotransformation, *Fate of pollutants, *Groundwater pollution, *Hydrocarbons, *Oil spills, *Organic compounds, Anoxic conditions, Organic acids.

The transformation of benzene and a series of alkylbenzenes was studied in anoxic groundwater of a shallow glacial-outwash aquifer near Bemidji, Minnesota. Monoaromatic hydrocarbons, the most water-soluble components of crude oil, were transported downgradient of an oil spill, forming a plume of contaminated groundwater. Organic acids that were not original components of the oil were identified in the anoxic groundwater. The highest concentrations of these oxidized organic compounds were found in the anoxic plume where a decrease in concentrations of structurally related alkylbenzenes was observed. These results suggest that biological transformation of benzene and alkylbenzenes to organic acid intermediates may be an important attenuation process in anoxic environments. The transformation of a complex mixture of hydrocarbons to a series of corresponding oxidation products in an anoxic subsurface environment provides new insight into in situ anaerobic degradation processes. (Author's abstract)
W91-02818

ESTIMATION OF THE CONTRIBUTION OF THE SULFATE ION TO RAINWATER ACIDITY.
Kanazawa Univ. (Japan). Faculty of Technology.
E. Hirai, M. Miyazaki, T. Chohji, M. Kitamura, and N. Okubo.
Environmental Technology (Letters) ETLEDB, Vol. 11, No. 8, p 757-764, 1990. 7 fig, 10 ref.

Descriptors: *Acid rain, *Instrumentation, *Meteorological data, *Sulfates, *Water pollution sources, Anions, Atomic absorption spectrophotometry, Chlorides, Hydrogen ion concentration, Ion exchange chromatography, Ion-selective electrodes, Japan, Nitrates.

A new method to estimate the contribution of sulfate to acidity in rainwater has been developed. Rainwater samples were analyzed for pH, NH4(+), SO4(-2), NO3(-), Cl(-), Ca(+2), Mg(+2), Na(+), and K(+). Analytical methods were as follows: pH was determined by an ion electrode probe; NH4(+) by an indophenol method; anion by ion chromatography; and metallic cations by atomic absorption spectrophotometry. The application of the method was demonstrated using rainwater data representing four local weather configurations collected at Kanazawa, an area of low industrial activity on the Japan Sea side of Japan. Contribution percentages of the sulfate ion, the main contributor, to acidity in rainwater of a pH between 4.0 and 4.6 were approximately 70% during non-winter weather, and about 85% during winter. Contribution ratios of nitrate and chloride ions, which are expected to account for the remaining acidity, could not be determined with the same accuracy, because the relationship of those ions with the total cation concentration is not as simple as that of the sulfate ion. Results were also compared to estimates based on the widespread method of using excess sulfate (non-seasalt-derived sulfate) for the estimation of acidity. An estimation of the contribution of these anions will soon be made available, and it is expected that their contribution ratios will also prove valuable for the analysis of acid rain phenomena. (Fish-PTT)
W91-02827

CHEMICAL CONSTITUENTS OF PRECIPITATION AND THEIR ROLE IN DETERMINING ITS ACIDITY IN BOMBAY.
Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
V. K. Sharma, P. P. Joshi, and R. S. Patil.
Environmental Technology (Letters) ETLEDB, Vol. 11, No. 8, p 777-784, 1990. 1 fig, 6 tab, 13 ref.

Descriptors: *Acid rain, *Acid rain effects, *Air pollution, *Hydrogen ion concentration, *India, *Water pollution sources, Aerosols, Ammonia, Bombay, Chemical analysis, Chlorides, Nitrates, Nitric acid, Physical analysis, Seawater, Sulfates, Sulfuric acid.

Acidity of precipitation, especially for industrialized regions, has been the subject of concern and research in recent times. Many studies in western countries have reported that acid deposition is increasing and this is mainly due to H(+) ions associated with the anions SO4(--), NO3(-), and Cl(-) which are generated primarily from anthropogenic emissions. Physical and chemical analysis of precipitation in Bombay, India, was conducted at two sites. The samples were analyzed for 12 physical and chemical constituents. It was observed that HNO3, H2SO4, and HCl were responsible for lowering the pH but due to high emissions of ammonia there was a neutralizing effect. The rain was found to be mostly alkaline in nature. The considerable emission of NH3 in the atmosphere causes a reaction to form (NH4)2SO4 which has a neutralizing effect. Calculations of sea salt ratios and ionic balance of aerosols indicate the significant contribution from continental and anthropogenic sources. (Fish-PTT)
W91-02829

SOURCES AND SINKS OF FORMIC, ACETIC, AND PYRUVIC ACIDS OVER CENTRAL AMAZONIA. 2. WET SEASON.
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
R. W. Talbot, M. O. Andreae, H. Berresheim, D. J. Jacob, and K. M. Beecher.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 95, No. 10, p 16,799-16,811, September 10, 1990. 10 fig, 4 tab, 40 ref. NSF Grant Nos. NSF-ATM 8413153 and NSF-ATM 8858074.

Descriptors: *Acetic acid, *Acid rain, *Amazon River Basin, *Atmospheric chemistry, *Formic acid, *Pyruvic acid, *Seasonal variation, *Water chemistry, Aerosols, Chemical interactions, Fluctuations, Forests, Model studies, Tropical regions.

The gas phase concentrations of formic (HCOOH), acetic (CH3COOH), and pyruvic (CH3C(O)COOH) acids in the forestry canopy, boundary layer, and free troposphere over the central Amazon Basin during the April-May segment of the 1987 wet season have been determined. At 150-m altitude in the boundary layer the daytime average concentrations were 430 +/-225, 340 +/-155, and 25 +/-15 ppt for HCOOH, CH3COOH, and CH3C(O)COOH, respectively. These values were five-fold lower than those observed in the 1985 dry season. Concentrations measured near the canopy top were not significantly different from boundary layer values (P = 0.10), while concentrations in the lower canopy were significantly less. Concentrations in the free troposphere (5 km) were lower than in the boundary layer and averaged 170 +/-40, 210 +/-40, and 15 +/-15 ppt for HCOOH, CH3COOH, and CH3C(O)COOH, respectively. Five-fold enhancements of CH3C(O)COOH concentrations were observed in convective outflows at 5 to 6 km altitudes. Aerosol carboxylate concentrations were usually below the detection limits of 5-10 ppt.

Preliminary branch enclosure measurements indicated significant direct emission of carboxylic acids by vegetation. A one dimensional photochemical model for the canopy and the boundary level was used to examine the contributions from various sources to the carboxylic acid budgets. Model results indicate that direct emissions from vegetation can account for most of the concentrations observed in the canopy. These emissions peak during the daytime hours. Direct emissions from vegetation can account for only a small fraction of the observed carboxylic acid concentrations in the boundary layer, suggesting a large contribution from atmospheric sources. appear to be too slow to explain the observed concentrations. Other atmospheric reactions, so far unidentified, could make a major contribution to the carboxylic acid budgets. (Author's abstract)
W91-02838

TMOSPHERIC SULFUR CYCLE OVER THE MAZON BASIN. 2. WET SEASON.
lorida State Univ., Tallahassee. Dept. of Oceanography.
. O. Andreae, H. Berresheim, H. Bingemer, D. J. cob, and B. L. Lewis.
ournal of Geophysical Research (D) Atmospheres GRDE3, Vol. 95, No. 10, p 16,813-16,824, September 20, 1990. 10 fig, 3 tab, 57 ref. NASA roposheric Chemistry Program Grant No. AG-1-588; NSF Grant Nos. ATM-8407137, TM-8413153, ATM-8858074.

escriptors: *Amazon River Basin, *Atmospheric emistry, *Path of pollutants, *Sulfur cycle, Vater pollution sources, Aerosols, Canopy, Fors, Model studies, Sulfates, Sulfides, Sulfur compunds, Tropical regions.

e fluxes and concentrations of atmospheric fur species at ground level and from aircraft er the Amazon Basin during the 1987 wet season re determined, providing a comprehensive deiption of the sulfur cycle over a remote tropical gion. The vertical profile of dimethyl sulfide MS) during the wet season was found to be very ilar to that measured during the dry season, ggesting little seasonal variation in DMS fluxes. e concentrations of hydrogen sulfide (H2S) re almost an order of magnitude higher than se of DMS, which makes H2S the most impor- t biogenic source species in the atmospheric fur cycle over the Amazon Basin. The flux of MS at the top of the tree canopy was determined ng the gradient-flux approach. The canopy was ource of DMS during the day, and a weak sink ring the night. Measurements of sulfur gas emisns from soils, using the chamber method, wed very small fluxes, consistent with the hyhesis that the forest canopy is the major source sulfur gases. The observed soil and canopy ssion fluxes are similar to those measured in perate regions. The concentrations of SO2 and ate aerosol in the wet season atmosphere were ilar to dry season values. The sulfate concentra- in rainwater, on the other hand, was lower by actor of 5 during the wet season. Due to the her precipitation rate the wet deposition flux of ate was not significantly different between the ons. The measured fluxes and concentrations of S, H2S, and SO2 were consistent with a model cribing transport and chemistry of these sulfur cies in the boundary layer. The concentration aerosol and the sulfate deposition rate could be explained by import of significant amounts marine and anthropogenic sulfate aerosol into Amazon Basin. (Author's abstract)
1-02839

ECIPITATION CHEMISTRY IN CENTRAL AZONIA.
rida State Univ., Tallahassee. Dept. of Oceanphy.
primary bibliographic entry see Field 2B.
1-02840

ACHING OF PESTICIDES FROM TREATED MBERS--A SOURCE OF POLLUTION.
McNeill.
nal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 4, p 330-334, August 1990. 3 fig, 4 tab, 3 ref.

Descriptors: *Leaching, *Pesticides, *Preservatives, *Saw mills, *Water pollution sources, *Wood preservatives, Dieldrin, Industrial wastewater, Lossie River, Pentachlorophenol.

Observations at a sawmill where two major spillages of preservative had led to pollution of the River Lossie indicated that bad timber treatment practices, together with minor spillages when preservative was delivered to the premises, were contributing to the overall unsatisfactory state of the watercourse. Also, soil sampling at the saw mill, and laboratory trials, revealed that the storage of freshly treated timbers can be a significant source of pollution. In order to prevent contamination of water from these sources, recommendations were issued to the sawmill, and the company relocated the timber treatment plant on a specially prepared self contained site to avoid pollution should further spillages occur. Remedial recommendations encompassed: (1) strict adherence to the preservative manufactures guidelines; (2) relocation of treatment area to a confined site; and (3) preventing future spillages. (Lantz-PTT)
W91-02844

RECENT INVESTIGATION OF TOTAL CARBONATE IN THE BALTIC SEA: CHANGES FROM THE PAST AS A RESULT OF ACID RAIN.
Goeteborg Univ./Chalmers Univ. of Technology (Sweden). Dept. of Analytical and Marine Chemistry.
M. Ohlson, and L. Anderson.
Marine Chemistry MRCHBD, Vol. 30, No. 1/3, p 259-267, 1990. 3 fig, 1 tab, 12 ref.

Descriptors: *Acid rain effects, *Baltic Sea, *Carbonates, *Gulf of Bothnia, *Path of pollutants, Alkalinity, Calcium, Chemical analysis, Mixing, Salinity.

In a plot of the concentration of either total alkalinity or calcium versus salinity in the Baltic Sea, two mixing lines are evident: one for the mixing of low alkalinity river water, from the Gulf of Bothnia, with Baltic Proper surface water, and one for the mixing of Baltic Proper surface water with Kategatt water. The intercept at salinity = 0 for the Baltic-Kategatt mixing line gives the mean river concentration, which is compared with earlier results of other workers. The earlier mean river concentrations are different for both calcium and total alkalinity, but the ratio is about the same (approximately 0.41). However, a 1986 investigation gave a significantly different ratio (0.691) as a result of both an increased calcium and a decreased total alkalinity concentration. Explanations for the differences in the mean river concentration are offered, based on reactions in the drainage basins including the decay of organic matter, precipitation of acid rain, and dissolution of carbonate minerals. (Author's abstract)
W91-02853

HYDROCARBON POLLUTION IN PARTICLE-RICH WATERS (GULF OF FOS-SUR-MER): COMPARATIVE STUDY OF EXTRACTION PROCEDURES.
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 5A.
W91-02854

FATE OF ALDICARB IN THE UNSATURATED ZONE BENEATH A CITRUS GROVE.
Florida Univ., Gainesville. Dept. of Soil Science.
A. G. Hornsby, P. S. C. Rao, and R. L. Jones.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2287-2302, October 1990. 15 fig, 2 tab, 50 ref. Union Carbide Agricultural Company contract 81065-C.

Descriptors: *Aldicarb, *Citrus crops, *Fate of pollutants, *Florida, *Path of pollutants, *Pesticides, Drainage, Leaching, Root zone, Soil chemistry, Testing procedures.

A field study was conducted in a 1.6 ha citrus grove located in central Florida to evaluate transport and transformations of the nematicide aldicarb and its two metabolites (aldicarb sulfoxide and aldicarb sulfone) in the unsaturated zone over a 218-day period during 1984. Bromide leaching was also monitored to provide a tracer of water movement in this well-drained, deep, sandy soil. Aldicarb and bromide were applied in 3-m wide treatment bands located midway between tree rows (7.62 m apart) and incorporated into the top 5 cm soil by disking. This application method resulted in extreme variability in solute concentrations across and within the treatment bands, which persisted at all depths even as the pesticide and bromide leached during the study period. Aldicarb, its metabolites (sulfoxide and sulfone), and bromide leached readily through the soil and moved past the 7.92 m depth by the last sampling date (218 days). Aldicarb dissipated rapidly (half-life <= 2 weeks), yielding aldicarb sulfoxide and aldicarb sulfone. Both of these compounds also dissipated but at a rate slower than that for aldicarb. The dissipation of total carbamate residues under field conditions was characterized by a half-life of about 69 days, which was in agreement with laboratory-derived values. On the basis of the findings of this study, it is suggested that although generic guidelines are useful for studying the environmental fate of pesticides, rigid protocols should not be specified by regulatory agencies for these types of studies. Instead, a specific protocol must be developed (based on site characteristics, agricultural practices, and the chemical of interest) which can account for both extrinsic and intrinsic variability at each particular field site. (Author's abstract)
W91-02859

EXPERIMENTAL INVESTIGATION OF VARIABLE DENSITY FLOW AND MIXING IN HOMOGENEOUS AND HETEROGENEOUS MEDIA.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 2F.
W91-02862

ANALYTICAL SOLUTION FOR ONE-DIMENSIONAL TRANSPORT IN HETEROGENEOUS POROUS MEDIA.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5F.
W91-02863

APPARENT DISPERSION IN TRANSIENT GROUNDWATER FLOW.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W91-02864

GAS MIGRATION IN DISCRETE FRACTURE NETWORKS.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Land and Water Resources.
For primary bibliographic entry see Field 5E.
W91-02871

UNCERTAINTY PROPAGATION WITH NUMERICAL MODELS FOR FLOW AND TRANSPORT IN THE UNSATURATED ZONE.
Polytechnic Univ., Brooklyn, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2G.
W91-02875

NUMERICAL SIMULATION OF SOLUTE TRANSPORT IN THREE-DIMENSIONAL, RANDOMLY HETEROGENEOUS POROUS MEDIA.
Lawrence Livermore National Lab., CA. Earth Sciences Dept.
A. F. B. Tompson, and L. W. Gelhar.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2541-2562, October 1990. 12 fig, 2 tab, 57 ref. United States Nuclear Regulatory Commission

Contracts NRC-04-83-174 and NRC-04-88-074, National Science Foundation Grant ECE-8311786, United States Department of Energy Contract W-7405-Eng-48.

Descriptors: *Groundwater movement, *Mathematical models, *Path of pollutants, *Porous media, *Soil porosity, *Soil water, *Solute transport, Advection, Dispersion, Flow rates, Heterogeneity, Hydraulic conductivity, Plumes.

Subsurface porous materials typically exhibit a large degree of natural variability in terms of their type and spatial distribution. A three-dimensional solute transport model has been developed to study detailed contaminant movements through large heterogeneous flow systems in porous media. The model is based upon a random walk particle method to treat multidimensional advection and dispersion processes in saturated or unsaturated media in a computationally efficient manner. The transport simulations are used to examine the large time and spatial effects of the variable flow field on developing solute plumes, and, in particular, to investigate the nature of the large-scale dispersive behavior. Numerical transport experiments were conducted using single realizations of random hydraulic conductivity fields with three different degrees of heterogeneity. Experiments with different source locations were used to investigate preasymptotic and nonergodic effects that would appear as differences in plume evolution among the experiments. Spatial moments of the particle distributions in statistically isotropic saturated media compare favorably with stochastic theory predictions in terms of longitudinal advection and mixing, but differ markedly from predictions of transverse mixing. The simulations also demonstrate that significant nonergodic effects occur, as reflected in strong differences in the second moment evolution curves among the individual experiments and as predicted from the ensemble stochastic theory. (Author's abstract)
W91-02881

ANALYTICAL TRAVELING WAVE SOLUTIONS FOR TRANSPORT WITH NONLINEAR AND NONEQUILIBRIUM ADSORPTION.
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Plant Nutrition.
For primary bibliographic entry see Field 2G.
W91-02882

APPLICATION OF THE ARNOLDI ALGORITHM TO THE SOLUTION OF THE ADVECTION-DISPERSION EQUATION.
Manitoba Univ., Winnipeg. Dept. of Geological Engineering.
A. D. Woodbury, W. S. Dunbar, and B. Nour-Omid.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2579-2590, October 1990. 11 fig, 5 tab, 38 ref.

Descriptors: *Advection, *Dispersion, *Groundwater movement, *Mathematical models, *Path of pollutants, *Plumes, *Pollutants, *Solute transport, Camp Borden Site, Differential equations, Finite difference methods.

The solution to the finite element matrix differential equations resulting from the discretization of the contaminant transport equation is normally carried out by a finite difference approximation to the time derivative. The total computational effort in simulating a contaminant plume is then directly related to the number of unknowns and the number of time steps required to obtain accurate and stable solutions. An alternative method is the Arnoldi algorithm which uses orthogonal matrix transformations to reduce the finite element equations to a much smaller upper Hessenberg system of first-order differential equations. This new system can be solved by a standard Crank-Nicolson algorithm with very little computational effort. A matrix-vector multiplication is then used to obtain the original solution at desired time steps. The algorithm is used to simulate accurately the contaminant plumes for a strip source areal aquifer, a cross-sectional problem, and the Borden landfill in Ontario, Canada. The Arnoldi algorithm shows an impressive 613% increase in speed over the conventional Crank-Nicolson scheme for the Borden landfill. The method affords an efficient means of solving large problems, particularly when time durations are long. (Author's abstract)
W91-02883

STOCHASTIC ANALYSIS OF THE CONCENTRATION VARIABILITY IN A THREE-DIMENSIONAL HETEROGENEOUS AQUIFER.
Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle, Baden (Switzerland).
For primary bibliographic entry see Field 2F.
W91-02884

METAL-ORGANIC ASSOCIATIONS IN SEDIMENTS--I. COMPARISON OF UNPOLLUTED RECENT AND ANCIENT SEDIMENTS AND SEDIMENTS AFFECTED BY ANTHROPOGENIC POLLUTION.
Munich Univ. (Germany, F.R.). Mineralogisch-Petrographisches Inst.
A. V. Hirner, K. Kritsotakis, and H. J. Tobschall.
Applied Geochemistry APPGEY, Vol. 5, No. 4, p 491-505, July/August 1990. 2 fig, 4 tab, 89 ref.

Descriptors: *Metals, *Organic matter, *Path of pollutants, *Sediment contamination, Arsenic, Boron, Cadmium, Cobalt, Comparison studies, Copper, Humic acids, Kerogen, Lead, Manganese, Mangrove swamps, Mercury, Molybdenum, Nickel, Oil shale, Silver, Spectrometry, Trace elements, Vanadium, Wastewater pollution, Zinc.

The concentrations of 19 trace elements were determined by plasma emission spectrometry in organic fractions (organic solvent extractables, soluble humics, protokerogen and kerogen concentrates) separated from various recent and ancient sediments (Mangrove sediments, algal mats, oil shales, phosphorites) as well as sediments polluted by industrial metal emissions (Rhine River, Port Pirie smelter effluent). Often the organic constituents were found to be enriched in trace elements (especially B, V, Mn, Co, Ni, Cu, Zn, As, Mo, Ag, Cd, Sb, Hg, and Pb) up to more than three orders of magnitude compared to the bulk sediments, indicating the importance of organic substances with respect to transport and fixation trace elements with sediments. The formation of metal-organic associations was found to reflect the environment of deposition (marine to terrestrial) as well as diagenetic transformations (recent to ancient). Against an unpolluted natural background, increasing metal pollution led to increasing metal uptake by organic substances (especially for B, Cr, Fe, Co, Cu, Zn, As, Cd, and Pb). (See also W91-02892) (Author's abstract)
W91-02891

INTEGRATED CHEMICAL AND BIOLOGICAL STUDY OF THE BIOAVAILABILITY OF METALS IN SEDIMENTS FROM TWO CONTAMINATED HARBOURS IN NEW BRUNSWICK, CANADA.
Environmental Protection Service, Dartmouth (Nova Scotia).
H. S. Samant, K. G. Doe, and O. C. Vaidya.
Science of the Total Environment STENDL, Vol. 96, No. 3, p 253-268, August 1990. 1 fig, 8 tab, 12 ref.

Descriptors: *Bioavailability, *Canada, *Heavy metals, *Path of pollutants, *Sediment contamination, *Water pollution effects, Bioaccumulation, Cadmium, Cobalt, Copper, Fate of pollutants, Geochemistry, Harbors, Iron, Lead, Manganese, Oxides, Strontium, Trace metals, Zinc.

Harbor sediments in Dalhousie and Belledune, New Brunswick, Canada, are known to be contaminated with copper, zinc, lead, and cadmium. Relatively high concentrations of these metals in the resident organisms were reported from previous surveys. Experiments were conducted in the laboratory to study partitioning and bioavailability of heavy metals present in the contaminated sediments. A procedure to extract metals sequentially from sediments was used to determine their distribution in various geochemical fractions. A companion experiment was also set up to determine the bioavailability of trace metals from these sediments. Experimental data indicated that the metals associated with hydrous oxides of iron and manganese and the residual fraction carried the major burden of heavy metals in the sediment. Appreciable uptake of metals was observed to occur only from the Belledune sediment. Biota accumulated lead and cadmium to the greatest extent, with strontium, cobalt, and zinc taken up to a lesser degree as compared with control animals in uncontaminated sediments. Concern is directed to heavy metals associated with hydrous oxides of iron and manganese because changing environmental conditions can transfer these elements from the sediments into the aqueous phase. (Author's abstract)
W91-02931

MONITORING AND ASSESSMENT OF MERCURY POLLUTION IN THE VICINITY OF A CHLORALKALI PLANT: I. DISTRIBUTION, AVAILABILITY AND GENOTOXICITY OF SEDIMENT MERCURY IN THE RUSHIKULYA ESTUARY, INDIA.
Berhampur Univ. (India). Dept. of Botany.
K. K. Panda, M. Lenka, and B. B. Panda.
Science of the Total Environment STENDL, Vol. 96, No. 3, p 281-296, August 1990. 5 fig, 5 tab, 26 ref.

Descriptors: *Bioassay, *Bioavailability, *Estuarine sediments, *Genotoxicity, *India, *Industrial wastewater, *Mercury, *Path of pollutants, *Water pollution effects, Bioaccumulation, Biological magnification, Hydrogen ion concentration, Roots, Sediment contamination.

Industrial effluent discharged into the Rushikulya India, estuary from a chloralkali plant has been identified as the source of mercury which has polluted the estuary for the past two decades. Sediment samples taken from eight sites representing the effluent channel, effluent discharge point and the course of the estuary, were analyzed for total mercury. The leachability of mercury from sediments was studied as a function of pH. Chemical extraction was used to assess bioavailability of mercury from the sediments. Further, sediment samples were bioassayed by the Allium micronucleus (MNC) assay. The endpoints measured were root length, root mercury (bioconcentrated mercury) and frequency of root meristematic cells with MNC. The mercury concentrations in sediment samples ranged from 1.6 to 192 mg/kg. The results indicated that pH was an important factor regulating the availability of mercury; the lower the pH the higher the availability of mercury. Of the different chemical extractants used, 0.05 M CaCl2 extractable mercury showed the highest correlation with the bioconcentrated mercury, emphasising the fact that 0.05 M CaCl2 was the best predictor of bioavailable mercury form the sediment. Similarly, the frequency of root meristematic cells with MNC was highly correlated not only with bioconcentrated mercury, but also with bioavailable mercury, as evidenced by 0.05 M CaCl2 extractable mercury. The Allium MNC assay can assess mercury pollution and takes into account the bioavailability of the metal. The overall assessment indicated that, although localized, the sediment of the estuary is contaminated with high concentrations of mercury with respect to both bioavailability and toxicity. (Author's abstract)
W91-02932

ABSENCE OF CADMIUM IN THE BLOOD OF HORSES FED OATS GROWN ON MUNICIPAL SLUDGE-AMENDED SOIL.
For primary bibliographic entry see Field 5E.
W91-02933

CONTAMINANT MIGRATION THROUGH FRACTURED TILL INTO AN UNDERLYING AQUIFER.
University of Western Ontario, London. Geotechnical Research Centre.
R. K. Rowe, and J. R. Booker.
Canadian Geotechnical Journal CGJOAH, V 27, No. 4, p 484-495, August 1990. 7 fig, 1 tab,

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ref, append. NSERC Grant No. A1007.

Descriptors: *Aquifers, *Geologic fractures, *Glacial drift, *Groundwater movement, *Groundwater pollution, *Groundwater quality, *Landfills, *Mathematical models, *Model studies, *Path of pollutants, Computer models, Diffusion coefficient, Dispersivity, Effective porosity.

The potential impact on groundwater quality of contaminant migration from a landfill site, through fractured till, and into an underlying aquifer was studied. A simple, semi-analytic technique for modeling contaminant transport through the fractured till was developed, including consideration of diffusion of contaminants from the fractures into the till matrix, sorption, and radioactive decay. The model also considered the finite mass of contaminant and dilution due the flow of groundwater in the aquifer. The model can be easily implemented on a microcomputer. The model allowed examination of variations in fracture spacing, fracture opening size, thickness of the fractured zone, diffusion coefficient, dispersivity, effective porosity of the matrix, radioactive decay, Darcy velocity, thickness of the aquifer, distribution coefficient, and mass of the contaminant. A limited parametric study was made to illustrate the application of the theory, practical implications, and inter alia, examined the effects of uncertainty in fracture spacing, the thickness of the fractured till, and the effective porosity of the till matrix. (Author's abstract)
W91-02941

IGRATION OF POLLUTANTS IN GROUND-ATER: IV. MODELING OF THE PUMPING F CONTAMINANTS FROM FRACTURED EDROCK.
anderbilt Univ., Nashville, TN. Dept. of Chemis-.
r primary bibliographic entry see Field 2F.
91-02945

LUMINIUM DEPOSITION IN BONE AFTER ONTAMINATION OF DRINKING WATER PPLY.
nt George's Hospital Medical School, London ngland). Dept. of Cellular and Molecular Sci-es.
r primary bibliographic entry see Field 5C.
91-02951

C. Effects Of Pollution

ALUATION OF THE SEA URCHIN ECHIN-IETRA IUCUNTER AS AN INDICATOR OF AVY-METAL CONTAMINATION IN CUBA 'ALUACION DEL ERIZO DE MAR ECHIN-IETRA IUCUNTER COMO INDICATOR DE NTAMINACION POR METALES PESADOS, BA).
ututo de Investigaciones del Transporte, vana (Cuba). Unidad de Proteccion Ambiental.
primary bibliographic entry see Field 5A.
1-02044

BLETHAL AND HISTOPATHOLOGICAL FECTS OF TRACE LEVELS OF TRIBUTYL- FLUORIDE ON ADULT OYSTERS CRAS-STREA GIGAS.
itut Francais de Recherche pour l'Exploitation a Mer, Paris.
Chagot, C. Alzieu, J. Sanjuan, and H. Grizel.
atic Living Resources ALREEA, Vol. 3, No. 121-130, 1990. 19 fig, 1 tab, 26 ref.

criptors: *Antifoulants, *Organotin compds, *Oysters, *Tributyltin fluoride, *Water ution effects, Aquaculture, Ecotoxicology, ue analysis, Toxicity.

lt oysters (Crassostrea gigas) were exposed to ronmental concentrations of tributyltin fluo- (2, 13.1 and 64.8 ng/L), for a period of 1 th, which included both an exposure and de-tion phase. The results showed that the diges-gland is the primary target organ. Recoverable ifications were observed at the lowest concentration. Limited necrosis was observed at the highest concentration and a longer exposure could have led to extensive and irreversible tissue lesions. Shell malformations (chambering) were observed during the depuration phase. Suggested safe tributyltin levels in mariculture waters should be < 2 ng/L. (King-PTT)
W91-02045

EFFECTS OF HEAVY METALS ON EELS, ANGUILLA SP.
Perpignan Univ. (France). Lab. de Biologie Marine.
J. Brusle.
Aquatic Living Resources ALREEA, Vol. 3, No. 2, p 131-141, 1990. 2 tab, 73 ref.

Descriptors: *Bioindicators, *Ecotoxicology, *Eel, *Heavy metals, *Literature review, *Water pollution effects, *Water quality, Japan, Marine environment, Mercury, Sediment contamination, Toxicity.

About 60 papers and reports dealing with heavy metal contents in different eel species are reviewed in order to document various patterns of uptake, elimination and accumulation of the metals and to underline their detrimental effects such as lethality and histopathology. Two main toxicological topics are considered: observation on contaminant levels in eels taken from the wild (mainly from contaminated waters), and experimental studies under laboratory conditions. Eels are found to acquire heavy metals directly from the water, from the sediments or from their food. (Author's abstract)
W91-02046

RESPONSE AND RECOVERY OF BRAIN ACETYLCHOLINESTERASE ACTIVITY IN ATLANTIC SALMON (SALMO SALAR) EXPOSED TO FENITROTHION.
Department of Fisheries and Oceans, St. John's (Newfoundland). Science Branch.
For primary bibliographic entry see Field 5A.
W91-02061

EFFECTS OF CALCIUM AND PH ON THE REPRODUCTIVE SUCCESS OF AMNICOLA LIMOSA (GASTROPODA).
Guelph Univ. (Ontario). School of Engineering.
M. A. Shaw, and G. L. Mackie.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1694-1699, September 1990. 3 fig, 4 tab, 24 ref.

Descriptors: *Acid rain effects, *Acidic water, *Calcium, *Gastropods, *Hydrogen ion concentration, *Lake acidification, *Mollusks, *Reproduction, *Water chemistry, *Water pollution effects, Buffer capacity, Embryonic growth stage, Invertebrates, Laboratory methods, Limiting nutrients.

Field and laboratory experiments were designed to examine the relationship between water chemistry (especially pH and calcium) and the reproductive success of Amnicola limosa. Fecundity (number eggs/female) was positively correlated with lake buffering capacity ($P = 0.002$) in naturally occurring populations. Ther was a 66% reduction in fecundity in lakes over a pH range of 7.5 to 5.8. However, fecundity was higher than expected in a highly-coloured, low-pH lake. The number of juveniles produced per egg was not related to any water chemistry variable (multiple R-squared = 0.186). A laboratory experiment demonstrated that pH, and not calcium, was limiting embryonic development. All embryos held at pH 4.5 failed to hatch. Eggs held at pH 5.5 experienced reduced hatching success ($P = 0.013$) and delayed development ($P<0.001$) compared with those held at pH 6.5. Length of newly hatched snails did not differ significantly between treatments ($P = 0.891$). The critical calcium concentration required for embryonic development in laboratory incubation lay between 0.14 and 1.11 mg/L. This is well below the calcium concentration of acidifying lakes in south-central Ontario. (Author's abstract)
W91-02064

PROTECTIVE ACTION OF IONS AGAINST CADMIUM TOXICITY TO YOUNG BUFO ARENARUM TADPOLES.
Universidad Nacional de Lujan (Argentina). Lab. of Ecophysiology.
C. V. Muino, L. Ferrari, and A. Salibian.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 3, p 313-319, September 1990. 1 fig, 2 tab, 21 ref. Comision de Investigaciones Cientificas Grant 7812/86.

Descriptors: *Acute toxicity, *Amphibians, *Cadmium, *Toads, *Toxicology, *Water pollution effects, Aquatic animals, Heavy metals, Inorganic ions, Ionic strength, Lethal limit.

The impact of Cd(II) on the response of tadpoles (Bufo arenarum) to solutions of varying ionic strength was investigated. At 0.5 and 1.0 mg/L of Cd(II) in ionic solutions, mortality was less than 10%; above these concentrations, toxicity showed an abrupt rise. The 96 h LC50 for tadpoles exposed to Cd(II) was 2.08 mg/L. In ion-free or non-ionic solutions, 1.0 mg/L Cd(II) caused 100% mortality within a few hours. The presence of 1.0 mg/L Cd(II) in solutions of varying ionic strength was not associated with changes in the water balance of the animals. The data indicate that inorganic ions have a protective action on the toxic effects of Cd(II). The cadmium toxicity may be interpreted as a secondary consequence of the known inhibitory effect on epithelial ATPases. (MacKeen-PTT)
W91-02092

SUBLETHAL EFFECTS OF 2,2-DICHLOROPROPIONIC ACID (DALAPON) ON FOSSARIA CUBENSIS, INTERMEDIATE HOST OF THE LIVER FLUKE, FASCIOLA HEPATICA.
Southern Univ., Baton Rouge, LA. Dept. of Biological Sciences.
F. A. Christian, and J. A. Thompson.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 3, p 343-349, September 1990. 2 fig, 2 tab, 8 ref. NIH Grant RR 08025.

Descriptors: *Animal parasites, *Dalapon, *Herbicides, *Snails, *Toxicology, *Water pollution effects, Chronic toxicity, Dose-response relationships, Experimental data, Hatching, Liver flukes, Sublethal effects.

The chronic effects of the herbicide 2,2-dichloropropionic acid (dalapon) on the hatching success of Fossaria cubensis snails after several generations of exposure at sublethal levels were investigated. Snails were reared in dalapon at 0, 0.1, 1.0, or 10.0 mg/L for three successive generations with renewal of the dalapon solutions every 4 d. In the first generation there was 100% hatching of snails in the control by the 14th day while only 5.55%, 8.47% and 66.6% hatched in the 0.1, 1.0 and 10.0 mg/L dalapon groups, respectively. There was also a significant delay in hatching of the young snails in the dalapon-treated groups. In the 3rd generation, embryo development and hatching had improved in 0.1, 1.0 and 10.0 mg/L dalapon to 29%, 38.2% and 74.7%, respectively, by the 14th day and 100% in all groups by the 20th day. The results indicate that chronic exposure to sublethal concentrations of dalapon may decrease the time required for F. cubensis embryo development and hatching, possibly resulting in more snails available for the propagation of the liver fluke, Fasciola hepatica, which in turn could increase the incidence of liver fluke infections. (MacKeen-PTT)
W91-02095

OXYGEN UPTAKE OF PSEUDOSUCCINEA COLUMELLA AND FOSSARIA CUBENSIS TREATED WITH SUBLETHAL CONCENTRATIONS OF CUTRINE-PLUS, AN ALGICIDE.
Southern Univ., Baton Rouge, LA. Dept. of Biological Sciences.
F. A. Christian, and T. M. Tesfamichael.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 3, p 336-342, September 1990. 1 fig, 2 tab, 13 ref. NIH Grant RR 08025.

Descriptors: *Algicides, *Oxygen uptake, *Snails, *Sublethal effects, *Toxicology, *Water pollution effects, Aquatic animals, Chelating agents, Dose-response relationships, Experimental data, Oxygen requirements.

The influence of sublethal concentrations of CUTRINE-PLUS, a copper-chelating algicide, on the oxygen uptake of uninfected (free from trematode larvae) Pseudosuccinea columella and Fossaria cubensis was investigated. Snails were treated with CUTRINE-PLUS for 3 h and oxygen consumption measurements taken every 15 min during the test period. The average oxygen consumption of P. columella control snails was 168 O(2) microl/h/g wet weight including the shell, whereas snails treated with 0.3, 0.6, 0.9, and 1.5 ppm CUTRINE-PLUS consumed an average of 127, 106, 101, and 77 O(2) microl/h/g wet weight, respectively. F. cubensis snails treated with 0, 0.3, 0.6, 0.9, and 1.5 ppm CUTRINE-PLUS consumed an average of 178, 126, 123, 122, and 97 O(2) microl/h/g wet weight, respectively. The data indicate that F. cubensis snails were less affected by CUTRINE-PLUS exposure than were P. columella. Possible explanations for the observed effects of CUTRINE-PLUS treatment included inhibition of DNA synthesis, decreased hemolymph oxygen carrying capacity, and inhibition of ATPase activity. (MacKeen-PTT)
W91-02096

METHYLPARATHION-INDUCED ALTERATIONS IN THE ACETYLCHOLINESTERASE AND PHOSPHATASES IN A PENAEID PRAWN, METAPENAEUS MONOCEROS.
Sri Venkateswara Univ., Kavali (India). Div. of Toxicology.
M. Srinivosulu Reddy, and K. V. Ramana Rao.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 3, p 350-357, September 1990. 2 tab, 25 ref.

Descriptors: *Aquatic animals, *Enzymes, *Insecticides, *Methyl parathion, *Organophosphorus pesticides, *Shrimp, *Toxicology, *Water pollution effects, Animal metabolism, Dose-response relationships, Enzyme activity, Experimental data, Sublethal effects.

The effects of exposure to methylparathion on the activities of acetylcholinesterase (AChE), acid and alkaline phosphatases (ACPase and ALPase), and on carbohydrate metabolism were studied in the penaeid prawn, Metapenaeus monoceros. Specimens were treated with 40 microg/L of methylparathion (one-third of 48 h LC50) for up to 5 days. The AChE activity of thoracic ganglionic mass was significantly inhibited in prawns exposed to methylparathion for 2, 3, 4 or 5 days. The ACPase activity of hepatopancreas was enhanced by exposure to the sublethal concentration of methylparathion, whereas ALPase activity of this organ was inhibited. A significant decrease of hepatic glycogen content was observed after treatment. The hemolymph glucose level was increased up to 4 days of exposure, leading to hyperglycemia. After 5 days of exposure hemolymph glucose was decreased significantly. The inhibition of AChE activity and accumulation of ACh at the synaptic junctions caused by methylparathion exposure may lead to the observed behavioral changes such as hyperexcitability, movement restriction, and loss of coordination and equilibrium, and ultimately, to the death of the organism. (MacKeen-PTT)
W91-02097

TOXICITY EVALUATION OF THE PROPOSED SECONDARY AND THE PRIMARY EFFLUENTS DISCHARGED TO MASSACHUSETTS BAY.
Springborn Labs., Inc., Wareham, MA.
For primary bibliographic entry see Field 5B.
W91-02101

LAKE ACIDIFICATION AND FISHERIES PROJECT: BROOK TROUT (SALVELINUS FONTINALIS) EARLY LIFE STAGES.
Wyoming Univ., Laramie. Fish Physiology and Toxicology Lab.
H. L. Bergman, and J. S. Mattice.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 8, p 1578-1579, August 1990. 17 ref. Electric Power Research Institute Contract RP-2346.

Descriptors: *Acid rain effects, *Brook trout, *Fish, *Fish populations, *Lake acidification, *Lake fisheries, *Trout, *Water pollution effects, Acid lakes, Acidic water, Aluminum, Bioassay, Calcium, Embryonic growth stage, Fish eggs, Fish growth, Fish physiology, Juvenile growth stage, Larval growth stage, Toxicity, Water chemistry.

A brief review of a series of seven papers from the Lake Acidification and Fisheries (LAF) project of the Electric Power Research Institute is presented. The overall goal of the LAF Project is to determine cause-effect relationships between surface water acidification and fish population responses by integrating bioassay data from the laboratory and water quality and fish population data from the field into a predictive modeling framework. In the set of seven papers, LAF investigators report the results from a series of experiments with brook trout eggs, fry, and juveniles exposed for as long as 91 d to as many as 84 different combinations of pH (4.0-6.5), aluminum (0-1.00 mg/L), and calcium (0.5-8.0 mg/L) representative of acidic and acid-sensitive surface waters. Mortality and growth effects of acid/aluminum exposure were shown to depend on life stage. Whole body ion concentrations were found to be most affected by water calcium concentration during the full 91-d early life exposure, while pH was the dominant influence on whole body electrolytes during the 21-d yolk sac and swim-up fry exposures. The three final papers explore the effects of pulsed acid/aluminum exposure, aluminum complexation, and the relative sensitivity of different brook trout strains to combinations of acid, aluminum and low calcium concentrations. (See W91-02103 thru W91-02109) (MacKeen-PTT)
W91-02102

EFFECTS OF PH, ALUMINUM, AND CALCIUM ON SURVIVAL AND GROWTH OF EGGS AND FRY OF BROOK TROUT (SALVELINUS FONTINALIS).
Wyoming Univ., Laramie. Fish Physiology and Toxicology Lab.
C. G. Ingersoll, D. R. Mount, D. D. Gulley, T. W. La Point, and H. L. Bergman.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 8, p 1580-1592, August 1990. 9 fig, 2 tab, 75 ref. Electric Power Research Institute Contract RP-2346-01.

Descriptors: *Acid rain effects, *Acidic water, *Acidity, *Aluminum, *Brook trout, *Calcium, *Fish, *Fish populations, *Growth, *Hydrogen ion concentration, *Larval growth stage, *Survival, *Trout, *Water pollution effects, Bioassay, Fish eggs, Fish growth, Fish physiology, Fishkill, Life stages, Toxicity, Water chemistry.

Freshly fertilized eggs, eyed eggs, yolk-sac fry, and swim-up fry of brook trout (Salvelinus fontinalis) were exposed to a matrix of 84 combinations of pH (4.0-6.5), aluminum (0-1.00 mg/L), and calcium (0.5-8.0 mg/L) in 21-91-d experiments. The response to pH, aluminum, and calcium was dependent on life stage. Sensitivity to acid toxicity generally decreased with age (freshly fertilized eggs> eyed eggs>yolk-sac fry=swim-up fry). Survival or hatching of freshly fertilized eggs and eyed eggs decreased at pH 5.2 and below, whereas survival of yolk-sac and swim-up fry was reduced at pH 4.4-4.0. Sensitivity to aluminum toxicity generally increased with age (freshly fertilized eggs=eyed eggs<yolk-sac fry<swim-up fry). At low pH, survival of freshly fertilized and eyed eggs increased with exposure to increasing aluminum concentrations. In contrast, elevated aluminum (greater than or equal to 0.333 mg/L) was often toxic to fry. Increasing calcium was beneficial to all life stages, although the magnitude of this benefit depended on life stage and on the specific pH and aluminum concentration. Survival after previous exposure to toxic combinations of pH, aluminum, and calcium generally improved during a post-exposure recovery period at pH 6.5. However, increased mortality in many exposure combinations did not begin until this recovery period. (See W91-02102 and W91-02104 thru W91-02109) (Author's abstract)
W91-02103

EFFECTS OF WATER ACIDITY, CALCIUM, AND ALUMINUM ON WHOLE BODY IONS OF BROOK TROUT (SALVELINUS FONTINALIS) CONTINUOUSLY EXPOSED FROM FERTILIZATION TO SWIM-UP: A STUDY BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS.
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
C. M. Wood, D. G. McDonald, C. G. Ingersoll, D. R. Mount, and O. E. Johannsson.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 8, p 1593-1603, August 1990. 10 fig, 35 ref. Electric Power Research Institute Contract RP-2346-01.

Descriptors: *Acid rain effects, *Acidic water, *Aluminum, *Analytical methods, *Brook trout, *Calcium, *Electrolytes, *Fish, *Fish populations, *Population exposure, *Trout, *Water pollution effects, Bioassay, Fish eggs, Fish physiology, Hydrogen ion concentration, Life stages, Neutron activation analysis, Tissue analysis, Water chemistry, Whole body ion concentrations.

Water Ca, rather than pH or Al, was the most important factor affecting whole body electrolyte levels in fry exposed from fertilization to swim-up (91 d) to 84 combinations of pH (6.5, 5.2, 4.8, 4.4, 4.0), Ca (0.5, 1, 2, 4, 8 mg/L), and Al (0, 12, 37, 111, 333, 1000 microg/L) in flowing soft water. Aluminum accumulation occurred only at water Al levels >111 microg/L; Al accumulation was inhibited both by increasing Ca and decreasing pH. Under control conditions (pH=6.5, Ca=2 mg/L, Al=0 microg/L), whole body Na, Cl, K, and Ca levels all increased greatly during development, while Mg decreased. Body Ca levels were elevated up to 3-fold, and Na, Cl, and K up to 2-fold by increasing water Ca at the same pH and Al. Low pH had a small negative influence, intermediate levels of Al (37, 111) had a slight positive influence, and higher levels of Al a negative influence on Na, Cl, K, and Ca levels. Whole body Mg showed opposite trends, reflecting delayed development under adverse conditions. At pH 6.5, the positive influence of increasing water Ca on most whole body ions showed a clear threshold between 0.5 and 1.0 mg/L. At lower pH, this threshold was shifted to between 2 and 8 mg/L, indicating that Ca levels sufficient to support healthy development at circumneutral pH may prove inadequate under acidified conditions. (See W91-02102 thru W91-02103 and W91-02105 thru W91-02109) (Author's abstract)
W91-02104

WHOLE BODY IONS OF BROOK TROUT (SALVELINUS FONTINALIS) ALEVINS: RESPONSES OF YOLK-SAC AND SWIM-UP STAGES TO WATER ACIDITY, CALCIUM AND ALUMINUM, AND RECOVERY EFFECTS.
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
C. M. Wood, D. G. McDonald, C. G. Ingersoll, D. R. Mount, and O. E. Johannsson.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 8, p 1604-1613, August 1990. 10 fig, 3 tab, 36 ref. Electric Power Research Institute Contract RP-2346-01.

Descriptors: *Acid rain effects, *Acidic water, *Aluminum, *Brook trout, *Calcium, *Electrolytes, *Fish, *Fish populations, *Larval growth stage, *Trout, *Water pollution effects, Bioassay, Fish physiology, Hydrogen ion concentration, Life stages, Neutron activation analysis, Water chemistry, Whole body ion concentrations.

Water pH, rather than Ca or Al, was the most important factor affecting whole body ions in yolk-sac or swim-up fry exposed to a matrix of pH (6.5-4.0), Ca (0.5-8.0 mg/L), and Al (0-1000 microg/L). Fry were raised from fertilization day (day 0)

flowing soft water (pH=6.5, Ca=2 mg/L, Al=0microg/L), exposed to pH/Ca/Al on day 49 (yolk-sac, 2 d post-hatch) or day 70 (swim-up) for 21 d, and then allowed to recover a further 20 d. Yolk-sac fry were extremely resistant at pH greater than or equal to 4.4; developmental effects, as indicated by body weight and Mg, were negligible. However, whole body Na, Cl, K, and Ca were depressed by low pH, while water Ca was protective. Aluminum (37-111 microg/L) raised most ions above control values, while higher Al lowered them. Swim-up fry were more sensitive, showing pronounced developmental inhibition (lower weight, higher Mg) under adverse conditions; mortality continued during recovery. Low pH was again the dominant influence on body ions, water Ca was protective, while Al (12-111 microg/L) was only protective and not stimulatory. These effects persisted significantly; indeed responses in body Ca were larger after recovery than after the exposure itself. In the field, emergence from the redd into ambient acidic water is probably the critical stage. Water pH will be the principal determinant of whole body ions in alevins surviving this emergence, in contrast to fry exposed continuously from fertilization. (See W91-02102 thru W91-02104 and W91-02106 thru W91-02109) (Author's abstract)
W91-02105

EPIDERMAL RESPONSE TO PH, ALUMINUM, AND CALCIUM EXPOSURE IN BROOK TROUT (SALVELINUS FONTINALIS) FRY.
Wyoming Univ., Laramie. Fish Physiology and Toxicology Lab.
C. G. Ingersoll, D. A. Sanchez, J. S. Meyer, D. D. Gulley, and J. E. Tietge.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 8, p 1616-1622, August 1990. 1 fig, 2 tab, 58 ref. Electric Power Research Institute Contract RP-2346-01.

Descriptors: *Acid rain effects, *Acidic water, *Aluminum, *Brook trout, *Calcium, *Epidermis, *Fish, *Fish populations, *Hydrogen ion concentration, *Juvenile growth stage, *Population exposure, *Trout, *Water pollution effects, Analytical methods, Cell morphology, Fish eggs, Fish physiology, Microscopy, Mucous cells, Water chemistry.

Fed brook trout eggs were exposed to various concentrations of pH (4.3-6.3), aluminum (0-1000 microg/L), and calcium (0.5-8.0 mg/L) for 40 d through hatching until the swim-up life stage. High resolution light microscopy, image analysis, and morphological techniques were used to quantitatively determine morphological changes in the epidermis of fry surviving this exposure. Exposure to increased acidity resulted in both mucous cell hypertrophy (increase in size) and hyperplasia (increase in number); exposure to low calcium resulted in mucous cell hyperplasia. Aluminum did not significantly affect mucous cell size or number. Epidermal thickness was not consistently affected by exposure to pH, aluminum, or calcium. The changes observed in epidermal mucous cells may be a compensatory mechanism used by brook trout to counter ionoregulatory stress resulting from extended exposure to acidic conditions. (See W91-02102 thru W91-02105 and W91-02107 thru W91-02109) (Author's abstract)
W91-02106

RESPONSES OF BROOK TROUT (SALVELINUS FONTINALIS) FRY TO FLUCTUATING ACID, ALUMINUM, AND LOW CALCIUM EXPOSURE.
Wyoming Univ., Laramie. Fish Physiology and Toxicology Lab.
C. G. Ingersoll, D. D. Gulley, D. R. Mount, M. J. Swanson, J. E. Breck, A. M. Farag, and H. L. Bergman.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 8, p 1623-1630, August 1990. 2 fig, 2 tab, 41 ref. Electric Power Research Institute Contract RP-2346.

Descriptors: *Acid rain effects, *Acidic water, *Acidity, *Aluminum, *Brook trout, *Calcium, *Fish, *Fish populations, *Juvenile growth stage, *Population exposure, *Trout, *Water pollution effects, Acclimatization, Bioassay, Fish eggs, Fish growth, Fish physiology, Fishkill, Toxicity, Water chemistry, Water quality.

In certain instances, fish kills have been directly associated with acidic 'pulses'. Brook trout fry were exposed for 30 d to temporal combinations of two water qualities: (1) pH 5.21, 51 microg/L total aluminum, with 2.39 mg/L calcium (baseline); and (2) pH 4.59, 329 microg/L total aluminum with 1.56 mg/L calcium (pulse). Although continuous exposure to the pulse conditions caused nearly complete mortality, exposures alternating between the two conditions caused much less mortality. In fact, fish experiencing 18 d of baseline conditions before their first pulse exposure had mortality rates equal to fish never experiencing a pulse, indicating acclimation to acid/aluminum/low calcium stress. The data indicate that the pattern of fluctuating acid/aluminum/low calcium exposure is very important in determining its toxicity, and that the toxicity of acid 'pulses' in field situations may be lower than would be expected from laboratory exposures using naive fish, due to the existence of acclimation. (See W91-02102 thru W91-02106 and W91-02108 thru W91-02109) (Author's abstract)
W91-02107

INORGANIC MONOMERIC ALUMINUM AND PH AS PREDICTORS OF ACIDIC WATER TOXICITY TO BROOK TROUT (SALVELINUS FONTINALIS).
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
B. R. Parkhurst, H. L. Bergman, J. Fernandez, D. D. Gulley, and J. R. Hockett.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 8, p 1631-1640, August 1990. 3 fig, 5 tab, 37 ref.

Descriptors: *Acid rain effects, *Acidic water, *Acidity, *Aluminum, *Brook trout, *Fish, *Fish populations, *Hydrogen ion concentration, *Toxicity, *Trout, *Water pollution effects, Bioassay, Dissolved organic carbon, Fish physiology, Fishkill, Fluorides, Regression analysis, Survival, Water chemistry, Water quality, Water temperature.

Inorganic monomeric aluminum concentrations were found to be the primary determinant of survival of brook trout feeding fry exposed for 21 d to various combinations of total aluminum and pH, plus several concentrations of fluoride or dissolved organic carbon (DOC), or several temperatures. Total aluminum concentrations in the 4 x 4 x 4 experimental matrices ranged from 3-1276 ppb, pH from 4.4-6.7, fluoride from <10-328 ppb, DOC from <1-9.2 ppm, and temperatures from 5.4-12.0 C. Stepwise logistic regression was used to determine the significance of the effect of each water quality variable on survival. Inorganic monomeric aluminum accounted for 78-98% of the variation in survival. Except in the fluoride bioassay where pH was not significant, pH was the second factor in order of importance, accounting for up to 16% of the variation in survival. Fluoride or temperature accounted for 1-2% of the variation in survival, while DOC accounted for 6% of the variation in survival. (See W91-02102 thru W91-02107 and W91-02109) (Author's abstract)
W91-02108

ALUMINUM AND ACID TOXICITY TO TWO STRAINS OF BROOK TROUT (SALVELINUS FONTINALIS).
Wyoming Univ., Laramie. Fish Physiology and Toxicology Lab.
C. G. Ingersoll, D. D. Gulley, D. R. Mount, M. E. Mueller, and J. D. Fernandez.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 8, p 1641-1648, August 1990. 4 fig, 1 tab, 50 ref. Electric Power Research Institute Contract RP-2346-01.

Descriptors: *Acid rain effects, *Acidic water, *Acidity, *Aluminum, *Brook trout, *Fish, *Fish populations, *Toxicity, *Trout, *Water pollution effects, Bioassay, Calcium, Comparison studies, Fish eggs, Fish growth, Fish physiology, Fishkill, Gills, Histology, Survival, Water chemistry.

Two strains of 1 yr-old brook trout were exposed to 14 combinations of pH, aluminum, and calcium during a 28-d experiment. Survival, weight, and gill histology of both strains were affected similarly by pH, aluminum, and calcium exposure. Survival was reduced at inorganic monomeric aluminum concentrations (IA1) of 29 microg/L at pH 5.2 and greater than or equal to 228 microg/L at pH 4.4 and 4.8. Fish weight was reduced with exposure to pH below 4.8 or aluminum concentrations greater than or equal to 34 microg/L. The gills sampled from fish exposed to low pH exhibited lifting of the outer epithelium and hypertrophy (increase in size) of chloride and epithelial cells. The response of gills sampled from fish exposed to low pH and elevated aluminum was more pronounced relative to the low pH exposure alone. In addition to the effects observed in the low pH exposed fish, the gills from fish exposed to both acid and aluminum exhibited vacuolation and degeneration of epithelial and chloride cells and the presence of dense cells. Finally, fish confined in PVC tubes designed to mimic in situ field exposure procedures were more sensitive to the toxic effects of acid and aluminum compared to free-swimming fish. Caution must be taken when extrapolating safe field levels from in situ exposures of caged fish. (See W91-02102 thru W91-02108) (Author's abstract)
W91-02109

ELECTRON MICROSCOPY DOCUMENTING THE CELLULAR METABOLIC FATE OF HG IONS.
University of Science, Penang (Malaysia). School of Biological Sciences.
P. M. Sivalingam, and R. Billet.
Toxicological and Environmental Chemistry TXECBP, Vol. 26, No. 1/4, p 1-14, 1990. 9 fig, 3 tab, 15 ref.

Descriptors: *Electron microscopy, *Mercury, *Path of pollutants, *Toxicity, *Toxicology, *Water pollution effects, Fish, Fish physiology, Liver, Tilapia, Tissue analysis.

The uptake of toxic heavy metals, including mercury, by aquatic flora and fauna appears to be a phenomenan involving the passive diffusion by direct absorption into the organism. Electron microscope studies of hepatic cellular alterations in fish exposed to a 75 ppb lethal dose of inorganic Hg (++) ions (in the form of HgCl2) utilized five specimens of tilapia ranging from 5.0 to 7.5 cm in length. The hepatic cells exposed to mercury for a week were comparatively empty while fat droplets, a few secondary lysosomes and mitochondria were present in the controls. The morphological structure of mitochondria was unaltered, but glycogen levels were depleted. Grape-like globulets resembling fatty bodies formed in the nuclei of the exposed fish; some nuclei possessed a lot of these bodies, while others only formed two or three. These droplets ranged between 0.2-0.5 micrometers in diameter, while those in the cytoplasm averaged 1.2 micrometers. Nevertheless, the nuclear and cellular membranes were normal. In vivo response of hepatic enzymes indicated an increase in alkaline, acid, and glucose-6-phosphatase activities while catalase was inhibited. However, under in vitro conditions all four hepatic enzymes were inhibited at varying rates. These observations show conclusively the depletion of bioenergy in relation to enhanced energy requirements, and indirect inhibition of oxidative phosphorylative processes in the electron transport system of mitochondria. (Author's abstract)
W91-02171

ELECTRON MICROSCOPY DOCUMENTING THE CELLULAR METABOLIC FATE OF ZN IONS.
University of Science, Penang (Malaysia). School of Biological Sciences.
P. M. Sivalingam, and R. Billet.
Toxicological and Environmental Chemistry TXECBP, Vol. 26, No. 1/4, p 15-26, 1990. 6 fig, 3 tab, 28 ref.

Descriptors: *Electron microscopy, *Path of pollutants, *Toxicity, *Toxicology, *Water pollution effects, *Zinc, Enzymes, Fish, Fish physiology, Tissue analysis.

In vertebrates and invertebrates Zn exists as complexed compounds with metallothioneins. However, its cellular level effects and metabolic fates are scantly documented. Electron microscopy is a useful technique for studying hepatic cellular alterations in fish, at a lethal dose exposure of 4.0 ppm over a week. A large number of lysosomes in hepatic cells prevailed on exposure to Zn in its sulfate form. Evidently, due to metal compound stress and cellular damage, lysosomal activity is augmented. The lysosomes harbored digestible material, presumably the aforementioned substrates. Fat droplets prevailed, while glycogen depletion was noticeable. Unlike the effects of Hg, the nuclei were normal with granular chromatin and prominent nucleoli. However, the mitochondria contained some small intramitichondrial bodies. Similar to the effects of Hg, the cell membrane remained intact. In vivo enzymatic studies indicated augmentation in catalase, acid and alkaline phosphatases, while glucose-6-phosphatase was inhibited. However, only alkaline and glucose-6-phosphatases were inhibited under in vitro conditions. It is evident that Zn enhances cellular bioenergetic requirements culminating in glycogen depletion owing to stress, concomitantly causing inhibition of oxidative phosphorylation in the electron transport system. (Author's abstract)
W91-02172

ENVIRONMENTAL CHEMISTRY AND BIOLOGICAL EFFECTS OF CADMIUM COMPOUNDS.
International Association of Environmental Analytical Chemistry, Therwil (Switzerland).
For primary bibliographic entry see Field 5B.
W91-02173

APPLICATION OF QSARS TO PREDICT POTENTIAL AQUATIC TOXICITIES OF ORGANOCHLORINE PESTICIDES.
Bayreuth Univ. (Germany, F.R.). Chair of Ecological Chemistry and Geochemistry.
H. Fiedler, G. Herrmann, K.-W. Shramm, and O. Hutzinger.
Toxicological and Environmental Chemistry TXECBP, Vol. 26, No. 1/4, p 157-160, 1990. 1 tab, 7 ref. IRPTC/UNEP Contract No. G/CON/89-01.

Descriptors: *Aquatic habitats, *Chlorinated hydrocarbons, *Hazard assessment, *Pesticide toxicity, *Pesticides, *Structure-activity relationships, *Water pollution effects, Environmental fate, Model studies, Organic pesticides, Population exposure, Prediction.

Pesticides, including insecticides, herbicides, fungicides, and rodenticides, are widely used in many industrialized and developing countries. Organochlorine pesticides are still being widely used and are commonly found in surface waters. On the basis of physicochemical data, such as water solubility and vapor pressure, as well as acute toxicity tests, an ecotoxicological model for preliminary hazard assessment has been developed using data mostly collected from the literature. The Quantitative Structure Activity Relationship (QSAR) system was used to make predictions about the potential threat of chlorinated pesticides to aquatic organisms. By use of the reciprocal product for log H and LC50 a suitable ranking system was developed that allows the prediction of potential damage to aquatic organisms through pesticides. The QSAR system estimated chemical properties, environmental fate, and toxicity of organic compounds using models based upon chemical structure. The preliminary hazard assessment consists of an evaluation of potential exposure and the potential effects of that exposure. (Tappert-PTT)
W91-02178

SURVIVAL OF STRIPED BASS LARVAE AND YEARLINGS IN RELATION TO CONTAMINANTS AND WATER QUALITY IN THE UPPER CHESAPEAKE BAY.
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
L. W. Hall, A. E. Pinkney, R. L. Herman, and S. E. Finger.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 4, p 391-400, July 1987. 1 fig, 8 tab, 21 ref. The Johns Hopkins University/FWS Cooperative Agreement No. 14-16-0009-85-910.

Descriptors: *Bass, *Chesapeake Bay, *Estuarine environment, *Larval growth stage, *Survival, *Water pollution effects, Acute toxicity, Animal pathology, Fish pathology, Fishkill, Histology, Laboratory methods, Larvae, Toxicology.

This study was designed to: evaluate the survival of striped bass yolk-sac larvae and yearlings at three locations in their natural spawning habitat in the upper Chesapeake Bay (Chesapeake and Delaware Canal) using 'in situ' chambers; correlate larval and yearling survival with the presence of 11 water quality parameters, 10 inorganic contaminants and 21 organic contaminants; and assess histological effects on yearlings after exposure to habitat water. The cumulative percent survival ranged from 42-59.5% for striped bass larvae after 96 hr of exposure to habitat water during two experiments. Survival in control conditions during these two experiments was 77.5% and 80.5%. Data from previous studies have shown that mortality rates for wild yolk-sac larvae ranged from 7-19% per day. Daily mortality of larvae in the present study was 13-16%; therefore, suspected acutely harmful water quality or contaminant conditions affecting survival were not substantiated. All yearling striped bass survived 10 days of exposure to habitat water. Although habitat water was not acutely toxic, histological examination of surviving yearling striped bass indicated sublethal effects. Telangiectases (lamellar dilations) of the gills was reported for yearlings exposed to habitat water. This pathological change was not found in the controls. (Author's abstract)
W91-02194

SHORT-TERM EXPOSURE OF ZOOPLANKTON TO THE SYNTHETIC PYRETHROID, FENVALERATE, AND ITS EFFECTS ON RATES OF FILTRATION AND ASSIMILATION OF THE ALGA, CHLAMYDOMONAS REINHARDII.
Guelph Univ. (Ontario). Dept. of Environmental Biology.
K. Day, and N. K. Kaushik.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 4, p 423-432, July 1987. 3 fig, 3 ref, 41 ref.

Descriptors: *Acute toxicity, *Bioindicators, *Chlamydomonas, *Fenvalerate, *Pesticides, *Toxicology, *Water pollution effects, *Zooplankton, Bioassay, Biological studies, Daphnia, Feeding rates, Laboratory methods, Lethal limit, Waterfleas.

The feeding behavior of zooplankton is a physiological function which may be of value in the study of the toxicity of pollutants to aquatic organisms. In acute tests of toxicity, two cladocerans, Daphnia galeata mendotae and Ceriocaphnia lacustris, and the calanoid, Diaptomus oregonesis, were more sensitive to fenvalerate (FV) than Daphnia magna, the organism used in standard laboratory bioassays. The 48-hr 50% lethality concentrations (EC50s) for each species/stage in order of increasing sensitivity were adult D. magna-2.52 micrograms/L; D. magna (</=48-hr old)-0.83 micrograms/L; adult D. galeata mendotae-0.29 micrograms/L; adult C. lacustris-0.21 micrograms/L; D. galeata mendotae (</=48-hr old)-0.16 micrograms/L; and adult Diaptomus oregonensis-0.12 micrograms/L. No toxicity was observed when these organisms were exposed to a range of concentrations of the emulsifiable concentrate without FV (the EC blank). Rates of filtration of the 14-C labeled alga, Chlamydomonas reinhardii by D. galeata mendotae, C. lacustris and D. Oregonensis were decreased significantly at sublethal concentrations of FV after only 24-hr exposure. Ceriodaphnia lacustris showed the greatest sensitivity with rates of filtration significantly decreased at 0.01 micrograms FV/L. Concentrations of FV >/=0.05 micrograms/L resulted in decreased rates of filtration by D. galeata mendotae. A concentration of 0.10 micrograms FV/L caused rates of filtration to increase in D. oregonensis, whereas 0.05 and 0.5 micrograms/L resulted in a decrease in these rates. Rates of assimilation of algae by D. galeata mendotae, C. lacustris and D. oregonensis exposed to similar concentrations of fenvalerate were decreased at concentrations >= 0.05 micrograms FV/L. Changes in rates of assimilation were not as sensitive a parameter of toxicity as changes in rates of filtration. The EC blank had no significant effects on rates of filtration or assimilation for all three species. (Author's abstract)
W91-02195

CHANGES IN PLASMA, LIVER, AND OVARY VITELLOGENIN IN LANDLOCKED ATLANTIC SALMON FOLLOWING EXPOSURE TO SUBLETHAL CYANIDE.
Concordia Univ., Loyola Campus, Montreal (Quebec). Dept. of Biology.
S. M. Ruby, D. R. Idler, and Y. P. So.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 4, p 507-510, July 1987. 1 fig, 1 tab, 30 ref.

Descriptors: *Acute toxicity, *Cyanide, *Fish physiology, *Salmon, *Toxicology, *Water pollution effects, Immunoassay, Laboratory methods, Liver.

Hydrogen cyanide (HCN) is a toxicant that occurs frequently in terrestrial and aquatic ecosystems both naturally and from man-made sources, and affects fish physiology, particularly reproduction. Female landlocked Atlantic salmon (Salmo salar Ouananiche) were exposed to 0.005 mg/L HCN for 12 days at 7 +/-1 C during late vitellogenesis (October). Plasma vitellogenin and liver and gonad vitellogenin-like protein (VLP) levels were measured by homologous radioimmunoassay specifically developed for this species. Results indicated that plasma vitellogenin levels increased in cyanide exposed fish. VLP levels in the liver did not change relative to control fish suggesting that the increased levels of plasma vitellogenin did not result from a change in synthesis in the liver. VLP levels declined in the gonad relative to the control by day 12. Elevated plasma vitellogenin level along with decreased VLP in the gonads suggests that exposure of female salmon to sublethal HCN during late vitellogenesis inhibits the uptake of vitellogenin at the ovarial level. The recommended safe concentration for cyanide (0.005 mg/L) which offers a safe water quality objective alters pattern of plasma vitellogenin just prior to spawning. (Author's abstract)
W91-02196

SHORT-TERM LETHALITY AND SEDIMENT AVOIDANCE ASSAYS WITH ENDRIN-CONTAMINATED SEDIMENT AND TWO OLIGOCHAETES FROM LAKE MICHIGAN.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
T. J. Keilty, D. S. White, and P. F. Landrum.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 1, p 95-10 January 1988. 2 fig, 4 tab, 35 ref. Great Lakes Environmental Research Laboratory/NOAA Cooperative Agreement NA81-RA-H-00003.

Descriptors: *Acute toxicity, *Bioassay, *Endrin, *Lake Michigan, *Lake sediments, *Oligochaete, *Path of pollutants, *Sediment contamination, *Toxicology, *Water pollution effects, Animal behavior, Benthic fauna, Fate of pollutants, Halogenated pesticides.

Toxic compounds with high partition coefficient that enter the Laurentian Great Lakes adsorb significantly to fine particles and settle to the bottom. The fate of these compounds and their interaction with the larger benthic organisms is largely unknown. Mean 96-hr 50% lethality (LC50) values and standard deviations for the oligochaetes Stylodrilus heringianus and Limnodrilus hoffmeisteri exposed to endrin-contaminated sediments w

2588+/-1974 micrograms/g dry weight sediment for 4 assays and 2725+/-955 micrograms/g for 2 assays, respectively. Mixed species testing data suggested that the toxicity to L. hoffmeisteri was reduced in the presence of S. heringianus, yet further testing is required. Ninety-six hour 50%-effective (EC50) burrowing avoidance values for both species (19 and 15.3 microgram/g for S. heringianus and 59 micrograms/g for L. hoffmeisteri) were approximately 46 and 150 times lower than their respective mean 96-hr LC50 values. Both S. heringianus and L. hoffmeisteri initially burrowed in contaminated sediment and then returned to the surface in numbers somewhat proportional to the sediment concentration and length of exposure. Future use of oligochaete behavioral responses to sublethal sediment contamination for pollution impact on benthic communities is promising. (Author's abstract)
W91-02199

ARTIFICIALLY INDUCED METAMORPHOSIS ACETONE IN ACRIS GRYLLUS.
Tennessee State Univ., Nashville. Dept. of Biological Sciences.
S. Pollard, and J. A. Adams.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 4, p 419-428, July 1988. 8 fig, 2 tab, 21 ref. NIH Grant No. SO6RR08092.

Descriptors: *Acetone, *Amphibians, *Bioindicators, *Frogs, *Metamorphosis, *Toxicology, *Water pollution effects, Hormones, Iodine, Laboratory methods, Larval growth stage, Thyroid gland.

The causative agents (hormones) involved in amphibian metamorphosis as well as the involved specific endocrine organs have been well established for decades. Tri-iodothyronine and thyroxin, both secretions of the larval thyroid gland, are directly responsible for metamorphosis under physiological conditions. High amounts of the element iodine (approximately 300 times the amount found in equally effective levels of thyroxin) can also induce metamorphosis in amphibians. In a search for an appropriate emulsifier to be employed in studying the effects of hydrophobic polychlorinated biphenyls (PCBs) on metamorphosis, reagent-grade acetone (a commonly-used carrier molecule for PCBs) was found to be a potent inducer of metamorphosis in Acris gryllus (a cricket frog species). The acetone was employed as a component of an artificial pond water medium. Other test conditions included exposure to thyroxin and dimethyl sulfoxide for comparison. Not only was metamorphosis enhanced in the acetone-treated animals, but the effect was concentration-dependent when acetone levels of 10 mg/L and 50 mg/L were employed. The 50 mg/L acetone-treated group showed precocious metamorphosis at a rate not significantly different from that produced by thyroxin. Dimethyl sulfoxide exposure produced no significant increase in metamorphic rate. (Author's abstract)
W91-02201

EFFECTS OF ATRAZINE ON FRESHWATER MICROBIAL COMMUNITIES.
Pennsylvania State Univ., University Park. School of Forest Resources.
R. Pratt, N. J. Bowers, B. R. Niederlehner, and J. Cairns.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 4, p 449-457, July 1988. 2 fig, 4 tab, 44 ref. EPA Grant R-2813-01-0 and Air Force Office of Scientific Research Grant AFOSR-85-0324.

Descriptors: *Atrazine, *Bioassay, *Bioindicators, Herbicides, *Pesticides, *Toxicity, *Toxicology, Water pollution effects, Algae, Aquatic fungi, Biomass, Calcium, Chlorophyll a, Colonization, Dissolved oxygen, Laboratory methods, Magnesium, Microbial degradation, Proteins, Protozoa, Species diversity.

A multispecies toxicity test system using naturally-derived microbial communities (comprised of bacteria, fungi, protozoa, algae and micrometozoans) on polyurethane foam substrates was used to evaluate the toxic effects of the herbicide atrazine. Both structural (e.g., protozoan species number, biomass) and functional (e.g., colonization rate, oxygen production) community responses were measured. Oxygen production and the ability of communities to sequester Mg and Ca were the most sensitive measures of toxic stress due to atrazine (maximum allowable toxicant concentrations (MATCs) = 17.9 micrograms/L). Dissolved oxygen was 33% lower, and there was 15% less Ca and Mg in communities at and above 32.0 micrograms/L atrazine compared to controls. Species richness and estimates of biomass (total protein and chlorophyll a) were less sensitive (MATCs = 193) to atrazine. At the highest atrazine concentration (337 micrograms/L), species numbers were 30% lower than controls, and protein and chlorophyll a content of communities were reduced by 38 and 91%, respectively. Low levels of atrazine (3.2-32.0 micrograms/L) resulted in a 46% increase in species numbers and a greater concentration of total protein and chlorophyll a (41 and 57%, respectively). Results compared well with other estimates of chronic toxicity for effects of atrazine on aquatic communities. Reported MATCs ranged from 70.7 to 3400 micrograms/L. The results from this test emphasize the importance of monitoring both structural and functional measures of community integrity in toxicity testing with multispecies. (Author's abstract)
W91-02202

RESPONSES OF ZOOPLANKTON AND CHAOBORUS TO TEMEPHOS IN A NATURAL POND AND IN THE LABORATORY.
Saint Olaf Coll., Northfield, MN. Dept. of Biology.
J. C. Helgen, N. J. Larson, and R. L. Anderson.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 4, p 459-471, July 1988. 9 fig, 4 tab, 24 ref. EPA/St. Olaf College Cooperative Agreement Cr-810016-01.

Descriptors: *Bioindicators, *Chronic toxicity, *Organophosphorus pesticides, *Pesticides, *Ponds, *Toxicology, *Water pollution effects, *Waterfleas, *Zooplankton, Acute toxicity, Bioassay, Copepods, Daphnia, In situ tests, Laboratory methods, Larval growth stage, Life cycles, Minnesota, Risk assessment, Rotifers.

A two year field study was performed on the effects of the organophosphorus insecticide temephos on zooplankton and the phantom midge larva Chaoborus americanus in natural ponds in central Minnesota. Application of temephos to a pond was followed by reduction within 24 hr in all cladocerans, in Diaptomus leptopus and in C. americanus, and increases in cyclopoid copepods, copepod nauplii and the rotifer Keratella cochlearis. Daphnia pulex that reappeared 35 days post-application were ex-ephippial. After application, reproduction of cladocerans and Diaptomus was markedly reduced compared to the previous year, an effect attributed to temephos. Daphnia population density was strongly reduced into the fall season, long after the spring applications, compared with both a reference pond's and the previous season's populations. On-site bioassays demonstrated 24-hr mortalities of Daphnia and Chaoborus that were comparable to the population decreases in the pond. Laboratory toxicity tests showed Daphnia was the most sensitive followed by Chaoborus and Diaptomus. Comparable results were seen in the pond population changes, in situ bioassays and laboratory toxicity data for Daphnia and for Chaoborus, but sensitivities in the pond were somewhat greater than in the laboratory. Risk assessment research calls for long-term field reproduction analysis to avoid a false 'recovery' report, combined with laboratory life cycle analysis and short acute exposure tests. (Author's abstract)
W91-02203

CALCIUM METABOLISM IN TWO POPULATIONS OF THE SNAIL HELIX ASPERSA ON A HIGH LEAD DIET.
Polytechnic of the South Bank, London (England). Dept. of Biotechnology.
A. Beeby, and L. Richmond.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 4, p 507-511, July 1988. 3 fig, 3 tab, 20 ref.

Descriptors: *Air pollution effects, *Animal metabolism, *Calcium, *Lead, *Snails, *Toxicology, Bioassay, Chemical analysis, Excretion, Heavy metals, Magnesium, Trace metals.

The uptake and loss of toxic metals by organisms may depend on their mechanisms for binding and excreting essential metals. Ca is often associated with heavy metal retention in vertebrates and invertebrates. Soft tissue concentrations of Pb, Ca and Mg were measured in two populations of the garden snail, Helix aspersa, over a 64-day dosing regime to determine if differences in Pb metabolism could be predicted by differences in Ca metabolism. Snails compared from an uncontaminated site and from a grossly polluted car park. In each case, 25 snails were given a diet with 500 micrograms/g Pb (as PbSO4), and 25 were removed to a Pb-free diet after two days on the Pb dose. The snails from the car park maintained a higher concentration of Ca in the soft tissues, and assimilated Ca faster on a high Pb diet. Concentrations of Pb and Ca can be correlated for the soft tissues of the dosed car park snails. No such relationship was found for the snails from the rural site. The rate of Ca assimilation may determine the excretion rate of intracellular granules, where Pb is bound. Population differences in Pb uptake might result from variations in Ca metabolism, which, in the car park snails, could represent an adaptation to high ambient Pb. (Author's abstract)
W91-02205

SELENIUM TERATOGENESIS IN NATURAL POPULATIONS OF AQUATIC BIRDS IN CENTRAL CALIFORNIA.
Patuxent Wildlife Research Center, Laurel, MD.
D. J. Hoffman, H. M. Ohlendorf, and T. W. Aldrich.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 4, p 519-525, July 1988. 8 fig, 2 tab, 28 ref.

Descriptors: *California, *Kesterson Reservoir, *Selenium, *Teratogenic effects, *Water birds, *Water pollution effects, *Waterfowl, Agricultural runoff, Eggs, Embryonic growth stage, Liver, Trace metals.

The frequency and types of malformations are described that were encountered during the spring of 1983 in a natural population of aquatic birds exposed to agricultural drainwater ponds and food items containing high concentrations of Se in central California. A total of 347 nests of aquatic birds containing 1,681 eggs was selected for study at Kesterson Reservoir located in the Kesterson National Wildlife Refuge, Merced County, California. Embryos collected during incubation or from eggs that failed to hatch were examined to determine the age at death and presence of malformations. Embryonic death was generally high; approximately 17-60% of the nests of different species contained at least one dead embryo. The incidence of malformed embryos was also high; approximately 22-65% of the nests where at least two embryos were examined contained abnormal embryos. American coots (Fulica americana) and black-necked stilts (Himantopus mexicanus) experienced the highest incidence of malformed embryos. For all species, the average percentage of eggs containing dead or live abnormal embryos was 16.1 whereas the average percentage containing live abnormal embryos was 10.7. Multiple gross malformations of the eyes, brain, and feet were often present. Brain defects included hydrocephaly and exencephaly. Eye defects included both unilateral and bilateral anophthalmia and microphthalmia. Eye and foot defects with ectrodactyly and swollen joints were the most common in coots. Beak defects also occurred frequently and most often included incomplete development of the lower beak of ducks (Anas spp.) and stilts. Wing and leg defects were most prevalent in stilts and ducks, with ectromelia and amelia most prevalent in stilts. Other malformations occurring at lower frequencies included enlarged hearts with thin ventricular

walls, liver hypoplasia, and gastroschisis. Based upon simultaneous examination of a control population of aquatic birds of the same species and published studies, the incidences of embryonic mortality and deformities were 9-30 times greater than expected. (Author's abstract)
W91-02206

WEATHERED CRUDE OIL EFFECTS ON CHICKS OF FORK-TAILED STORM-PETRELS (OCEANODROMA FURCATA).
Washington Univ., Seattle. Inst. for Environmental Studies.
P. D. Boersma, E. M. Davies, and W. V. Reid.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 4, p 527-531, July 1988. 3 tab, 23 ref.

Descriptors: *Chronic toxicity, *Hydrocarbons, *Oil pollution, *Prudhoe Bay, *Toxicology, *Water birds, *Water pollution effects, Marine pollution, Oil, Oil spills.

Adult Storm-Petrels had between 0.004 and 0.0008 ml of fossil fuel hydrocarbons present in their food samples when they were considered contaminated. Chicks of Fork-Tailed Storm-Petrels (Oceanodroma furcata) were fed 0.1 ml of weathered Prudhoe Bay crude oil, which should be close to the maximum dose that they might receive at a feeding. Chicks dosed orally once, twice, or weekly with 0.1 ml weathered Prudhoe Bay crude oil did not differ significantly in gross morphology, bill, tarsus, or wing growth from control chicks. Chicks dosed one time gained weight between the ages of 0-21 days at significantly slower rates. Chicks aged 22-51 days grew similarly regardless of treatment. Dosed chicks fledged on average two days later than control chicks. Ingesting small amounts of weathered oil had little effect perhaps because Storm-Petrels may be able to ingest long-chained hydrocarbons (like petroleum) with relative impunity, because these compounds are relatively nontoxic and are part of their normal diet. (Author's abstract)
W91-02207

ECOLOGY OF A SOUTHERN OHIO STREAM RECEIVING FLY ASH POND DISCHARGE: CHANGES FROM ACID MINE DRAINAGE CONDITIONS.
American Electric Power Service Corp., Columbus, OH. Environmental Engineering Div.
R. J. Reash, J. H. Van Hassel, and K. V. Wood.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 4, p 543-554, July 1988. 3 fig, 4 tab, 46 ref.

Descriptors: *Acid mine drainage, *Acid streams, *Ecological effects, *Ecosystems, *Fly ash, *Ohio, *Stabilization ponds, *Waste disposal, *Water pollution effects, *Water pollution treatment, Benthic environment, Benthic fauna, Electric power industry, Electric powerplants, Fish, Hydrogen ion concentration, Species diversity, Water pollution control.

Prior to 1975, Stingy Run was a third-order tributary of Kyger Creek, which empties into the Ohio River at Mile 260 (Gallia County, Ohio). Both streams drained strip mine refuse areas and physicochemical measurements indicated acidic-mine drainage conditions (e.g., low pH). A depauperate macroinvertebrate community, dominated by a few acid-tolerant taxa, was found in both streams and no fishes were collected. In 1974, Stingy Run was impounded to form a fly ash pond which contains fly ash sluiced from Ohio Power Company's General James M. Gavin coal-fired power plant. Physicochemical and biological sampling during 1975-1986 indicated marked changes in the aquatic ecology of Stingy Run between (1) preimpoundment and post-impoundment conditions; and (2) effluent pH control treatments after impoundment. Fly ash discharge eliminated acidic-mine drainage characteristics in Stingy Run and lower Kyger Creek. After impoundment, net spinning caddisflies and a few dipteran taxa dominated the Stingy Run benthic community, reflecting changes in functional niches likely due to improved habitat and greater food availability. Replacement of acid feed by CO2 injection for effluent pH control and changes in ash pond chemistry occurred concomitant with elimination of a substrate floc; increased species richness and densities of invertebrates were subsequently observed. In Stingy Run, species richness and diversity of fishes increased from 1983 to 1986, reflecting improved water quality and increased benthic production after impoundment. Many of these fishes are opportunistic feeders on drifting insects. (Author's abstract)
W91-02208

METHODS FOR ASSESSING FERTILIZATION AND EMBRYONIC/LARVAL DEVELOPMENT IN TOXICITY TESTS USING THE CALIFORNIA MUSSEL (MYTILUS CALIFORNIANUS).
California Univ., Bodega Bay. Bodega Marine Lab.
For primary bibliographic entry see Field 5A.
W91-02212

POPULATION-SPECIFIC TOXICITY RESPONSES BY THE FRESHWATER OLIGOCHAETE, STYLODRILUS HERINGIANUS, IN NATURAL LAKE MICHIGAN SEDIMENTS.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. J. Keilty, and P. F. Landrum.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 9, p 1147-1154, September 1990. 9 fig, 1 tab, 19 ref.

Descriptors: *Aquatic populations, *Bioassay, *Bioindicators, *Lake Michigan, *Lake sediments, *Oligochaetes, *Sediment contamination, *Toxicity, *Toxicology, *Water pollution effects, Animal behavior, Chronic toxicity, Laboratory methods, Sediment analysis.

Sediment reworking rate, mortality and organism dry weight were measured for Stylodrilus heringianus in laboratory microcosms. The experiments were designed to identify potential population-specific response differences to mixed (stirred to obtain a more uniform particle size distribution over depth) and unmixed (passively settled) microcosm sediments. Lake Michigan sediments and worms were collected off Benton Harbor, Michigan and Grand Haven, Michigan. The mixed Benton Harbor sediments were toxic to S. heringianus collected from Grand Haven, whereas there were no significant differences in measured responses between mixed and unmixed sediment microcosms for Grand Haven-collected worms exposed to Grand Haven sediments or Benton Harbor-collected worms exposed to Benton Harbor sediments. Note that the mixing of sediments resulted in increased availability of contaminants sorbed to the fine sediment fraction. Because contaminant and oligochaete population data suggest that Grand Haven sediments are less contaminated, the population-specific response suggests that S. heringianus may adapt to the low level long-term stressful conditions (chemical or otherwise). Results also suggest caution and consideration of the history of test organisms in the design and interpretation of toxicity tests. (Author's abstract)
W91-02213

AVOIDANCE OF SELENIUM-TREATED FOOD BY MALLARDS.
Patuxent Wildlife Research Center, Laurel, MD.
G. H. Heinz, and C. J. Sanderson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 9, p 1155-1158, September 1990. 1 tab, 8 ref. USFWS/San Joaquin Valley Drainage Program Interagency Agreement 6-AA-20-04170.

Descriptors: *Animal behavior, *Ducks, *Food habits, *Selenium, *Toxicology, *Water pollution effects, Feeding rates, Toxicity, Water birds, Waterfowl.

The first step in understanding whether avoidance of selenium-treated diets in laboratory studies will limit extrapolation of results to the field is to determine why birds avoid these diets in the laboratory. Adult, male mallards (Anas platyrhynchos) were given a choice between a control diet and a diet containing 5, 10 or 20 ppm selenium as selenomethionine dissolved in water and mixed into the diet. At 10 and 20 ppm, selenium-treated diets were avoided. Avoidance appeared to be caused by a conditioned response, probably to illness caused by the selenium and not to an aversion to the taste of the selenium. A comparison of the acceptance by wild birds of selenium in natural foods and laboratory diets is needed. (Author's abstract)
W91-02214

STAGE SPECIFIC TOXICITY OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN EMBRYOS OF THE JAPANESE MEDAKA (ORYZIAS LATIPES).
Rutgers - The State Univ./UMDNJ-Robert Wood Johnson Medical School, Piscataway, NJ. Joint Graduate Program in Toxicology.
J. D. Wisk, and K. R. Cooper.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 9, p 1159-1169, September 1990. 6 tab, 31 ref. NJ Department of Environmental Protection/USGS D-10407-2-88.

Descriptors: *Dioxins, *Embryonic growth stage, *Fish, *Medaka, *Toxicity, *Toxicology, *Water pollution effects, Acute toxicity, Animal pathology, Fertilization, Liver, Median tolerance limit, Sublethal effects.

Embryos of the Japanese medaka were individually exposed to varying concentrations of (H3)2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in a static, nonrenewal system. The EC50 with 95% confidence interval (C.I.) to prevent hatching was 14(11-17) nanograms (ng) TCDD equivalents/L of water (parts per trillion). The LC50 with 95% C.I. for survival to 3 d posthatch was 9(6-12) ng TCDD equivalent/L. The EC50 with 95% C.I. for embryos with minor lesions and severe, life-threatening lesions were 3.5(1.3-5.7) ng TCDD equivalents/L and 14(12.4-15.6) ng TCDD equivalents/L, respectively. In a separate experiment that was terminated prior to the embryos hatching or dying, the EC50 for lesions was calculated to be 2.2(1.4-3.0) ng TCDD equivalents/L. Based on the amount of TCDD equivalents recovered from dechorionated embryos, the ED50 with 95% C.I. for lesions was calculated to be 0.24 picograms TCDD equivalents/mg of dechorionated embryo weight (parts per billion). When the embryos were exposed to (H3)TCDD with 1 to 2 h after fertilization, no concentration dependent increase in visible lesions was observed until after the formation of the liver rudiment (day 4 of development). By exposing Japanese medaka embryos to lethal concentrations of TCDD beginning on different days of embryonic development, it was demonstrated that the sensitive period for toxicity was during liver formation on day 4 or 5 of development. The sensitive period for development was not caused by differences in TCDD absorption across the chorion. When embryos were exposed to (H3)TCDD prior to, during or after liver formation, there was no statistical difference in the dose of TCDD equivalents that crossed the chorion and entered the yolk and embryo. (Author's abstract)
W91-02215

TOXICITY OF INORGANIC AND ORGANIC SELENIUM TO DAPHNIA MAGNA (CLADOCERA) AND CHIRONOMUS RIPARUS (DIPTERA).
National Fisheries Contaminant Research Center, Columbia, MO.
C. G. Ingersoll, F. J. Dwyer, and T. W. May.
Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 9, p 1171-1181, September 1990. 6 tab, 57 ref.

Descriptors: *Acute toxicity, *Bioaccumulation, *Chronic toxicity, *Daphnia, *Kesterson Reservoir, *Midges, *Selenium, *Toxicology, *Water pollution effects, California, Chlorides, Food chains, Larval growth stage, Magnesium, Potassium, Sodium, Toxicity, Trace metals.

Elevated concentrations of Se have been previously measured in biota sampled from the Kesterson National Wildlife Refuge (KNWR) in the San Joaquin Valley of central California. Acute and chronic toxicity tests were conducted with the cladoceran Daphnia magna and the midge Chironomus riparius to determine the toxicity or bioaccumulation of waterborne Se in a reconstituted water similar to the San Joaquin River. Daphnids were more acutely sensitive than midges to the effects of inorganic Se. An organic form of Se (seleno-(L)-methionine) was extremely toxic to daphnids, but was relatively nontoxic to midges. In long-term exposure to a 6:1 mixture of selenate to selenite (a mixture representative of KNWR), the emergence time of adult midges was delayed at Se concentrations >= 837 micrograms/L. Daphnid reproduction and intrinsic rate of natural increase (r) were reduced at Se concentrations >=348 micrograms/L and growth of adults were reduced at >= 156 micrograms/L. Whole body Mg, K and Na concentrations in daphnids were not affected by chronic Se exposure; however, whole body Ca concentration increased at intermediate Se exposure concentrations. In addition, whole body Cl concentration was reduced at 711 micrograms Se/L. Daphnids accumulated potentially toxic concentrations of Se from water that may adversely affect fish or waterfowl through the food chain. (Author's abstract)
W91-02216

RAINBOW TROUT LIVER ACTIVATION SYSTEMS WITH THE AMES MUTAGENICITY TEST.
National Fisheries Contaminant Research Center, Columbia, MO.
For primary bibliographic entry see Field 5A.
W91-02217

COMPARATIVE EVALUATION OF FIVE TOXICITY TESTS WITH SEDIMENTS FROM SAN FRANCISCO BAY AND TOMALES BAY, CALIFORNIA.
National Ocean Service, Seattle, WA. Ocean Assessments Div.
For primary bibliographic entry see Field 5A.
W91-02218

SUMMARY OF BIOLOGICAL INVESTIGATIONS RELATING TO SURFACE-WATER QUALITY IN THE KENTUCKY RIVER BASIN, KENTUCKY.
Geological Survey, Reston, VA. Water Resources Div.
L. D. Bradfield, and S. D. Porter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4051, July 1990. 63p, 7 fig, 1 tab, 205 ref.

Descriptors: *Algae, *Aquatic insects, *Bioindicators, *Biological communities, *Ecology, *Kentucky River, *Mine drainage, *Water pollution effects, Benthic fauna, Benthic flora, Brines, Mussels, Pollutant identification, Stream fisheries.

The Kentucky River basin, an area of approximately 7,000 sq mi, is divided into five hydrologic units that drain parts of three physiographic regions. Data on aquatic biological resources were collected and reviewed to assess conditions in the major streams for which data were available. The North, Middle, and South Forks of the Kentucky River are in the Eastern Coal Field physiographic region. Streams in this region are affected by drainage from coal mines and oil and gas operations, and many support only tolerant biotic streams. The Kentucky River from the confluence of the three forks to the Red River, is in the Knobs physiographic region. Oil and gas production operations and point discharges from municipalities have affected many streams in this region. The Red River, a Kentucky Wild River, supported a unique flora and fauna but accelerated sedimentation has eliminated many species of mussels. The Millers Creek drainage is affected by brines discharged from oil and gas operations, and some reaches support only halophilic algae and a few fish. The Kentucky River from the Red River to the Ohio River is in the Bluegrass physiographic region. Heavy sediment loads and sewage effluent from urban centers have limited the aquatic biota in this region. Silver Creek and South Elkhorn Creek have been particularly affected and aquatic communities in these streams are dominated by organisms tolerant of low dissolved oxygen concentrations. Biological data for other streams indicate that habitat and water quality conditions are favorable for most commonly occurring aquatic organisms. (USGS)
W91-02232

EFFECT OF SEWAGE SLUDGE ON NUTRIENT AND TOXIC METAL CONTENT OF SOIL AND SELECTED CROPS GROWN ON TROPICAL SOILS.
Puerto Rico Univ., Mayaguez. Dept. of Agronomy and Soils.
N. Cavallaro, and J. Villarrubia.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-240045/AS. Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, Puerto Rico Water Resources Research Institute, Mayaguez, August 1989. 51p, 29 tab, 24 ref. USGS Contract No. 14-08-0001-G1611. USGS Project G1611-03.

Descriptors: *Land disposal, *Municipal wastes, *Puerto Rico, *Sewage sludge, *Sludge disposal, *Water pollution effects, Crop yield, Oxisol, Soil types, Vertisol.

Application of municipal sewage sludge to agricultural land is one means of disposing of this material. In general, no important negative effects on either quality of fruit, grain, or forage was observed in this study involving two soil types (one Oxisol and one Vertisol) representing northwestern and southwestern Puerto Rico. Sorghum, pigeon pea (Vertisol site), and eggplant (Oxisol) were grown in field experiments using from 0 to 24 mg/ha of aged Ponce municipal sludge. Yields were determined and leaf, fruit, grain and soils were analyzed. Sludge tended to increase yields and increases in iron concentration in sorghum grain and zinc concentration in pigeon pea are seen as positive effects on quality. Nickel content increased in the leaf tissue of the sorghum while it decreased in the eggplant fruit tissue. Positive effects on exchangeable bases, pH, and available phosphorus, copper, and zinc were seen for the soils, consistent with earlier findings on a Ultisol treated with the same type of sewage sludge. This sludge appears to be a useful amendment for agricultural crops in western Puerto Rico. (USGS)
W91-02239

USE OF THE INDEX OF BIOTIC INTEGRITY TO ASSESS THE IMPACT OF LAND MANAGEMENT ACTIVITIES ON LOW ORDER STREAMS IN NORTHERN IDAHO.
Idaho Univ., Moscow. Dept. of Fish and Wildlife.
For primary bibliographic entry see Field 5G.
W91-02242

STABLE ISOTOPE TRACERS OF NITROGEN SOURCES TO THE NEUSE RIVER, NORTH CAROLINA.
North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
W. J. Showers, D. M. Eisenstein, H. Paerl, and J. Rudek.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-235342/AS. Price codes: A03 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No. 253, (UNC-WRRI-253), May 1990. 28p, 16 fig, 4 tab, 56 ref, append. USGS Contract No. 14-08-0001-G1440. USGS Project No. G1440-02.

Descriptors: *Isotope studies, *Neuse River, *Nitrates, *Nitrogen, *Path of pollutants, Algae, Cyanophyta, Cycling nutrients, Eutrophication, Fate of pollutants, Isotopes, Nonpoint pollution sources, North Carolina, Nuisance algae, Pollutant identification, Water pollution effects.

Stable nitrogen isotopic analyses were conducted on dissolved nitrate in surface water samples collected over a two-year period from the lower Neuse River, North Carolina, to assess temporal variation of nitrate sources to the watershed. Nitrate samples collected at the Raleigh and Durham Municipal Sewage Treatment Plants have nitrogen isotopic values in the +9 to +14/mil range. Nitrate samples collected from agricultural drainage areas in the lower portion of the Neuse River basin have nitrogen isotopic values in the +4 to +9/mil range. These nitrogen isotopic values correspond well to literature values published for point and nonpoint nitrate sources, respectively, and confirm that there is a well defined isotopic difference between point and nonpoint nitrate inputs to the Neuse River Basin. The nitrogen isotopic values of nitrate from the lower Neuse, which integrates the nutrient loading trends over the entire basin, show an annual cycle. Surface water nitrate during low discharge periods is isotopically enriched and is in the point range of +9 to +14/mil. Surface water nitrate collected during high discharge periods is isotopically depleted and is in the nonpoint source range of +4 to +9/mil. Over the entire annual hydrological cycle, surface water nitrate nitrogen isotopic values are exponentially related to river discharge rate. This relationship suggests that a residence time delay factor in an intermediate reservoir (groundwater, wetlands) plays an important role in the transfer of nonpoint source nitrate to the riverine system during the falling discharge (spring) period. The enhanced fertilizer loading in wet years during the critical spring period can influence the biological species succession and would therefore play a significant role in enhancing nuisance algae bloom potential in late summer. (USGS)
W91-02244

IMPACTS OF URBAN WASTE ON SURFACE WATER IN OUAGADOUGOU AND BOBO-DIOULASSO (BURKINA FASO) (IMPACTS DES REJETS URBAINS SUR LES EAUX DE SURFACE A OUAGADOUGOU ET BOB-DIOULASSO (BURKINA FASO)).
Centre National de la Recherche Scientifique et Technologique, Ouagadougou (Burkina Faso).
For primary bibliographic entry see Field 5B.
W91-02369

LIMNOLOGY AND EUTROPHICATION OF BARRA BONITA RESERVOIR, S. PAULO STATE, SOUTHERN BRAZIL.
Sao Paulo Univ., Sao Carlos (Brazil). Escola de Engenharia.
For primary bibliographic entry see Field 2H.
W91-02371

PHOSPHORUS CYCLE AND ITS SIGNIFICANCE IN THE EUTROPHICATION OF LAKE SEVAN.
Akademiya Nauk Armyanskoi SSR, Sevan. Hydrobiological Station.
R. M. Parparova.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 709-712, 1990. 3 tab, 7 ref.

Descriptors: *Cycling nutrients, *Eutrophic lakes, *Eutrophication, *Lake Sevan, *Limnology, *Phosphates, *Phosphorus, *Water pollution effects, Diffusion, Lake sediments, Organic compounds, Orthophosphates, Plankton, Pore water, Precipitation, Primary productivity, Sedimentation, Surface water, USSR, Vertical stratification.

Eutrophication of Lake Sevan caused by its artificial level lowering has resulted in sharp changes in the nutrient regime. Tributaries are rich in P, due to geological peculiarities of the lake basin, with orthophosphate the main form of P. There is a positive relation between yearly average concentrations of total P and orthophosphate. During the last 50 years input of P from the basin to Lake Sevan had a small increase, from 133 to 150 t/yr. (The content of P in snow and rain increased almost two-fold.) Almost half of the P of tributaries and rain water is orthophosphate. The P concentration of the lake is determined by the concentration of its organic form to a much greater degree than in the river water. An increase in

vertical stratification of orthophosphate is an important consequence of eutrophication. Unlike many lakes, P in Lake Sevan consists mainly of dissolved forms. Mineral and organic compounds make up approximately equal parts of dissolved P. The concentration of P in pore water exceeds that of surficial water by 1-2 orders of magnitude. Internal processes (diffusion from bottom and sedimentation) are the most significant components of the P budget; external components (tributaries and precipitation) are insignificant. Excess of P sedimentation over its diffusion from the bottom is not compensated by discharge from the lake basin. This has caused a decreasing P concentration in the lake for many years. Lowering of the level of the lake itself could destroy the P cycle. Under a decreasing mean depth more of the P store in the water column is sedimented. Eutrophication of the lake in conjunction with the lowering led to a relative increase of particulate P and consequent increase in sedimentation. Resuspension of particulate matter as a result of lake lowering should also contribute to P sedimentation as a result of its sorption on resuspended particles. An increase of plankton primary production under a decreasing P concentration is a peculiarity of the eutrophication of Lake Sevan. Internal processes (sedimentation and diffusion from the bottom) should determine the P regime of the lake in the near future. (Sand-PTT)
W91-02376

EUTROPHICATION OF NIGERIA'S LAKE ASEJIRE.
Benin Univ., Benin City (Nigeria). Dept. of Zoology.
A. B. M. Egborge.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 793-802, 1990. 8 fig, 15 ref.

Descriptors: *Enrichment, *Eutrophication, *Limnology, *Nigeria, *Nutrients, *Reservoirs, *Water pollution effects, Dissolved oxygen, Hydrogen ion concentration, Lake Asejire, Nitrates, Phosphates, Stratification, Water temperature.

Thirteen years after the inundation of the River Oshum to form Lake Asejire, the three phases of impoundment have been completed. An increase in nutrient levels, indicated by conductivity, progressed steadily until 1978. Five years later, although the general nutrient load was similar to that of 1978, its vertical distribution showed a stratification with more nutrients in the bottom strata. Between 1978 and 1983 there were also significant increases in temperature, pH, and particularly phosphate, which showed a 200% increase over its 1975/76 levels. Increases in phosphate levels associated with marked decreases in nitrate-N and dissolved oxygen content are indications of a deteriorating lake environment. (Author's abstract)
W91-02384

INFLUENCE OF CAGE REARING PISCICULTURE ON WATER QUALITY AND BOTTOM SEDIMENTS IN ARTIFICIAL LAKES.
KNIPIBKS Vodokanalproject, Sofia (Bulgaria). Dept. of Scientific and Technological Research.
V. Semov, and A. Kuntcheva.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 875-879, 1990. 1 fig, 2 tab, 6 ref.

Descriptors: *Artificial lakes, *Bottom sediments, *Carp, *Fish farming, *Lake sediments, *Path of pollutants, *Water pollution effects, *Water pollution sources, Antonivanovtzi Dam, Bulgaria, Detritus, Hydrogen sulfide, Iron, Manganese, Nitrogen, Organic matter, Oxygen, Phosphorus, Water quality.

Studies were carried out on water quality and bottom sediments in the Antonivanovtzi Dam in Bulgaria, where carp are reared in cages. During periods of maximum fish yield, the quantity of discharged organic matter as scattered (non-utilized) food is more than 1400 tons annually. The pollution impact of cage rearing pisciculture most distinctly affects the bottom sediments, leading to a significant increase in their oxygen uptake rates. The oxygen uptake by bottom sludges in the Antonivanovtzi Dam cage rearing farm zone, expressed in mg O2/1 gm dry sediment for a 24-hr period, is 7.0, and by sediments in the upper part of the lake, outside the cage rearing zone, only 1.8 mg O2. The loss on ignition value, the total N, organic N and total P values, expressed in % of the dry sediments in the samples from the cage rearing zone, are respectively 13.70, 1.18, 0.78, and 0.47, against 10.37, 0.19, 0.14, and 0.07 in samples from the upper part of the lake. The raised consumption of oxygen at the bottom is the cause of anaerobic hypolimnion formation in the dam, starting in July and August, and lasting until the autumn vertical circulation of water begins. Within the rotting organic matter, under anaerobic conditions, hydrogen sulfide is formed, and accumulates in the bottom layers. Iron, manganese and phosphorus also change to soluble forms and accumulate in the water layer, entering the circle of matter. With the aim of preserving the natural water regime and the biological equilibrium in the Antonivanovtzi Dam as a potential water supply source, it was recommended that cage rearing pisciculture be eliminated or reduced to a minimum. (Author's abstract)
W91-02393

WAYS OF EVALUATING HUMAN-INDUCED IMPACTS ON THE FUNCTIONING OF WATERBODY ECOSYSTEMS.
Institute of Ecology of the Volga River Basin, Tolyatti (USSR).
For primary bibliographic entry see Field 4C.
W91-02397

GROWTH, PRODUCTION, AND DECOMPOSITION DYNAMICS OF SPHAGNUM UNDER NATURAL AND EXPERIMENTALLY ACIDIFIED CONDITIONS.
Alberta Univ., Edmonton. Dept. of Botany.
L. Rochefort, D. H. Vitt, and S. E. Bayley.
Ecology ECOLAR, Vol. 71, No. 5, p 1986-2000, October 1990. 6 fig, 6 tab, 74 ref. Natural Sciences and Engineering Research Council of Canada grant A-6390.

Descriptors: *Acid rain effects, *Acidification, *Decomposition, *Mosses, *Peat bogs, *Plant growth, *Primary productivity, *Sphagnum, Acid rain, Acidic water, Canada, Environmental effects, Growth rates, Nitrates, Ontario, Peat, Sulfates, Water pollution effects.

Annular linear growth, net primary production, and decomposition of Sphagnum fuscum, Sphagnum magellanicum, and Sphagnum angustifolium were measured under experimental acidification and natural conditions in a poor fen at the Experimental Lakes Area, Ontario, Canada. For the experiment, the mire received two treatments: a control area was sprayed with lake water only and an acidified area was sprayed with lake water plus strong acids to simulate acidic rain equivalent to a pH of 4.0. Acidification increased growth and production of most species (2 out of 3 in the oligotrophic zone, and 2 out of 3 in the minerotrophic zone) in the first 2 years. After 2-3 years of artificial acidification, growth and production were not stimulated to the same extent in experimental areas as in earlier years. After 4 years, growth and production in the experimental area declined so that they were the same as controls for 4 of the 6 treatments. Therefore, the effect of the acid treatment changed over the years. With 4-year simulated acid rain, decomposition was unaffected. Our results suggest that the fertilizing effect of SO4(2-) and NO3(-) in North American acid precipitation as suggested previously in the literature is a very short-term one, a least for this type of peatland. Under natural conditions, in the oligotrophic central zone of the mire, production for hollow species was somewhat greater than for hummock species for the 4 years studied. Since the decomposition rate ratio between hummock-top, mid-hummock, and hollow species is roughly in the ratio 7:9:13, the rate of peat accumulation should be higher in hummocks. Hence hummocks appear to be maintained in this poor fen due to low decomposition rates rather than relatively high production. The relative decomposition rates of the species in the minerotrophic edge zone had the same ratio as in the oligotrophic zone. Thus hummocks appear to be expanding in this minerotrophic edge zone at a faster rate than in the oligotrophic zone. (Mertz-PTT)
W91-02404

ELEVATED ATMOSPHERIC CO2 EFFECTS ON BELOWGROUND PROCESSES IN C3 AND C4 ESTUARINE MARSH COMMUNITIES.
Smithsonian Environmental Research Center, Edgewater, MD.
P. S. Curtis, L. M. Balduman, B. G. Brake, and D. F. Whigham.
Ecology ECOLAR, Vol. 71, No. 5, p 2001-2006, October 1990. 4 fig, 1 tab, 26 ref.

Descriptors: *Air pollution effects, *Carbon dioxide, *Climatic changes, *Estuarine environment, *Greenhouse effect, *Marsh plants, *Salt marshes, *Wetlands, Air pollution, Cord grasses, Ecological effects, Growth rates, Marshes, Nitrogen, Roots, Sedges.

Recent work on the responses of native perennial plants to elevated CO2 has begun to explain the ecological consequences of rising atmospheric CO2. It has been shown that plants have a wide range of aboveground morphological and physiological responses to high CO2. Belowground carbon allocation is a major component of a plant's carbon budget, yet relatively little is known about the response of roots to elevated atmospheric CO2. Three brackish marsh communities dominated by perennial macrophytes were exposed to twice ambient CO2 concentrations for two full growing seasons using open top chambers. One community was dominated by the C3 sedge Scirpus olneyi, one was dominated by the C4 grass Spartina patens, and one was a mixture of S. olneyi, S. patens, and Distichlis spicata, a C4 grass. Root and rhizome growth were studied in the second year of exposure by measuring growth into peat cores previously excavated and refilled with sphagnum peat devoid of roots. Growth under elevated CO2 resulted in an 83% increase in root dry mass per core in the Scirpus community. Those roots were also significantly lower in percentage of nitrogen than roots from ambient-grown plants. There was no effect of elevated CO2 on root growth or nitrogen content in the Spartina community or in the C4 component of the mixed community. (Mertz-PTT)
W91-02406

PREDATION ON AMPHIBIAN EGGS AND TADPOLES BY COMMON PREDATORS IN ACIDIFIED LAKES.
Goeteborg Univ. (Sweden). Dept. of Zoology.
B. I. Henrikson.
Holarctic Ecology HOECD2, Vol. 13, No. 3, p 201-206, August 1990. 3 tab, 43 ref.

Descriptors: *Acid rain effects, *Acidification, *Amphibians, *Eggs, *Lake acidification, *Larval growth stage, *Predation, Acid rain, Acidic water, Aquatic insects, Dragonflies, Ecological effects, Frogs, Newts, Toads, Water beetles, Water boatmen, Water bugs.

During the last few decades, the large-scale acidification of surface waters has been shown to be a threat to amphibians inhabiting even non-agricultural areas. The negative impact of chemical changes to amphibian eggs and larvae such as low pH and high aluminum content is documented in both field and laboratory studies. In an attempt to determine potential predators on moor frog, Rana arvalis and common toad, Bufo bufo eggs in acidified lakes and the palatability of eggs and tadpoles researchers offered eggs and three different stages of premetamorphic tadpoles to the following potential predators in acidified lakes: newt Triturus vulgaris, water beetles Rhantus exoletus and Dytiscus lapponicus, dragonfly larvae Leucorrhinia dubia and Aeshna spp., water boatman Notonecta glauca and water bugs, Cymatia bonsdorffi, Glaenocorisa p. propinqua, and Corixa dentipes. The predation pressure on eggs of R. arvalis was low due to thick jelly. The eggs of B. bufo were not attractive to predators with chewing mouth parts due to unpalatability but predators with sucking mouth parts were not repulsed. Tadpoles of R arvalis were eaten by all predators but tadpoles o

B. bufo were unpalatable to most predators. The predators used in the experiments are the new top predators in acidified fishless lakes. They may contribute to the reduction of populations of R. arvalis in acidified areas. (Mertz-PTT)
W91-02407

PREMATURE THELARCHE IN PUERTO RICO: A SEARCH FOR ENVIRONMENTAL ESTROGENIC CONTAMINATION.
Centers for Disease Control, Atlanta, GA. Center for Environmental Health.
W. H. Hannon, R. H. Hill, J. T. Bernert, L. Haddock, and G. Lebron.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 3, p 255-262, May 1987. 1 fig, 3 tab, 28 ref.

Descriptors: *Chlorinated hydrocarbons, *Hormones, *Human physiology, *Premature thelarche, *Public health, *Puerto Rico, *Water pollution effects, Centers for Disease Control, Chemical analysis, Drinking water, Foods, Gas chromatography, Hormone supplementation, Laboratory methods, Mass spectrometry, Pesticides, Water analysis, Water pollution sources.

Premature thelarche is usually defined as breast development in girls below the age of eight years without other signs of premature sexual development. This condition is usually viewed as a variation in maturation or ovarian sensitivity, and is regarded as a benign condition that is not the beginning phase of a more serious problem. The etiology and population incidence are unknown. As part of an investigation into the cause of premature thelarche in Puerto Rico, the Centers for Disease Control (CDC) conducted various laboratory analyses to screen for estrogenic sources. Samples were obtained from case and control households, children, parents, and environmental sources. Serum samples were analyzed from parents and children and household water samples for chlorinated hydrocarbons and no results were found above normal. Using gas chromatography/mass spectroscopy (GC/MS) procedures, serum was analyzed for zearalonol and its derivatives. Four case samples from the residual sample set were reported presumptively positive for zearalonol. Analyses of 96 case samples for estradiol, follicle-stimulating hormone (FSH) and luteinizing hormone (LH) yielded values within the normal reference range. The rat uterine cytosol-receptor assay was used as nonspecific screen for estrogenic activity. Two different contract laboratories used this assay to analyze milk, meat, poultry, and water samples collected from the households and local markets. The reliability of this assay was dependent upon the type of sample matrix. No significant difference between case and control samples was found with this screening process. (Author's abstract)
W91-02429

ACUTE TOXICITY OF AQUEOUS AND SUBSTRATE-BOUND COPPER TO THE MIDGE, CHIRONOMUS DECORUS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
P. Kosalwat, and A. W. Knight.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 3, p 275-282, May 1987. 4 fig, 3 tab, 33 ref. EPA Cooperative Agreement No. CR-808424 and Lawrence Livermore National Laboratory Intramural Order No. 4383305.

Descriptors: *Bioassay, *Biological magnification, *Copper, *Larvae, *Midges, *Toxicity, *Toxicology, *Water pollution effects, Bioconcentration factor, Chemical analysis, Chemical interactions, Chemical properties, Chemical speciation, Experimental data, Experimental design, Larval growth stage, Substrates, Water analysis.

Fourth instar larvae of the midge, Chironomus decorus, were exposed to copper in water and copper in food and substrate (bound forms). Copper present in aqueous forms was more toxic than when it was present in bound forms. The relationship between copper in water and copper in midges could be described by an exponential equation while the relationship between copper in substrate and midges was best described by a simple linear regression equation. Midge larvae accumulated copper from water and possessed some mechanisms to regulate copper uptake and excretion when exposed to copper concentrations of 0.05-1.0 mg/L (aqueous forms) and lost that ability when the concentration exceeded 1.0 mg/L. On the contrary, the midge larvae were unable to accumulate copper from food, since the estimated bioconcentration factor was between 0.10 and 0.16. When the midge larvae were exposed to copper in water, the uptake rate increased rapidly from 0-10 hr and then the rate increased very slowly or in some cases it reached a steady state after 10 hr. The steady state was attained within 1 to 3 hr when the midges were exposed to copper in food and substrate. (See also W91-02431) (Author's abstract)
W91-02430

CHRONIC TOXICITY OF COPPER TO A PARTIAL LIFE CYCLE OF THE MIDGE, CHIRONOMUS DECORUS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
P. Kosalwat, and A. W. Knight.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 3, p 283-290, May 1987. 5 fig, 1 tab, 33 ref. EPA Cooperative Agreement CR-808424 and Lawrence Livermore National Laboratory Intramural Order No. 4383305.

Descriptors: *Chronic toxicity, *Copper, *Eggs, *Embryonic growth stage, *Larvae, *Larval growth stage, *Midges, *Sublethal effects, *Teratogenic effects, *Toxicity, *Water pollution effects, Bioassay, Hatching, Incubation, Sediment contamination, Statistical analysis, Substrates.

A study was undertaken to evaluate the sublethal effects of sediment copper on the life history of the midge Chironomus decorus. The development and hatchability of C. decorus eggs were not affected by 0.1 to 5 mg/L of copper in water. The embryos developed normally and hatched at about the same time (after 55 hr of incubation). All larvae survived the duration of the test (72 hr) except those subjected to 5 mg/L of copper in water, which died after only partial emergence from the egg shell. Apparently, eggs were protected by their shell from copper. Growth of C. decorus larvae was reduced significantly when they were reared in copper-spiked food-substrate (bound copper) from the age of 1 to 15 days old (900-4500 mg/kg of copper). The substrate copper concentration at which larval growth was reduced to 50% (EC50) was 1,602 mg/kg. Substrate copper caused deformities in the epipharyngeal plate of larval mouthparts and copper concentrations higher than 1800 mg/kg delayed adult emergence. The copper concentration in pupal exuviae and adults were positively correlated to copper concentrations in the substrate in which they had been reared as larvae. Larval stage appeared to be the most sensitive to copper toxicity, while eggs were the least sensitive. Larval growth was the best indicator in detecting copper pollution, since it could detect copper at relatively low concentrations. The time to adult emergence was not considered a very good indicator, while larval deformities offered a quick tool to evaluate copper pollution. (See also W91-02430) (Author's abstract)
W91-02431

TOXIC EFFECTS OF TETRAETHYL LEAD AND ITS DERIVATIVES ON THE CHRYSOPHYTE POTERIOCHROMONAS MALHAMENSIS: VIII. COMPARATIVE STUDIES WITH SURFACTANTS.
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Botanik.
G. Roderer.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 3, p 291-301, May 1987. 7 fig, 2 tab, 39 ref.

Descriptors: *Algae, *Algal growth, *Chrysophyta, *Cytology, *Lead, *Lethal limit, *Organometals, *Surfactants, *Toxicity, *Toxicology, *Water pollution effects, Algal physiology, Assay, Cytolysis, Flagellates, Germany, Lipids, Microtubules, Poteriochromonas malhamensis, Tetraethyl lead, Triethyl lead.

The toxic effect of triethyl lead (TriEL) on the phytoflagellate Poteriochromonas malhamensis (Chrysophyceae) was compared with those of eight surfactants some of which represent environmental pollutants. The surfactants typically inhibited algal growth and caused cytolysis in the concentration range from 12-310 microM. TriEl was cytolytic, similar to the surfactants, while lethal concentrations of inorganic lead did not cause cytolysis. It is postulated that this cytolytic effect was mainly governed by combined hydrophobic and electrostatic interactions with the lipid phase of the membranes. The cationic and zwitterionic surfactants and sodiumdodecylsulfate (SDS) and TriEL selectively inhibited mitosis and cytokinesis of the alga and caused the formation of giant multinucleated cells, suggesting selective interaction on the algal microtubules (MTs). However, sodiumdeoxycholate (DOC), Triton X-100 (TX100), and Triton X-405 (TX405) had no selective effects on these parameters. The most active surfactant, SDS, inhibited MT assembly in vitro and caused an instant and complete disassembly is applied to MTs that were preassembled without surfactant. TX100, which was inactive in the algae, showed no effect in the in vitro MT assay, even is applied in ten times higher concentrations than SDS. The observations indicate that the surfactants did not act chaotropically on the alga's cell membranes and that not only TriEL, but also the active surfactants selectively interfered with MTs, resulting in their selective toxic action in P. malhamensis. (Author's abstract)
W91-02432

TRIBUTYLTIN RETARDS REGENERATION AND PRODUCES DEFORMITIES OF LIMBS IN THE FIDDLER CRAB, UCA PUGILATOR.
Rutgers - The State Univ., Newark, NJ. Dept. of Biological Sciences.
J. S. Weis, J. Gottlieb, and J. Kwiatkowski.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 3, p 321-326, May 1987. 4 fig, 1 tab, 23 ref.

Descriptors: *Antifoulants, *Crabs, *Organotin compounds, *Toxicity, *Toxicology, *Water pollution effects, Aquatic animals, Aquatic environment, Aquatic life, Crustaceans, Ecdysis, Hormesis, Marine animals, Marine environment, Marine pollution.

Treatment of fiddler crabs, Uca pugilator, with levels of tributyltin (TBT) as low as 0.5 micro g/L during limb regeneration resulted in a retardation of the regenerative growth and a delay in ecdysis at the end of the regeneration process. Limbs regenerated in the presence of TBT showed a variety of deformities, primarily a curved appearance. This was particularly apparent in regenerated chelae, in which the dactyl curved away from, rather than towards, the pollex. The number of setae was reduced in limbs that regenerated in TBT, compared to those that regenerated in clean sea water, which in turn had a reduced number of setae in comparison to intact limbs. The production of deformities in the regenerated limbs was the most sensitive response and is consistent with findings in other groups of organisms, in which TBT also produces morphological abnormalities. (Author's abstract)
W91-02434

TOXICITY OF CHLORINATED BORNANE (TOXAPHENE) RESIDUES ISOLATED FROM GREAT LAKES LAKE TROUT (SALVELINUS NAMAYCUSH).
Michigan State Univ., East Lansing. Pesticide Research Center.
J. W. Gooch, and F. Matsumura.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 3, p 349-355, May 1987. 3 fig, 3 tab, 33 ref. Michigan Sea Grant Program Grant No. NA84AA-D-SG045C.

Descriptors: *Bioassay, *Great Lakes, *Insecticides, *Lakes, *Path of pollutants, *Pesticide residues, *Pesticide toxicity, *Tissue analysis, *Toxaphenes, *Toxicity, *Toxicology, *Trout, *Water pollution effects, Aquatic animals, Aquatic environment, Aquatic life, Fish, Laboratory methods, Water pollution, Water sampling.

Lake trout samples from the Great Lakes contain residues of a complex pattern of chlorinated bornanes similar to the insecticide toxaphene. These residues, although structurally similar to toxaphene, are composed of a different profile of compounds than the analytical standard. Chlorinated bornane residues were isolated from tissues of Lake Michigan and Siskiwit Lake (Isle Royale) lake trout using a variety of purification techniques. Toxicity studies were conducted to determine the toxicological properties of the isolated residues in comparison to both technical material and the procedural standard. Static 24-hr acute bioassays with mosquito larvae (Aedes egypti) demonstrated that the residues were as toxic as the toxaphene standard. Additionally, experiments performed on the picrotoxinin receptor of the GABA (gamma-aminobutyric acid)-chloride ionophore complex of the central nervous system revealed that the residues were very potent at the 35S-t-butylbicyclophosphorothionate binding site. Therefore, both non-specific and specific measures of toxicologic potency show that environmentally derived residues of toxaphene retain significant biologic activity. There is no trend for decreasing toxicity of toxaphene residues for the period of 1982-85. Also, the residues found in samples from Siskiwit Lake were as toxic as those found in Lake Michigan. (Author's abstract)
W91-02435

EFFECTS OF CHLORINATED BENZENES ON DIATOM FATTY ACID COMPOSITION AND QUANTITATIVE MORPHOLOGY: I. 1,2,4-TRICHLOROBENZENE.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
L. Sicko-Goad, D. Lazinsky, J. Hall, and M. S. Simmons.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 5, p 629-637, September 1989. 7 fig, 1 tab, 31 ref. US EPA Grant No. R-810684.

Descriptors: *Benzenes, *Bioaccumulation, *Biological magnification, *Chlorinated hydrocarbons, *Diatoms, *Fatty acids, *Lipids, *Morphology, *Path of pollutants, *Structure-activity relationships, *Toxicity, *Toxicology, *Water pollution effects, Aromatic compounds, Correlation analysis, Experimental design, Lipophilicity, Octanol/water partition coefficients, Photosynthesis, Trichlorobenzenes.

It is believed that there is a correlation between the uptake of chlorinated hydrocarbons by organisms and their lipid contents. It has also been demonstrated that exposure to hydrophobic compounds may result in changes in fatty acid composition. A series of studies was undertaken to determine the effect of selected chlorinated benzenes on diatom fatty acid composition and cell structure. This study hopes to determine that, under similar controlled environmental conditions, observed sensitivity parallels that predicted by environmental chemistry. Cells of the diatom Cyclotella meneghiniana were exposed in a closed system to 0.245 ppm 1,2,4-Trichlorobenzene. Response to this chlorinated benzene was monitored over a period of 5 days by quantitative ultrastructure and fatty acid percent composition. Over the time period examined, 41 significant morphological changes and 12 significant changes in fatty acid composition were observed. Autophagic-like vacuoles were frequently observed, indicating lysis of cellular constituents. In general, there was an increase in the C20:5 fatty acid, which may be indicative of photosynthetic impairment, since this fatty acid probably substitutes for linolenic acid in diatoms. The most significant numbers of changes were observed after 8 hr of exposure to this lipophilic toxicant, and these changes occurred in membranous organelles. It is suggested that the daily photoperiodic variation in lipid content of phytoplankton may be an important consideration in evaluating effects of lipophilic toxicants. (See W91-02437 thru W91-02439) (Korn-PTT)
W91-02436

EFFECTS OF CHLORINATED BENZENES ON DIATOM FATTY ACID COMPOSITION AND QUANTITATIVE MORPHOLOGY: II. 1,3,5-TRICHLOROBENZENE.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
L. Sicko-Goad, J. Hall, D. Lazinsky, and M. S. Simmons.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 5, p 638-646, September 1989. 7 fig, 1 tab, 29 ref. US EPA Grant No. R-810684.

Descriptors: *Benzenes, *Bioaccumulation, *Biological magnification, *Chlorinated hydrocarbons, *Diatoms, *Fatty acids, *Lipids, *Morphology, *Path of pollutants, *Structure-activity relationships, *Toxicity, *Toxicology, *Water pollution effects, Aromatic compounds, Correlation analysis, Experimental design, Lipophilicity, Octanol/water partition coefficients, Photosynthesis, Trichlorobenzenes.

It has been suggested that increased toxicity of more octanol-soluble compounds to unicellular green algae may be related either to the greater ability of these compounds to penetrate and damage the lipoprotein cell membrane or to overall lipid content of the algae. Cells of the diatom Cyclotella meneghiniana were exposed in a closed system to 0.245 ppm 1,3,5-trichlorobenzene. Response of the diatom was measured by quantitative ultrastructure and fatty acid percent composition over a 5-day period. During that time, 28 significant morphological and 13 significant fatty acid percent composition changes occurred. Autophagic-like vacuoles were observed consistently through the sampling periods. In comparison with exposure to 1,2,4-trichlorobenzene, 1,3,5-trichlorobenzene exerts fewer effects in the parameters studied, and these effects were observed most frequently in membranous components during the initial eight hours of exposure. It is suggested that the amount of cellular lipid and the relative reactivity of the isomer are responsible for the observed effects. (See W91-02436, W91-02438, and W91-02439) (Author's abstract)
W91-02437

EFFECTS OF CHLORINATED BENZENES ON DIATOM FATTY ACID COMPOSITION AND QUANTITATIVE MORPHOLOGY: III. 1,2,3-TRICHLOROBENZENE.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
L. Sicko-Goad, J. Hall, D. Lazinsky, and M. S. Simmons.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 5, p 647-655, September 1989. 8 fig, 1 tab, 32 ref. US EPA Grant No. R-810684.

Descriptors: *Benzenes, *Bioaccumulation, *Biological magnification, *Chlorinated hydrocarbons, *Diatoms, *Fatty acids, *Lipids, *Morphology, *Path of pollutants, *Structure-activity relationships, *Toxicity, *Toxicology, *Water pollution effects, Aromatic compounds, Correlation analysis, Experimental design, Lipophilicity, Octanol/water partition coefficients, Photosynthesis, Trichlorobenzenes.

Cells of the diatom Cyclotella meneghiniana were exposed in a closed system to 0.245 ppm 1,2,3-trichlorobenzene. Response of the diatom was measured by quantitative ultrastructure and fatty acid percent composition over a 5-day period. During that time, 35 significant morphological and 12 significant fatty acid percent composition changes occurred. The most pronounced morphological change that occurred was a significant increase in lipid volume. In addition, changes were observed in vacuolar relative volume, suggesting that the tonoplast became more permeable. Fewer significant changes were observed in fatty acid percent composition upon exposure to this isomer. However, there was a consistent increase in oleic acid (C18:1). The observed changes in morphological and fatty acid percent composition were uniformly distributed with time after the first hour of exposure. Results support the hypothesis that increased lipid stores alter the timing of response to lipophilic toxicants. (See W91-02436, W91-02437, and W91-02439) (Author's abstract)
W91-02438

EFFECTS OF CHLORINATED BENZENES ON DIATOM FATTY ACID COMPOSITION AND QUANTITATIVE MORPHOLOGY: IV. PENTACHLOROBENZENE AND COMPARISON WITH TRICHLOROBENZENE ISOMERS.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
L. Sicko-Goad, M. S. Evans, D. Lazinsky, J. Hall, and M. S. Simmons.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 5, p 656-668, September 1989. 12 fig, 1 tab, 28 ref. US EPA Grants No. R-810684 and R-812311.

Descriptors: *Benzenes, *Bioaccumulation, *Biological magnification, *Chlorinated hydrocarbons, *Diatoms, *Fatty acids, *Lipids, *Morphology, *Path of pollutants, *Structure-activity relationships, *Sublethal effects, *Toxicity, *Toxicology, *Water pollution effects, Aromatic compounds, Correlation analysis, Experimental design, Lipophilicity, Octanol/water partition coefficients, Pentachlorobenzene, Photosynthesis, Trichlorobenzenes.

Cells of the diatom Cyclotella meneghiniana were exposed in a closed system to 0.095 ppm pentachlorobenzene over a period of 5 days. Changes in fatty acid and morphological percent composition were monitored to determine the effect of the toxicant. The greatest morphological change observed was an increase in lipid volume. Most morphological changes occurred in the 1 hour and 5 day sampling periods. Few changes in morphological characteristics or fatty acid percent compositions were observed at eight hours, when the cells were in the dark. The C18:1 and C20:5 fatty acids were most variable with exposure to pentachlorobenzene. Results suggest that at sublethal doses, lipophilic toxicants exert effects that are biphasic. That is, immediately measurable effects are observed in the cells that include increases in storage products and changes in membranous organelles. Long-term effects are postulated to be the result of mobilization of lipophilic toxicants that have partitioned into lipid stores and are more available when lipids are metabolized. Although pentachlorobenzene has a higher octanol/water partition coefficient, it appears to exert fewer cellular changes than any trichlorobenzene isomer. (See W91-02436 thru W91-02438) (Author's abstract)
W91-02439

SKELETAL DEFORMITIES IN SMALLMOUTH BASS, MICROPTERUS DOLOMIEUI, FROM SOUTHERN APPALACHIAN RESERVOIRS.
Georgia Cooperative Fishery and Wildlife Research Unit, Athens.
M. J. Van Den Avyle, S. J. Garvick, V. S. Blazer, S. J. Hamilton, and W. G. Brumbaugh.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 5, p 688-696, September 1989. 2 fig, 7 tab, 30 ref.

Descriptors: *Animal pathology, *Animal tissues, *Appalachian Mountains, *Black bass, *Fish, *Reservoirs, *Water pollution effects, Aquatic animals, Aquatic environment, Aquatic life, Bioindicators, Contaminant residues, Skeletal deformities.

Smallmouth bass (Micropterus dolomieui) populations in two of five reservoirs sampled in the southern Appalachian Mountains contained high percentages of individuals with lordosis, kyphosis or scoliosis. Deformities of the vertebral column occurred in several year classes and varied with fish size; they were absent in small fish, present in 25-30% of the fish 241-300 mm long, and then decreased in occurrence with increased length

ecause environmental contamination is often re-
onsible for high occurrences of deformed fish,
hole-body concentrations of contaminants, bone
evelopment characteristics, and blood plasma
oncentrations of calcium and phosphorus in
rmal and deformed fish were measured and were
mpared with the results of fish from reservoirs
here no deformed fish were found. Vertebrae
ere significantly weaker and more elastic in de-
rmed that in normal fish, but biochemical prop-
ies of vertebrae were similar among the groups
ted. Concentrations of pesticides and metals
ere not elevated in deformed fish, and concentra-
ns of calcium and phosphorus in blood plasma
ere similar in normal and deformed groups. Most
vironmental contaminants that have been shown
cause fish deformities could be discounted as
sative agents on the basis of these results; how-
er, the exact cause was not determined. Further
empts to diagnose the cause of the deformities
re limited by the lack of background informa-
n on relationships among the bone development
ocesses, types of stresses that cause deformities
types of bone tissue in fish. (Author's abstract)
1-02440

**CROCONTAMINANTS AND REPRODUC-
VE IMPAIRMENT OF THE FORSTER'S
RN ON GREEN BAY, LAKE MICHIGAN-
3.**

h and Wildlife Service, Green Bay, WI. Habitat
ancement Field Office.
. Kubiak, H. J. Harris, L. M. Smith, T. R.
wartz, and D. L. Stalling.
hives of Environmental Contamination and
icology AECTCV, Vol. 18, No. 5, p 706-727,
tember 1989. 4 fig, 8 tab, 134 ref. Sea Grant
eral Grant No. NA84AA-D-00065.

criptors: *Chlorinated hydrocarbons, *Dioxins,
gs, *Green Bay, *Hatching, *Incubation,
ke Michigan, *Nesting, *Polychlorinated bi-
nyls, *Population exposure, *Water birds,
ater pollution effects, Animal behavior, Animal
ulations, Aquatic animals, Aquatic environ-
t, Aquatic life, Birds, Great Lakes, Reproduc-
success, Terns, Toxicity.

the 1983 nesting season, Forster's tern (Sterna
eri) reproductive success was significantly im-
ed on organochlorine contaminated Green
Lake Michigan compared to a relatively un-
aminated inland location at Lake Poygan, Wis-
in. Compared with tern eggs from Lake
gan, eggs from Green Bay had significantly
er median concentrations of 2,3,7,8-tetrachlor-
enzo-p-dioxin (TCDD), other polychlorinated
nzo-p-dioxins (PCDDs), total polychlorinated
enyls (PCBs), total (three congeners) non-
, ortho' PCBs, five individual PCB congeners
vn to induce aryl hydrocarbon hydroxylase
H) and several other organochlorine contami-
. Two PCB congeners, 2,3,3',4,4'-, and
,4',5-pentachlorobiphenyl (PeCB) accounted
ore than 90% of the median estimated TCDD
alents at both Green Bay and Lake Poygan.
hatching success of Green Bay sibling eggs
nests where eggs were collected for contami-
analysis was 75% lower at Green Bay than at
Poygan. In both field and laboratory, mean
num incubation periods were significantly
r for eggs from Green Bay compared to Lake
an. Nest abandonment and egg disappearance
substantial at Green Bay but nil at Lake
an. Thus, not only factors intrinsic to the egg,
lso extrinsic factors (Parental attentiveness),
red reproductive outcome at Green Bay. The
miological evidence from this study strongly
sted that contaminants were a casual factor.
-active PCB congeners (intrinsic factors) and
in general (extrinsic effects) appeared to be
nly contaminants at the concentrations meas-
n eggs, capable of producing the effects that
observed at Green Bay. (Author's abstract)
02441

**CITY TEST PROCEDURES FOR HYA-
A AZTECA, AND CHRONIC TOXICITY
CADMIUM AND PENTACHLORO-
NOL TO H. AZTECA, GAMMARUS FAS-
US, AND DAPHNIA MAGNA.**

Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
For primary bibliographic entry see Field 5A.
W91-02444

**ACUTE TOXICITY OF INDUSTRIAL SURFAC-
TANTS TO MYSIDOPSIS BAHIA.**

AWARE, Inc., Nashville, TN.
W. S. Hall, J. B. Patoczka, R. J. Mirenda, B. A. Porter, and E. Miller.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 5, p 765-772, September 1989. 2 fig, 3 tab, 17 ref.

Descriptors: *Acute toxicity, *Bioindicators, *Crustaceans, *Estuarine environment, *Marine environment, *Opossum-shrimp, *Surfactants, *Toxicology, *Water pollution effects, Aquatic animals, Ethylene oxide, Hazard assessment, Industrial wastes, Lethal limit, Solubility, Water pollution sources.

The estuarine crustacean Mysidopsis bahia has been increasingly used to evaluate the toxicity of pure chemicals, effluents, and drilling muds in estuarine and marine environments. M. bahia is ecologically important due to its utilization as a major food source for bottom feeding fishes. A study was conducted to determine the acute toxicities of a variety of industrial surfactants to M. bahia and to gain some insight as to the importance of different chemical characteristics in influencing the toxicity of each surfactant. Three-day to eight-day old M. bahia were used to evaluate the acute toxicities of 17 industrial surfactants having a wide range of physicochemical characteristics. LC50s, based on nominal concentrations covered approximately three orders of magnitude (<1 to >4,000 mg/L). The base structure of the surfactants (i.e., aromatic, alipathic, branched, or linear) was not a factor controlling toxicity. Low solubility surfactants with low ethylene oxide (EO) molar ratios were the most toxic surfactants tested. Ethylene oxide chain length was the best predictor of toxicity, and would be a good parameter to use to screen for surfactant toxicity in hazard assessment. Substitution of terminal OH with SO3 or PO4 reduced toxicity of a selected group of surfactants. Sensitivity of M. bahia up to 26 days old was not significantly different from that of 3 to 8 day old animals. Use of one surfactant as a reference toxicant demonstrated that sensitivity of M. bahia was consistent throughout the various tests. (Author's abstract)
W91-02445

**EFFECT OF WATER QUALITY ON BACTER-
IOPLANKTON DENSITIES IN RIVER, BROOK
AND PEAT MINING WATER IN THE BASIN
OF THE HUMIC RIVER KIIMINKIJOKI,
NORTHERN FINLAND.**

Water and Environment District of Oulu (Finland).
K. Heikkinen, and A. Visuri.
Archiv fuer Hydrobiologie AHYBA4, Vol. 119, No. 2, p 215-230, 1990. 2 fig, 5 tab, 52 ref.

Descriptors: *Colloids, *Microorganisms, *Organic carbon, *Rivers, *Water pollution effects, Bacteria, Chemical properties, Finland, Humic substances, Iron, Phosphorus, Mining, Nitrogen, Peat, Peat bogs, Physical properties, Temperature effects, Water chemistry, Water temperature.

Total densities of suspended bacteria and physicochemical water quality parameters were studied in river, brook and peat mining water in the drainage basin of the humic Kiiminkijoki River in Finland. Bacterial densities ranged from 960,000 to 8,220,000 cells/ml, biomasses from 12 to 105 microgram C/L and cell volumes from 0.074 to 0.144 cu micrometers. Organic carbon in the bacterial biomasses accounted for 0.05-0.66% of total organic carbon concentrations, 0.51-5.47% of particulate organic carbon and 0.06-0.83% of dissolved organic carbon. Bacterial densities increased with water temperature. The results indicated that organic iron-phosphorus colloids were important for bacterial growth in these humic waters. Bacterial densities in the river also increased with increasing particulate organic carbon concentrations, but dissolved organic carbon alone had only a small influence on them. Microbial activity in the river was probably also limited by the low ammonium nitrogen concentrations. Bacterial growth in the peat mining water seemed largely to be controlled by detrital phosphorus content, and bacteria in bog iron-ore formation also seemed to be important. Concentrations of inorganic nitrogen, iron and phosphorus in filtrates and dissolved organic carbon, and also bacterial densities, increased in the river downstream of the peat production areas. The increased in bacterial densities in the area of loading was probably mainly due to increasing concentrations of inorganic nitrogen and organic iron-phosphorus colloids. The increase in inorganic nitrogen concentrations could mainly be attributed to loading from the peat mining areas. (Author's abstract)
W91-02455

**INFLUENCE OF SEASON AND EXERCISE ON
THE LETHAL TOXICITY OF CYANIDE TO
RAINBOW TROUT (SALMO GAIRDNERI).**

Concordia Univ., Loyola Campus, Montreal (Quebec). Ecotoxicology Research Lab.
S. M. McGeachy, and G. Leduc.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 3, p 313-318, May 1988. 2 fig, 4 tab, 27 ref.

Descriptors: *Cyanide, *Toxicity, *Trout, *Water pollution effects, Environmental effects, Exercise effects, Fish behavior, Seasonal variation.

The response of continuously exercised and non-exercised juvenile rainbow trout (Salmo gairdneri Richardson) to lethal levels (96-hour LC50) of cyanide was examined for different seasons of the year. Trout were acclimated to the 12 C test temperature for 3-4 weeks, under a 12 hour photoperiod before being tested at different times of the year. In summer, there was no significant difference of sensitivity between exercised and non-exercised trout. From summer to winter, the 96-hour LC50 for exercised trout remained unchanged at 0.052 mg/L cyanide, while the LC50 of the non-exercised trout dropped significantly to 0.043 mg cyanide/L. The median survival times of the two groups of trout were the same in the summer, but in winter the exercised fish survived twice as long as the non-exercised fish. A longer acclimation period of the non-exercised trout from 4 weeks to 10 weeks during the winter increased resistance to cyanide. (Author's abstract)
W91-02458

**HISTOPATHOLOGY OF RAINBOW TROUT
EXPOSED TO A BLEACHED KRAFT PULP
MILL EFFLUENT.**

Montreal Univ. (Quebec). Dept. of Occupational and Environmental Health.
C. M. Couillard, R. A. Berman, and J. C. Panisset.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 3, p 319-323, May 1988. 1 fig, 5 tab, 18 ref.

Descriptors: *Fish, *Histology, *Pulp wastes, *Toxicity, *Trout, *Water pollution effects, Bacteria, Environmental effects, Fins, Fish diseases, Gills, Water pollution.

The toxicity of an untreated bleached kraft pulp mill effluent was evaluated histopathologically, using rainbow trout. Gills, liver, kidney, spleen, digestive tract, and skin were examined in a 96-hour LC50 acute test. Fish exposed to lethal concentrations of effluent had an extensive fusion of gill lamellae. This lesion was also present in fish that survived the 96-hour LC50 acute test but to a lesser extent. Trout exposed for 20, 40, and 60 days to sublethal effluent concentrations were also examined. No lesions that could be attributed specifically to the effluent were observed, but exposed fish had a higher incidence of fin necrosis and damaged gills than the unexposed fish after 40 and 60 days. Loss of resistance to bacterial pathogens may be a significant stress-related effect of this effluent in fish exposed for long periods to low concentrations. (Author's abstract)

W91-02459

TOXICITY TESTING OF SUBLETHAL EFFECTS OF DREDGED MATERIALS.
Old Dominion Univ., Norfolk, VA. Applied Marine Research Lab.
R. W. Alden, A. J. Butt, and R. J. Young.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 3, p 381-389, May 1988. 7 fig, 1 tab, 24 ref. U.S. Army Corps of Engineers contract number DACW65-81-C-0051.

Descriptors: *Dredging wastes, *Hampton Roads, *River sediments, *Shrimp, *Toxicity, *Water pollution effects, *Water pollution sources, Dredging, Elizabeth River, Path of pollutants, Pollution load, Virginia, Water pollution.

A series of toxicity tests were conducted on liquid and suspended solid phase fractions of sediments from the Port of Hampton Roads, Virginia. There were significant sublethal effects associated with exposure of the test organisms to fractions of sediments taken from certain stations in the Port of Hampton Roads. The respiration rates of the grass shrimp populations were depressed dramatically upon exposure to the liquid and suspended solid fractions of sediments from the most highly industrialized region of the Southern Branch of the Elizabeth River. Likewise, he hyporegulation capacity of grass shrimp exposed to high salinities declined following exposure to the elutriates from the same stations. The low levels of mortalities was apparently due to the removal of the most highly contaminated sediments by maintenance dredging operations 4-6 months prior to the tests. Lethal effects of the sediments were observed to return during tests 18 months following dredging. The sublethal effects of the sediments appear to be negligible in a region of the Southern Branch where the River makes a right angle turn and the sediments are somewhat sandy. The stations further upstream produced moderate sublethal effects, but only low levels of mortalities. The relative quality of the sediments which would be dredged during any future harbor deepening operations appears to be quite good. The sublethal effects of sediments composited to a depth of 3m did not produce significant sublethal effects. The toxic agent(s) producing respiratory depression and diminishment of osmoregulation capacity is unknown, but previous investigations indicate that this type of sublethal response is not uncommon and may be produced by different types of pollutants. (Mertz-PTT)
W91-02461

INORGANIC POLLUTION OF THE MAN-MADE LAKES OF WADI EL-RAIYAN AND ITS IMPACT ON AQUACULTURE AND WILDLIFE OF THE SURROUNDING EGYPTIAN DESERT.
Cairo Univ., Giza (Egypt). Faculty of Agriculture.
For primary bibliographic entry see Field 5B.
W91-02462

CHRONIC EFFECTS OF 2,2'-DICHLOROBIPHENYL ON REPRODUCTION, MORTALITY, GROWTH, AND RESPIRATION OF DAPHNIA PULICARIA.
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
S. D. Bridgham.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 6, p 731-740, November 1988. 7 fig, 4 tab, 28 ref. EPA Grant CR810775.

Descriptors: *Daphnia, *Polychlorinated biphenyls, *Sublethal effects, *Toxicity, *Water pollution effects, Biological studies, Environmental effects, Water pollution.

Previous studies have shown toxic effects of polychlorinated biphenyls (PCBs) on aquatic life only in the microgram/L range, well above normal ambient concentrations. Daphnia pulicaria was isolated from Lake Erie and exposed to 50 ng/L to 10 microgram/L of 2,2'-dichlorobiphenyl (DCB) in lifetable and physiological studies. Reproduction, mortality, growth, and respiration were measured for periods up to the entire lifespan of the animal with and without the use of an organic surfactant. One experiment was conducted for three generations of the daphnid continuously exposed to 2,2'-dichlorophenyl. Significant mortality and inhibition of reproduction were found at levels as low as 50-100 ng/L in lifetable studies, an no safe level could be determined. These are among the lowest levels ever reported for a PCB congener to cause significant biological effects. A unique, yet repeatable, dose-response curve occurred in lifetables with maximum inhibition at low to intermediate concentrations. Inhibition at the highest level tested, 10 microgram/L, occurred only after continuous exposure for three generations. Increasing concentrations of 2,2'-dichlorobiphenyl stimulated growth, while respiration experiments yielded variable results. (Author's abstract)
W91-02466

EFFECTS OF PULP MILL EFFLUENTS ON VERTEBRAE OF FOURHORN SCULPIN, MYOXOCEPHALUS QUADRICORNIS, BLEAK, ALBURNUS ALBURNUS, AND PERCH, PERCA FLUVIATILIS.
National Swedish Environment Protection Board, Nykoeping. Brackish Water Toxicology Lab.
B. E. Bengtsson, A. Bengtsson, and U. Tjarnlund.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 6, p 789-797, November 1988. 2 fig, 5 tab, 21 ref.

Descriptors: *Fish diseases, *Pulp wastes, *Water pollution effects, Bleak, Environmental effects, Gulf of Bothnia, Perch, Sculpin, Sublethal effects, Sweden, Water pollution.

In 1980 and 1981, fourhorn sculpin, Myoxocephalus quadricornis, were sampled systematically in the Gulf of Bothnia (Sweden) to monitor skeletal deformation related to bleached kraft mill effluents. Elevated frequencies of deformation were found outside several industries and a thorough study at one industry verified a correlation between distance from the industry and incidence of spinal deformation. Current laboratory investigation with juvenile fourhorn sculpin, exposed for 4.5 months to four pulp mill effluents resulted in elevated frequencies of vertebral deformation. Vertebrae composition and mechanical strength were altered as a result of the treatment. The same parameters were also altered for bleak, Alburnus alburnus, exposed for 3.5 months to the same effluents. The response pattern was, however, different and no vertebral deformation could be confirmed by X-ray technique. A field survey on feral perch, Perca fluviatilis, sampled in the vicinity of two kraft pulp mills with and without bleaching, on the Swedish east coast (Gulf of Bothnia) gave results similar to those obtained for bleak. Depleted ascorbate stores with subsequent disturbance in collagen metabolism is suggested as a possible mode of action. (Mertz-PTT)
W91-02468

SUBCLINICAL EFFECTS OF GROUNDWATER CONTAMINANTS. II. ALTERATION OF REGIONAL BRAIN MONOAMINE NEUROTRANSMITTERS BY BENZENE IN CD-1 MICE.
Utah State Univ., Logan. Dept. of Biology.
G. C. Hsieh, R. D. R. Parker, and R. P. Sharma.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 6, p 799-805, November 1988. 1 fig, 3 tab, 32 ref. U.S. Geological Survey grant no. G-1255-04.

Descriptors: *Benzene, *Toxicity, *Water pollution effects, Brain, Chromatography, Groundwater pollution, Health effects, Mice, Neurological effects, Sublethal effects, Water pollution.

Benzene, a common groundwater contaminant, possesses neurotoxic and behavioral effects. Male, adult CD-1 mice were continuously fed drinking water ad libitum containing 0, 31, 166 and 790 mg/L benzene for four weeks. Endogenous levels of the catecholamines norepinephrine and dopamine, the catecholamine metabolites 3-methoxy-4-hydroxymandelic acid, 3,4-dihydroxyphenylacetic acid and homovanillic acid, and the indoleamine serotonin and it metabolite 5-hydroxyindoleacetic acid, were measured by high-performance liquid chromatography in six discrete brain regions. In the hypothalamus, the brain region richest in norepinephrine, concentrations of norepinephrine increased by 40% when mice received doses at 31 mg/L; 58% with 166 mg/L; and 61% with 790 mg/L. Significant increases of norepinephrine were also observed in the medulla oblongata and cerebellum. Dopamine concentrations increased significantly in the hypothalamus and corpus striatum. Increases of catecholamine metabolites were seen in a number of brain regions: midbrain (3,4-dihydroxyphenylacetic acid), corpus striatum (homovanillic acid, 3-methoxy-4-hydroxymandelic acid, and 3,4-dihydroxyphenylacetic acid), cerebral cortex (3-methoxy-4-hydroxymandelic acid, and cerebellum (3-methoxy-4-hydroxymandelic acid). Benzene ingestion significantly increased serotonin concentrations in the hypothalamus, corpus striatum, midbrain, cerebral cortex and medulla oblongata. Concomitant with increases of serotonin, 5-hydroxyindoleacetic acid increased in corpus striatum, midbrain, cerebral cortex and medulla oblongata. The findings indicate that oral ingestion of benzene by mice induced both synthesis and catabolism of the monoamine neurotransmitters investigated. (Author's abstract)
W91-02469

ENVIRONMENTAL EPIDEMIOLOGY OF NON-HODGKIN'S LYMPHOMA IN EASTERN NEBRASKA.
Nebraska Univ., Omaha.
D. D. Weisenburger.
American Journal of Industrial Medicine AJIMD, Vol. 18, No. 3, p 303-305, 1990. 13 ref. Nebraska Department of Health Grant LB-506.

Descriptors: *Cancer, *Epidemiology, *Groundwater pollution, *Human diseases, *Pesticides, *Population exposure, *Water pollution effects, Agricultural chemicals, Atrazine, Carbamate pesticides, Drinking water, Halogenated pesticides, Herbicides, Histology, Nebraska, Nitrates, Non-Hodgkin's lymphoma, Organophosphorus pesticides, Phenoxy acid herbicides.

The incidence of non-Hodgkin's lymphoma (NHL) is increased in many counties in eastern Nebraska. Histologic analysis has revealed a twofold increase in the clinically aggressive, diffuse large cell subtype of NHL. To investigate the possible association between NHL and agricultural exposures, a population-based case-control study was conducted in eastern Nebraska in 1985. Telephone interviews were conducted with 201 men having histologically confirmed NHL and 725 controls. Among men, the use of the herbicide 2,4-D was associated with a 50% increased risk of NHL (OR 1.5, 95% CI 0.9, 2.4). Personal exposure to 2,4-D more than 20 days per year increased the risk threefold (OR 3.3, 95% CI 0.5, 22.1). Several classes of insecticides were also associated with increased risk: organophosphates (OR 1.9, 95% CI 1.1, 3.1), carbamates (OR 1.8, 95% CI 1.0, 3.2), and chlorinated hydrocarbons (OR 1.4, 95% CI 0.7, 2.3). As a result of intense agricultural use, extensive contamination of shallow groundwater by nitrate and atrazine has also occurred in eastern Nebraska. A twofold increase of NHL is present in counties with greater than 20% of the wells contaminated by nitrate (>10 ppm) and in counties with intense fertilizer use. These findings suggest that NHL in eastern Nebraska may be related to the use of pesticides and nitrogen fertilizers. (Author's abstract)
W91-02507

DRINKING WATER CONTAMINATION AND THE INCIDENCE OF LEUKEMIA: AN ECOLOGIC STUDY.
New Jersey State Dept. of Health, Trenton. Div. of Occupational and Environmental Health.
J. Fagliano, M. Berry, F. Bove, and T. Burke.
American Journal of Public Health AJHEA, Vol. 80, No. 10, p 1209-1212, October 1990. 1 fig, 1 tab, 31 ref.

escriptors: *Cancer, *Drinking water, *Epidemi-
ogy, *Population exposure, *Public health,
/olatile organic compounds, *Water pollution ef-
cts, Leukemia, New Jersey, Regression analysis,
richloroethylene, Water pollution.

n ecologic study was performed to examine the
lation between the incidence of leukemias and
e occurrence of volatile organic chemical (VOC)
ntamination of drinking water supplies within a
idy area comprising subpopulations differentially
posed to drinking water VOCs (trichloroethy-
ie and related solvents). Populations served by
mmunity water supplies were classified into ex-
sure categories according to VOC contamina-
n status based on 1984-85 sampling data. Leuke-
a incidence data (1979-1984) were collected
m a population-based cancer registry. For fe-
les, the standardized incidence ratio was elevat-
only in towns in the highest of three exposure
egories. No association was observed in males
any of the exposure categories. A Poisson re-
ssion analysis of the data, using finer exposure
ata, indicated an increased risk among females
h increasing level of contamination which ap-
ared to be distributed evenly across all age
ata. The rate ratio for females at the highest
osure stratum for total non-trihalomethane
OCs compared to the least exposed stratum was
8. The observed association appears to suggest
t drinking water contaminated with VOCs may
rease the incidence of leukemia among exposed
ales, but caution is advised in the interpretation
hese results because of the uncertainties inher-
in ecologic studies. (Author's abstract)
1-02509

**ALUATING THE IMPACT OF MUNICIPAL
TER FLUORIDATION ON THE AQUATIC
VIRONMENT.**
eshore General Hospital, Pointe Claire
ebec). Community Health Dept.
V. Osterman.
erican Journal of Public Health AJHEAA,
. 80, No. 10, p 1230-1235, October 1990. 4 tab,
ef.

criptors: *Drinking water, *Environmental ef-
s, *Fluoridation, *Fluorides, *Path of pollut-
, *Water pollution effects, *Water treatment,
ada, Environmental impact, Environmental
ity, Montreal, Municipal treatment, Quebec,
ers.

ough highly beneficial for dental health, low
centrations of fluoride in environmental waters
be toxic to several organisms. In an era of
htened public awareness about the environ-
t, this may lead city officials to withhold im-
enting water fluoridation for environmental
ons. A mass balance approach was used to
uate this perceived risk. Generally speaking,
idated water loss during use, dilution of
ge by rain and groundwater infiltrate, fluoride
val during secondary sewage treatment, and
sion dynamics at effluent outfall combine to
nate fluoridation-related environmental ef-
. In Montreal, water fluoridation would raise
ge aquatic fluoride levels in the waste water
e immediately below effluent outfall by only
0.09 mg/L. Downstream, these changes
d be only 0.02-0.05 mg/L at 1 km, and 0.01-
mg/L at 2 km below outfall. Overall river
ide concentrations theoretically would be
d by 0.001-0.002 mg/L, a value not measura-
y current analytical techniques. All resulting
ntrations would be well below those recom-
ed for environmental safety and would not
d natural levels found elsewhere in Quebec.
erature review did not reveal any examples of
cipal water fluoridation causing recommend-
nvironmental concentrations to be exceeded,
ugh excesses occurred in several cases of
e industrial water pollution. (Author's ab-
)
-02510

**KEMIA INCIDENCE AND RADIOACTIV-
IN DRINKING WATER IN 59 IOWA
NS.**
Univ., Oakdale. Coll. of Medicine.
L. Fuortes, L. A. McNutt, and C. Lynch.
American Journal of Public Health AJHEAA, Vol. 80, No. 10, p 1261-1262 October 1990. 2 tab, 7 ref.

Descriptors: *Cancer, *Drinking water, *Epidemiology, *Leukemia, *Population exposure, *Public health, *Radium radioisotopes, *Water pollution effects, Iowa, Radioactivity, Statistical analysis, Water pollution.

Fifty-nine towns in Iowa with single source drinking water were stratified on the basis of radium content in finished non-softened water to test the hypothesis of an association with total or acute myeloid leukemia. Fourteen towns had radium concentrations in drinking water exceeding the EPA safety limit of 5 pCi/L. A small increasing trend existed for total leukemia with increased radium content in drinking water that is in accordance with either the hypothesis of no effect or of a small effect. Future study of cancer incidence and radium concentration in drinking water in these and other communities is needed to clarify the risk of leukemia secondary to naturally occurring Ra-226. (Author's abstract)
W91-02511

FREE AMMONIA AND TOXICITY CRITERIA IN A POLLUTED URBAN LAKE.
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5B.
W91-02536

BREEDING BIOLOGY OF THE SPOTTED SALAMANDER AMBYSTOMA MACULATUM (SHAW) IN ACIDIC TEMPORARY PONDS AT CAPE COD, USA.
Cape Cod National Seashore, South Wellfleet, MA.
J. W. Portnoy.
Biological Conservation BICOBK, Vol. 53, No. 1, p 61-75, 1990. 1 fig, 3 tab, 32 ref.

Descriptors: *Acid rain effects, *Acidic water, *Cape Cod, *Ephemeral lakes, *Hatching, *Salamanders, *Spawning, *Water pollution effects, Biological studies, Hydrogen ion concentration, Lignin, Mortality, Organic acids, Survival, Tannins, Toxicity.

Many researchers have expressed concern that temporary ponds could be the most sensitive freshwater bodies to atmospheric acidification because of isolation from inorganic soil buffers and direct exposure to both acidic rainfall and unbuffered snowmelt. The many temporary woodland ponds on Cape Cod appear especially vulnerable to acidification because of the low buffering capacity of local soils, the natural acidity from surrounding coniferous forest, and the low pH (4.0 to 5.0) of local precipitation. The relationship between water chemistry and breeding success of spotted salamanders (Ambystoma maculatum (Shaw)) was examined in temporary woodland ponds on outer Cape Cod, MA in 1985 and 1986. Most pond waters were dilute (median conductivity = 57 micromhos/cm (1 micromhos/cm = 0.1 mS/m)), acidic (median pH = 4.82), and highly colored (median = 140 Pt-Co units). Most acidity was due to abundant organic acids. Salamander survival to hatching was over 80% at 8 of 12 ponds monitored. Complete mortality, preceded by gross abnormalities, was observed only among embryos in the most acidic spawning pond (pH 4.3 to 4.5) in both years. Embryo transfers between ponds and laboratory studies indicated that reduced survival was due to the interaction of low pH with high tannin-lignin concentration. The use of amphibian embryonic survival to indicate acid rain effects is complicated by multiple habitat parameters and should only be attempted in conjunction with long-term population monitoring. (Author's abstract)
W91-02550

S-OXYGENATION OF THIOBENCARB (BOLERO) IN HEPATIC PREPARATIONS FROM STRIPED BASS (MORONE SAXATILIS) AND MAMMALIAN SYSTEMS.
California Univ., San Francisco. School of Pharmacy.
J. R. Cashman, L. D. Olsen, R. S. Nishioka, E. S. Gray, and H. A. Bern.
Chemical Research in Toxicology CRTOEC, Vol. 3, No. 6, p 433-440, September/October 1990. 6 tab, 1 fig, 36 ref. NIH Division of Research Resources Grant FFD 1614 and California Department of Fish and Game Contract 8026.

Descriptors: *Bass, *Biotransformation, *Liver, *Metabolites, *Pesticide toxicity, *Pesticides, *Thiocarbamate pesticides, *Water pollution effects, Bioassay, California, Cytochromes, Hogs, In vitro tests, Metabolism, Toxicity.

Since about 1975, the striped bass populations in the Sacramento Valley Delta (California) have experienced a sharp decline. Accompanying this decline is the striped bass die-off which may be linked to application of thiocarbamate herbicides such as the chemically persistent thiobencarb (Bolero). The in vitro S-oxygenation of thiobencarb (p-chlorobenzyl-N,N-diethylthiocarbamate) in the presence of hepatic microsomes from freshwater and seawater-adapted striped bass was investigated. Thiobencarb S-oxide was the principal metabolite and accounted for 98% of the total thiobencarb metabolized by striped bass liver microsomes. Studies on the biochemical mechanisms for striped bass hepatic S-oxygenation suggest that this reaction is catalyzed largely by the flavin-containing monooxygenase and to a lesser extent by cytochromes P-450. Following the short incubation period used, no thiobencarb sulfone was detected and no evidence was found for a contribution of cooxidation in the S-oxidation of thiobencarb. This conclusion was supported by studies with microsomes and purified mammalian monooxygenases which also metabolized thiobencarb without cooxidizing factors. Highly purified cytochrome P-450IIB-1 S oxygenated thiobencarb more efficiently than highly purified hog liver flavin-containing monooxygenase. Thiobencarb S-oxide and thiobencarb sulfone were efficient carbamylating agents and reacted with thiol and amine nucleophiles, whereas thiobencarb itself was relatively stable to trans-thiocarbamylation. Monooxygenase-catalyzed S-oxygenation of thiobencarb by striped bass liver microsomes may represent a bioactivation process which could explain the known toxicity of thiobencarb in fish. (Author's abstract)
W91-02552

ANALYTICAL APPROACH TO ASSESSMENT OF LONG-TERM EFFECTS OF LOW LEVELS OF CONTAMINANTS IN THE MARINE ENVIRONMENT.
Cambridge Univ. (England). Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W91-02554

ASSESSMENT OF OCEAN WASTE DISPOSAL. TASK 5. HUMAN HEALTH IMPACTS OF WASTE CONSTITUENTS. II. PATHOGENS AND ANTIBIOTIC-AND HEAVY METAL-RESISTANT BACTERIA.
Maryland Univ., College Park. Dept. of Microbiology.
For primary bibliographic entry see Field 5E.
W91-02616

LIMITATIONS TO THE UNDERSTANDING OF ION-EXCHANGE AND SOLUBILITY CONTROLS FOR ACIDIC WELSH, SCOTTISH, AND NORWEGIAN SITES.
Institute of Hydrology, Wallingford (England).
C. Neal, J. Mulder, N. Christophersen, M. Neal, and D. Waters.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 11-23, August 1990. 1 fig, 21 ref.

Descriptors: *Acid rain effects, *Acidic water, *Acidification, *Aluminum, *Land use, *Norway, *Scotland, *Wales, *Weathering, Cation exchange, Hydrogen ion concentration, Ion transport, Mathematical models, Soil water, Solubility, Water chemistry.

Predicting the consequences of atmospheric deposition and land-use changes such as conifer afforestation/harvesting, for acidic and acid sensitive systems, requires a thorough understanding of the interactions of major chemical, biological, and hydrological processes. Mathematical models depicting streamwater and lake water chemistry behavior are well established and have successfully depicted short-term event streamwater data and historical acidification patterns for lake water. Among the hydrochemical mechanisms depicted in these models, emphasis is placed on ion-exchange and weathering reactions. A summary of soilwater and streamwater data from acidic catchments in Wales, Scotland, and Norway is presented. It is concluded that insufficient detail has been established to describe quantitatively the ion-exchange and weathering processes in determining streamwater chemistry. Such a description is required before reliance can be placed on mathematical models describing short-term and long-term changes. The need for manipulative studies is highlighted, emphasis being placed on minimizing perturbation of the system from field conditions. An appeal is made for the use of a standardized method for determining the exchangeable cations. The studies provide overwhelming evidence showing the incorrectness of the commonly used modelling assumption that Al(OH)3 solubility determines inorganic aluminum levels in the soil and streams. The importance of simple mixing of soil and ground water, in explaining streamwater aluminum-hydrogen ion relationships, is emphasized. (Korn-PTT)
W91-02735

ORIGINS OF ACID RUNOFF IN A HILLSLOPE DURING STORM EVENTS.
Sveriges Lantbruksuniversitet, Umea. Dept. of Forest Site Research.
K. H. Bishop, H. Grip, and A. O'Neill.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 35-61, August 1990. 15 fig, 2 tab, 27 ref.

Descriptors: *Acid rain, *Acid streams, *Acid water, *Acidification, *Geochemistry, *Soil organic matter, *Soil water, *Storm runoff, Geohydrology, Groundwater, Hydrogen ion concentration, Hydrology, Slopes, Streamflow, Sweden.

At the Svartberget Research Catchment in northern Sweden, stream pH had risen to 5.7 after a period of dry summer weather in 1987 before it dropped to below 4.4 during three ensuing storm events. To clarify the relationship between flow pathways and episodic acidity, the sources of storm runoff and its acidity in one of the catchment hillslopes were investigated. Hydrological considerations locate the origins of the runoff within the upper four decimeters of the soil in a swath some 50 m wide along the stream. Groundwater remained alkaline throughout the episodes. Increases in the total organic carbon content of runoff appeared to play a central role in the stream pH decline. The episode's acidity and distinctive chemical fingerprint originated in the runoff's passage through the organic-rich forest mor and/or streambank vegetation. Results from a column-leaching experiment supported this hypothesis. Such localized origins of runoff and especially of acidity may be of significance when calculating the rate at which acid episodes in other catchments respond to changes in acid deposition. A better understanding of the interaction between runoff and organic material is needed to determine whether the acidity at Svartberget is natural or if it had been affected by atmospheric inputs of anthropogenic origin. (Author's abstract)
W91-02737

EVIDENCE FOR LONG-TERM DETERIORATION OF STREAMWATER CHEMISTRY AND SOIL ACIDIFICATION AT THE BIRKENES CATCHMENT, SOUTHERN NORWAY.
Senter for Industriforskning, Oslo (Norway).
N. Christophersen, A. Robson, C. Neal, P. G. Whitehead, and B. Vigerust.
Journal of Hydrology JHYDA7, Vol. 116, No. 1/4, p 63-76, August 1990. 3 fig, 4 tab, 22 ref.

Descriptors: *Acid rain, *Acidic soils, *Acidification, *Calcium, *Magnesium, *Norway, *Sulfates, *Water chemistry, Air pollution effects, Aluminum, Hydrogen ion concentration, Soil chemistry, Soil solution, Soil water, Statistical methods, Streams, Watersheds.

In recent years sulfate concentrations in the fresh waters of southern Norway have declined, presumably owing to reduced atmospheric emissions of sulfur dioxide in Western Europe. There has also been a parallel decline in calcium and magnesium in fresh waters. An important question to be resolved is whether reduced base cation concentrations can be explained predominantly as a response only to declines in sulfate levels, or whether concurrent soil acidification also plays a role. To help clarify long-term trends in freshwater chemistry and potential soil acidification, an investigation, in which all major chemical species were considered, was conducted in the Birkenes catchment, southern Norway. Emphasis was placed on the choice of statistical tools and soil water data. For the period 1972-1987, a steady decline was observed for calcium (1.1-1.4 microeq/L/yr) and magnesium (0.6-0.8 microeq/L/yr) in streams at the Birkenes catchment. No similar significant trends were observed for other chemical species or for discharge over the whole record, but sulfate declined over the last two years of the study. The long-term deterioration of streamwater chemistry is ascribed to soil acidification in the catchment, which may offset the beneficial effects of reductions of anthropogenic sulfur deposition. Results from monitoring of soil solutions from 1984-1987 indicate that reductions of sulfate are accompanied by further reductions of base cations, but not of hydrogen ion and inorganic monomeric aluminum. (Korn-PTT)
W91-02738

REVERSAL OF STREAM ACIDIFICATION AT THE BIRKENES CATCHMENT, SOUTHERN NORWAY: PREDICTIONS BASED ON POTENTIAL ANC CHANGES.
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W91-02739

ELEMENT BUDGETS OF TWO CONTRASTING CATCHMENTS IN THE BLACK FOREST (FEDERAL REPUBLIC OF GERMANY).
Freiburg Univ. (Germany, F.R.). Inst. of Soil Science and Forest Nutrition.
For primary bibliographic entry see Field 5B.
W91-02740

PATHOGENIC MARINE VIBRIO SPECIES IN SELECTED NOVA SCOTIAN RECREATIONAL COASTAL WATERS.
Dalhousie Univ., Halifax (Nova Scotia). Faculty of Medicine.
For primary bibliographic entry see Field 5B.
W91-02780

OUTBREAK OF CAMPYLOBACTER ENTERITIS ASSOCIATED WITH A COMMUNITY WATER SUPPLY.
Centre Hospitalier Regional de la Beauce, Beauceville East (Quebec). Dept. de Sante Communautaire.
M. Alary, and D. Nadeau.
Canadian Journal of Public Health CJPEA4, Vol. 81, No. 4, p 268-271, 1990. 1 fig, 1 tab, 22 ref.

Descriptors: *Campylobacter, *Enteric bacteria, *Path of pollutants, *Potable water, *Public health, *Water pollution effects, Chlorination, Coliforms, Contamination, Water quality.

In June 1987, an outbreak of acute enteritis occurred over a period of two weeks in a small rural community where the potable water supply is unfiltered and unchlorinated. Campylobacter jejeuni was isolated from six patients. A case control study performed in a local fiberglass shop where workers drink a lot of water, showed an association between the occurrence of enteritis and the consumption of ten or more 8 ounce glasses of water per day (Odds ratio = 6, p = 0.04). The attack rate of enteritis was 23.2% (13/56) and a dose response relationship was also noted (p = 0.05). C. jejeuni was not recovered from the local water supply, which had temporarily been chlorinated the day before the samples were taken. However, samples taken just before the outbreak showed high coliform counts. This episode suggests that unprotected water systems may be contaminated by C. jejeuni. (Author's abstract)
W91-02781

DIFFERENCES BETWEEN FRESHWATER AND SEAWATER-ACCLIMATED GUPPIES IN THE ACCUMULATION AND EXCRETION OF TRI-N-BUTYLTIN CHLORIDE AND TRIPHENYLTIN CHLORIDE.
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
T. Tsuda, S. Aoki, M. Kojima, and H. Harada.
Water Research WATRAG, Vol. 24, No. 11, p 1373-1376, November 1990. 4 fig, 1 tab, 15 ref

Descriptors: *Antifoulants, *Bioaccumulation, *Bioassay, *Bioconcentration, *Fish physiology, *Guppies, *Organotin compounds, *Tri-n-butyltin chloride, *Triphenyltin chloride, *Water pollution effects, Chemical properties, Excretion, Freshwater, Path of pollutants, Seawater.

Differences between freshwater and seawater-acclimated guppies (Lebistes reticulatus) in the accumulation and excretion of tri-n-butyltin chloride (Bu3SnCl) and trephenyltin chloride (Ph3SnCl) were studied. The bioconcentration factors (BCF) of Bu3SnCl and Ph3SnCl reached plateau values after 7 and 10 days of exposure, respectively, in both types of fish. The BCF values of both Bu3SnCl and Ph3SnCl (460 and 110) in the freshwater fish were about twice as high as those (240 and 530) in the seawater-acclimated fish. The excretion rate of Ph3SnCl from the seawater-acclimated fish (0.30/d) was about twice as rapid as that from the freshwater fish (0.13/d), but there was no difference between the fish in the rate for Bu3SnCl (0.35 and 0.32/d). These differences are probably due to the differences in the chemical properties and the physiological mechanisms employed by the fish for regulation of the osmotic pressure. (Author's abstract)
W91-02793

ACID DEPOSITIONS, SUMMER DROUGHTS FOREST DECLINE: DEVELOPMENT OF THE NITROUS ACID HYPOTHESIS.
Association pour la Prevention de la Pollution Atmospherique, Bordeaux (France).
J. A. Bardy.
Environmental Technology (Letters) ETLEDI, Vol. 11, No. 8, p 765-776, 1990. 1 fig, 132 re

Descriptors: *Acid rain effects, *Drought, *Fore ecosystems, *Nitrogen cycle, *Nitrous acid, A aerobic conditions, Climatic changes, Defores ation, Denitrification, Forest hydrology, Nitr acid, Nitrification, Organic matter, Soil bacteri

The acidity of the organic layer and the underlyi soils associated with most undisturbed forests pr vide edaphic conditions which are not conduci to autotrophic nitrification. The pattern of nitrog accumulation and retranslocation of nutrients living biomass may be severely altered by anthr pogenic activities such as deforestation; fertiliz tion of podzolic forest soils; and industries, tra portation vehicles, etc. inducing acid rain. T nitrous acid hypothesis could explain the triggeri effect of drought on forest decline. The first ra fall after summer drought revivifies nitrifiers a so gives rise to an acidification push with nit acid production. But also denitrifiers are rapi revivified in anaerobic microsites. During this c matic event, intermediate NO2(-) of nitrificati denitrification (as undissociated HNO2 speci would react drastically and without discriminati on dead and living organic matter, thus alteri roots and mycorrhizas, particularly in the dir vicinity of aggregates. (Fish-PTT)
W91-02828

COMPARATIVE SURVEY OF IMPOSEX NORTHEAST PACIFIC NEOGASTROPO

ROSOBRANCHIA) RELATED TO TRIBU-
/LTIN CONTAMINATION, AND CHOICE OF
SUITABLE BIOINDICATOR.
ctoria Univ. (British Columbia). Dept. of Biol-
y.
r primary bibliographic entry see Field 5A.
91-02894

/ERVIEW OF CASE STUDIES ON RECOV-
Y OF AQUATIC SYSTEMS FROM DIS-
RBANCE.
nnesota Univ.-Duluth. Natural Resources Re-
rch Inst.
r primary bibliographic entry see Field 5G.
91-02898

COVERY OF LOTIC PERIPHYTON COM-
UNITIES AFTER DISTURBANCE.
k Ridge National Lab., TN. Environmental Sci-
es Div.
r primary bibliographic entry see Field 2H.
1-02899

COVERY OF LOTIC MACROINVERTE-
ATE COMMUNITIES FROM DISTURB-
CE.
rgia Univ., Athens. Dept. of Entomology.
primary bibliographic entry see Field 2H.
1-02900

/IRONMENTAL VARIATION, LIFE HIS-
RY ATTRIBUTES, AND COMMUNITY
UCTURE IN STREAM FISHES: IMPLICA-
NS FOR ENVIRONMENTAL MANAGE-
NT AND ASSESSMENT.
th Dakota Univ., Grand Forks. Dept. of Biol-

primary bibliographic entry see Field 2H.
-02901

EMBLAGE STABILITY IN STREAM
HES: A REVIEW.
rgia Univ., Athens. School of Forest Re-
ces.
primary bibliographic entry see Field 2H.
-02904

ECTS OF OIL SPILLS ON MACRO-INVER-
RATES OF SALTMARSHES AND MAN-
VE FORESTS IN BOTANY BAY, NEW
TH WALES, AUSTRALIA.
ey Univ. (Australia). Inst. of Marine Ecology.
. McGuinness.
ıal of Experimental Marine Biology and Ecol-
/EMBAM, Vol. 142, No. 1,2, p 121-135, Octo-
, 1990. 4 fig, 6 tab, 46 ref.

riptors: *Botany Bay, *Macroinvertebrates,
grove swamps, *Oil spills, *Salt marshes,
er pollution effects, Australia, Crustaceans,
gical effects, Mollusks, Oil pollution, Recov-

tany Bay, Australia, salt marshes and man-
forests are not uncommonly threatened by
ills. Studies were done to examine the short
ong-term effects of spills on mollusks and
aceans in these habitats, through simulation of
spill. Long-term effects were examined by
ing oiled patches in the experiment for 14
s, and by sampling areas which had been
ed by spills 2 to 6 years earlier. Mortality of
species followed simulated spills but densities
ed control levels within a few weeks. The
ing of areas previously affected by spills also
ed little, if any, evidence of long-term ef-
There were few residual effects of the oil;
ore, recolonization would normally be rela-
rapid, depending only on the size of the path
ed and the rate of recruitment from the
on. (Author's abstract)
02912

UENCE OF WASTE WATERS FROM THE
OF VENICE AND THE HINTERLAND
THE EUTROPHICATION OF THE
ON.

Venice Univ. (Italy). Facolta di Chimica Industriale.
B. Pavoni, A. Sfriso, R. Donazzolo, and A. A. Orio.
Science of the Total Environment STENDL, Vol. 96, No. 3, p 235-252, August 1990. 4 fig, 2 tab, 19 ref.

Descriptors: *Eutrophication, *Italy, *Venice Lagoon, *Wastewater pollution, *Water pollution effects, Canals, Coliforms, Hydrogen ion concentration, Metropolitan water management, Nutrients, Oxidation-reduction potential, Salinity, Sewer systems, Wastewater facilities.

The unique location of Venice, Italy, built on a number of islands in the middle of a lagoon, has rendered it impossible, up to now, to construct an adequate sewage system. Most of the industrial and urban wastewaters from the hinterland are conveyed to treatment plants which have been progressively enlarged and improved; wastewaters from the city are discharged directly into the lagoon. Four seasonal samplings of lagoon waters were carried out during successive phases of high and low tide at stations located within Venice and its surroundings to monitor various physico-chemical parameters (pH, redox potential, temperature), salinity, nutrient concentrations (nitrogen, phosphorus, carbon compounds) and bacteria (total coliform bacteria). Salinity was used as a parameter for estimating the hydrographic distance from the Adriatic Sea, and for grouping stations into five homogeneous areas. A negative correlation was found between salinity and the concentrations of nutrients. Gradients of increasing concentrations of nutrients were observed at increasing hydrographic distance from the sea. The contributions to eutrophication of fresh waters entering the lagoon from the hinterland and of wastewaters from the city have been estimated and found to be comparable. Some necessary interventions for the restoration of the lagoon are: increasing the efficiency of the treatment plants; diverting the canal courses from the hinterland into closed ponds suitable for cultivatable of aquatic plants; enlarging and deepening the natural lagoon channels; and opening one or more small dam-regulated canals. Meanwhile, an adequate sewage system for the city of Venice has to be designed and built. (Author's abstract)
W91-02930

ABSENCE OF CADMIUM IN THE BLOOD OF HORSES FED OATS GROWN ON MUNICIPAL SLUDGE-AMENDED SOIL.
For primary bibliographic entry see Field 5E.
W91-02933

HYDROGEOLOGIC ASSESSMENT OF EXPOSURE TO SOLVENT-CONTAMINATED DRINKING WATER: PREGNANCY OUTCOMES IN RELATION TO EXPOSURE.
California Univ., San Francisco. Dept. of Epidemiology and Biostatistics.
M. Wrensch, S. Swan, P. J. Murphy, J. Lipscomb, and K. Claxton.
Archives of Environmental Health AEHLAU, Vol. 45, No. 4, p 210-216, July/August 1990 2 fig, 4 tab, 11 ref.

Descriptors: *California, *Drinking water, *Groundwater pollution, *Statistical analysis, *Teratogenic effects, *Toxic wastes, *Water pollution effects, *Water pollution sources, *Well water, Flow models, Leakage, Toxicity, Trichloroethane.

The California Department of Health Services conducted several studies to investigate community concerns that an alleged cluster of adverse pregnancy outcomes might result from exposure to drinking water from a single well that was contaminated by trichloroethane and traces of other chemicals leaked from an underground storage tank of a semiconductor manufacturing firm in the Los Paseos neighborhood of Santa Clara County, California. Earlier studies in 1980 and 1981 found statistically significant excesses of spontaneous abortions and birth defects in a presumably exposed area compared with an unexposed area. This second interview study in 1986 was conducted to obtain information about the occurrence of these adverse pregnancy outcomes in an adjacent census tract that was presumed to have water exposure comparable to the originally studied area and to determine the occurrence of these outcomes in the original and new study areas after the contaminated well was closed in December 1981. Using quantitative methods to model movement of the solvent leak plume and water flow within the distribution system, it was estimated that women with adverse outcomes were no more likely to have received contaminated water than women with normal live births. The validity of this conclusion depends on the assumption that the two areas had comparable exposure. These results strengthen the hypothesis that exposure to water from the contaminated well were not responsible for the excess of adverse outcomes observed in the Los Paseos area. (Medina-PTT)
W91-02935

IMPACT OF DISTILLERY EFFLUENT APPLICATION TO LAND ON SOIL MICROFLORA.
National Environmental Engineering Research Inst., Nagpur (India).
A. Juwarkar, and S. A. Dutta.
Environmental Monitoring and Assessment EMASDH, Vol. 15, No. 2, p 201-210, September 1990. 5 fig, 3 tab, 12 ref.

Descriptors: *Bioindicators, *Industrial wastes, *Microorganisms, *Toxic wastes, *Wastewater utilization, *Water pollution effects, Actinomyces, Effluents, Nitrogen fixing bacteria, Rhizobium, Soil bacteria, Soil fungi.

A pot culture experiment was conducted to evaluate the effect of different treatments of distillery wastewater mixed with domestic waste stabilization pond effluent (1:1) on populations of bacteria, fungi, actinomycetes, nitrogen fixing bacteria, and on the nodulation of groundnut plants. The results indicated that raw wastewater decreased the population of bacteria, fungi and actinomycetes. The growth rates of Rhizobium and Azotobacter were also reduced after raw wastewater application. The toxic effect of raw wastewater was minimized when it was mixed with stabilization pond effluent (1:1). This was demonstrated by an increase in the population of all microorganisms studied. When groundnut plant was irrigated with raw distillery wastewater, no fruits were produced and there was also less nodulation. Raw distillery water is therefore very toxic to soil microorganisms which are important in the soil ecosystem. (Author's abstract)
W91-02946

ALUMINIUM DEPOSITION IN BONE AFTER CONTAMINATION OF DRINKING WATER SUPPLY.
Saint George's Hospital Medical School, London (England). Dept. of Cellular and Molecular Sciences.
J. B. Eastwood, G. E. Levin, M. Pazianas, A. P. Taylor, and J. Denton.
Lancet LANAAI, Vol. 336, No. 8713, p 462-464, August 25, 1990. 1 fig, 1 tab, 14 ref.

Descriptors: *Aluminum sulfate, *Drinking water, *Water pollution, *Water pollution effects, Bioaccumulation, Human physiology, Water pollution sources.

Two healthy individuals who drank water accidentally contaminated at source with aluminum sulfate were investigated 6-7 months later. On July 6, 1988, at the Lowermoor water treatment works near Camelford, Cornwall, England, 20 tonnes of 8% aluminum sulfate solution were inadvertently deposited directly into a water tank (contact tank) instead of the storage tank. Because the contact tank was downstream from the pH monitors at the treatment works, the contaminated water was distributed. Shortly afterwards some of the 20,000 potential consumers noticed that the water had an unpleasant metallic taste and some manifested various symptoms. Water Al concentrations recorded at the time of the contamination ranged from 30 to 620 mg/L, levels that are well above the maximum admissable concentration of 0.2 mg/L given in the

EC Drinking Water Directive. The two individuals examined, claimed to have drunk the water at the time it was most heavily contaminated and the early symptoms of ulceration of the lip and mouth accord with mucosal damage resulting from the ingestion of an acidic, metallic solution. The bone biopsy findings of local areas of aluminum staining indicate a short period of increased gastrointestinal absorption of aluminum. During the pollution incident the aluminum was presumably in an abnormally acidic medium so absorption was facilitated. Aluminum absorption is also enhanced when the integrity of the intestinal mucosa is interrupted. These findings show that under certain conditions, normal individuals can absorb aluminum via the gut, and that such aluminum can be deposited in bone. (Author's abstract)
W91-02951

HEALTH EFFECTS OF CHEMICAL WASTE IN AN URBAN COMMUNITY.
Queensland Univ., Brisbane (Australia). Dept. of Psychiatry.
M. P. Dunne, P. Burnett, J. Lawton, and B. Raphael.
Medical Journal of Australia MJAUAJ, Vol. 152, No. 11, p 592-597, 1990. 6 tab, 27 ref.

Descriptors: *Australia, *Chemical wastes, *Hazardous wastes, *Public health, *Urban areas, *Water pollution effects, Human diseases, Morbidity, Mortality, Stress, Surveys, Toxicity.

Results are given of a community health survey of people living near a hazardous chemical waste site in Kingston, Queensland, Australia. Compared with a matched control group, people near the site were no more likely to report serious diseases. Likewise, reports of cancer and mortality rates did not differ in the two groups. Kingston residents reported higher rates of symptoms of general poor health, high levels of stress and anxiety, and a higher incidence of miscarriages. The reports of poor physical health appeared to be independent of proximity to the hazardous waste site and duration of residence in the area. Symptom prevalence and perceived recent decline in health correlate most strongly with the stress and anxiety measures. While long-term investigation is necessary, it appears at this stage that the chemical waste is not associated with an increase in major diseases as reported by those who were interviewed. Healthwise, it is clear that the situation has had a negative impact. (Author's abstract)
W91-02952

5D. Waste Treatment Processes

BIODEGRADABILITY OF MONO- AND DISUBSTITUTED BENZENE-DERIVATIVES (ZUR BIOLOGISCHEN ABBAUBARKEIT MONO- UND DISUBSTITUIERTER BENZOLDERIVATE).
Hoechst A.G., Frankfurt am Main (Germany, F.R.).
H. Wellens.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 23, No. 3, p 85-98, June 1990. 3 fig, 4 tab, 57 ref. English summary.

Descriptors: *Aromatic compounds, *Benzene, *Biodegradation, *Wastewater treatment, Analytical techniques, Decomposition, Degradation, Zahn-Wellens test.

The biodegradability of 161 mono-, and disubstituted benzene derivatives was determined using the static Zahn-Wellens test and compared with the results from other laboratories. The qualification of the test method is discussed as well as the valuation of the results following the course of testing. All of the monosubstituted compounds with only one exception, proved to be biodegradable. The dependence of the biodegradability of the disubstituted benzene derivatives, as a function of type and position of the substituents, is discussed. From 141 compounds tested, 21 proved to be resistent against decomposition, while 32 derivatives exhibited prolonged acclimatization or degradation times. (Author's abstract)
W91-02055

APPLICATION OF THE ANAEROBIC FLUIDIZED BED REACTOR FOR THE BIOLOGICAL WASTEWATER TREATMENT AT LOW TEMPERATURES (ANWENDUNG DES ANAEROBEN FLIESSBETTREAKTORS IN DER BIOLOGISCHEN ABWASSERREINIGUNG BEI NIEDRIGEN TEMPERATUREN).
Forschungsgesellschaft Joanneum G.m.b.H., Graz (Austria). Inst. fuer Oekosystemforschung und Umweltmanagement.
C. Hayer, and H. M. Knoflacher.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 23, No. 3, p 106-113, June 1990. 4 fig, 7 tab, 31 ref. English summary.

Descriptors: *Anaerobic digestion, *Biological wastewater treatment, *Fluidized bed process, Biological treatment, Chemical oxygen demand, Protozoa, Retention time, Temperature, Wastewater treatment.

Two anaerobic fluidized beds were tested with lab-scale equipment using synthetic wastewater. The experiments were designed to examine the effect of reduced temperatures in the fluidized bed (14 C and 18 C), low influent substrate concentration (mean soluble COD 405 mg/l; 30-580 mg/ SCOD) and short retention times (2.0 and 5.8 hours) on the efficiency of the anaerobic process. About 20-25% SCOD-reduction could be achieved at both temperatures and at organic loading rates as high as 0.12-0.86 kg/ cu m COD/d. The variability of the individual numbers of Histomonas meleagridis (SMITH) was observed. This flagellate was the only protozoan living in the two anaerobic fluidized beds. (Author's abstract)
W91-02058

SIMPLIFIED OPTIMISATION PROCEDURE FOR FIXED BED ADSORPTION SYSTEMS.
Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
G. McKay, and M. J. Bino.
Water, Air and Soil Pollution WAPLAC, Vol. 51, No. 1/2, p 33-41, May 1990. 10 fig, 4 ref.

Descriptors: *Adsorption, *Design criteria, *Fixed bed adsorption, *Optimization, *Systems analysis, *Wastewater treatment, Activated carbon, Flow rates, Liquid retention, Mercury, Phenols.

Selection of contacting and regeneration systems for granular activated carbon utilization in wastewater treatment processes is integrated. The operating line concept can be used to optimize a basic bed design to achieve the lowest cost. Once the operating line has been established, it is possible to select the combination of carbon exhaustion rate and liquid retention time which give the optimum or lowest-cost design. For a given system, in which liquid flow rate, impurity concentrations and carbon characteristics are fixed, the costs are dependent upon two primary variables: the carbon exhaustion rate, and the superficial liquid retention time. These two variables were determined for phenol, p-chlorophenol, and mercuric ions onto activated carbon in fixed bed systems. The effects of secondary process variables such as flow rate and the effect of percentage breakthrough show that for flow rates below 3.3 cu m/sec there is no significant gain in the carbon exhaustion rate by reducing the flow rate. When the flow rate is increased from 2.5 to 3.33 cu m/sec, the increase in carbon exhaustion rate is about 20%. The results have been used to predict optimum conditions for the systems based upon the C exhaustion rate and the empty bed residence time (EBRT). For a fixed EBRT, the carbon exhaustion rate is higher for lower percentage breakthrough required. For a fixed operating condition such as flow rate and pollutant initial concentration, the carbon usage rate reaches an optimum higher value corresponding to a minimum EBRT. (Brunone-PTT)
W91-02081

LABORATORY MESOCOSM STUDIES OF FE, AL, MN, CA, AND MG DYNAMICS IN WETLANDS EXPOSED TO SYNTHETIC ACID COAL MINE DRAINAGE.
Villanova Univ., PA. Dept. of Biology.
R. K. Wieder, M. N. Linton, and K. P. Heston.
Water, Air and Soil Pollution WAPLAC, Vol. 51 No. 1/2, p 181-196, May 1990. 5 fig, 1 tab, 31 ref

Descriptors: *Acid mine drainage, *Artificial wet lands, *Mesocosms, *Wastewater treatment, *Wet lands treatment, Aluminum, Calcium, Cost analysis, Iron, Magnesium, Manganese, Mine wastes Peat, Trace metals.

To evaluate the potential for constructed wetland to treat acid coal mine drainage, six model wetlan mesocosms (each 2.4 m by 15 cm) were filled wit Sphagnum peat (15 cm deep), planted either wit cattails (Typha latifolia) and living Sphagnum living Sphagnum only, or left as bare peat (mesocosms per treatment). The model wetland were exposed to synthetic acid coal mine drainag (pH 3.5, concentrations of iron, aluminum, manga nese, calcium and magnesium ions of 78.8, 10.0 5.2, 12.0 and 4.5 mg/L, respectively) at a rate of 9 ml/min, 6 hours/day, 5 days/week over a 16 wee period. Chemical analyses of peat at periodic inter vals indicated that the model wetlands were n sources of aluminum, manganese, calcium, an magnesium, but net sinks for iron. Type of vegeta tion had no significant effect on iron retention; c the 204 g of iron added to the model wetlan systems, 162 g were retained. Formation of iro oxides accounted for 73 to 86% of the iron reten tion, with exchangeable iron contributing 0.2 t 1.2%, organically bound iron contributing 4 t 19%, and residual iron contributing 7 to 15% c total iron retention. Iron retention was greatest the inflow ends of the model wetlands where iro retention appeared to reach saturation at a fin iron concentration in the peat of 235 mg/g. At th rate of application of the synthetic acid mine drai age, the model wetland systems would hav reached an estimated complete iron saturation aft 157 days. The mesocosm approach could be usef in generating site-specific data that can be applie to the formulation of cost-benefit analyses that ca compare a proposed wetland treatment syste with alternative conventional chemical metho for treating acid mine drainage. (Author's abstrac
W91-02091

THERMOPHILIC CAMPYLOBACTERS I TWO SEWAGE TREATMENT PLANTS I LIBYA.
Lancaster Univ. (England). Inst. of Environment and Biological Sciences.
M. Betaieb, and K. Jones.
Letters in Applied Microbiology LAMIE7, Vo 11, No. 2, p 93-95, August 1990. 1 tab, 16 r

Descriptors: *Decontamination, *Enteric bacter *Libya, *Pathogenic bacteria, *Sludge digestio *Sludge drying, *Wastewater facilitie *Wastewater treatment, Filtered wastewater, P mary wastewater treatment, Sabratha, Seconda wastewater treatment, Stabilization ponds, Tripo Water quality monitoring.

Monitoring of thermophilic campylobacters in tw Libyan sewage treatment plants has shown that t communities of Tripoli and Sabratha almost c tainly harbor campylobacters capable of produci enteritis. The most probable number of thermop lic campylobacters per 100 ml ranged betwe 3733 and 6277 in the primary sedimentation tan at the two sewage treatment plants. The plant Tripoli eradicated the campylobacters from eff ent by secondary treatment with trickling filtrati followed by chlorination. The plant at Sabrat which was not working well at the time of sa pling, reduced campylobacter numbers by o 53% and 74% during secondary treatment in stabilization pond. A reservoir in Sabratha, whi received effluent from the stabilization pond a which supplies water for irrigation, also contain thermophilic campylobacters. In both treatm plants, campylobacters were eradicated fr sewage sludge by digestion and drying. (Autho abstract)
W91-02122

GUIDELINES AND INTEGRATED MEASURES FOR PUBLIC HEALTH PROTECTION IN AGRICULTURAL REUSE SYSTEMS.
World Health Organization, Geneva (Switzerland). Div. of Environmental Health.
For primary bibliographic entry see Field 5E.
W91-02142

SELECTIVE ADSORPTION OF ARSENIC(V) ION BY USE OF IRON(III) HYDROXIDE-LOADED CORAL LIMESTONE.
Kagoshima Univ. (Japan). Dept. of Applied Chemistry.
S. Maeda, A. Ohki, Y. Tsurusaki, and T. Takeshita.
Separation Science and Technology SSTEDS, Vol. 25, No. 5, p 547-555, April 1990. 6 fig, 1 tab, 8 ref.

Descriptors: *Adsorption, *Arsenic, *Chemical treatment, *Limestone, *Wastewater treatment, Adsorption-desorption, Anions, Corals, Hydrogen ion concentration, Industrial wastewater, Iron, Phosphates.

In Japan, the arsenic level of water is regulated below 0.5 ppm in wastewater and 0.05 ppm in natural water. Accordingly, a treatment process is necessary to remove arsenic from industrial wastes in order to reduce its arsenic content below regulated values. By use of iron(III) hydroxide-loaded coral limestone (Fe-coral) as an adsorbent, a trace level of arsenic(V) ion in aqueous solution could be efficiently and selectively adsorbed onto the adsorbent surface. The arsenic adsorptibility of the Fe-coral depended upon the amount of iron(III) hydroxide loaded on the coral limestone. The arsenic adsorption was almost unaffected by the initial pH of the solution in the pH range 2-10, and was not practically influenced by the addition of such anions as chloride, nitrate, sulfate, perchlorate, and acetate in the aqueous solution. However, only coexisting phosphate caused a great depression in the arsenic adsorption. The arsenic adsorbed onto Fe-coral was only slightly desorbed in contact with aqueous solution under a wide pH range (3.5-10). The arsenic adsorption was effectively applied to a column-type operation. (Author's abstract)
W91-02220

HEAVY METAL DISTRIBUTION IN ANAEROBIC SLUDGES.
Universidad Complutense de Madrid (Spain). Dept. de Ingenieria Quimica.
J. Tijero, E. Guardiola, M. Cortijo, and A. Diaz-Barrionuevo.
Separation Science and Technology SSTEDS, Vol. 25, No. 5, p 653-658, April 1990. 1 fig, 1 ref, 9 ref.

Descriptors: *Anaerobic digestion, *Digested sludge, *Heavy metals, *Sludge analysis, Wastewater treatment, Chemical analysis, Chemical composition, Copper, Effluents, Nickel, Sludge solids, Zinc.

The distribution of the heavy metals Cu, Ni and Zn in the different phases of the effluent proceeding from an anaerobic digester operating under complete mixture conditions was studied. Specifically, the heavy metal distribution between the solid sludge and supernatant liquid of the final effluent was measured. Cu retention was very high, 96-98%, and increases as the concentration in the effluent increases. An increase in Ni concentration in the effluent produces a decrease in the retai associated with the solid effluent, going from 98% for 5 mg/L to 81% for 30 mg/L. Some 90% of the Zn was retained in the solid sludges. Thus, small amounts of heavy metals remain in the clear liquid of the effluent. (Author's abstract)
W91-02221

SOLVENT SUBLATION OF HEXACHLOROBUTADIENE AND 2,4,6-TRICHLOROPHENOL.
National Tsing Hua Univ., Hsinchu (Taiwan). Dept. of Chemistry.
C. Y. Shih, W. D. Han, and S. D. Huang.
Separation Science and Technology SSTEDS, Vol. 25, No. 4, p 477-487, April 1990. 4 fig, 6 tab, 20 ref.

Descriptors: *Chlorinated hydrocarbons, *Separation techniques, *Solvent sublation, *Solvents, *Wastewater treatment, *Water analysis, *Water treatment, Air-water interfaces, Organic solvents, Surfactants, Volatile organic compounds.

Solvent sublation, a surface chemical separation method, has shown promise for the removal of certain types of organic compounds from aqueous systems. In the solvent sublation procedure, a surface-active (or volatile) solute is transported from the aqueous phase to an overlying layer of nonvolatile organic liquid on the air-water interfaces (or in the interior) of bubbles rising through the solvent sublation column. Hexachlorobutadiene (HCB) and 2,4,6-trichlorophenol were removed from aqueous solutions into paraffin oil by solvent sublation. Over 99% of HCB was removed from a solution containing 100 ppb HCB initially in 10 min. The rate of removal of HCB by air stripping is somewhat slower than that by solvent sublation. The effects of added salt and ethanol on solvent sublation and air stripping of HCB were studied. About 64% of 2,4,6-trichlorophenol (TCP) were removed by solvent sublation from a solution containing 50 ppm 2,4,6-trichlorophenol initially at pH 1.84 for a 1 hour run. The rate of removal of 2,4,6-trichlorophenol can be improved by adding the cationic surfactant, hexadecyltrimethylammonium bromide (HTA). As high as 95% of 2,4,6-trichlorophenol was removed in 1 hour if 10 ppm HTA was added to the solution before solvent sublation runs. (Hoskin-PTT)
W91-02403

HAZARDOUS WASTE MINIMIZATION: SOURCE REDUCTION ALTERNATIVES IN THE AEROSPACE INDUSTRY.
CH2M Hill, Milwaukee, WI.
H. G. Allerton.
Journal of Environmental Health JEVHAH, Vol. 53, No. 1, p 28-29, July/August 1990. 1 tab, 3 ref.

Descriptors: *Aerospace industry, *Hazardous waste disposal, *Hazardous wastes, *Industrial wastes, *Waste recovery, *Waste reduction, *Waste treatment, Cyanide, Halogenated wastes, Heavy metals, Solvents, Waste identification, Waste minimization.

Aerospace industry research and manufacturing operations generate a diverse spectrum of chemical wastes. A cooperative effort by three major aerospace companies and the California Department of Health Services successfully identified alternatives for hazardous waste minimization. A priority was given to source reduction alternatives that would allow the generator to cost-effectively maximize on-site activity to reduce liabilities associated with off-site waste disposal. Study coordinators developed a standard data reporting form to collect hazardous waste generation and disposal information from a majority of the three companies' research and manufacturing operations located in southern California. Waste streams were then correlated with the processes or activities responsible for generating the wastes. Candidate waste streams were evaluated with respect to on-site treatment methods that have either been applied in other industries or have recently become commercially available. Available off-site treatment methods were identified and summarized for commercial treatment, storage and disposal facilities that carry out recycling, destruction or treatment of the types of waste streams covered in the study. The following water stream categories were targeted for potential waste minimization: spent halogenated solvents, ferric chloride solutions, photodeveloping solutions, water soluble coolants and cutting oils, cyanide plating solutions, heavy metal waste treatment sludges, noncyanide plating/etching/stripping solutions, plating in cleaning solutions, and lab pack miscellaneous wastes. These waste streams, typical of the aerospace industries' operations, represent more than 90% of the total volume of hazardous waste generated by the participant companies. (Mertz-PTT)
W91-02411

WASTEWATER TREATMENT, THE UTILIZATION OF EARTH MATERIALS AS COAGULANTS.
Cleveland State Univ., OH. Dept. of Geological Sciences.
H. H. Lo, and Y. T. Hung.
Journal of Environmental Health JEVHAH, Vol. 53, No. 2, p 22-25, September/October 1990. 8 fig, 6 ref.

Descriptors: *Coagulation, *Materials testing, *Municipal wastewater, *Wastewater treatment, Activated carbon, Basalts, Carbon, Granites, Limestone, Organic carbon, Pretreatment of wastewater, Raw wastewater, Shales, Turbidity, Wastewater, Zeolites.

Removal of total organic carbon and total suspended solids are major concerns in municipal wastewater treatment. The effects of several earth materials, at varying dosages, were investigated as potential coagulants and compared to activated carbon and fly ash. Wastewater samples were collected from the city of Painesville Pollution Control Plant in Painesville, OH and from the Central Wastewater Treatment Plant in Solon, OH. Earth materials used for coagulation study were granite, basalt, shale, limestone and zeolite. Dosages used were 0.4, 1.0, 2.0, 4.0, and 6.0 g/L. For each of the coagulants tested, total organic carbon concentrations were lower in wastewaters containing coagulants than in the untreated wastewater, and the difference was more pronounced in the primary wastewater samples. Limestone was most efficient for primary effluent, while granite worked best for secondary effluent. Zeolite was most effective in removing sodium, calcium, and magnesium. Use of earth materials in the coagulation of municipal wastewaters at various degrees of pretreatment also increased the turbidity of wastewater. Powdered activated carbon effectively removed turbidity in the raw wastewaters and primary effluent, as well as effectively removing total organic carbon from wastewaters. (Mertz-PTT)
W91-02412

INNOVATIVE SLUDGE DRYING BED DESIGN.
Camp, Dresser and McKee, Inc., Bradenton, FL.
J. A. Banks, and W. K. Lederman.
Public Works PUWOAH, Vol. 121, No. 10, p 112, 134, September 1990. 1 fig.

Descriptors: *Sand filters, *Sludge drying, *Sludge filters, *Wastewater treatment, *Wastewater treatment facilities, Cellular confinement system, Florida, Gravity filters, Percolating filters, Sludge.

Dewatering sludge at wastewater treatment plants has traditionally been a major operational concern. Smaller facilities rely on the sand filter drying bed for sludge dewatering. The sludge is applied to a graduated sand/gravel media. The water separates from the solids in the sludge via gravity and percolates down through the media. The sand filter's upper layers are of a finer material to filter out the solid particles of the liquid sludge. Removing dried sludge from sand filter drying beds can be a problem because small tractors or loaders cannot operate on the loose soils of a conventional sand drying bed. Because of this, past methods used to clean the beds have included hand labor and various forms of mechanical devices that are not directly supported by the sand structure. In Florida, the Sarasota County-Solid Waste Operations Division had a problem with its fixed-mechanical, vacuum sludge-drying beds, which were used to dewater a chemically oxidized septage sludge. The fixed media material deteriorated under constant use and replacement was very expensive. A product, known as the cellular confinement system, had been developed specifically to support vehicular traffic over poor soil conditions. In September 1989, a cellular confinement system was installed in the top sand layer in one of the two sand filter drying beds at the Sarasota facility. Since installing the cellular confinement system, no change was noticed in the filter bed's drying efficiency compared to it other bed without the cellular confinement system. Clean-up operations have been extensively improved, even beyond that of the original

fixed-media filter bed. In April 1990, the waste operations division converted its second fixed-media filter bed to a sand filter bed reinforced with the cellular confinement system to further increase the efficiency of its operation. Through this system, maintenance costs have been cut by 50%. (Mertz-PTT)
W91-02426

SURVEY OF SMALL SEWAGE TREATMENT FACILITIES IN OHIO.
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
K. Mancl.
Ohio Journal of Science OJSCA9, Vol. 90, No. 4, p 112-117, September 1990. 9 fig, 11 ref, append.

Descriptors: *Ohio, *Surveys, *Wastewater facilities, *Wastewater management, *Wastewater treatment, Aerobic treatment, Data acquisition, Permits, Site selection, Urban areas.

In 1987, a small sewage treatment facilities survey was conducted of all county and local health departments in Ohio. The objective was to learn how local sewage treatment facilities programs are managed, the types of systems in use, the numbers of permits issued, and the number of systems that are failing. Survey results indicate that urban areas in Ohio have the largest health departments and account for the largest number of permits issued, with over 13,000 permits issued in 1986. Site evaluation procedures varied greatly across the state. In 25 counties, permits were issued without a visit to the site. Sanitarians estimated that 27% of the septic systems are failing. Aerobic systems are used heavily in Ohio, while alternative systems have limited use. To address the problems of failing systems and unsuitable sites for septic systems, more information is needed at the county level about alternative sewage systems and on-site system management. (Author's abstract)
W91-02532

EFFECTS OF WASTEWATER TREATMENT AND SEAWATER DILUTION IN REDUCING LETHAL TOXICITY OF MUNICIPAL WASTEWATER TO SHEEPSHEAD MINNOW (CYPRINODON VARIEGATUS) AND PINK SHRIMP (PENAEUS DUORARUM).
Environmental Research Lab.-Narragansett, Newport, OR. Pacific Div.
D. R. Young, D. J. Baumgartner, S. C. Snedaker, L. Udey, and M. S. Brown.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 6, p 763-770, September/October 1990. 1 fig, 5 tab, 40 ref. EPA Grants R-804749 and R-806307, and EPA Contract 68-03-1706.

Descriptors: *Killifish, *Marine animals, *Mortality, *Municipal wastewater, *Shrimp, *Wastewater treatment, *Water pollution control, *Water pollution effects, Activated sludge, Chlorination, Flocculation, Florida, Population exposure, Primary wastewater, Secondary wastewater treatment, Toxicity, Wastewater dilution.

The effects of treatment and seawater dilution of municipal wastewater on marine organisms were determined at an experimental facility in southeast Florida that provided both unchlorinated and chlorinated effluent from three standard treatments: primary settling, chemical flocculation, and activated sludge secondary treatment. Exposure tests lasting longer than one month were conducted on the sheepshead minnow (Cyprinodon variegatus) and the pink shrimp (Penaeus duorarum), with each of these six effluent types at seawater dilution ratios of 30:1, 100:1, and 300:1. The shrimp showed a much more sensitive response than the minnow. Almost 100% mortality occurred for shrimp exposed to the unchlorinated 30:1 seawater dilutions of primary-settled wastewater, while mortality for the other two effluents was similar to that of controls. Mortality could not be attributed to any of the chemicals measured in the wastewater. For the 30:1 dilution experiments, chlorination usually resulted in much higher toxicity; increasing the dilution factor from 30:1 to 100:1 reduced the mortality observed (in both chlorinated and unchlorinated samples) essentially to control levels. Little bioaccumulation of metals or chlorinated organics was observed in exposed specimens. (Author's abstract)
W91-02535

INTERACTION BETWEEN SULFATE REDUCERS AND METHANOGENS FED ACETATE AND PROPIONATE.
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
G. F. Parkin, N. A. Lynch, W. C. Kuo, E. L. Van Keuren, and S. K. Bhattacharya.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 6, p 780-788, September/October 1990. 7 fig, 5 tab, 27 ref. U.S. EPA Contract R-811657-01-0.

Descriptors: *Acetates, *Anaerobic digestion, *Methane bacteria, *Propionate, *Sulfates, *Sulfur bacteria, *Wastewater treatment, Anaerobic bacteria, Biological treatment, Biological wastewater treatment, Chemostats, Organic loading, Sulfides.

Anaerobic chemostats maintained at solids retention times of 15, 25, and 40 days were used to investigate the interaction between sulfate-reducing bacteria (SRB) and methane bacteria fed acetate and propionate. Organic loading rates of 0.25-0.50 g COD/L-d were used with feed COD/S ratios ranging from 60/1 to 2/1. Results indicated that SRB play an unexpected role in process failure. When systems failed, both sulfate reduction and methane production shut down. Levels of hydrogen sulfide associated with irreversible failure were near 60 mg S/L for both acetate and propionate systems; corresponding total dissolved sulfide levels were 145 mg S/L for acetate systems and nearly 200 mg S/L for propionate systems. For similar loading conditions, propionate systems failed sooner than acetate systems. For the conditions tested, solids retention time had little impact on overall process performance and metal nutrition was not a problem. The maximum tolerable sulfate loading rates were estimated to be 26 and 33.3 mg S/L-d for the propionate and acetate systems, respectively. (Author's abstract)
W91-02537

DENITRIFICATION BY AN EXPANDED BED BIOFILM REACTOR.
D. V. MacDonald.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 6, p 796-802, September/October 1990. 9 fig, 6 tab, 9 ref.

Descriptors: *Biofilm reactors, *Denitrification, *Wastewater reactors, *Wastewater treatment, Anoxic conditions, California, Methanol, Nitrates, Nitrogen, Rancho California Wastewater Reclamation, Wastewater facilities, Wastewater renovation.

The Rancho California Wastewater Reclamation Plant, which has a design capacity of 23.6 mL/d, is located in Southern California approximately 64 km northeast of the city of San Diego. The effluent from this plant is used for irrigation and groundwater recharge. In order to protect the local groundwater from nitrite contamination, the plant must nitrify and subsequently denitrify the plant's effluent to a nitrate-N concentration of 2.5 mg/L. The influent nitrate-N concentration to the denitrification facility is normally in the range of 15 to 20 mg/L. Denitrification is achieved with an upflow expanded bed biofilm reactor. The reactor is designed for a loading of 3.0 kg of nitrate-N/day/cu m of expanded bed volume. The upflow velocity is 0.4 cm/s and the reactor has an empty bed contact time of 10 minutes at design flow. Each reactor has a design capacity of 7.5 mL/d. The biofilm is grown on a medium of sand with an effective size of 0.6 mm and a uniformity coefficient of 1.2. The reactor has a perforated concrete underdrain, 0.6 meters of support gravel, and 1.2 m of sand. Following a two-month startup period, the facility consistently removed 95 to 100% of the nitrate-N. Several requirements were identified from the first year of operation: (1) an effective method of measuring and controlling biofilm growth; (2) a reliable methanol feed system; and (3) if very low concentrations of nitrate-N must be produced, then consideration should be given to scrubbing the off gases and eliminating the potential for odors. It was concluded that the fixed-film expanded bed denitrification system is a cost-effective method of reducing nitrate-N. (MacKeen-PTT)
W91-02539

BATCH BIODEGRADATION OF INDUSTRIAL ORGANIC COMPOUNDS USING MIXED LIQUOR FROM DIFFERENT POTWS.
New Jersey Inst. of Tech., Newark. Dept. of Chemical Engineering.
G. A. Lewandowski.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 6, p 803-809, September/October 1990. 7 fig, 4 tab, 47 ref.

Descriptors: *Activated sludge, *Biodegradation, *Biological wastewater treatment, *Organic compounds, *Waste treatment, *Wastewater treatment, Biological treatment, Chlorinated hydrocarbons, Kinetics, Microbial degradation, Mixed liquor, solids, Publicly owned treatment works.

The biological treatment of organic compounds with mixed liquor from different publicly owned treatment works (POTWs) was studied. Experiments conducted using several 5-L batch reactors involved the degradation of single compounds and mixtures of compounds with two different mixed liquors. One mixed liquor came from a municipal treatment plant with a throughput of 9.5 ML/d of domestic waste; the other came from a plant that treats 95 ML/d of waste that is 55% industrial on a biological oxygen demand basis, including about 227 kg/d of phenol. Microorganisms from the domestic treatment plant degraded chlorinated hydrocarbons (2-chlorophenol, 2,6-dichlorophenol and 2,4-D) at rates that were virtually the same as those for the plant handling industrial waste. The phenol degradation rates were the same, even though one plant had experienced significant prior exposure. The dominant microbial populations were also similar, both before and after phenolic exposure. Microbial adaptation to the compounds was quite rapid, resulting in a two-fold to five-fold increase in the average degradation rates after only the second exposure in a batch reactor. When multiple substrates were tested, the individual compound degradation rates in the mixture were very similar to the degradation rates as sole carbon source. The amount of throughput and the magnitude of degradation rates indicate the potential of the plant handling industrial waste to treat significant quantities of the compounds tested. (Author's abstract)
W91-02540

OPERATIONAL WATER QUALITY MANAGEMENT: CONTROL OF STORM SEWAGE AT A WASTEWATER TREATMENT PLANT.
P. Lessard, and M. B. Beck.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 6, p 810-819, September/October 1990. 9 fig, 10 tab, 36 ref.

Descriptors: *Storm wastewater, *Wastewater facilities, *Wastewater management, *Wastewater treatment, Control systems, Model studies, Storm water management, Storm-overflow sewers, Water quality control.

In almost all wastewater treatment plants it is customary to control the effects of a surge of stormwater by bypassing flows above a certain threshold directly to the receiving waters. The threshold is normally set at three times the dry weather flow (3DWF) of wastewater, and in the U.K., is usually accompanied by the installation of storm tanks between the overflow and receiving water. A dynamic model of treatment plant behavior was applied in a comparative study of several alternative strategies of stormwater control. The model comprises the typical unit processes of the liquid train of the plant: storm tanks, primary clarifiers, aeration basins, and secondary clarifiers. The control options include: alternative locations for the overflow and storm tanks, variations on the theme of the 3DWF concept, alternative modes of operation of the storm tanks, and the manipulation

overflow settings during the event. The results dicate the virtue of allowing for flexibility in ant designs, especially with respect to: incorpoing more than one overflow location, the need different strategies for different events and ferent categories of pollutants, and the potential the beneficial use of real-time forecasting and ntrol of events of low intensity and long dura-n. (Author's abstract)
91-02541

ST DETERMINATION OF THE BIODEGRALITY OF ORGANIC COMPOUNDS IN A BORATORY-TRICKLING-FILTER (RASCHE STIMMUNG DES BIOABBAUS ORGANCHER STOFFE IN EINEM LABOR-TROPFRPER).
genoessische Materialpruefungs- und Versuchstalt fuer Industrie, Bauwesen und Gewerbe, St. l (Switzerland).
Baumann, G. Kuhn, and W. Schefer.
tschrift fuer Wasser - und Abwasser Forschung 'ABAQ, Vol. 23, No. 4, p 129-132, August 0. 7 fig, 1 tab, 2 ref. English summary.

criptors: *Analytical methods, *Biodegrada-, *Organic compounds, *Trickling filters, astewater treatment, Bacteria, Carbon dioxide, solved organic carbon, Kinetics, Laboratory hods, Nitrification, Toxicity.

mple continuous test procedure which allows he rapid determination of the biological elimi-on of organic compounds is described. The tances to be tested for biodegrability are dis-ed in water, and the solution is continuously nto a laboratory trickling filter, while measurhe dissolved organic carbon (DOC) remaining ne eluate and the carbon dioxide formation. d on the kinetics of the DOC concentration in luate and the kinetics of carbon dioxide forma- information is obtained about biodegrability, nation, toxicity to bacteria and adaptation. fication inhibitors are also easily identified. procedure is also suitable for the rapid extracof refractory substances from sewage. (Aus abstract)
-02544

NITORING PROGRAM ASSESSES WATER LITY PROGRESS.
aukee Metropolitan Sewerage District, WI.
agruder.
r Environment & Technology WAETEJ, 2, No. 10, p 8-9, October 1990.

riptors: *Data collections, *Monitoring, *Mual water, *Water districts, *Water pollution ol, *Water pollution prevention, *Water qualanagement, Baseline studies, Data interpretaMilwaukee, Planning, Stream pollution, r quality control.

cent years, Milwaukee's water quality has ated much interest. Area residents are awaite completion of the Milwaukee Metropolitan rage District's (MMSD) 2.25 billion Water ion Abatement Program (WPAP), and city s hope to make a revitalized Milwaukee the focal point of downtown redevelopment. e primary agency charged with protecting water resources, the MMSD has a responsito track water quality. The district's surface quality monitoring program provides more decade of baseline data. At its inception in the monitoring program covered eight samlocations on the metro area's three rivers and sampling locations from Milwaukee's Outer r to Lake Michigan. Today the program passes six major survey types and 64 samlocations. The district's monitoring program ses two major areas: the impact of effluent he district's two wastewater treatment plants e overall water quality within the district. f the sites are visited every other week, and he aid of computers, MMSD technicians can the water quality conditions of specific and days against data collected up to a earlier. Water quality testing parameters o four broad categories: conventional testomonitoring by exposing daphnia magna, Ceriodaphnia dubia and fathead minnows; tracking of conservative tracers (i.e., chloride, specific conductance, total alkalinity, and hardness); and heavy metals testing monitoring the 13 EPA priority pollutant metals. In recent years, other public agencies have used the data extensively as a basis for planning. By providing such long-term, comprehensive information to a wide array of users, the monitoring program has helped promote the wise use of limited resources to improve water quality. (VerNooy-PTT)
W91-02561

NORTH CAROLINA PLANT SOLVES TEXTILE-WASTEWATER PROBLEMS.
East Burlington Wastewater Treatment Plant, NC.
A. R. Kornegay, and C. Sell.
Water Environment & Technology WAETEJ, Vol. 2, No. 10, p 26, October 1990.

Descriptors: *Dyes, *Industrial wastewater, *Textile mill wastes, *Wastewater facilities, *Wastewater treatment, Activated carbon, Bioassay, Monitoring, North Carolina, Wastewater composition, Water pollution prevention, Water quality standards.

The East Burlington (NC) wastewater treatment plant is a 12 mgd facility that was upgraded 11 years ago to deal with textile-manufacturing wastewaters that comprised up to 60% of the flow. However, as recently as 6 years ago, the plant's effluent averaged 23 mg/L biological oxygen demand (BOD), 86 mg/L total suspended solids (TSS), and 7.1 mg/L ammonia nitrogen (NH3-N). All three parameters violated East Burlington's summer discharge permit. The plant was upgraded to deal with the problem of old textile plants in the area discharging highly colored effluent, by installation of a PACT system and wet-air regeneration unit. The PACT system follows treatment in an aerated equalization basin and primary treatment, and involves the addition of powdered activated carbon to the aeration chambers of the activated-sludge system. In effect, physical and biological treatment take place simultaneously, successfully removing color, biodegradeables, and non-biodegradeables. Several changes in equipment and operational practices relating to solids control have improved performance. Improvements have greatly reduced foam buildup on the final clarifiers, and the use of skimmers on the secondary clarifiers protects the final filters and has helped lower effluent suspended solids. Before the upgrade, the river was a dark black color. Now, discharge from the plant is crystal clear and the river quality is much improved. Biomonitoring of the effluent with Daphnia is now required, and the plant is passing these new toxicity tests without any problems. (VerNooy-PTT)
W91-02562

ENERGY-EFFICIENT MUNICIPAL SLUDGE INCINERATION.
Camp, Dresser and McKee, Inc., Cambridge, MA.
For primary bibliographic entry see Field 5E.
W91-02563

FLUID BEHAVIOR/WASTE MANAGEMENT IN LOW-GRAVITY ENVIRONMENTS.
Air Force Academy, CO. Dept. of Civil Engineering.
A. M. Wachinski, and K. T. Preston.
Water Environment & Technology WAETEJ, Vol. 2, No. 10, p 56-58, October 1990. 2 fig.

Descriptors: *Fluid mechanics, *Gravity studies, *Satellite technology, *Wastewater management, *Wastewater renovation, *Wastewater treatment, Buoyancy, Convection, Design criteria, Microgravity, Sedimentation, Systems engineering, Waste management.

Current plans for the US space station are to recycle as much wastewater as possible to reduce shuttle resupply requirements. However, fluid behavior in space differs markedly from that in a gravity-dominated environment. The term zero-G strictly means a total absence of gravity where the net contact force on the system under consideration is zero. Aboard an orbiting spacecraft objects behave as they would in a very weak gravitational field (in microgravity), and space engineers must account for the effects. Basic phenomena such as buoyancy, settling, convection, mixing and diffusion are considerably different in a microgravity environment. Multi-phase water systems, such as water and air or water and suspended solids, will pose special design considerations in a microgravity environment. In low gravity or microgravity, body forces approach zero, consequently hydrostatic pressure, buoyancy, convection, and sedimentation approach zero. A discussion is presented of these forces. The characteristics of microgravity fluid behavior that affect waste management stem from one fact--there is an absence of body forces. Sedimentation and flotation are eliminated, while surface tension and capillarity play the major role in fluid behavior. The changes are significant for all fluid processes, but they are extremely critical in spacecraft environmental design. (VerNooy-PTT)
W91-02565

USING PROGRAMMABLE LOGIC CONTROLLERS.
Central Contra Costa County Sanitary District, Martinez, CA.
A. R. Grieb, and G. Williams.
Water Environment & Technology WAETEJ, Vol. 2, No. 10, p 64-67, October 1990. 8 fig.

Descriptors: *Automation, *Control systems, *Electronic equipment, *Process control, *Programmable logic controllers, *Wastewater facilities, California, Computer programs, Monitoring, Project planning, Secondary wastewater treatment, Sludge drying.

Programmable logic controllers (PLCs) are a good choice for equipment and process control in wastewater treatment plants. Central Contra Costa Sanitary District in Martinez, CA, operates a 45-mgd secondary treatment plant designed during the late 1960s. In 1986, the district constructed a new furnace-control room and, in doing so, replaced all of the relays in the existing control panels with a small PLC. For the furnace-control room, a PLC was chosen as a relay replacement; however, the PLC was also used instead of extending all of the wires from the existing control panels to the new furnace-control room. Next the district specified a PLC system for its dewatering system to control new sludge-dewatering centrifuges and associated equipment. With PLCs controlling the centrifuges, the district began using PLCs for PID control, to adjust the differential speed of the centrifuge's scroll conveyor. This control maintains a consistent sludge-cake density. One of the main advantages in a PLC system is the ease with which the system can be modified. Another advantage is the ease of PLCs in troubleshooting. With the programming device connected to the PLC, the ladder logic can be viewed on a screen showing the current flow instead of measuring voltages. Discussion is made of the process of getting from the planning stage of a PLC system to a working system, including specifications, testing, and operator training. Since the system has been in operation, many new uses have been found. Sludge-incinerator hearth-burner status was brought in to the central computer so it could be monitored and status signals for equipment were sent to the alarm panel in the furnace-control room. The district has also evaluated the interface to see if it could replace the existing telemetry system. (VerNooy-PTT)
W91-02566

BIODEGRADATION OF TOXIC ORGANICS: STATUS AND POTENTIAL.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
C. P. L. Grady.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 805-828, 1990. 1 fig, 2 tab, 82 ref.

Descriptors: *Biodegradation, *Biological treatment, *Organic compounds, *Wastewater treat-

ment, Biotechnology, Decision making, Literature review, Mathematical models, Microbiological studies, Waste management, Waste treatment.

The ability of biological treatment systems to degrade toxic organic compounds is assessed through a review of the literature. While much general information is available, there is little kinetic information that can be used directly by engineers making decisions about process alternatives. Nevertheless, useful kinetic information can be obtained from biodegradation studies in which the toxic compound of interest serves as the sole substrate for microbial growth. A scheme is proposed whereby such information can be used in mathematical models to predict the extent to which the toxic compounds can be removed from complex waste streams. A methodology is proposed whereby the impacts of the toxic compounds on the biodegradation of the biogenic organic material in the waste streams can be predicted. New information about environmental biotechnology is being generated by biologists faster than engineers can assimilate and apply it. Thus, close alliances must be formed between engineers and scientists to fully exploit the potential offered by biotechnology. (Author's abstract)
W91-02568

SIMPLE SOLUTIONS FOR STEADY-STATE BIOFILM REACTORS.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
P. S. Golla, and T. J. Overcamp.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 829-836, 1990. 1 fig, 9 ref, append.

Descriptors: *Biofilm reactors, *Biological reactors, *Model studies, *Wastewater reactors, *Wastewater treatment, Biofilms, Biological treatment, Biological wastewater treatment, Limiting factors, Substrates.

Simple analytical models for use in preliminary calculations are developed to approximate the steady-state concentration and biofilm thickness in a biofilm reactor. The models presented considered the case in which a single substrate limits growth. These models assume that the flux of substrate to the biofilm has a first order dependence on the bulk substrate concentration. This assumption restricts the use of the models to low initial substrate concentrations. One of the models assumes plug flow, and the other incorporates longitudinal dispersion of substrate. The models allow the substrate concentration to approach the minimum rate limiting concentration and the biofilm thickness to approach zero as predicted by the steady-state theory. Predictions of these models are compared to those of a steady-state numerical model. For an example taken from the literature, the solution of the model with longitudinal dispersion is in good agreement with the numerical solution. (Author's abstract)
W91-02569

FREEZING OF WATER AND WASTEWATER SLUDGES.
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and C. J. Martel.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 854-862, 1990. 5 fig, 20 ref.

Descriptors: *Freezing, *Sludge drying, *Wastewater management, *Wastewater treatment, Crystallization, Freeze-thaw tests, Physical treatment, Sludge, Sludge treatment, Temperature.

When sludge is allowed to freeze slowly and then thaw, its dewatering properties are usually greatly improved. The mechanisms by which this improvement occurs are not well understood. Therefore, the authors have proposed a conceptual model for how sludge freezes. The effectiveness of freeze/thaw is measured using the capillary suction apparatus with the results indicating that colder temperatures, longer freezing times and slower freezing rates all have a beneficial effect. These results suggest that if freeze/thaw is to be used commercially, thin layers of sludge must be frozen for long periods of time, thereby promoting the growth of crystals that will exclude the solid particles and promote particle aggregation. (Author's abstract)
W91-02571

CONTINUOUS PRE-ANOXIC AND AEROBIC DIGESTION OF WASTE ACTIVATED SLUDGE.
Maryland Univ., College Park. Dept. of Civil Engineering.
O. J. Hao, and M. H. Kim.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 863-879, 1990. 11 fig, 5 tab, 19 ref, append.

Descriptors: *Activated sludge process, *Aerobic digestion, *Sludge digestion, *Sludge stabilization, *Wastewater treatment, Biomass, Denitrification, Nitrates, Nitrification, Suspended solids, Volatile solids.

Conventional aerobic sludge stabilization requires extensive energy input. Incorporation of endogenous nitrate respiration (ENR) into the aerobic-digestion system offers an energy saving advantage. In the ENR system, nitrate instead of oxygen is utilized for biomass destruction. Continuous pre-anoxic and aerobic digestion of waste activated sludge was studied to evaluate its effectiveness for volatile suspended solids (VSS) destruction and nitrogen removal. The ENR occurs in the anoxic digester because of the recycling of nitrate from the aerobic digester. The anoxic effluent, in turn, provides a high pH and adequate buffer capacity for enhancing the subsequent aerobic decay and nitrification. Two experimental runs, differing in hydraulic detention time in anoxic and aerobic tanks, are conducted with the same recycling rate. The results indicate that total nitrogen removal is approximately 25%, with 40% VSS destruction. The denitrification/nitrification efficiencies and rates were also determined. A mathematical model developed from the mass balance of biomass, ammonium, and nitrate can reasonably predict the transient responses of these parameters. (Author's abstract)
W91-02572

TESTING EXPERT SYSTEM FOR ACTIVATED SLUDGE PROCESS CONTROL.
A.T. and T. Bell Labs., Naperville, IL.
W. Lai, and P. M. Berthouex.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 890-909, 1990. 6 tab, 44 ref. EPA Agreement No. CR-812655-01-0.

Descriptors: *Activated sludge process, *Computer programs, *Expert systems, *Process control, *Wastewater treatment, Data interpretation, Information management, Sludge digestion, Wastewater facilities.

The wastewater treatment plant operator's most difficult problem is collecting, storing, manipulating and interpreting data; an information management problem. The operator's performance in controlling the treatment process can be improved if he is equipped with a convenient and efficient method for extracting useful information from the data. A rule-based expert system within an integrated information management system is presented in this article. The expert system only considers the activated sludge process, but the information system is for the entire treatment plant. The expert system provides the operator with timely advice based on the latest available process data as interpreted by a set of rules constructed with the help of experienced and skilled operators. Case studies are presented to help develop an approach for refining the control rules as well as testing their accuracy and effectiveness. The expert system consistently reproduced the expert operators decisions and performed better than nonexpert operators. (Lantz-PTT)
W91-02573

BOUNDED IMPLICIT ENUMERATION FOR WASTEWATER-TREATMENT SYSTEMS.
North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Civil Engineering.
S. Y. Chang, and S. L. Liaw.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 910-926, 1990. 6 fig, 5 tab, 49 ref.

Descriptors: *Mathematical models, *Model studies, *Systems engineering, *Wastewater treatment, Computer programs, Cost-benefit analysis, Mathematical studies.

A wastewater treatment system can be represented by a multistage configuration consisting of a variety of unit processes from various stages. The number of treatment combinations may be very large when the number of unit processes in a stage and the number of stages in a system increase. Enumeration techniques, e.g., total enumeration and implicit enumeration, have been used to eliminate infeasible treatment combinations and to identify the least cost treatment system. A bounded implicit enumeration approach is proposed to make the implicit enumeration more efficient. A lower bound is calculated at each stage and added to the up-to-date objective function value to eliminate more combinations before reaching the final stage. The results for two wastewater treatment system synthesis models indicate that the bounded implicit enumeration is consistently more efficient than the total and implicit enumeration approaches in identifying least cost and feasible treatment alternatives. (Author's abstract)
W91-02574

NEW APPROACH FOR OPTIMIZATION OF URBAN DRAINAGE SYSTEMS.
Bradford Univ. (England). Dept. of Civil Engineering and Structural Engineering.
G. Li, and R. G. S. Matthew.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 927-944, 1990. 4 fig, 5 tab, 16 ref, append.

Descriptors: *Drainage systems, *Optimization, *Urban drainage, *Urban runoff, Construction, Costs, Design standards, Flow rates, Pipes, Pumping plants, Surface runoff.

A new approach for the optimization of urban drainage systems, including the optimal selection of layout using the searching direction method and the optimal design of a given layout by discrete differential dynamic programming (DDDP), were developed and applied to a typical field study. It was found that the inclusion of such hydraulic factors as flow rate, the sizes and gradients of pipes, and the effect of on-line pumping stations into consideration, is very important in urban drainage systems layout selection. Also, the optimization of urban drainage systems, including optimal layout selection, can achieve much greater construction cost savings than that without the inclusion of layout optimization. It was also demonstrated that the minimum buried depth design is not the global optimum design. Rather, the global optimum design is the alternative of the optimal balance among the buried depth, and the number and locations of on-line pumping stations. (Author's abstract)
W91-02575

CHARACTERIZATION OF ACTIVATED SLUDGE FOAMS FROM TWO PLANTS.
Blue Plains Wastewater Treatment Plant, Washington, DC.
G. T. Fahmy, and O. J. Hao.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 991-997, 1990. 2 fig, 2 tab, 27 ref.

Descriptors: *Activated sludge process, *Foaming, *Wastewater treatment, Adenosine triphosphate, Biomass, Carbohydrates, Nitrogen, Sludge digestion, Volatile solids.

Activated sludge (AS) foaming problems have recently received considerable attention. Excessive foaming not only causes deterioration in effluent quality, but also presents operational and mainte-

problems, and possible health hazards. The ence of sludge foaming has been associated ifferent and often conflicting operational and nmental factors. The objective of this study o characterize activated sludge foams in f volatile content, lipid, nitrogen and carbo- e composition, adenosine triphosphate level, hydrolysis characteristics, and sub- utilization. Excessive foams must be re- promptly, otherwise the recycle of foams d to more severe scum production. Conse- the results of foam hydrolysis and its treat- may provide an alternative for ultimate disposal. For the purpose of comparison, liquor (ML) was also used for these parame- asurements. The results indicate that foam ntain a significant amount of substrate and he foam contents vary from plant to plant en within the same plant. The microbial of AS foam was found to be similar to that These factors provide a perfect environ- nd abundant substrate for foam causing bac- at can degrade many of the organic com- previously accumulated at the air-water e. The net result is that an active biomass ion exists at the surface of the aeration at has a significant impact on the system and hence substrate removal. In addition, m biomass should be included in the bio- ventory used to calculate the solids reten- e. The disposal of AS foams presents addi- perational and maintenance problems. Hy- of foam using low pH plus heat treatment o be a viable alternative for foam disposal. iminates the problem of transferring foam organisms to the anaerobic digester. Hy- d foam can be effectively treated in an d sludge plant with little impact on the moval efficiency. (Lantz-PTT)
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NUOUS ANAEROBIC TREATMENT OF NG WASTEWATERS.
tural Univ., Wageningen (Netherlands). f Environmental Technology.
a-Alverez, J. Harbrecht, S. Kortekaas, and nga.
of Fermentation and Bioengineering , Vol. 70, No. 2, p 119-127, 1990. 9 fig, 5 ef.

tors: *Anaerobic digestion, *Industrial ater, *Pulp wastes, *Wastewater treatment, al treatment, Biological wastewater treat- hemical oxygen demand, Lignin, Organic nds, Thermal wastes.

erobic treatability of thermochemical pulp- P) effluents and soda pulping liquors was d in this study. Continuous experiments nducted in laboratory scale upflow anaero- ge bed (UASB) reactors innoculated with ic granular sludge at 30 C +/-2 C. TMP ters were found to be highly suitable for ic treatment. The application of high or- adings (31 g COD/L/d) was feasible by of the continuous experiment with TMP ters, with 68 and 98%, total COD and dable COD elimination efficiencies, re- ly. Unlike TMP effluents, soda pulping ters were highly inhibitory to methano- cteria and they contained important frac- recalcitrant organic matter. Wood resin nts were shown to be responsible for most methanogenic inhibition in these ters. None-the-less, anaerobic wastewater t was found to be feasible for the removal egradable substrates in soda pumping ters if the wastewaters are diluted to sub- vels or detoxified by pretreatment with t Amberlite XAD-2 prior to biological t. Low COD removal efficiencies were during the continuous experiment (45 to ith soda pulping liquors, due to the high of recalcitrant lignin in these wastewaters. nination of UV280 absorbance (15-20%) the partial removal of some lignin com- by anaerobic treatment. The lignin frac- oved or biotransferred anaerobically cor- d to low molecular weight lignin deriva- confirmed by gel chromatography results. s abstract)

W91-02580

INVESTIGATION OF REST AREA REQUIREMENTS: APPENDIX-PERTINENT REST AREA LITERATURE.
Texas Univ. at Austin. Center for Transportation Research.
W. T. Straughan, D. W. Fowler, and K. W. Perry.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-194807. Price codes: A03 in paper copy, A01 in microfiche. Research Report 442-1, Volume 2, November 1987. 62 p, 66 ref, append. Texas State Department of Highways and Public Transportation Project 3-18-86-442.

Descriptors: *Data acquisition, *Highways, *Literature review, *Municipal water, *Surveys, *Wastewater management, Design standards, Site selection, Water supply.

Rest areas are an important part of highway systems, particularly on the interstate systems. Based on the findings presented in previous reports, recommended design procedures are presented. Recommendations include: spacing, site requirements, example architectural designs, materials, mechanical systems, and operation and maintenance. Recommendations for energy sources, water systems, and wastewater systems are also made. The appendix contains detailed information on surveys and interviews. (Lantz-PTT)
W91-02620

WETLAND AREAS: NATURAL WATER TREATMENT SYSTEM (JAN 78 - AUG 89). CITATIONS FROM THE POLLUTION ABSTRACTS DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-862244. Price codes: N01 in paper copy, N01 in microfiche. March 1990. 99p.

Descriptors: *Artificial wetlands, *Bibliographies, *Environmental effects, *Environmental protection, *Path of pollutants, *Wastewater treatment, *Wetland treatment, *Wetlands, Agricultural runoff, Flooding, Habitats, Water pollution effects.

This bibliography contains citations concerning the ability of salt marshes, tidal flats, marshlands, bogs, and other wetland areas to degrade, absorb, filter, consume, mitigate natural and man-made pollution and wastes, while maintaining their ability to provide refuge and breeding grounds for wildlife. The ecology, biochemistry, and viability of naturally occurring and artificially established wetlands as water-treatment systems and wildlife areas are considered. The effects of individual pollutants, environmental factors, species diversity, and cleansing ability of wetland areas on the potential for wildlife refuge, sewage treatment, treatment of industrial and municipal wastes, handling agricultural runoff, mitigating accidental spills, and flooding are discussed. This updated bibliography contains 243 citations, 21 of which are new entries to the previous edition. (Author's abstract)
W91-02642

WASTEWATER TREATMENT: CHEMICAL INDUSTRY (JAN 70 - SEP 89). CITATIONS FROM THE POLLUTION ABSTRACTS DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-871057. Price codes: N01 in paper copy, N01 in microfiche. September 1989. 79p.

Descriptors: *Bibliographies, *Chemical wastes, *Industrial wastewater, *Wastewater treatment, Activated carbon, Biological treatment, Fertilizers, Mercury, Pesticides.

This bibliography contains citations concerning wastewater treatment in the chemical industry relative to a wide variety of industrial pollutants. Biological treatments including carbon additives are described relative to effectiveness. The removal of mercury and its compounds are included, as well as associated problems and recommendations from fertilizer and pesticide pollution. This updated bibliography contains 250 citations, 16 of which are new entries to the previous edition. (Author's abstract)
W91-02644

PULPING EFFLUENTS: BIOLOGICAL TREATMENT (JAN 76 - SEP 89). CITATIONS FROM THE PAPER & BOARD, PRINTING & PACKAGING INDUSTRIES RESEARCH ASSOCIATION.
Davis (J.J.) Associates, Inc., McLean, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-871248. Price codes: A01 in paper copy, A01 in microfiche. September 1989. 31p.

Descriptors: *Bibliographies, *Biological wastewater treatment, *Pulp and paper industry, *Pulp wastes, *Wastewater treatment, Design criteria, Management, Pilot plants, Solid wastes, Toxicity.

This bibliography contains citations concerning effluent and wastewater biological treatment and disposal in the pulping industry. Effluent toxicity; treatment plant management, treatment systems and equipment design; combined mechanical and biological treatment processes; biological degradation treatment in chemical pulp mills; and the handling and disposal of solid wastes are among the topics discussed. Performance evaluations of biological treatment processes in domestic and foreign plants in full scale operation and pilot programs are considered. This updated bibliography contains 48 citations, 10 of which are new entries to the previous edition. (Author's abstract)
W91-02645

REMOVAL AND FATE OF RCRA AND CERCLA TOXIC ORGANIC POLLUTANTS IN WASTEWATER TREATMENT.
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
S. J. Bhattacharya, R. V. R. Angara, D. F. Bishop, R. A. Dobbs, and B. M. Austern.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-195200/AS. Price codes: A08 in paper copy, A01 in microfiche. Report No. EPA/600/2-89/026. June 1989. 159p, 1 fig, 14 tab, appends.

Descriptors: *Activated sludge process, *Organic pollutants, *Testing procedures, *Toxic wastes, *Wastewater treatment, Aliphatic solvents, Benzene, Biodegradation, Chemical oxygen demand, Suspended solids.

Two separate studies were conducted to investigate the removal and fate of 28 selected Resource Conservation and Recovery Act (RCRA) compounds (0.25 mg/L of each compound) and 19 selected CERCLA compounds (0.5 mg/L of each compound) in conventional activated sludge treatment. In each study, two pilot-scale (35 gpm) activated sludge systems (sludge retention time: 4 days for RCRA study and 8 days for CERCLA study) were operated in parallel at the U.S. EPA Test and Evaluation Facility in Cincinnati, Ohio. One system was spiked continuously with either RCRA or CERCLA toxics to produce an acclimated biomass; the other was spiked intermittently with the same toxics and sampled to determine performance under unacclimated conditions. The selected RCRA or CERCLA compounds did not cause any adverse effects on chemical oxygen demand (COD) and suspended solids (SS) removal. The concentrations of organics (RCRA study) in air emissions indicated that the chlorinated aliphatic solvents were essentially volatilized into the plant air emission stream, whereas the aromatic volatile benzenes were substantially degraded. Pesticides and phthalates are removed by both sorption on sludges and by biodegradation. These air emission results qualitatively confirm results from earlier bench scale studies which had superior analytical reliability but without the real world sampling and wastewater matrix effects. (Author's abstract)

W91-02653

WASTEWATER TREATMENT: OZONATION PROCESSES AND EQUIPMENT (JAN 77-APR 90). CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-864422. Price codes: NO1 in paper copy, AO1 in microfiche. Report No. NZ9955. April 1990. 160p.

Descriptors: *Bibliographies, *Disinfection, *Ozonation, *Wastewater treatment, *Water treatment, Chlorination, Comparison studies, Inorganic wastes, Organic wastes, Reaction kinetics.

This bibliography contains citations concerning the use of ozonation processes for wastewater disinfection. Topics include system descriptions and evaluation, comparisons with the chlorination process, reaction kinetics, and the use of the process in combination with other wastewater treatment methods. The treatment of organic and inorganic compounds in wastewater and municipal water supplies is discussed. (This updated bibliography contains 318 citations, 26 of which are new entries to the previous edition.) (Author's abstract)
W91-02667

WASTE WATER, INFILTRATION-PERCOLATION FOR AQUIFER RECHARGE OR WATER RE-USE.
Montpellier-2 Univ. (France). Lab. d'Hydrologie et de Modelisation.
F. Brissaud, F. Lefevre, C. Joseph, Z. Alamy, and A. Landreau.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 443-455, 4 fig, 14 ref.

Descriptors: *Aquifer management, *Groundwater management, *Groundwater resources, *Wastewater renovation, *Wastewater treatment, *Water resources management, *Water reuse, Effluents, France, Groundwater recharge, Irrigation water, Percolating filters, Percolating water, Pollution load, Self-purification, Water storage.

Renovated wastewater may be stored for reuse as irrigation water during the dry season. Infiltration-percolation is a rustic and extensive purifying technique which is capable of completely oxidizing and decontaminating wastewater. It is particularly adapted to wastewater reutilization projects and to the recharge of shallow groundwater planned to be used for the interseasonal storage of purified water. The wastewater is purified during its percolation through unsaturated sandy media. An exemplary model of the convective renewal of oxygen in the gaseous phase supplies the basis of the designs and, for only slightly-loaded or medium-loaded wastewater, of the dimensions of the infiltration-percolation plants. An experiment confirmed that this technique is capable of purifying heavily-loaded effluents (primary effluents with an oxygen demand of more than 250 mg/L) on the condition that hollow structures are introduced into the filtering beds. This laboratory work was followed by implementation of this technique into actual operations in France, with the aim of improving knowledge on the subject of basin-supplying systems and of monitoring the evolution of the gaseous oxygen stock in the filtering medium during purification. The various technologies are currently being tested at these stations. (See also W91-02672) (Author's abstract)
W91-02710

COMMITMENT TO MONITORING AND SAMPLING.
Lakeland, FL.
T. Lokken.
Water Engineering and Management WENMD2, Vol. 137, No. 9, p 28-31, September 1990. 2 fig, 1 tab.

Descriptors: *Florida, *Wastewater analysis, *Wastewater facilities, *Wastewater management, *Wastewater treatment, *Water quality monitoring, *Water sampling, Economic aspects, Industrial wastewater, Pretreatment of wastewater, Priority pollutants, Process control, Sludge.

The wastewater treatment facilities of the City of Lakeland, Florida, are among the most complex in the state, yet they are also recognized as being among the most effective and efficient. One major reason for this efficiency is commitment to thorough monitoring and sampling which exceeds Environmental Protection Agency (EPA) requirements but yields major benefits in treatment quality and cost savings. The key to successful process control at the plants is sampling. Careful monitoring prevents energy waste and allows more efficient use of materials. Monitoring also insures the most effective processing of the wastewater. Nutrients and nitrogen levels which affect biological activity can be examined and adjustments made if necessary. Data gathered through monitoring is used to control the activated sludge system, anaerobic digestion, and sludge thickening, and to control chemical usage. Monitoring is also used to track costs for such programs as odor control. Efficiency of processes is tracked by monitoring the quality of influent and effluent. In addition to in-plant monitoring, the Lakeland wastewater treatment program includes an extensive industrial monitoring program. Pretreatment programs conducted by area industries are monitored to insure that wastewater form the industrial plants meets EPA limits on heavy metals, cyanide and other priority pollutants which could damage the treatment plants. (Korn-PTT)
W91-02763

DIGESTER GAS IS ALTERNATE FUEL.
San Antonio Dept. of Wastewater Management, TX.
F. Rodriguez.
Water Engineering and Management WENMD2, Vol. 137, No. 9, p 32-33, September 1990. 1 fig.

Descriptors: *Anaerobic digestion, *Digester gas, *Energy recovery, *Energy sources, *Fuel, *Wastewater facilities, *Wastewater treatment, Insurance, Process control, San Antonio, Texas.

Dos Rios Wastewater Treatment Plant is an expansion facility that was built to service part of the growing community of San Antonio, Tex. The San Antonio wastewater treatment facilities require two medium-sized hot-water boilers and one small low-pressure steam boiler. Previously, the city was flaring the anaerobic gas supply and losing all energy potential. The city currently uses the heat to maintain a controlled environment in the digester to produce gas and then, fires the boilers with the gas in order to produce heat. The digester gas system uses a dual canister burner that is designed for separate combustion control for two gases with different fuel characteristics. The dual canister housing arrangement applies specifically to gases with low heating value. The separate burner arrangement-where the two gases do not use the same orifice ring-is critical to proper combustion setting and efficiency. The multi-gas system provides separate fuel-handling systems for each fuel. By using separate fuel trains, fuel consistency is maintained and problems associated with mixing of fuels is avoided. Also, by providing fuel trains that do not share any common piping, automatic change-over is easily incorporated. Furthermore, separate fuel trains comply with current insurance regulations. (Korn-PTT)
W91-02764

BIODEGRADATION OF P-NITROPHENOL IN AN AQUEOUS WASTE STREAM BY IMMOBILIZED BACTERIA.
Monsanto Environmental Sciences Center, St. Louis, MO.
M. A. Heitkamp, V. Camel, T. J. Reuter, and W. J. Adams.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 10, p 2967-2973, October 1990. 5 fig, 26 ref.

Descriptors: *Activated sludge process, *Bacteria, *Biodegradation, *Nitrophenols, *Wastewater treatment, Adsorption, Microbial degradation, Path of pollutants, Pseudomonas, Toxicity, Waste treatment.

Microbiological analyses of activated sludge reac tors after repeated exposure to 100 mg of p-nitro phenol (PNP) per liter resulted in the isolation o three Pseudomonas species able to utilize PNP as sole source of carbon and energy. Cell suspension of the three Pseudomonas sp., designated PNP1 PNP2, and PNP3, mineralized 70, 60, and 45% of a 70 mg/L dose of PNP in 24, 48, and 96 h. Mas balance analyses of PNP residues for all three cultures showed that undegraded PNP was < 1% (<50 microg); volatile metabolites, < 1%; cel residues, 8.4 to 14.9%; and water soluble metabo lites, 1.2 to 6.7%. A mixed culture of all three PNP-degrading Pseudomonas sp. was immobilized by adsorption onto diatomaceous earth biocarrie in a 1.75 L Plexiglas column. The column wa aerated and exposed to a synthetic waste strean containing 629 to 2513 mg of PNP per liter at flow rates of 2 to 15 ml/min. Chemical loading studies showed that the threshold concentration for acut toxicity of PNP to the immobilized bacteria wa 2100 to 2500 mg/L. Further studies at PNP con centrations of 1200 to 1800 mg/L showed that > 99, and 91 to 99% removal of PNP was achieve by immobilized bacteria at flow rates of 10 and 1 mL/min. These values represent hydraulic reten tion times of 48 to 58 min and PNP removal rate of 0.99 to 1.1 mg/h/g of biocarrier at 25 C unde optimal conditions. This study shows the success ful use of immobilized bacteria technology t remove high concentrations of PNP from aqueou waste streams. (Author's abstract)
W91-02768

DEGRADATION OF VINYL ACETATE B SOIL, SEWAGE, SLUDGE, AND THE NEWL ISOLATED AEROBIC BACTERIUM V2.
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fue Mikrobiologie.
M. Nieder, B. Sunarko, and O. Meyer.
Applied and Environmental Microbiolog AEMIDF, Vol. 56, No. 10, p 3023-3028, Octobe 1990. 4 fig, 3 tab, 25 ref. Bundesministerium fu Forschung und Technologie Grant No. 0318839 I

Descriptors: *Biochemistry, *Biodegradatio *Fate of pollutants, *Path of pollutants, *Vin acetate, *Wastewater treatment, Bacteria, Chem cal reactions, Enzymes, Hydrolysis, Sludge, Sc chemistry, Wastewater.

Vinyl acetate is subject to microbial degradation the environment and by pure cultures, and can b hydrolyzed by samples of soil, sludge, and sewag at rates of up to 6.38 and 1 mmol/h/g (dry weigh under aerobic and anaerobic conditions. Fo yeasts and thirteen bacteria that feed aerobical on vinyl acetate were isolated, but in this stud the pathway of vinyl acetate degradation was fo lowed in bacterium V2. Vinyl acetate is first d graded to acetate, which is then converted acetyl coenzyme A and oxidized through the t carboxylic acid cycle and the glyoxylate bypas The key enzyme of the pathway is vinyl aceta esterase, which hydrolyzes the ester to acetate a vinyl alcohol. The latter isomerizes spontaneous to acetaldehyde and converts to acetate. The ace aldehyde is then disproportionated into ethan and acetate. The enzymes involved in the metab lism of vinyl acetate were studied in extrac Vinyl acetate esterase (K-m = 6.13 mM) was al active with indoxyl acetate (K-m = 0.98 mM providing the basis for a convenient spectrophot metric test. Substrates of aldehyde dehydrogena were formaldehyde, acetaldehyde, propionald hyde, and butyraldehyde. The enzyme was equal active with NAD+ or NADP+. Alcohol deh drogenase was active with ethanol (K-m = 0. mM) and was linked to NAD+. The molecul sizes of aldehyde dehydrogenase and alcohol deh drogenase were 145 and 215 kilodaltons, respe tively. (Author's abstract)
W91-02769

OSSIBLE IMPORTANCE OF WIND AERTION IN CONTROLLING ODOURS FROM GGERY SLURRY STORED AFTER AEROC TREATMENT.
FRC Inst. of Engineering Research, Silsoe (Engd). Process Engineering Div.
W. Sneath, and A. G. Williams.
ological Wastes BIWAED, Vol. 33, No. 3, p -159, 1990. 1 fig, 1 tab, 6 ref.

scriptors: *Aeration, *Aerobic treatment, arm wastes, *Odor control, *Wastewater treatnt, *Wind, Aerated lagoons, Biochemical gen demand, Oxygen, Retention time, Waste age, Waste treatment.

eral methods of controlling odors from piggery ry have been used successfully, but aerobic tment is able not only to render odors inoffen-, but also, if more thorough, to remove them pletely. A manometric respirometer was used measure the long-term biochemical oxygen and of aerobically treated slurries. Different mes were used to treat each of two samples of slurry: a 1-day solids retention time with gen supplied to maintain dissolved oxygen at mg/L, and a 2-day solids retention time with a er aeration rate that controlled the redox poal at 181 mV and the dissolved oxygen at 0 L. Readings were taken daily for 80 days and once weekly for another 85 days. Calculations g data from the experiment estimate the effect the wind-mediated transfer of oxygen from the osphere into the slurry in a storage tank or on might have upon the time of the return of ffensive odor. Results show that the effect of l aeration is potentially far greater than that of a fourfold increase in the solids residence of the prior aerobic treatment. Storing aerobi-treated piggery slurry in a lagoon of maxi depth of 2 m could permit wind aeration cient to increase the period for which the s would not be offensive from a maximum of ays after a 4-day solids retention time treatto more than 180 days, even when the slurry had only a 1-day solids retention time treat. (Brunone-PTT)
-02772

IBITORY EFFECT OF CITRUS UNSHU L ON ANAEROBIC DIGESTION.
shima Industrial Inst. of Fukuoka Prefecture, (Japan).
izuki, T. Akao, and T. Saruwatari.
gical Wastes BIWAED, Vol. 33, No. 3, p 68, 1990. 4 fig, 1 tab, 7 ref.

riptors: *Anaerobic digestion, *Citrus crops, city, *Wastewater treatment, Biodegrada- Fermentation, Industrial wastes, Methane ria, Methanogenesis.

pan, Citrus unshu is the most commercially tant citrus fruit. A number of Japanese plants ce a large amount of canned and juice prodvith unshu juice. The citrus wastes from this ry are toxic to the anaerobic digestion of bes, and create a serious problem for their al. A significant inhibition of methane fertion was observed in the anaerobic digestion rus unshu peel at loadings above 2 g/L/day. effect was mainly due to the peel oil, but substances present in the peel also have an ory effect. The limiting load of peel oil for bic digestion proved to be about 65 microl/ . Citrus unshu peel did not inhibit methane ntation after the removal of peel oil by steam tion or aeration. (Author's abstract)
02773

E OBSERVATIONS ON ORGANIC REAL IN AN SBR.
nal Univ. of Singapore. Dept. of Civil Engig.
Ng, and J. C. Tan.
ical Wastes BIWAED, Vol. 33, No. 3, p 9, 1990. 8 fig, 2 tab, 14 ref.

ptors: *Biodegradation, *Wastewater reacWastewater treatment, Adsorption kinetics, treatment, Biomass, Chemical oxygen demand, Microbial degradation, Mixed liquor solids, Volatile solids.

A laboratory-scale sequencing batch reactor was fed with synthetic wastewater based on sucrose to determine the biokinetics of the process. The values for maximum specific removal rate (u-max) and half-saturation constant (K-s) were found to be 0.32/hour and 563 mg/L, respectively, while the yield constant was determined to be 0.656 with a standard deviation of 0.102. Chemical oxygen demand removal was good. The relationship between the food:microorganisms (F/M) ratio and sludge volume index (SVI) was explored and results showed that increases in the F/M ratio led to decreases in SVI values. The initial adsorption of substrate was proportional to the amount of biomass in the reactor. Comparisons between changes in mixed liquor volatile suspended solids (MVLSS) and total viable count were made, and MVLSS was not found to be a good indicator for the viability of organisms in the reactor. (Author's abstract)
W91-02774

PERFORMANCES OF DIGESTERS TREATING THE ORGANIC FRACTION OF MUNICIPAL SOLID WASTES DIFFERENTLY SORTED.
Barcelona Univ. (Spain). Dept. of Chemical Engineering.
J. Mata-Alvarez, F. Cecchi, P. Pavan, and P. Llabres.
Biological Wastes BIWAED, Vol. 33, No. 3, p 181-199, 1990. 4 fig, 6 tab, 22 ref. NATO Grant No. 0178/87 and CICYT Project PS87-0018.

Descriptors: *Anaerobic digestion, *Municipal wastes, *Organic matter, *Solid wastes, *Waste treatment, Biodegradation, Biogas, Kinetics, Mathematical studies, Methane, Thermodynamics.

When considering the anaerobic digestion of a given waste, both the kinetics and the thermodynamics of the process must be taken into account. The thermodynamic aspect is related to the biodegradability of the waste, and distinguishing between biodegradability and the rate of biodegradation is necessary. Digester performances are highly sensitive to the quality of the feed. To evaluate the real reactor performance, the bioprocess efficiency, defined as the percentage of the maximum biodegradation achievable, is examined. This parameter takes into account the kinetics of the process and the biodegradability. Biodegradation kinetics, measured through a first-order kinetic constant for the source-selected organic fraction municipal solid waste (SS-OFMSW), is around five to ten times larger than that of fresh mechanically-selected OFMSW. The ultimate biogas yield is also 2.5 times larger for SS-OFMSW than for MS-OFMSW. Bioprocess efficiency can achieve very large values (around 95 to 99% in both cases). Hydraulic retention time has a small influence on bioprocess efficiency if it is larger than 15 days. Lower yields are obtained if the MS-OFMSW has been precomposted. (Brunone-PTT)
W91-02775

ACUTE TOXICITY OF HEAVY METALS TO AEROBIC DIGESTION OF WASTE CHEESE WHEY.
Messina Univ. (Italy). Dipt. di Chimica Organica e Biologica.
G. Cimino, and C. Caristi.
Biological Wastes BIWAED, Vol. 33, No. 3, p 201-210, 1990. 3 fig, 6 tab, 14 ref.

Descriptors: *Aerobic digestion, *Food-processing wastes, *Heavy metals, *Toxicity, *Waste disposal, *Waste treatment, *Wastewater treatment, Acidity, Activated sludge, Biochemical oxygen demand, Dairy industry, Synergistic effects.

Cheese whey constitutes a major waste disposal problem for the dairy industry throughout the world. Effects of the acidity and of metal ions on the metabolic activity of activated sludge from waste cheese whey biological treatment, have been determined. The 10% and 50% inhibitory concentrations were evaluated for each ion. In decreasing order of toxicity, two groups were found: Hg(2+) > Cd(2+) > CrO4(2-) > Cr(3+); and Pb(4+) > Zn(2+). A discrepancy in results from other toxicity studies reveals the impossibility of defining, on an absolute scale, an order of toxicity for these ions. A very strong synergistic effect was noted in the mixed copper and zinc studies, revealing the difficulty of setting a water quality standard based on single toxic chemicals. (Author's abstract)
W91-02776

METHANOGENIC TOXICITY OF WOOD RESIN CONSTITUENTS.
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
R. Sierra-Alvarez, and G. Lettinga.
Biological Wastes BIWAED, Vol. 33, No. 3, p 211-226, 1990. 4 fig, 4 tab, 54 ref.

Descriptors: *Methanogenesis, *Resins, *Wastewater treatment, *Wood wastes, Anaerobic conditions, Bioassay, Inhibition, Sludge digestion, Toxicity.

The inhibitory effect of representative wood resin compounds on the activity of methanogenic bacteria is evaluated. Resin is, by definition, the mixture of wood components that are extractable with apolar solvents. Major resin constituents are long-chain fatty acids, terpenes, resin acids, lignans, and apolar phenols. The methanogenic inhibition was determined at a temperature of 30 C in standardized toxicity assays utilizing anaerobic granular sludge. An apolar phenol, 4-hydroxystilbene, was the most toxic of the compounds studied, with a 50% inhibiting concentration of 20 mg/L. Resin acids and volatile terpenes were also highly toxic to methanogenic activity. Concentrations causing 50% inhibition ranged from 43 to 330 mg/L. In contrast, triterpenes were non-toxic at relatively high concentrations, 1000 to 1300 mg/L. These results suggest that wood resin constituents play an important role in the anaerobic inhibition exerted by several forest industry wastewaters. (Author's abstract)
W91-02777

OZONATION OF O-CRESOL IN AQUEOUS SOLUTIONS.
Universidad de Extremadura, Badojoz (Spain). Dept. de Ingenieria Quimica y Energetica.
F. J. Beltran, J. M. Encinar, and J. F. Garcia-Araya.
Water Research WATRAG, Vol. 24, No. 11, p 1309-1316, November 1990. 8 fig, 5 tab, 27 ref. Comision Interminsterial de Ciencia y Tecnologia of Spain Grant No. PA85/332.

Descriptors: *Chemical properties, *Chemical reactions, *Cresol, *Ozonation, *Wastewater, *Wastewater treatment, Flux rate, Hydrogen ion concentration, Kinetics, Mass transfer, Partial pressure, Temperature effects.

The o-cresol aqueous solution ozonation of concentrations similar to those encountered in some wastewaters was studied. The ozone concentration was measured in the gas stream, iodometrically. During the absorption, ozone at the reactor outlet was also determined by the same procedure. In this way, the ozone absorption rate could be evaluated from the difference between the ozone molar flux rates at the reactor inlet and outlet. The degradation rate of o-cresol increased with temperature, pH, gas flow rate, agitation speed and ozone partial pressure. For a 0.001 M initial concentration of o-cresol a mass rate of 11.7 mg of ozone per minute leads to o-cresol conversions of about 70% in less than 20 min of ozonation, the liquid side mass transfer coefficient for the cuprous chloride-oxygen system (m/s) of the reactor is between 2.8 and 13.0/h. From the variation observed in the o-cresol ozonation yield with time a competitive effect of secondary reaction was shown. The ozone absorption rate was always higher than 3 times the maximum ozone absorption in organic-free water (value defined as reaction factor). This finding indicates that the reactions involved in the proximity of the gas-liquid interface and the kinetic regime is fast. (Author's abstract)
W91-02783

ELECTROLYTIC DECOMPOSITION OF CYANIDE EFFLUENT WITH AN ELECTROCHEMICAL REACTOR PACKED WITH STAINLESS STEEL FIBER.

National Tsing Hua Univ., Hsinchu (Taiwan). Dept. of Chemical Engineering.
S. P. Ho, Y. Y. Wang, and C. C. Wan.
Water Research WATRAG, Vol. 24, No. 11, p 1317-1321, November 1990. 10 fig, 9 ref.

Descriptors: *Cyanide, *Electrolysis, *Packed beds, *Wastewater reactors, *Wastewater treatment, Copper, Electrical resistance, Energy consumption, Silver nitrate, Titration.

An investigation was conducted to determine the feasibility of using a packed-bed electrochemical reactor with stainless steel fiber as electrodes to decompose cyanide-containing effluent. The analysis of cyanide variation during the electrolysis was made by standard titration method with AgNO3. The copper content was measured via atomic absorption spectroscopy. Every layer of the electrode was packed with 2 cm of stainless steel fiber. The anode and cathode layers were separated by a perforated lucite 12 cm diameter plate. The current collector was of the same shape and dimension as the plate and located on top of the separator. The results indicate that it is possible to reduce the cyanide content from 1400 mg/L to below 20 mg/L within 4-20 h with a 5-13 kw h/kg CN energy consumption. The cyanide destruction rate increased as the current was increased. It was found that the high current efficiency coupled with the low electrical resistance advantage due to the multiple layer electrode set-up results in a lower energy consumption than the conventional packed-bed reactor. The process can be accelerated with the existence of copper ions. (White-Reimer-PTT)
W91-02784

PERIPHYTON ASH WEIGHT ESTIMATION FROM RESIDUE NOT DIGESTED AFTER HACH METHOD OF KJELDAHL PROTEIN NITROGEN ANALYSIS.

Victoria Univ. (British Columbia). Dept. of Biology.
For primary bibliographic entry see Field 7B.
W91-02785

MICROBIAL NUMBERS AND ACTIVITY DURING INFILTRATION OF SEPTIC-TANK EFFLUENT IN A SUBSURFACE SAND FILTER.

Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Mikrobiologi.
M. Pell, F. Nyberg, and H. Ljunggren.
Water Research WATRAG, Vol. 24, No. 11, p 1347-1354, November 1990. 1 fig, 7 tab, 34 ref.

Descriptors: *Adenosine triphosphate, *Microbial degradation, *Nutrient removal, *Sand filters, *Septic tanks, *Wastewater treatment, Biochemical oxygen demand, Carbon dioxide, Chemical oxygen demand, Infiltration, Nitrogen, Phosphorus, Sweden.

A subsurface, 4-person sand-filter system for treating septic-tank effluent was subjected to conventional water analysis and to an extended microbial analysis of the filter material. Measured rates of CO2 production in the filter media suggest that the system has a good microbial capacity to degrade the organic matter in wastewater; the volume effectively treated depends on the BOD (e.g. 951 sq m/d at a BOD of 169 mg/L and 2851 sq m/d at a BOD of 74 mg/L). The actual load was 40 to 801 sq m/d. Based on viable counts of bacteria the amounts of P and N bound in the 13 +/-10 g dw/sq m viable biomass were calculated to correspond to the amounts produced by 1 person in <2 days. From the ATP levels in the sand, the active biomass was calculated to be 19 +/-15 g dw/sq m, indicating that the viable biomass also gives an accurate estimate of the active biomass. The levels of ATP in the sand-filter surface revealed that the loading of wastewater occurred unevenly. The high numbers of ammonium-oxidizing bacteria and denitrifying bacteria in the surface layer show that the system was predominantly operating aerobically and had a high potential for removing nitrogen. The microbial techniques used were sensitive enough to detect the decrease in biomass that occurred with increasing depth. Reduction of COD, P and N in the wastewater during infiltration were estimated to be 86, 70, and 60% respectively. These figures are considered to be overestimates, since analysis of Cl(-) showed that groundwater had leaked into the bed, diluting the effluent water. A correction factor for the dilution effect was therefore introduced. In addition, N and P from the surrounding arable land periodically leaked into the bed. The environment in the sand filter was sufficiently stable to ensure high microbial activity; thus the purifying capacity of septic-tank effluent should remain high throughout the year. (Author's abstract)
W91-02789

SIMPLE METHOD TO DISTINGUISH BETWEEN POLYPHOSPHATE AND OTHER PHOSPHATE FRACTIONS OF ACTIVATED SLUDGE.

Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
D. Uhlmann, I. Roske, M. Hupfer, and G. Ohms.
Water Research WATRAG, Vol. 24, No. 11, p 1355-1360, November 1990. 8 fig, 1 tab, 16 ref.

Descriptors: *Activated sludge process, *Analytical methods, *Phosphates, *Polyphosphate, *Wastewater analysis, *Wastewater treatment, Fractionation, Lake sediments, Mixed liquor solids, Organophosphorus compound, Physicochemical properties.

The Psenner procedure of sequential extraction steps to quantify ecologically relevant phosphate fractions in lake sediments was applied to activated sludge from waste treatment plants for biological phosphate removal. The principal goal was to distinguish between proportions of chemical/physicochemical and biochemical processes in treatment plants with biological phosphate elimination. Using this method the phosphate fractions that may be distinguished are: (1) redox-sensitive phosphate, mainly bound to Fe(OH)3; (2) phosphate adsorbed to surfaces (Al2O3), exchangeable against OH(-), and alkali-soluble phosphate; (3) phosphate bound to CaCO3, MgCO3 and apatite; and (4) a fraction which hitherto was designated 'organically bound phosphate.' By means of nuclear magnetic resonance spectroscopy and by inclusion of a hot water extraction step it became evident that the 'organically bound phosphate' mainly contained polyphosphate (PP). In activated sludge samples with phosphate-accumulating bacteria, the PP content amounted to 80 mg/g mixed liquor volatile suspended solids. The difference in the PP concentration caused by an alternation of anaerobic and aerobic conditions (which is characteristic of biological phosphate removal) was reflected by corresponding differences in the proportion of the NaOH fraction. By combination of the Psenner fractionation and hot water extraction, indications of a significant proportion of PP in lake sediments have been found. (Author's abstract)
W91-02790

ACTIVATED SLUDGE PROCESS: A PROPOSED METHOD TO PREDICT PROCESS PARAMETERS.

W. H. Chapman.
Water Research WATRAG, Vol. 24, No. 11, p 1361-1363, November 1990. 4 ref.

Descriptors: *Activated sludge process, *Middle East, *Temperature effects, *Wastewater facilities, *Wastewater treatment, Design criteria, Mathematical models, Mixed liquor solids, Oxygen, Process control.

Sewage treatment plants in the Middle East operate on a wide temperature range which necessitates a revised approach to process control. Observations made while running these sewage treatment plants were used to develop a theory on activated sludge and to illustrate how the theory can be used to aid both operation and design of activated sludge plants. It was observed that as the ambient temperature increases, the sludge production and the power required for the process increase. If the mass balance for an activated sludge plant is then considered, and the system is in equilibrium, the material entering the plant is: (1) discharged in the effluent; (2) removed as surplus sludge; or (3) destroyed by respiration in the sludge. Equations subsequently derived to describe these relationships can be used to predict the operation of an activated sludge plant under varying site conditions. When a plant is being designed it is necessary to know the mean cell residence time (MCRT) for plant operation in order to calculate the respiration rate and the BOD load per K of mixed liquor solids at maximum and minimum temperatures. These figures can then be used to predict the surplus sludge produced and the power required under specific conditions. The variation in oxygen required and thus the degree of adjustment required on the aeration system can then be determined. When a plant is operated at constant mixed liquor solids, the power required varies to a greater degree than if the MCRT is kept constant. Allowing the mixed liquor solids to increase in winter within reasonable limits allows better use to be made of sludge treatment facilities. (White-Reimer-PTT)
W91-02791

KINETIC STUDY ON METHANOGENESIS B ATTACHED BIOMASS IN A FLUIDIZED BE

Kyushu Univ., Fukuoka (Japan). Dept. of Civ Engineering.
T. Kuba, H. Furumai, and T. Kusuda.
Water Research WATRAG, Vol. 24, No. 11, 1365-1372, November 1990. 8 fig, 6 tab, 11 re

Descriptors: *Fluidized beds, *Kinetics, *Metha ogenesis, *Wastewater reactors, *Wastewat treatment, Biomass, Comparison studies, Fat acids, Growth rates, Model studies.

The growth kinetic constants and the concentr tion of 'active' attached biomass in an anaerot fluidized bed, which decomposes acetic, propion and butyric acids were estimated. The fluidiz bed was operated as a methanogenic reactor w synthetic zeolite as support medium. The react was supplied with synthetic wastewater (1000 COD/L), a mixture of volatile fatty acids (VFA in the range of hydraulic retention time (HR from 0.25 to 2 days. After the effluent reached steady state in quality, batch experiments in bed reactor were conducted using acetic, propio ic and butyric acids as substrate in order to inve gate the decomposition characteristics of each s strate by the attached biomass. Detached biom from the support media was also used in ba experiments under the completely mixed condit in order to estimate parameter values of growth kinetics of the bacteria. The changes fatty acid concentrations with time were expres with the Monod growth model. The two kine parameters, maximum specific growth rates saturation constants, and 'active' biomass conc trations were obtained by the curve fitting meth The comparison of the measured concentration volatile suspended solids (VSS) and protein v the estimated 'active' biomass concentrations i cated that a large amount of inert organic ma exists in the attached growth reactor. (Auth abstract)
W91-02792

REDUCTIONS OF ENTERIC MICROOR NISMS DURING AEROBIC SLUDGE DIG TION.

Cornell Univ., Ithaca, NY. Center for Envi mental Research.
J. H. Martin, H. E. Bostian, and G. Stern.
Water Research WATRAG, Vol. 24, No. 1 1377-1385, November 1990. 4 fig, 10 tab, 20
USEPA Cooperative Agreement CR-811776.

Descriptors: *Aerobic digestion, *Enteric bact *Enteroviruses, *Sludge digestion, *Wastew treatment, Coliforms, Comparison studies, F streptococci, Mathematical equations, Temp ture effects.

Seasonal variations in the reductions of total form, fecal streptococci and enterovirus den

iat occur during conventional aerobic sludge di-
estion in cold climates were characterized. In
ddition, the potential for reduction in the densities
f these four groups of enteric microorganisms in
old climates by simple modifications that increase
rocess temperature by reducing heat losses was
emonstrated. To obtain the data, two 32 cu m
erobic digesters located at a small municipal
astewater treatment plant were operated continu-
sly over a period of 20 months. One digester was
conventional digester while the other was de-
gned to minimize heat losses and thus, facilitate
toheating. When the results obtained during 11
parate periods of steady-state operation at mean
ixed liquor temperatures ranging from 8 to 40 C
d at residence times of 10, 15, and 20 days were
mbined for analysis, it was evident that signifi-
nt reductions in the densities of the four groups
enteric microorganisms were dependent on both
sidence time and temperature. Using the Arrhen-
equation, it was possible to describe mathemati-
lly the temperature dependence of the rate of
10 reduction in density of each of these four
oups of enteric microorganisms. The four mathe-
tical relationships developed provide a rational
sis to determine residence times necessary to
ieve desired levels of indicator organism and
erovirus reductions during aerobic sludge diges-
n at mixed liquor temperatures ranging from 8
40 C. (Author's abstract)
91-02794

ACTIVATION OF BACTERIOPHAGE MS2 WASTEWATER EFFLUENT WITH MON-CHROMATIC AND POLYCHROMATIC UL-AVIOLET LIGHT.
ksinstituut voor de Volksgezondheid en Milieu-
giene, Bilthoven (Netherlands). Lab. for Water
Food Microbiology.
H. Havelaar, C. C. E. Meulemans, W. M. Pot-
geboom, and J. Koster.
ter Research WATRAG, Vol. 24, No. 11, p
7-1393, November 1990. 9 fig, 1 tab, 13 ref.

scriptors: *Bacteriophage, *Disinfection, *Ul-
iolet radiation, *Viruses, *Wastewater treat-
t, Calibrations, Kinetics, Lambert-Beers Law,
hematical models.

odel using bacteriophage MS2 for the calcula-
of the effective dose in u.v.-disinfection by
chromatic light from a medium pressure mer-
lamp was studied. The model was based on
-order inactivation kinetics, the u.v.-absorption
trum of MS2-RNA as the action spectrum and
bert-Beer's law for light absorption by the
ents. The u.v.-sensitivity of the phage was
rated with a low pressure mercury lamp; the
tivation rate constant (k) was 0.0106 sq m/J,
ch corresponded well with previously reported
. The model fitted actual data in most experi-
ts, although tailing effects were observed. In
e experiments a different value of k was neces-
to fit the actual inactivation curves, varying
een 0.0077 and 0.0121 sq m/J. The repeatabi-
of inactivation experiments with RNA-bacter-
ages appears to be good, which is an advan-
when proposing these organisms as biological
dards for calibration of u.v.-lamps and disinfec-
units. (Author's abstract)
-02795

E OF RESIN ACIDS IN THE ANAEROBIC ICITY OF CHEMITHERMOMECHANI-PULP WASTEWATER.
wa Univ. (Ontario). Dept. of Civil Engineer-

McCarthy, K. J. Kennedy, and R. L. Droste.
r Research WATRAG, Vol. 24, No. 11, p
1405, November 1990. 5 fig, 2 tab, 10 ref.

riptors: *Industrial wastewater, *Pulp and
r industry, *Pulp wastes, *Resin acids, *Toxic-
Anaerobic toxicity assay, Bacteria, Chemither-
echanical pulp, Methanogenesis, Synergistic
ts.

nithermomechanical pulp (CTMP)
ewaters are treated anaerobically, in full scale
ations, in spite of the presence of inhibitory
ounds. These compounds have not been well identified nor placed in an order of priority in terms of inhibitions to anaerobic bacteria. Therefore, anaerobic toxicity assays (ATA) were used to quantify the relative toxicity of resin acids to the total toxicity in bleached CTMP (BCTMP) wastewater. A resin acid mixture was prepared that matched as closely as possible the mean resin acid composition reported in wastewater from the Quesnel River Pulp Co. on five separate occasions. A series of resin acid concentrations ranging from 20 to 700 mg/L were assayed during the ATA. Resin acids were partitioned between the soluble wastewater and the fiber fractions. Therefore fiber toxicity was also compared to raw BCTMP wastewater toxicity. Results indicated that anaerobic toxicity in BCTMP with fiber wastewater is partly soluble and partly fiber associated. The anaerobic toxicity that is removed with the fiber is methanol soluble. The bulk of the fiber which is not methanol soluble exhibited no toxicity to the anaerobic cultures used. Resin acids inhibit anaerobic activity but BCTMP wastewater toxicity to anaerobic bacteria can only be partially explained by the presence of resin acids. The possible synergistic effects that other compounds may have in conjunction with the resin acids in BCTMP with fiber wastewater toxicity could not be excluded. (White-Reimer-PTT)
W91-02797

PHOTOCATALYTIC DEGRADATION OF ORGANOPHOSPHOROUS INSECTICIDES IN AQUEOUS SEMICONDUCTOR SUSPENSIONS.
National Chemical Lab. for Industry, Yatabe (Japan).
K. Harada, T. Hisanaga, and K. Tanaka.
Water Research WATRAG, Vol. 24, No. 11, p 1415-1417, November 1990. 6 fig, 12 ref.

Descriptors: *Catalysts, *Insecticides, *Organophosphorus pesticides, *Photolysis, *Wastewater treatment, Chemical treatment, Degradation products, Degradation rates, Formaldehyde, Hydrogen peroxide, Photocatalytic degradation.

A method was sought to improve the efficiency of the photocatalytic process for the degradation of organic and inorganic substances in wastewater. Two organophosphorus insecticides, dimethyl-2,2-dichlorovinyl phosphate (DDVP) and dimethyl-2,2,2-trichloro-1-hydroxyethyl phosphonate (DEP), were degraded in the presence of suspended TiO2 by illumination with a super-high pressure mercury lamp or by exposure to sunlight. Pt-loading to TiO2 enhanced the degradation rates 4.5 for DDVP and 6-fold for DEP. The addition of H2O2 to the suspension also enhanced the rates 10-fold for DDVP and 2-fold for DEP. The final degradation products were Cl(-), PO4(3-), H(+) and CO2, and one of the intermediates was formaldehyde. (Author's abstract)
W91-02799

IONIC STRENGTH IN DEEP BED FILTRATION.
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
J. S. Chang, and S. Vigneswaran.
Water Research WATRAG, Vol. 24, No. 11, p 1425-1430, November 1990. 4 fig, 3 tab, 15 ref.

Descriptors: *Deep bed filtration, *Filtration, *Ionic strength, *Ions, *Wastewater treatment, Conductance, Particulate matter, Removal efficiency, Sodium chloride, Zeta potential.

The removal efficiency of particles in deep bed filtration depends on both transport and attachment mechanisms of particles. The particle attachment mechanisms depend mainly on chemical characteristics of aqueous phase, suspended particles and filter media. Two different suspensions were used to study the effect of ionic strength on the particle removal efficiency. The ionic strength of suspension was varied by adding a known amount of sodium chloride. The removal efficiencies were related to ionic strength and zeta potential. Most of the suspended particles found in water and filter grain used in deep bed filtration carry negative charges which produce a repulsion force that can be measured in terms of the zeta potential. The zeta potential gets closer to zero the higher the filter removal efficiency. Two different zones were observed when the initial collection efficiency was platted against the concentration of electrolyte (ionic strength). For ionic strength lower than a certain value of NaCl concentration (in this study less than 0.219 mol/L), the variation of the initial collection efficiency was significant even for a small change in ionic strength; for ionic strength above this value the initial collection was constant. The clean filter bed efficiency and removal efficiency during the ripening period for various strengths were quantitatively related to the two model coefficients appearing in the O'Melia-Ali model. These model coefficients represent the filter medium-particle and particle-particle attachments. This type of quantification of the effect of ionic strength in terms of filter efficiency is very useful in filter design and operation control. (Author's abstract)
W91-02801

MODELING TRANSIENT SUBSTRATE LOADS IN COMPLETELY MIXED AERATION BASINS AT HYDRAULIC STEADY STATE.
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
V. J. Boero, A. D. Koussis, and A. R. Bowers.
Environmental Technology (Letters) ETLEDB, Vol. 11, No. 8, p 695-708, 1990. 4 fig, 11 ref.

Descriptors: *Activated sludge process, *Environmental engineering, *Model studies, *Substrates, *Wastewater treatment, Aerated lagoons, Biomass, Computer programs, Differential equations, Model testing, Monod term, Numerical models.

In many engineering fields it is common practice to use simple models for design purposes. In environmental engineering it is customary to design biological treatment systems on the basis of steady-state reactor behavior, which is inadequate for the study of treatment systems under operational conditions. The description of transient behavior requiring the use of differential equations, as opposed to algebraic steady-state equations, increases the modeling effort substantially. A numerical technique for predicting the response of a completely mixed activated sludge system (with recycle) to transient substrate inputs has been developed. Substrate utilization and biomass growth were modeled by Monod kinetics. Computational efficiency is achieved by 'locally linearizing' the Monod expression, and by decoupling the two mass balances by assuming biomass to be constant locally over a time step. The subsequent solutions are simple and ideally suited for personal computers. Comparisons with numerical solutions of the complete equations show a high degree of accuracy and robustness for the proposed technique. (Author's abstract)
W91-02822

EFFECTS OF CHEMICAL PHOSPHORUS PRECIPITATION ON ANAEROBIC DIGESTION.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
S. Yeoman, J. N. Lester, and R. Perry.
Environmental Technology (Letters) ETLEDB, Vol. 11, No. 8, p 709-720, 1990. 6 fig, 2 tab, 30 ref.

Descriptors: *Anaerobic digestion, *Biological wastewater treatment, *Chemical precipitation, *Phosphorus removal, *Sludge digestion, *Wastewater treatment, Activated sludge, Alkalinity, Alum sludge, Aluminum sulfate, Methane.

The use of chemicals such as aluminum sulfate and ferric chloride in biological wastewater treatment can achieve excellent phosphorus removals; however, it can also influence the process of anaerobic digestion. Results from the operation of laboratory scale anaerobic digesters using chemically precipitated sludges indicated that such treatment had detrimental effects on digester operation. A digester that only contained 25% precipitated activated sludge and the control were similar in terms of performance, because the sludge concentration was not high enough to affect performance signifi-

cantly. It was concluded that alum and ferric chloride used for the precipitation of phosphorus do adversely affect anaerobic digestion, especially in terms of methane production and alkalinity. However, this could be overcome if co-precipitation was used and the majority of sludge sent to anaerobic digestion (approximately 75% depending on works practice) is chemically untreated. (Fish-PTT)
W91-02823

IMPACT OF NITROGEN ON THE ADSORPTIVE CAPACITY OF ACTIVATED CHARCOAL.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-02825

DEGRADATION OF BLUE GREEN ALGA, MICROCYSTIS AERUGINOSA BY FLAGELLATA, MONAS GUTTULA.
Ibaraki Prefecture Inst. of Public Health, Mito (Japan).
For primary bibliographic entry see Field 5F.
W91-02826

CHARACTERIZATION OF BACTERIAL BIOMASS POTENTIAL ACTIVITY BY PROTEOLYTIC ACTIVITY MEASUREMENTS.
Centre des Sciences de l'Environment, Metz (France).
P. Bauda, C. Bouzendorffer, J. C. Block, G. Faup, and F. Colin.
Environmental Technology (Letters) ETLEDB, Vol. 11, No. 8, p 785-792, 1990. 5 fig, 2 tab, 13 ref.

Descriptors: *Activated sludge process, *Bacterial analysis, *Biomass, *Enzymes, *Wastewater treatment, Artificial substrates, Assay, Biodegradation, Fermentation.

To control biomass activity within any process (e.g. fermentation or activated sludge in wastewater treatment), it is necessary to choose enzymatic activities not only representative of the physiological state of the bacterial cells but also easy to measure. Phosphatase, glycosidase, and protease activities are possible candidates for this assay as they were shown to respond to environmental stress such as starvation or poisoning. Bacterial protease activity was assayed using L Leucine beta naphthylamide as artificial substrate. Apparent KM values ranging from 112 to 606 micromoles of substrate consumed/g of biomass (dry weight) were obtained with activated sludge samples. Specific activities were in the range from 7 to 26 micromoles of substrate consumed/min/g of sludge (dry weight). It was established that proteolytic activity from various bacterial populations can be conveniently measured at 30 C and pH 8.5. In these conditions, the substrate and product molecules of the protease assay are nonbiodegradable, nontoxic, and not significantly adsorbed by the biomass. (Author's abstract)
W91-02830

HEAD LOSSES IN STORM SEWER MANHOLES: SUBMERGED JET THEORY.
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
For primary bibliographic entry see Field 8B.
W91-02916

DECONTAMINATION TECHNOLOGIES FOR RELEASE FROM BIOPROCESSING FACILITIES: PART V. DECONTAMINATION OF SLUDGE.
Battelle Memorial Inst., Columbus, OH. Environmental Science Dept.
G. B. Wickramanayake.
CRC Critical Reviews in Environmental Control CCECAU, Vol. 19, No. 6, p 515-537, 1990. 1 fig, 18 tab, 33 ref.

Descriptors: *Chemical treatment, *DNA, *Decontamination, *Gamma radiation, *Incineration, *Microwaves, *Pharmaceutical wastes, *Sludge treatment, *Thermal radiation, *Wastewater treatment, Cost analysis, Sludge analysis, Sludge solids, Suspended solids.

Sludge generated at recombinant DNA processing facilities consists mainly of biological solids such as cells and cell debris. The solid levels in the sludge samples can vary depending on the process used to concentrate solid materials. The solids content and physical properties of sludge will affect the selection of an appropriate decontamination agent. Potential techniques for sludge decontamination include incineration, thermal (dry-heat and steam) treatment, gamma and electron radiation, microwave radiation and chemical decontamination. Each of these techniques on microbial inactivation can be effective in the treatment of recombinant DNA sludge. However, the required dosage for each of these procedures needs to be established on a case-by-case basis. Depending on the sludge characteristics, volume and treatment cost, the need for pretreatment or combined treatments should also be evaluated. Since the verification of the extent of decontamination is extremely difficult with sludges, high safety factors should be incorporated during the design of treatment units and good maintenance and operating procedures employed. (See also W91-02937) (Medina-PTT)
W91-02936

DECONTAMINATION TECHNOLOGIES FOR RELEASE FROM BIOPROCESSING FACILITIES: PART VI. VERIFICATION OF WASTEWATER DECONTAMINATION.
Battelle Memorial Inst., Columbus, OH. Environmental Science Dept.
G. B. Wickramanayake.
CRC Critical Reviews in Environmental Control CCECAU, Vol. 19, No. 6, p 539-555, 1990. 2 fig, 5 tab, 29 ref. EPA Contract No. 68-03-3248.

Descriptors: *DNA, *Decontamination, *Hazard assessment, *Microorganisms, *Pharmaceutical wastes, *Statistical analysis, *Sterilization, *Wastewater treatment, Effluent streams, Waste treatment.

Wastes generated in bioprocessing facilities can be decontaminated using chemical and physical agents commonly employed in wastewater disinfection and sterilization processes. The decontamination process involves inducing irreversible loss of viability to the organism and its subcellular components, such as genetic elements, if necessary. The extent of decontamination or the permissible levels of recombinant DNA microorganisms in the final effluent is governed by the acceptable risk associated with the organism of concern. For biological agents with a high degree of risk, sterility can be the targeted treatment end point. Because of the limitations associated with sampling and viability assessment techniques, the sterility of a waste stream cannot be absolutely verified. At best, the waste stream can be shown to contain less than a given number of microbes at a desired confidence limit. Binomial probabilities can be used to make statistical inferences from verification test results. Large sample sizes (total numbers of samples) are required to verify high levels of decontamination. Statistically, the total volume of the waste stream has little or no effect on the selection of sample size to determine a certain concentration of microorganisms. The frequency of conducting verification tests depends on the risk level associated with the organism and the variability of waste characteristics and operating parameters of the decontamination system. The validity of verification test results has a significant bearing on the viability-assessment method. Any concentration or recovery methods to improve the sensitivity of this technique should be employed with caution because such techniques can have adverse impacts in the accuracy of results. Because almost all of the detecting and monitoring techniques are based on the culturability of organisms, such in vitro tests have to be representative of the viability of the organism. If biological indicators are used to verify sterility, such organisms (1) need to be more resistant than the rDNA organism, (2) should be able to be detected at low concentration and (3) should not pose a health risk. (See also W91-02936) (Medina-PTT)
W91-02937

LOW-TECH, LOW-COST SOLUTION T TREATMENT IN ST. IGNACE, MICH.
Granger and Associates, Inc., St. Ignace, MI.
G. R. Hampton.
Water Environment & Technology WAETE Vol. 2, No. 9, p 6-11, September 1990.

Descriptors: *Clean Water Act, *Michiga *Wastewater disposal, *Wastewater facilit *Wastewater treatment, Aerators, Effluents, E dangered species, Forests, Gravity flow, La Huron, Lake fisheries, Wastewater lagoons, W lands.

A new wastewater treatment plant in St. Igna Michigan, was designed to provide low-co simple to operate, and not requiring advanc technical educational backgrounds for its pers nel to maintain it. This project was patterned af unique wastewater-disposal problems result from the area's fluctuating population and ha winters, while addressing concern for the are forests, wetlands, endangered species, high qua lake trout waters, and archaeological sites. T plant operates on a relatively simple aera lagoon process with gravity flow, which preclu the need for pumps. The wastewater treatm process involve surface aspirators using guideli developed for dual-power level lagoons in southeast USA. Effluent is detained for half a in a final polishing pond for additional clarifica before it is disinfected by UV. A cascade wate aerator raises the dissolved oxygen content of effluent before discharge to Lake Huron. The wastewater treatment plant was placed onlin June 1988, just before the July 1 deadline secondary treatment under the Clean Water From the outset, the plant met discharge limits secondary treatment set by the Michigan Dep ment of Natural Resources. However, operati problems related to the chemical feed system the phosphate removal process caused effl phosphorus levels to exceed the 1.0 mg/L limi a short period. Adjustments were successf made to correct this problem. (Medina-PTT)
W91-02953

SITING AND TECHNOLOGY POSE CH LENGES FOR COMMUNITIES END OCEAN DISPOSAL OF SLUDGE.
Black and Veatch, Inc., Cambridge, MA.
G. F. Shimp.
Water Environment & Technology WAE Vol. 2, No. 9, p 38-42, September 1990. 1

Descriptors: *Administrative agencies, *Bo *Digested sludge, *Massachusetts, *Public opi *Sludge disposal, *State jurisdiction, *Waste facilities, Education, Legislation, Sludge s Tides.

Phasing out ocean disposal of wastewater sl and choosing alternate sites to dispose o sludge require cities to make unpleasant accor dations in solving this example of an environm problem. Such is the case in Northeastern c cities like Boston, Massachusetts. Twice dail gested sludge from the two primary treat plants serving Boston and 42 neighboring and towns is flushed into the shallow wate Boston Harbor on the outgoing tides. Stud the early 1970s concluded that 25-30% o discharge solids return and settle out in the h floor. Since that time, several plans were oped for sludge disposal by other means, but were implemented because the public and re tory agencies did not support the recomm technology or the siting choice. Finally, court pressure, the state legislature in early formed the Massachusetts Water Resource thority (MWRA) to take charge of the h cleanup. Studies made by this agency ind that the most effective tool for educatin public about sludge management technolog information about similar systems in other co nities and how it would apply to the local tion. Also, after weighing public comment MWRA enhanced its credibility and public

y dealing decisively on ruling out incineration, in
ite of regulatory pressure for continued contin-
ency planning, and agreeing to drop composting
favor of another reuse technology with better
dor control in spite of potentially higher cost.
Medina-PTT)
91-02955

WO DECADES OF PROGRESS.
airfax County Dept. of Public Works, Lorton,
A. Wastewater Treatment Div.
or primary bibliographic entry see Field 5G.
91-02957

ARBON COLUMNS VS. THE PACT PROCESS
OR PRIORITY-POLLUTANT REMOVAL.
u Pont de Nemours (E.I.) and Co., Deepwater,
. Chambers Works.
J. O'Brien, R. A. Reich, L. S. Salata, M. H.
ibes, and C. N. McManus.
ater Environment & Technology WAETEJ,
ol. 2, No. 9, p 72-75, 238-240, September 1990. 5
, 2 tab, 6 ref.

escriptors: *Activated carbon, *Biodegradation,
arbon filters, *Chemical wastewater, *Delaware
ver, *New Jersey, *Patents, *Wastewater facili-
s, *Wastewater treatment, *Water quality stand-
ls, Cost analysis.

Chambers Works, a large, diversified, organic
emicals plant at Deepwater Point in southern
w Jersey, Du Pont operates a 40 mgd
stewater treatment plant to remove pollutants
m aqueous wastes generated on site and at other
Pont plants and commercial facilities. Com-
rcial wastes received from 32 states and about
% of New Jersey's liquid hazardous wastes that
shipped to non-municipal treatment facilities
treated by a combination of biodegradation and
itu carbon adsorption, a patented powdered
vated carbon treatment (PACT) process. The
er quality of the effluent discharged to the
laware River is closely monitored under a New
ey pollutant discharge elimination system
mit which, in June 1991, will incorporate limits
57 organic priority pollutants covered under the
anic Chemicals, Plastics, and Synthetic Fibers
PSF) guidelines. Because some compounds
e historically been above the guideline limits, a
ly was made to find an alternative end-of-pipe-
treatment or to determine the compounds that
uire source treatment. Two treatment technol-
es were considered and compared: carbon col-
ns and expanding the existing PACT process by
ing a second PACT stage. Experimental data
ored addition of a second PACT stage over
on columns for higher performance and lower
stment cost. (Medina-PTT)
1-02958

. Ultimate Disposal Of Wastes

L AND VEGETATION RESPONSES TO
WAGE SLUDGE ON A DEGRADED SEMI-
D BROOM SNAKEWEED/BLUE GRAMA
NT COMMUNITY.
ky Mountain Forest and Range Experiment
on, Albuquerque, NM.
. Fresquez, R. E. Francis, and G. L. Dennis.
nal of Range Management JRMGAQ, Vol. 43,
4, p 325-331, July 1990. 6 tab, 40 ref.

criptors: *Land disposal, *Plant growth,
niarid climates, *Sludge disposal, *Soil amend-
ts, *Soil chemistry, Heavy metals, Metals, Path
ollutants, Seasonal variation, Sludge drying,
city, Trace elements.

e rates of dried sewage sludge (22.5, 45.0, and
megag/ha) were applied to a degraded semi-
grassland site on the Upper Rio Puerco Wa-
ed in west-central New Mexico. Various soil
plant parameters were determined over four
ing seasons. Most soil macronutrients, such as
gen, phosphorus, and potassium, and micronu-
ts, such as copper, iron, manganese, and zinc,
ased linearly with increasing sludge amend-
rates. Heavy metals (cadmium and lead) did not change as a result of sludge amendment in the first three growing seasons. However, concentrations of soil copper, manganese, and cadmium were just above maximum acceptable standards in the heaviest sludge treatment after four growing seasons. Plant density, species richness, and diversity all decreased with increasing sludge rates. However, total plant foliar cover and herbaceous yields increased significantly with the application of sludge. Blue grama (Bouteloua gracilis (H.B.K.) Lag.) cover and yields, in particular, increased twofold to threefold over the control as a result of sludge amendment, whereas broom snakeweed (Gutierrezia sarothrae (Pursh) Britt. + Rusby) density decreased over four growing seasons. The most favorable soil and vegetation results were from the 22.5 and the 45 megag/ha sludge application rates. The near complete elimination of snakeweed after four growing seasons and the increase in blue grama cover and production as a result of sludge amendment may help to control and/or hinder the reestablishment of snakeweed plants. This study showed that sewage sludge from a nonindustrial city such as Albuquerque can be safely applied to a degraded grassland in the semi-arid Southwest without any apparent adverse environmental effects at sludge rates up to 45 megag/ha. (Brunone-PTT)
W91-02076

LEAD, ZINC, CADMIUM, AND FLUORIDE IN SMALL MAMMALS FROM CONTAMINATED GRASSLAND ESTABLISHED ON FLUORO-SPAR TAILINGS.
Sunderland Polytechnic (England). School of Biology.
For primary bibliographic entry see Field 5B.
W91-02082

TRACE METAL ANALYSIS OF SEWAGE SLUDGE AND SOILS IN BAHRAIN.
Bahrain Univ., Manama. Dept. of Chemistry.
M. S. Akhter.
Water, Air and Soil Pollution WAPLAC, Vol. 51, No. 1/2, p 147-152, May 1990. 2 tab, 16 ref.

Descriptors: *Bahrain, *Heavy metals, *Land disposal, *Path of pollutants, *Sludge analysis, *Sludge disposal, *Trace metals, Agriculture, Soil amendments, Soil chemistry, Soil contamination, Toxicity.

Trace metals such as lead, zinc, copper, nickel, cadmium, and iron were determined in sewage sludge produced at a sewage treatment plant in Bahrain (Tubli) and soils. The soils, both untreated and treated with the sludge are used for agricultural purposes in Bahrain. The trace metal levels showed the following range (microg/g dry weight): lead, 242 to 609; zinc, 704 to 836; copper, 329 to 512; nickel, 23 to 41; cadmium, 1.8 to 3.9; and iron, 1867 to 4824. The data show the degree to which untreated soils have already been contaminated with trace elements. The level of trace elements found in sludge showed the following range (microg/g dry weight): lead, 140 to 186; zinc, 597 to 836; copper, 348 to 449; nickel, 47 to 53; cadmium, 5.7 to 9.2; and iron, 5950 to 8520. Mean levels were generally close or lower than mean concentrations reported in the United Kingdom and the United States for sludge. They were also lower than the suggested concentration limits for application of sludge on agricultural land, which is one of the most cost-effective and attractive techniques for sludge disposal. Soils treated with this sludge (after 1 year) were also analyzed and showed substantial enhancement of the available level of trace elements in the soil. This enrichment will eventually lead to an increase in the trace element level in plants grown for human or animal consumption, with potential phytotoxic effects, and the possibility of toxic effects on livestock and human beings. (Author's abstract)
W91-02088

EFFECT OF SOLID-PHASE SPECIATION ON METAL MOBILITY AND PHYTOAVAILABILITY IN SLUDGE-AMENDED SOIL.
Instytut Uprawy, Nawozenia i Gleboznawstwa, Pulawy (Poland). Trace Element Lab.
S. Dudka, and A. Chlopecka.
Water, Air and Soil Pollution WAPLAC, Vol. 51, No. 1/2, p 153-160, May 1990. 8 tab, 16 ref.

Descriptors: *Bioavailability, *Land disposal, *Path of pollutants, *Sludge disposal, *Soil amendments, *Speciation, *Trace metals, Adsorption, Agriculture, Leaching, Lysimeters, Plant physiology, Sequential extraction.

In land application of sewage sludge large amounts of trace metals may be introduced into the soil. In addition, contamination of groundwater with trace metals is likely to occur following massive sewage sludge application to the land. Sequential extraction was utilized for partitioning cadmium, chromium, nickel, and zinc, in soil and sludge samples, into five operationally-defined fractions: exchangeable, bound to carbonates, bound to iron-manganese oxides, bound to organic matter, and residuals. The highest amount of cadmium, nickel, and zinc, expressed as percent of the total, were found in the iron-manganese oxide fraction of the sewage sludge. Chromium was significantly associated with the organic fraction of the sludge. The residue was the most abundant fraction for all metals studied in the untreated soil, and for cadmium and nickel in the sludge-treated soil. The concentration of exchangeable cadmium and chromium was relatively low in the untreated soil and did not change much after sludge application, whereas the concentrations of exchangeable zinc increased about 50 times and the concentrations of exchangeable nickel doubled in the sludge-treated soil. A lysimetric experiment revealed an increase in zinc and nickel uptake by ryegrass and in the percentage of metals leached from the soil profile after massive sludge application. In contrast, only negligible changes were observed for cadmium and chromium. The assumption that mobility and biological availability are related to metal speciation was confirmed by the agreement between the distribution pattern of cadmium, chromium, nickel and zinc in the soils, the uptake of the metals by plants and their capacity for leaching out from the soils. (Author's abstract)
W91-02089

GUIDELINES AND INTEGRATED MEASURES FOR PUBLIC HEALTH PROTECTION IN AGRICULTURAL REUSE SYSTEMS.
World Health Organization, Geneva (Switzerland). Div. of Environmental Health.
I. Hespanhol.
Aqua AQUAAA, Vol. 39, No. 4, p 237-249, August 1990. 5 fig, 8 tab, 22 ref.

Descriptors: *Public health, *Wastewater disposal, *Wastewater farming, *Wastewater irrigation, *Wastewater utilization, *Water reuse, Agriculture, Coliforms, Epidemiology, Helminths, Pathogenic bacteria, Pathogens, Population exposure, Sanitary wastewater.

Wastewater recycling through agricultural schemes should be considered the preferred method of disposal and treated as an integral part of water resources planning. Based on a theoretical model predicting a descending order of risks of pathogen transmission by irrigation with raw wastewater, and on extensive epidemiological research done in the past 15 years, a new microbiological quality guideline in terms of concentration of intestinal nematodes and fecal coliforms is appropriate. The actual risk of irrigation with treated wastewater is much lower than previously estimated, and the early microbial standards and guidelines for effluent reuse were unjustifiably restrictive, particularly with respect to bacterial pathogens. Public health protection of the exposed groups can be attained through integrated measures which include wastewater treatment, crop selection, appropriate wastewater application, and human exposure control. Appropriate technical and institutional measures to provide complete protection to both workers and consumers depends upon the availability of resources (institution, staff, funds), existing social and agricultural practices, and existing patterns of excreta-related diseases. Topics for additional research include wastewater quality assessment, treatment technology, applica-

tion technology, human exposure control, sociocultural research and integration measures, epidemiological research, and aquaculture research. (Tappert-PTT)
W91-02142

TRITIUM, OXYGEN-18, AND DEUTERIUM DIFFUSION AT THE CONFEDERATION ROAD LANDFILL SITE, SARNIA, ONTARIO, CANADA.
University of Western Ontario. London. Faculty of Engineering Science.
For primary bibliographic entry see Field 5B.
W91-02146

HYDROGEOCHEMICAL PROCESSES CONTROLLING THE TRANSPORT OF DISSOLVED ORGANIC CARBON THROUGH A FORESTED HILLSLOPE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W91-02159

ASSESSING DETOXIFICATION OF A COMPLEX HAZARDOUS WASTE, USING THE MICROTOX BIOASSAY.
Utah State Univ., Logan. Div. of Environmental Engineering.
B. D. Symons, and R. C. Sims.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 17, No. 4, p 497-505, July 1988. 8 fig, 4 tab, 19 ref.

Descriptors: *Bioassay, *Detoxification, *Hazardous wastes, *Industrial wastes, *Microtox assay, *Oil industry, *Soil treatment, *Toxicology, *Waste treatment, Acute toxicity, Laboratory methods, Leaching, Loam, Microbiological studies, Oil, Petroleum products, Soil columns, Soil filters, Soil types, Waste management.

Research has demonstrated the usefulness of the Microtox bioassay in assessing the acute toxicity of organic compounds. Recently, the use of the Microtox bioassay has been extended to applications in hazardous waste management. The rapidity of the test, low sample requirements, and low cost provide several advantages over chemical analysis, especially for complex waste mixtures. Microtox bioassay results correlate closely with results from rainbow trout bioassays, and are more sensitive to inhibitory chemicals than activated sludge organisms. An experimental approach using batch reactors and soil columns was implemented in the laboratory to evaluate the detoxification and mobility of a toxic complex hazardous waste (a composite of three types of petroleum refinery wastes including American Petroleum Institute separator sludge, dissolved air flotation float, and slop oil emulsion solids) in soil. The objective of the study was to quantify the extent and rate of detoxification of a complex hazardous waste as affected by soil type and waste application rate. The extent and rate of detoxification was directly related to waste loading rate for both soil types (Kidman sandy loam and Nunn clay loam) investigated, in both batch reactors and soil column reactors. Analysis of the toxicity of aqueous soil extracts at incremental depths through soil columns and of soil column leachate indicated a low leaching potential for the complex petroleum refinery waste. (Author's abstract)
W91-02204

EFFECT OF SEWAGE SLUDGE ON NUTRIENT AND TOXIC METAL CONTENT OF SOIL AND SELECTED CROPS GROWN ON TROPICAL SOILS.
Puerto Rico Univ., Mayaguez. Dept. of Agronomy and Soils.
For primary bibliographic entry see Field 5C.
W91-02239

HAZARDOUS WASTE MINIMIZATION: SOURCE REDUCTION ALTERNATIVES IN THE AEROSPACE INDUSTRY.
CH2M Hill, Milwaukee, WI.
For primary bibliographic entry see Field 5D.
W91-02411

SITING CONSIDERATIONS FOR RESOURCE RECOVERY FACILITIES.
STV, Inc., Pottstown, PA.
R. Zyma.
Public Works PUWOAH, Vol. 121, No. 10, p 84-86, 134, September 1990. 1 fig.

Descriptors: *Administrative agencies, *Resource recovery facilities, *Site selection, *Waste disposal, *Waste recovery, Economic aspects, Environmental assessment, Environmental impact, Political aspects, Resources management.

The siting of resource recovery facilities is a complicated and often time-consuming procedure. The process must withstand the significant and somewhat relentless scrutiny of the public, regulatory agencies, and other interested parties. Even upon completion of the siting process, the regulatory agency permitting process remains a major obstacle. There are many technical, financial, environmental, and political considerations in selecting resource recovery as the study area's solid waste disposal option. Selecting a site that has a reasonable chance of withstanding these pressures is the initial step toward a successful project. Steps for resource recovery site selection start with determining the siting objectives and the study area. After selecting siting criteria, how to utilize that criteria must be established. Regional screening will identify candidate areas which must be narrowed into a few preferred areas. Selected sites within those areas should be rated and ranked. Environmental assessments will be needed for the highest ranked sites. After a preferred site is selected, preliminary design and the process of gaining regulatory and public approval can begin. (Mertz-PTT)
W91-02421

DEGRADATION OF PESTICIDE WASTE TAKEN FROM A HIGHLY CONTAMINATED SOIL EVAPORATION PIT IN CALIFORNIA.
California Univ., Davis. Dept. of Environmental Toxicology.
For primary bibliographic entry see Field 5G.
W91-02443

TWENTY YEARS OF LAND APPLICATION RESEARCH.
Agricultural Research Service, Beltsville, MD. Soil-Microbial System Lab.
R. L. Chaney.
Biocycle BCYCDK, Vol. 31, No. 9, p 54-59, September 1990. 2 fig, 2 tab, 14 ref.

Descriptors: *Heavy metals, *Sludge utilization, Biological magnification, Cadmium, Food chains, Molybdenum, Municipal wastewater, Phytotoxicity, Selenium, Sludge, Soil-water-plant relationships, Toxicity.

Since around 1970, scientific research has been conducted to assess the benefits and risks of using municipal sewage sludge on cropland. One of the most important findings of sludge research is that certain sludges have a 'no observed adverse effect level'. Much work has shown that sludges can be beneficial. No observed adverse effect level sludges, however, have especially low risk. The adsorption of metals and organics by adsorption sites in sludges is the technical reason why equal amounts of metals or organics can be applied in no observed adverse effect level sludges without effects, while additions of pure chemicals to soils can cause adverse effects. The 'Soil-Plant Barrier' concept considers the potential toxicity to the food chain if trace elements are applied to soils. Some metals are so insoluble or so strongly adsorbed to soil or in plant roots that they are not translocated into edible plant parts. Other elements are taken up by plants from sludge treated soils to a level that they may reduce the yield or even kill crops. Because of this phytotoxicity, excessive plant uptake compared to levels tolerated by animals, is prevented, thus protecting the food chain. Exceptions to the Soil-Plant Barrier exist: livestock have been injured by excessive selenium and molybdenum and humans have been injured by cadmium. Sludge utilization was first regulated in 1979. The EPA has developed 12 fundamental pathways for risk assessment. The highest possible exposure to sludge applied contaminants can be avoided by using subsurface injection equipment or mixing the sludge into the plow layer soil before the grazing crop is seeded. (Mertz-PTT)
W91-02470

DIFFUSION AND DISPERSION IN COASTAL WATERS.
California Inst. of Tech., Pasadena. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-02521

ESTIMATION OF FLOW THROUGH AND OVER ARMORED SLOPES.
Nuclear Regulatory Commission, Washington DC. Div. of Waste Management.
R. B. Codell, S. R. Abt, T. Johnson, and J. Ruff.
Journal of Hydraulic Engineering (ASCE JHEND8, Vol. 116, No. 10, p 1252-1269, October 1990. 10 fig, 3 tab, 10 ref, append.

Descriptors: *Armored slopes, *Flow resistance, *Radioactive waste disposal, *Rainfall-runoff relationships, *Riprap, *Slopes, *Waste disposal, Bank protection, Crushed rock, Darcy-Weisbach equation, Embankments, Flow models, Flumes, Laboratory methods, Mine wastes, Porosity, Rainfall, Rainfall intensity, Water conveyance.

Hazardous and radioactive wastes created in uranium mining and milling are often stabilized from erosion by placing a protective filter blanket and armor riprap layer over a thick earth cover. Models developed for the transient routing of intense rainfall on these small armored slopes depend on expressions for flow resistance below and above the surface of the armored layer. A series of experiments was conducted in two flumes to collect data on the basic relationships of flow resistance. Crushed rock of 26-155 mm median diameter was placed on embankments with slopes ranging from 0.01 to 0.2 and subjected to steady flow in the flumes. Flow through the rock layer was approximately proportional to the rock-layer porosity, the square root of the slope, and the mean diameter of the rock, and weakly proportional to the stage. The portion of flow through the filter layer generally cannot be neglected. Flow resistance decreased and conveyance greatly increased when the stage exceeded the depth of the rock layer. A model for flow both beneath and above the rock surface on an armored slope was synthesized from formulas developed for flow in rubble dams and Darcy-Weisbach formulas developed for flow in gravel bed streams and mountain rivers. The results of the model compare favorably to the experimental flow measurements. (Author's abstract)
W91-02526

SAFETY AND EFFICACY OF FOOD PROCESSING SLUDGES AS ANIMAL FEED: CHEMICAL CHARACTERIZATION.
T. E. Clevenger.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 6, p 820-8, September/October 1990. 7 fig, 10 tab, 19 ref.
USDA Grant 85-CRSR-2-2548.

Descriptors: *Animal feed, *Food processing industry, *Industrial wastes, *Pollutant identification, *Priority pollutants, *Sludge analysis, Food processing wastes, Metals, Pathogens, Pesticides, Sludge disposal, Sludge utilization.

A long-term, comprehensive study was conducted to determine the safety and efficacy of food processing sludges when used as an animal feed supplement. Sixteen different food processing plants were sampled and their sludges analyzed for 144 different compounds and elements, including those on EPA's list of priority pollutants. All sludges were found to have high protein and nutritive value while having low priority pollutant concentrati

one of the recommended limits for minerals in imal diets would be exceeded when fed at the commended 10% level. The variability in sludge mposition over time was studied at one plant for o years and found to be low (less than 30%). en though there exists a variability in the major d trace elements between the different types of od processing industries and each will have to be aluated separately, all of the facilities using bio- gical treatment have one thing in common; the mass (sludge) produced has a high nutritive ue while being low in priority pollutants. Food ocessing sludges need can be excellent sources of mal feed and need to be better used. (Author's tract)
91-02542

ERGY-EFFICIENT MUNICIPAL SLUDGE CINERATION.
np, Dresser and McKee, Inc., Cambridge, MA.
J. Walsh, A. B. Pincince, and W. R. Niessen.
ter Environment & Technology WAETEJ, l. 2, No. 10, p 36-43, October 1990. 3 fig, 3 tab.

scriptors: *Energy costs, *Incineration, *Municipal wastes, *Sludge disposal, *Waste management, astewater treatment, Performance evaluation, dge treatment.

dge handling and disposal have become major rational concerns at many wastewater treatt facilities. Today there is renewed interest in ge incineration. There is an increased need for duals volume reduction, and technical improvets have occurred in the fields of energy recov- sludge thickening and dewatering and emis- s control. A study was performed to evaluate status of sludge incineration with low fuel use. ee of the facilities selected for the study used tiple-hearth technology and one facility used lized-bed technology. Raw data were obtained ugh a review of available plant records and ussions with each plant's staff. Both energy t and output were estimated for each unit ess, and energy efficiency was examined on ral levels. For a fuel efficient sludge incinerr facility, the study found that annual auxiliary consumption within the furnace should be in range of 1.2 to 1.4 mil kJ/dry tonne (1.0 to 1.2 Btu/dry ton) of sludge cake processed. Total al costs for the incineration system after dewag should be in the range of $180 to $225/dry e ($163 to $204/dry ton) of sludge cake proc- d when operating at capacity. The design, opon, and managerial features that strongly conte to energy-efficient sludge incineration in- e: a uniform furnace feed rate and quality; staff ing and motivation, and cooperation between oyees; a strong equipment maintenance pro- ; a common staff goal of energy efficient ce operation; and installation of a common ating philosophy and guidelines for the entire (VerNooy-PTT)
-02563

DELINES FOR PHYSICAL AND BIOLOGI- MONITORING OF AQUATIC DREDGED TERIAL DISPOSAL SITES.
y Engineer Waterways Experiment Station, sburg, MS. Environmental Lab.
primary bibliographic entry see Field 5A.
-02607

LUATION OF LOADING AND DREDGED TERIAL OVERFLOW FROM MECHANI- LY FILLED HOPPER BARGES IN BILE BAY, ALABAMA.
y Engineer Waterways Experiment Station, sburg, MS. Environmental Lab.
. Palermo, and P. A. Zappi.
able from the National Technical Information ce, Springfield, VA 22161. Miscellaneous EL-90-16, September 1990. 21 p, 14 fig, 2 ref.

riptors: *Dredging wastes, *Mobile Bay, rflow, *Waste disposal, Alabama, Dredging, tests, Slurries, Solids.

orizing legislation for the deepening of navi- channels in Mobile Bay specifies that the new work dredged material and material from future maintenance dredging must be placed in an approved open-water disposal site in the Gulf of Mexico. Large mechanical dredges with clamshell buckets are being used for the new work dredging. Hopper barges are loaded with the dredged material and transported by tug to the disposal site. Mechanical dredging is also the most likely technique for future maintenance. The economic loading of the hopper barges and the potential environmental impact associated with barge overflow during loading are important issues. Therefore, a field study was conducted to give site-specific information on the loading gains achieved by overflow, and the characteristics of the overflow for conditions in the Mobile Bay. The field study included: data collection on dredge-operating characteristics; sampling and testing of material comprising the barge overflow; and monitoring the loading characteristics of the barges. The dredge CHICAGO (equipped with a 30 cu yd clamshell bucket) and 6000 cu yd hopper barges were used during the study. Loads gained during three overflow tests were 4.1, 1.2, and 11.5% for overflow periods of 60, 24, and 65 minutes. For all three overflow tests, the overflow ended with a significant amount of diluted slurry ponded in the barges, indicating that additional load gains would be possible with prolonged periods of overflow. The solid concentrations of bucket material samples averaged 1,080 g/L, while the overflow was essentially constant for the entire period of overflow, and averaged 80 g/L. Results indicate that retention of solids in the hopper barges occurs during the overflow process for mechanical dredging. (Author's abstract)
W91-02609

ASSESSMENT OF OCEAN WASTE DISPOSAL. TASK 5. HUMAN HEALTH IMPACTS OF WASTE CONSTITUENTS. II. PATHOGENS AND ANTIBIOTIC-AND HEAVY METAL-RESISTANT BACTERIA.
Maryland Univ., College Park. Dept. of Microbiology.
D. J. Grimes.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-153084. Price codes: A08 in paper copy, A01 in microfiche. May 1986. 132 p, 11 fig, 27 tab, 283 ref.

Descriptors: *Human diseases, *Ocean dumping, *Public health, *Waste disposal, *Wastewater pollution, *Water pollution effects, Coastal waters, Estuaries, Pathogenic bacteria, Waste management, Water pollution control.

The disposal of wastes in the ocean has been practiced by coastal nations for decades. All areas of the ocean have been subject to disposal use, including estuaries, nearshore, open shelf, and deep ocean sites. Until recently it was believed that pathogenic bacteria did not survive for any significant period of time in estuarine and marine environments. This document provides a description of: potentially harmful constituents of wastes (viruses, pathogenic bacteria, pathogenic fungi, pathogenic algae, protozoa, and helminths); ways in which these constituents could reach humans; known incidents of human disease contracted from wastes; detection of waste-borne disease agents; management technologies (facultative lagoon systems, activated sludge treatment systems, trickling-filter treatment systems, and disinfection); and monitoring and predictive trends. (Lantz-PTT)
W91-02616

SEWAGE SLUDGE: APPLICATION TO SOILS (JAN 85 - JUL 89). CITATIONS FROM THE BIOBUSINESS DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-866495. Price codes: N01 in paper copy, N01 in microfiche. August 1989. 83p.

Descriptors: *Bibliographies, *Fertilizers, *Heavy metals, *Sludge disposal, *Sludge utilization, *Soil amendments, *Wastewater treatment, Regulations, Sludge analysis, Sludge treatment, Waste treatment.

This bibliography contains citations concerning the application of sewage sludge to soil for agricultural or ameliorative purposes. Distribution of heavy metals from sewage sludge in amended soils and in plants grown in these soils is discussed. The fertilizing effect of sewage sludges and methods of processing, application, and analysis are included. Some regulatory questions and marketing scenarios for sludge fertilizers are presented. Sewage treatment is discussed in separate bibliographies. This new bibliography contains 168 citations fully indexed with a title list. (Author's abstract)
W91-02643

SUMMARY OF RISK ASSESSMENT METHODOLOGIES FOR MUNICIPAL SLUDGE REUSE OR DISPOSAL OPTIONS.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
R. J. F. Bruins, L. Fradkin, and J. F. Stara.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-218168. Price codes: AO2 in paper copy, AO1 in microfiche. Report No. EPA/600/D-89/016. 1989. 7p, 13 ref.

Descriptors: *Path of pollutants, *Risk assessment, *Sludge disposal, Air pollution, Food chains, Groundwater pollution, Landfills, Leachates, Management practices, Municipal wastewater, Ocean disposal.

Risk assessment methods have been developed which can be used to calculate criteria for controlling toxic pollutants in municipal wastewater sludges. These methods consist of algorithms, ranging from simple to complex, which allow calculation of exposure and risk from various sludge disposal practices. These calculations may show a need for management practice controls or for numerical limits on specific pollutants. Criteria for land-applied or distributed and marketed sludge may take the form of application rate limits (kg/ha) or concentration limits, calculated to control pollutant levels in the food chain or off-site movement in air or water. Criteria for landfilled sludge are defined in terms of acceptable leachate concentrations, as determined by an appropriate leachate characterization test, to prevent excessive groundwater contamination of vapor emission. Incineration criteria are expressed as limitations on stack emission rates (g/sec), based on predicted air concentrations at ground level. Criteria for sludge which is ocean-disposed at the 106-Mile Site are calculated in terms of sludge concentration and total daily pollutant input to the site, in order to protect marine life and human consumers of seafood. These risk assessment methods were developed in a research environment in order to promote scientific consistency in the regulatory process. (Author's abstract)
W91-02666

HAZARDOUS WASTE CONTAINMENT USING CLAY LINERS.
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
C. J. Miller, and M. Mishra.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 191-199, 4 fig, 12 ref.

Descriptors: *Clay liners, *Groundwater pollution, *Groundwater quality, *Hazardous waste disposal, *Landfills, *Leaching, *Path of pollutants, *Water pollution control, *Water quality management, Darcys law, Drying, Flow models, Groundwater management, Landfill liners, Leakage, Mathematical analysis, Model studies, Open-channel flow, Porosity, Vertical flow, Water resources management.

The use of clay liners is prevalent in the waste disposal industry. The liner is expected to perform a most critical function. It provides a barrier between the natural environment and the deposited waste. It is obvious that unrestricted migration of the waste could lead to soil, groundwater, and

surface water contamination. However, it has also become evident that such environmental problems are also prevalent in the vicinity of landfills constructed with clay and/or synthetic liner barriers. Current models have been shown to underestimate the actual leakage volumes because of the existence of macropores, especially attributed to desiccation cracking. A conceptual model of flow through cover liners has been developed that acknowledges the existence of macropores. Flow through the clay matrix is modeled using Darcy's law, while the macropore flow component is modeled using the equations governing analogous processes in open channel and closed conduit hydraulics. These equations are well developed and verified in other applications. Future investigations will provide the complete mathematical model of flow through clay liners incorporating the macropore concepts. Collection of field data for verification of the model is underway. (See also W91-02672) (Fish-PTT)
W91-02690

HYDROLOGIC HYDROCHEMICAL CHARACTERIZATION OF TEXAS FRIO FORMATION USED FOR DEEP-WELL INJECTION OF CHEMICAL WASTES.
Texas Univ., Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 5B.
W91-02814

MECHANISM OF ENRICHMENT OF TRACE METALS ON FINE SLUDGES COLLECTED FROM FILTRATION PLANTS.
Kansei Kogyo K.K., Sakata (Japan). Inst. for Environmental Measurement.
For primary bibliographic entry see Field 5A.
W91-02819

EC BATHING WATERS DIRECTIVE AS APPLIED TO SCOTLAND.
Forth River Purification Board, Edinburgh (Scotland).
For primary bibliographic entry see Field 5G.
W91-02848

SLUDGE DISPOSAL STRATEGY FOR DUMFRIES AND GALLOWAY REGIONAL COUNCIL.
J. N. Dobson.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 4, p 371-378, August 1990. 3 fig, 9 tab, 7 ref.

Descriptors: *Land disposal, *Legislation, *Scotland, *Sludge disposal, *Waste disposal, Agriculture, Dumfries, Galloway, Odor control, Regulations, Septic tanks, Sludge lagoons, Sludge treatment, Waste management.

The Dumfries and Galloway Regional Council's largely rural statutory area extends to 6370 sq km, with a population of 146,000. During 1988, the Council, mindful of impending legislation likely to affect existing sludge disposal outlets, particularly those in agricultural land, commissioned a detailed study into all aspects of sewage sludge production, treatment, storage and disposal. The aim of the study was the production of a regional sludge disposal strategy. Consideration was given to five different options of sludge disposal. The following recommendations were outlined: (1) disposal of sewage sludge to agricultural land; (2) the Regional Council to carry out spreading operations; (3) retain lagoons as emergency reservoir storage; (4) construction of four sludge treatment centers, incorporating mesophilic anaerobic digestion and fine screening; (5) install an odor control plant; (6) operate a microcomputerized sludge maintenance control system; (7) appoint a sludge management officer; (8) purchase and operate farms; (9) utilize the expertise of the Barony College of Agriculture; (10) commission a study to identify an optimum working plan for sludge tanking operations; (11) rationalize the sizes of community septic tanks; (12) improve sludge thickening at larger works; (13) develop a program for emptying community and private septic tanks; (14) intensify trade effluent monitoring; and (15) terminate centrifuge dewatering and thermophilic aerobic digestion of sludge at Annan. (Lantz-PTT)
W91-02850

EUROPEAN ENVIRONMENTAL DIRECTIVES--IMPLICATIONS FOR NORTHERN IRELAND.
For primary bibliographic entry see Field 5G.
W91-02851

GAS MIGRATION IN DISCRETE FRACTURE NETWORKS.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Land and Water Resources.
R. Thunvik, and C. Braester.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2425-2434, October 1990. 6 fig, 3 tab, 7 ref.

Descriptors: *Fracture permeability, *Gas migration, *Geologic fractures, *Path of pollutants, *Radioactive waste disposal, *Underground waste disposal, Boundary conditions, Flow rates, Mathematical models, Permeability, Pressure distribution.

A mathematical model is presented for the upward pulsating gas-water displacement, from a gas source at a constant production rate or pressure at the bottom boundary to a constant pressure boundary at the top boundary. The study shows a complicated flow phenomenon caused by the unequal advance of the gas in fractures of different permeability or different inclinations. The results show that the gas breakthrough at the surface is governed by the high permeability factor. At a constant rate of gas production the breakthrough is associated with a gas pressure build up and reinitiates the upward displacement. Calculations with average properties of the fracture permeability, using the continuum approach, will underestimate the breakthrough time of the gas at the surface. Under the constant pressure boundary conditions at the top of the cavern the average permeability will overestimate the amount of gas carried out by the fracture network. Under constant flow rate boundary conditions at the top of the cavern, calculations with average fracture permeability will overestimate the pressure in the cavern. The problem is of practical interest for low-level radioactive waste repositories located in hard rock below the sea bottom. (Author's abstract)
W91-02871

DIVERSION CAPACITY OF CAPILLARY BARRIERS.
Disposal Safety, Inc., Washington, DC.
B. Ross.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2625-2629, October 1990. 2 fig, 7 ref.

Descriptors: *Capillary water, *Groundwater barriers, *Toxic wastes, *Waste disposal, *Water pollution control, Diversion structures, Hydraulic conductivity, Infiltration, Percolation, Permeability, Pressure potential, Soil porosity, Soil properties, Soil saturation, Waste management.

An important objective in the management of toxic wastes is to minimize the amount of water percolating through the wastes. An arrangement of unsaturated fine-grained soil overlying unsaturated coarse-grained soil along a sloping contact can, under appropriate circumstances, divert infiltrating water away from the coarser material. Such an arrangement is called a capillary barrier. The water is diverted by a capillary barrier flows downdip above the contact. The volume of water moving laterally increases in the downdip direction as additional infiltration is diverted by the barrier. Sufficiently far downdip, the laterally moving water wets the contact to the point that an amount of water equal to the infiltration flows downward through the coarse soil. The lateral flow at such a point represents the diversion capacity of the capillary barrier because this flow will not increase farther downdip. If the width (measured in the direction of dip) of the system is large enough that total infiltration exceeds the diversion capacity, the downdip portion of the barrier will not be effective. The diversion capacity can b calculated exactly in the quasi-linear approxima tion where the relationship between relative pe meability (k-rel) and pressure potential (psi) take the form k-rel = e to the alpha psi power. Th calculation shows that an upper bound on th width of capillary barriers is K-s tan phi/(q alpha), where K-s is the saturated hydraulic co ductivity of the fine soil, phi is the dip angle of th contact, and q is the infiltration rate. (Author abstract)
W91-02887

LABORATORY INVESTIGATION OF BEAC PROFILES IN TAILINGS DISPOSAL.
Alberta Univ., Edmonton. Dept of Chemical Eng neering.
X. Fan, and J. Masliyah.
Journal of Hydraulic Engineering (ASC JHEND8, Vol. 116, No. 11, p 1357-1373, Nove ber 1990. 12 fig, 23 ref.

Descriptors: *Beach profiles, *Hydraulic minin *Mine wastes, *Waste disposal, *Waste manag ment, Differential equations, Flumes, Mathematic models, Mining engineering, Sedimentation, Sett able solids, Slope stability, Slurries, Solid wast

Large quantities of tailings are produced daily mining processes. Proper tailings disposal and m agement of tailings ponds are required for envir mental and economical reasons. Hydraulic me ods, in which tailings and water are mixed to fo a slurry, are often employed to transport tailin from the producing plant to the disposal s When the slurry is discharged into the tailin pond, the coarse solids settle out, forming a bea while the fine solids and water end up in tailings pond as sludge, which has to be sto permanently. The management of hydraulica deposited tailings is an important component c mining operation, and involves prediction of beach profile formed by the coarse solids. Tr sient beach profiles in tailings disposal were in tigated both experimentally and theoretically. effects of feed solids concentration and total slu discharge on beach profiles were examined usir plexiglass flume. It was found that the slope of beach and the rising rate of the beach at the so feeding point were much influenced by feed so concentration. On the other hand, when the f solids concentration is constant and the total slu discharge is varied, the slope of the beach does change significantly. A nonlinear mathemat model is developed to predict beach profiles. resulting partial differential equation is solved merically by a simple explicit scheme. Very g agreement between the experimental data and theoretical prediction is observed. The experin tal data are also correlated successfully wit power expression, which is often seen in mi engineering literature. (Author's abstract)
W91-02919

ABSENCE OF CADMIUM IN THE BLOOD HORSES FED OATS GROWN ON MUNICI SLUDGE-AMENDED SOIL.
G. A. Maylin, C. A. Bache, and D. J. Lisk.
Science of the Total Environment STENDL, 96, No. 3, p 313-316, August 1990. 2 tab, 10

Descriptors: *Blood, *Cadmium, *Oats, *Pat pollutants, *Sludge disposal, *Sludge utiliza *Water pollution effects, Farms, Food chains dustrial wastes, Municipal wastes, Toxicity.

Effluents from a number of industries whicl typically treated in municipal sewage plants r in cadmium-containing sludge. Disposal of sewage sludge by application to agricultural can result in uptake of cadmium by crops. were grown on soils which had been ame with sewage sludge from Syracuse, New The cadmium concentration in the sludge-g oats was 1.79 ppm dry weight. Horses were fe sludge-grown oats for 6 weeks during which blood samples were taken for the determinati cadmium. No significant differences were fou the concentration of cadmium in the blood horses consuming the oats compared with th

ıe blood before feeding began (control). The ell-known efficient accumulation of renal cadmi- n by horses may account for a lack of significant- increased cadmium in blood during the feeding eriod. (Author's abstract)
'91-02933

MPACT OF SYNTHETIC LEACHATE ON HE HYDRAULIC CONDUCTIVITY OF A MECTITIC TILL UNDERLYING A LANDFILL EAR SASKATOON, SASKATCHEWAN.
ational Hydrology Research Inst., Saskatoon askatchewan). Ground Water Div.
K. Yanful, M. D. Haug, and L. C. Wong.
nadian Geotechnical Journal CGJOAH, Vol. , No. 4, p 507-519, August 1990. 14 fig, 6 tab, 41 f.

escriptors: *Glacial drift, *Hydraulic conductivi- *Landfill linings, *Leachates, *Permeability, mectitic till, Canada, Clay minerals.

ı evaluation is presented on the effects of leach- on the hydraulic conductivity, k, of a smectitic cial till used in the construction of a compacted rth liner for a landfill near the city of Saskatoon, skatchewan, Canada. Low gradient triaxial per- ability testing of the water-molded till over a 7- nth period with six pore volumes of test leach- at a hydraulic gradient of approximately 100 ve a hydraulic conductivity of 0.3 nm/s, com- red with 0.6 nm/s for the water-permeated nple at the same gradient. The k was also evalu- d at gradients of 20 and 50 during water perme- on and found to be 0.8 and 0.68 ncm/s, respec- ely. The slight decrease in k with increase in dient was attributed to a decrease in void ratio, ulting from a net increase in applied effective ess at the outflow end of the specimen. An essment of the clay mineral composition of the at the end of permeability testing did not show lapse of the smectite peak. Instead, the leachate peared to have actually enhanced the smectite k relative to the illite peak. It was concluded t the leachate did not have any detrimental act on the till and that the hydraulic conductiv- of the 0.3m thick liner underlying the landfill y not be expected to increase as a result of raction with leachate. (Author's abstract)
91-02943

PACT OF DISTILLERY EFFLUENT APPLI- TION TO LAND ON SOIL MICROFLORA.
ional Environmental Engineering Research ., Nagpur (India).
primary bibliographic entry see Field 5C.
1-02946

GIONAL SLUDGE MANAGEMENT PLAN- NG IN VERMONT.
Tresne-Henry, Inc., North Springfield, VT.
E. Lang, T. D. Nesbitt, and R. A. Jager.
ter Environment & Technology WAETEJ, 2, No. 9, p 15-18, September 1990.

criptors: *Composting, *Liquid sludge, dge cake, *Sludge management, *Sludge treat- nt, *Vermont, Administrative regulations, Land osal, Regional analysis, Regional planning, dge drying.

gher state regulations on sludge management ermont compelled Environmental Conserva- municipal officials in 1987 to study and evalu- options for regional sludge management. The ons involved as many communities as possible allowed those generating the least sludge to efit from the economy of scale. This study lted in two conclusions. First, land application ewatered sludge cake (20% solids) represented gnificant savings over land application of liquid ge, because of the additional storage and trans- ation needs associated with land application of d sludge. Second, with the exception of the application of liquid sludge and vertical plug composting, the present worth costs of the aining alternatives are relatively close, ranging n $8.9 million for contract land application of atered sludge to $10.3 million for horizontal ted bin composting. The analysis for the Rut- land and Connecticut River Valley regions yielded similar results. Recommendations are given for the most cost-effective sludge management for each region studied. (Medina-PTT)
W91-02954

SITING AND TECHNOLOGY POSE CHALLENGES FOR COMMUNITIES ENDING OCEAN DISPOSAL OF SLUDGE.
Black and Veatch, Inc., Cambridge, MA.
For primary bibliographic entry see Field 5D.
W91-02955

5F. Water Treatment and Quality Alteration

PROBLEMS OF GROUND WATER TREATMENT IN AN AREA OF DEPRESSION (ZUR PROBLEMATIK DER GRUNDWASSERAUFBEREITUNG IN EINEM ABSENKUNGSGEBIET).
Kreiskrankenhaus Treuenbrietzin (German D.R.).
For primary bibliographic entry see Field 5B.
W91-02060

MICROBIAL QUALITY OF THE WATER IN THE DISTRIBUTION SYSTEM OF FLORENCE.
Florence Univ. (Italy). Inst. of Hygiene.
L. Gambassini, C. Sacco, E. Lanciotti, D. Burrini, and O. Griffini.
Aqua AQUAAA, Vol. 39, No. 4, p 258-264, August 1990. 1 fig, 3 tab, 27 ref.

Descriptors: *Florence, *Italy, *Pathogenic bacteria, *Pathogens, *Water distribution, *Water quality, *Water treatment, Bacteria, Pollutant identification, Potable water, Staphylococcus, Surface water, Water conveyance, Water quality monitoring, Water sampling, Water supply.

A significant tract of the water distribution network of the Florence waterworks, which purifies surface water from the Arno River, was monitored between March 1987 and February 1988. Physiochemical and microbiological parameters were analyzed in 66 samples of water. Samples were collected at 3-4 week intervals at six different points along the water distribution network. The network sampling points selected were used in an effort to establish the real residence time of water in the system. It was found that bacterial growth values were constant with the exception of a point at the end of the network, which experienced a lowering of chlorine and temperature variation. The most commonly isolated bacteria belonged to the families Pseudomonadaceae, Bacillaceae, Micrococcaceae, and Enterobacteriaceae as found by other authors. Staphylococcus hominis, S. warneri, Pseudomonas maltophila, and Bacillus spp. were commonly found in the network. Opportunistic pathogens such as S. aureus and P. aeruginosa occurred only once in particularly favorable conditions at the terminal point of the network. The adoption of water filtration through granular activated carbon, which is in process in the treatment plant for the surface Arno River water, will further improve the quality of distributed drinking water by reducing the biodegradable organic carbon levels and limiting the growth of microorganisms. (Author's abstract)
W91-02144

EFFECT OF CHARGE DENSITY AND MOLECULAR MASS OF CATIONIC POLYMERS ON FLOCCULATION KINETICS IN AQUEOUS SOLUTION.
University Coll., London (England). Dept. of Civil Engineering.
J. Gregory, and S. Y. Lee.
Aqua AQUAAA, Vol. 39, No. 4, p 265-274, August 1990. 9 fig, 2 tab, 19 ref.

Descriptors: *Chemical coagulation, *Flocculation, *Polymers, *Suspension, *Water treatment, Cations, Physicochemical properties, Reagents, Silica.

At present there is limited understanding of dynamic aspects of polymer adsorption and flocculation, especially in agitated suspensions. Kinetic aspects of polymer adsorption and flocculation in stirred suspensions of silica particles have been studied using cationic polymers of different charge density and molecular mass. Silica particles were dispersed in deionized water and fractionated by sedimentation to give particles mainly in the 1-3 micrometer range. The polymeric flocculants were all copolymers of acrylamide or dimethylaminoethyl acrylate (DMAEA). The molar proportion of DMAEA determines the charge density. An optical method using a photometric dispersion analyzer was used to monitor flocculation. The results show that the rate of polymer adsorption can be slow compared to particle collision rate, especially when the polymer is of low charge density and low molecular mass. The charge density of a polymer is important in determining the optimum dosage. For all of the polymers used, the amount of positive charge adsorbed at their respective optimum dosages is about the same. However, the rate of adsorption and the flocculation rate may be affected by charge density and molecular mass. (Tappert-PTT)
W91-02145

PRECONCENTRATION OF COPPER ON ALGAE AND DETERMINATION BY SLURRY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY.
Texas Univ. at Austin. Dept. of Chemistry and Biochemistry.
For primary bibliographic entry see Field 5A.
W91-02191

COMPARISON OF QUARTER-HOURLY ON-LINE DYNAMIC HEADSPACE ANALYSIS TO PURGE-AND-TRAP ANALYSIS OF VARYING VOLATILE ORGANIC COMPOUNDS IN DRINKING WATER SOURCES.
Drexel Univ., Philadelphia, PA. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-02219

IMPACT OF HANDPUMP CORROSION ON WATER QUALITY.
International Bank for Reconstruction and Development, Abidjan (Ivory Coast). Regional Water and Sanitation Group.
O. Langenegger.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 594-604, 7 fig, 1 tab, 2 ref.

Descriptors: *Corrosion, *Domestic water, *Groundwater quality, *Pumps, *Wells, *West Africa, Biofilms, Deterioration, Developing countries, Galvanized metal, Ghana, Iron, Ivory Coast, Pipes, Rural areas, Steel, Water mains.

The exploitation of groundwater by means of boreholes for supplying small user groups and rural communities with water has been widely applied in various parts of the world for decades. In recent years this practice has become global, with hundreds of thousands of boreholes drilled to tap low-yielding aquifers. In developing countries handpumps usually are used for lifting the water, although solar or other systems with submersible pumps also are used. The experience gained with handpump-equipped boreholes within the World Bank executed inter-regional UNDP-Handpumps Project (INT/81/026) provided quantitative data on the water quality of wells in terms of iron concentration and other parameters. The corrosive attack on galvanized iron, the effect of biofilms on the corrosion rate, and the difference between internal and external corrosion of rising mains are shown by these data. A biofilm developed on a mild steel specimen at 27 C within about 30 to 40 hr, whereas no biofilm, or only traces, was observed on the specimen at 10 C. The dissolution of iron through corrosion measured as iron increase

(total Fe) was indirectly proportional to the formation of the biofilm and the NH4 concentration at 27 C. The iron increase was higher and relatively constant at 10 C. Under prevailing conditions in the investigated areas (Ivory Coast and Ghana), galvanization does not protect mild steel from corrosion. Internal parts of rising main assemblies seemed to show a higher tendency to form protective biofilms compared to the external parts. The less a pump is operated, the more corrosion products are formed and accumulated in the rising main assembly and in the well. (See also W91-02288) (Rochester-PTT)
W91-02338

PULSA SOLAR: SOLAR WATER OSCILLATION PUMPS FOR VILLAGE HYDRAULICS.
Fluxinos Italia S.R.L., Grosseto.
T. E. Manning, E. Mencarelli, and G. Cefis.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 712-721.

Descriptors: *Developing countries, *Pumps, *Rural areas, *Solar energy, *Water supply, Africa, Cost analysis, Design criteria, Drinking water, Economic aspects, Oscillation pumps, Pulsa Solar, Semiarid lands, Wells.

A solar water oscillation pump (PULSA SOLAR) for village hydraulics in developing countries was developed that will supply 25 liters of water per person per day from boreholes with water depths of 0-50 m. The pump is designed to provide the minimum water prescribed by the World Health Organization for villages of 200 people for drinking and personal use. Photovoltaic arrays of only 160-240 Wp are employed. Analysis of the cost effectiveness of the PULSA system hand pumps compared to PULSA SOLAR pumps was conducted. Global maintenance costs for both PULSA pumps and PULSA SOLAR pumps over a long period can be limited to $ 0.50 (US) per person per year. The additional investment cost of a PULSA SOLAR pump, if written off over a period of 10 yr, amounts to $ 1.50 per person per year in a village of 200 persons. (See also W91-02288) (Rochester-PTT)
W91-02347

DESIGN AND MANAGEMENT OF RURAL WATER SUPPLY PROJECTS: LESSONS LEARNED FROM COMPARATIVE STUDY OF USAID PROJECTS IN BURKINA FASO AND TOGO.
Water and Sanitation for Health Project, Arlington, VA.
P. Roark.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 902-910, 2 ref.

Descriptors: *Benefits, *Burkina Faso, *Developing countries, *Political aspects, *Public policy, *Rural areas, *Togo, *Water supply, Governmental interrelations, Maintenance, Management planning, Public health, Sanitation, Social aspects, Water resources development, Wells.

The design and management of rural water supply projects in many developing countries require the active participation of four institutional entities: government, local communities, private sector entrepreneurs, and international donors. A comparative study of two United States Agency for International Development (USAID)-funded projects in Burkina Faso and Togo provides interesting conclusions on the roles that each of the entities can assume most efficiently. The projects were similar in that they installed more than 1700 wells in specific regions of the two countries and stressed community development and health education as a part of the total program. Their design and management approaches were, however, different and led to different results and conclusions. The Burkina Faso project was conducted separately from the national government; it had its own personnel (342) and vehicles, office, and other equipment. Most of the staff were temporary and their employment ended at the end of the project. In Togo, existing social and technical agencies were involved and the well drilling itself was conducted by a private firm hired through a competitive bidding process. The advantage of the Togo project is that project sustainability and replicability are entrenched within a permanent Togo government institution that will continue in the future. Balanced development requires projects to coordinate the individual components of water, sanitation, health, education, and community participation. More emphasis is needed in the latter three components to maximize the health benefits of water supply. Operations and maintenance of water systems continues to be a problem that will require more attention by project designers and managers in the future. (See also W91-02288) (Rochester-PTT)
W91-02362

KEY FACTORS IN TASTE AND ODOUR PROBLEMS FOR MUNICIPAL WATER WORKS USING SURFACE WATER SOURCES.
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 881-891, 1990. 5 fig, 9 tab, 19 ref.

Descriptors: *Algae, *Aquatic bacteria, *Eutrophication, *Fungi, *Limiting nutrients, *Municipal water, *Odors, *Organoleptic properties, *Phytoplankton, *Taste, *Water pollution sources, *Water quality, *Water treatment, Diatoms, Lake Huron, Nitrates, Phosphorus, Silicates, Silicon.

Taste and odor problems of municipal water supplies can be grouped into two main categories: those associated with algae and other organisms naturally found in surface water, and those associated with industrial and municipal waste inputs to surface waters. This study considers taste and odor problems of natural origin. Planktonic algae are of importance in water supplies and water pollution, and fall into four classes: blue-green algae, green algae, diatoms, and pigmented flagellates. Fungi and bacteria associated with the decomposition of organic matter can also cause taste and odor problems. Primary environmental factors such as nutrient availability, sunlight and water temperature affect algal growth. Phosphorus is the most significant factor in blue-green algal blooms, while carbon and nitrogen are less likely to be limiting. Silicon, in the form of silicates, is essential to the growth of diatoms. Silicate depletion can limit diatom growth or cause a shift to other algae. A case study of five-year records at three locations from Lake Huron have indicated that: (1) the phytoplankton levels (primarily diatoms) are not of a level to create taste and odor problems; (2) when the total P levels are low, then P is limiting the growth of phytoplankton. When P concentrations increase, phytoplankton levels are not limited by P levels. In this situation, the phytoplankton intensities are responsive to levels of total Kjeldahl nitrogen, reactive silicate and nitrate. This finding is in agreement with other studies which indicate that with the high biomass of diatoms in the spring, silica concentration probably becomes a limiting factor in Lake Huron, leaving room for more eutrophic forms to develop later in the season. (Sand-PTT)
W91-02394

RELATING EMPIRICAL WATER QUALITY DIAGRAMS AND PLANKTON-DYNAMICAL MODELS: THE SAMPLE METHODOLOGY APPLIED TO A DRINKING WATER STORAGE RESERVOIR.
Rijksinstituut voor de Volksgezondheid, Utrecht (Netherlands).
T. Aldenberg, and J. S. Peters.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 893-911, 1990. 5 fig, 9 tab, 20 ref, 4 append.

Descriptors: *Drinking water, *Model studies, *Phytoplankton, *Sensitivity analysis, *Storage reservoirs, *Water quality, *Zooplankton, Chlorophyll, Irradiation, Limiting factors, Nutrients, Transparency, Water quality trends.

Relationships have been established betwee trends in empirical water quality diagrams an sensitivity of steady states of plankton-dynamica models to changes in input, such as nutrient loa and irradiance. A model with two trophic levels not likely to show input sensitivity to water qualit parameters like chlorophyll or transparency. Inpu responsiveness is carried over to the second troph ic level instead. To illustrate the methodology, th model is applied to data from a drinking wat storage reservoir near Amsterdam. The approac can be put into a more general setting. The limitin factor concept can be defined rigorously throug sensitivity analysis, which also seems the rig framework for monitoring indirect effects in gene al. The SAMPLE acronym (Sensitivity-Adde Models for the Prediction of Linkages in Ecosy tems) stresses the fact that, in order to monit these linkages (indirect effects), sensitivity modul could be a permanent and invaluable part of ec logical models. The linkages in fact then becon states themselves. (Author's abstract)
W91-02395

WATER TREATMENT PROBLEMS.
V. Moravcova.
Ergebnisse der Limnologie ERLIA6, Vol. 33, N 3, p 967-975, 1990. 6 tab, 5 ref.

Descriptors: *Drinking water, *Operating polici *Water quality management, *Water supp *Water treatment, Algae, Coagulation, Czechos vakia, Filtration, Performance evaluation, Wa quality standards.

Biological evaluations of changes in the quality raw water in several Czech and Moravian wat supply reservoirs were carried out during t period 1980-87. Present Czech standards requ the total absence of organisms in the drink water, but only a few waterworks can meet t requirement. However, at many waterworks wa treatment could be improved. Correctable pr lems encountered in a survey of Czech wat treatment facilities include: (1) failure to cho the optimal water intake depth; (2) use of ot than the optimal type and dose of coagulant; omission of laboratory coagulation tests; (4) in quent use of auxiliary organic flocculent; (5) n optimal length of filter runs; (6) failure to excl from the water system the first fraction of pollu water after washing of rapid sand filters; (7) quent interruption of treatment processes for 8 more hours per day; and (8) poor raw water q ity due to the overgrowth of algae, even in tr ment plants with good operating procedures. (thor's abstract)
W91-02400

POTENTIAL FOR EXPERT SYSTEMS WATER UTILITY OPERATION AND M AGEMENT.
Clarkson Univ., Potsdam, NY. Dept. of Civil Environmental Engineering.
A. G. Collins, S. J. Nix, T. K. Tsay, A. Gera, a M. A. Hopkins.
Journal of the American Water Works Associa JAWWA5, Vol. 82, No. 9, p 44-51, Septer 1990. 2 fig, 3 tab, 49 ref.

Descriptors: *Computer programs, *Expert tems, *Metropolitan water management, *Util *Water distribution, Computers, Water con ance, Water management, Water resources agement, Water supply, Water use efficie Water utilities.

The water utility industry has been and is se ways to use computer technology to enhance ations and management. One of the more exc technologies to emerge in the last decade i expert system. An expert system is designe simulate the advice and knowledge that ex provide about a problem or domain. These lack of potential applications for expert sy within the water industry. Generic expert sys

owever, are not a viable alternative for water ilities at this time. Expert systems can be applied any decision-making process. The more time voted to the development of the expert system, e more it will mimic the expert. Therefore, ap-ying expert systems is site and situation-depend-t. The major cost associated with an expert stem is usually the labor needed for development d maintenance. Computer hardware and soft-re should be carefully chosen with this in mind. with any other technology, it is important to refully assess its usefulness and effectiveness fore considerable resources are committed and pended. The usefulness of expert systems to a rticular utility can probably best be determined that utility. (Mertz-PTT)
91-02415

MPLE MEMBRANE FILTER METHOD TO ONCENTRATE AND ENUMERATE MALE-ECIFIC RNA COLIPHAGES.
rth Carolina Univ., Chapel Hill. Dept. of Envi-mental Sciences and Engineering.
r primary bibliographic entry see Field 5A.
91-02416

ROLYSIS-GC-MS FOR INVESTIGATING GH-MOLECULAR-WEIGHT THM PRECUR-RS AND OTHER REFRACTORY ORGAN-S.
ntre de Recherche Lyonnaise des Eaux - Degre-nt, Le Pecq (France).
Bruchet, C. Rousseau, and J. Mallevialle.
rnal of the American Water Works Association WWA5, Vol. 82, No. 9, p 66-74, September 0. 14 fig, 7 tab, 27 ref.

scriptors: *Analytical techniques, *Gas chroma-raphy, *Halogenated hydrocarbons, *Humic stances, *Mass spectrometry, *Organic com-nds, *Pyrolysis, *Water analysis, *Water treat-nt, Chlorination, Dissolved organic carbon, aration techniques, Trihalomethanes, Water lity.

ural waters typically contain 2 to 10 mg/L olved organic carbon (DOC). A refractory, chromatographable fraction comprising 85 to percent of the DOC is often improperly re-ed to as 'humic acids'. Considerable interest in transformation of these refractory organics ng treatment processes was sparked by the overy that the chlorination of humic sub-ces could yield toxic trihalomethanes (THMs). e 1985, a preseparation technique has been eloped using pyrolysis/gas chromatography)/mass spectrometry (MS). This method ws the preparation of apparent molecular ght fractions. Extensive use of pyrolysis/GC/ to further characterize these fractions has led significant results concerning the varying re of DOC and thus an understanding of many cts of water treatment, such as the efficiency agulation processes, the wide variations in the M formation potential between waters of differ-origins, the competitive effects in adsorption or ation processes, and the fouling problems in brane processes. (Mertz-PTT)
-02418

MPARISON OF THE ZINC SULFATE AND MUNOFLUORESCENCE TECHNIQUES DETECTING GIARDIA AND CRYPTO-RIDIUM.
rican Water Works Service Co., Inc., Belle-IL. Belleville Lab.
primary bibliographic entry see Field 5A.
-02419

ESSING DEFINED-SUBSTRATE TECH-OGY FOR MEETING MONITORING RE-REMENTS OF THE TOTAL COLIFORM E.
is State Environmental Protection Agency, gfield.
primary bibliographic entry see Field 5A.
-02420

M ZERO TO 20 MGD IN TEN MONTHS.
Indianapolis Water Co., IN.
G. S. Lyons.
Public Works PUWOAH, Vol. 121, No. 10, p 92-93, September 1990. 2 fig.

Descriptors: *Project planning, *Upgrading, *Water conveyance, *Water supply development, *Water treatment facilities, Drought effects, Indiana, Pumps, Water distribution, Water pressure, Wells.

The Indianapolis Water Company experienced low pressures and inadequate domestic and fire flow in seven sections of their service area during the drought of 1988. Problems due to treatment and transmission were experienced in the extremities of the system in four separate pressure districts. The company engineering department developed an eight-item improvement plan with an estimated cost of $9 million, to be implemented within one year. Seven of the eight projects were completed by the summer on 1989, resulting in no complaints attributed to low pressure in the four previously troubled areas. In addition, work came in $1 million under budget. The seven completed projects, which included constructing new well fields and adding and improving pump stations, provided 20 million gallons/day additional production and/or pumping capacity. Having a continuous and competent short, middle, and long-range system planning program and owning the land needed for the projects in advance of the actual need for plant construction significantly helped expediate implementation of improvements. Maintaining a competent engineering organization and obtaining the authorization to specify and order necessary equipment also kept the project moving at its rapid rate. Careful selection of local consulting engineering firms to spread the work and close monitoring of costs on a weekly basis allowed for continuous work flow within budget. Adding bonus/penalty in-service date clauses to contract documents provided incentives to complete projects on time. (Mertz-PTT)
W91-02422

COMPUTER-CONTROLLED WELL FIELD AND DISTRIBUTION SYSTEM.
Browne (Floyd) Associates Ltd., Marion, OH.
D. Merriman.
Public Works PUWOAH, Vol. 121, No. 10, p 113-114, September 1990. 1 fig.

Descriptors: *Automation, *Computers, *Process control, *Pumping, *Water distribution, *Water supply, *Well pumping, Economic aspects, Municipal water, North Carolina, Storage tanks, Water conveyance, Wells.

Controlling well pumps, storage tanks, and distribution system flow became more efficient and cost-effective when existing controls were upgraded with a computer in Atlantic Beach, North Carolina. Atlantic Beach is a small resort community on the North Carolina coast with a year-round population of 2000. The summer population climbs above 20,000 from May through September, with a peak of 50,000 on July 4th weekend. This wide population spread places unusual demands on the water supply system. The water supply comes from four wells, a fifth well is being added in 1990. The main problem with the existing control system was that lead well selection was based on the ground storage tank reaching its full level of 17 feet. Each time it did, another well was selected to be the lead well. However, this caused many short pump cycles in the off-season winter months. The lead well would pump for more than the recommended 12 hours, because lead well selection was based on tank level, not time. Economics dictated using existing equipment where possible. The wells' telemetering system could be used. Also, the water plant's existing pump control system could remain in place and act as the computer's backup. The only new equipment required was the computer, an interface relay panel (built on-site by the consultant), and customized software. The new program monitors the ground storage tank level, keeping the level between the high set point of 17 ft and a low set point of 12 feet. The computer selects a lead well pump to run when the ground storage tank is below 16 feet. It will run this pump for a total of 12 hours. The computer-based control system was operating in less than 8 weeks for under $15,000. The system has been on-line for over a year and functioning well. (Mertz-PTT)
W91-02427

LEIGH CREEK TOWN WATER SUPPLY--A HISTORY.
R. E. Reed.
Mines and Energy Review South Australia, No. 157, p 18-21, 1990. 3 fig, 7 ref.

Descriptors: *Desalination, *Leigh Creek, *Potable water, *Water supply, *Water supply development, Aroona Dam, Australia, Dams, Groundwater mining, Groundwater potential, Reverse osmosis, Saline groundwater, Salinity.

The township of Leigh Creek, 500 km north of Adelaide, Australia, was established progressively from 1941 to service the adjacent coalfields. Potable water was supplied initially from railway dams and natural catchments, but a more reliable source was required. The town was provided with water piped 48 km from Sliding Rock copper mine in 1944, but yields were low and the water was of poor quality. Aroona Dam was completed in 1954 to replace Sliding Rock, and this is still the main water source. By the mid-1970s, low water levels in Aroona Dam caused renewed interest in groundwater at Sliding Rock and areas closer to Leigh Creek. A drilling program was carried out in 1978, supplemented by further holes in 1981, and followed by a major program of 112 holes in 1982-83. Fifteen production wells resulted, with salinities ranging from 500 to 10,000 mg/L. These now supply up to 5.3 ML/day to a reverse osmosis desalination plant capable of producing 3.4 ML/day of potable water. (Author's abstract)
W91-02528

TOTAL TRIHALOMETHANE FORMATION DURING TARGETED AND CONVENTIONAL CHLORINATION OF SEAWATER FOR BIOFOULING CONTROL.
N. M. Ram, Y. G. Mussalli, and W. Chow.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 6, p 789-795, September/October 1990. 8 fig, 3 tab, 25 ref. EPRI Project RP 2300-2.

Descriptors: *Biofouling, *Chlorination, *Trihalomethanes, *Water pollution sources, *Water treatment, Condensers, Effluents, Electric powerplants, Path of pollutants, Powerplants, Seawater, Water quality control.

Microbiological fouling of condenser tube surfaces is a major contributor to poor condenser performance, which in turn reduces power plant availability and reliability. Biofouling has been controlled in the past by the chlorination of cooling waters, a method subject to increasingly stringent regulatory control in response to environmental and health concerns. Utilities are attempting to use chlorine more efficiently by utilizing targeted chlorination, a technique involving the application of a relatively low dose chlorine solution (1.0 mg/L) for short periods of time (5 min) twice per day to selected fractional areas of the inlet tubesheet of the condenser. The potential for total trihalomethane (TTHM) formation was compared using conventional versus targeted chlorination. Results indicated that targeted chlorination significantly decreased TTHM formation when compared to the conventional chlorination of cooling waters. Bromoform was the predominant THM formed in all cases, owing to the oxidation of naturally occurring bromide in seawater when chlorinated, with subsequent conversion to bromoform when reacted with organic precursors. Introduction of additional chlorine to all samples yielded considerable TTHMs after a 7-day incubation, highlighting the importance of limiting chlorine dosage in complying with discharge limitations. (MacKeen-PTT)
W91-02538

TOXICOLOGICAL RISK/BENEFIT-ASPECTS OF DRINKING WATER CHLORINATION AND

OF ALTERNATIVE DISINFECTION PROCEDURES.
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
K. Strobel, and H. H. Dieter.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 23, No. 4, p 152-162, August 1990. 9 tab, 156 ref.

Descriptors: *Chlorination, *Disinfection, *Drinking water, *Toxicity, *Water treatment, Byproducts, Carcinogens, Chlorinated hydrocarbons, Mutagens, Risk assessment, Water pollution sources, Water quality control.

Although drinking water chlorination represents one of the biggest successes in sanitation achieved in this century, an important disadvantage of the procedure is the formation of toxic and mutagenic or even carcinogenic chlorinated organic compounds. Such compounds can also be found after application of alternative disinfectants (chlorine dioxide, ozone, stabilized hydrogen peroxide), but probably to a lesser extent. Chlorination remains the best method of disinfection at present because of its superior disinfection capacity and permanent protection of the distribution system. The reduction of the amount of organic precursors can be achieved using appropriate technologies for the treatment of raw wastewater (filtration, flocculation, aerated reservoirs, slow and rapid filtration, treatment with ozone and activated carbon) and by optimal protection of water reservoirs. In many cases, these techniques will eliminate the need for chlorination. Testing for organic precursors of by-products from chemical disinfection in drinking water and establishing limits for carcinogenic/mutagenic substances in chemically disinfected water are recommended. In the long run, the protection of drinking water resources and the creation of water catchment areas seem to be the most effective and economic ways to keep the pollution of drinking water by disinfection products at a minimum level. (Author's abstract)
W91-02547

STRUCTURE OF AN ANHYDRIDE RELATED TO A MUTAGENIC COMPONENT OF DRINKING WATER, 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE.
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 5A.
W91-02551

MODELING INACTIVATION OF GIARDIA LAMBLIA.
Environmental Protection Agency, Cincinnati, OH. Risk Reduction Engineering Lab.
R. M. Clark.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 837-853, 1990. 3 fig, 12 tab, 21 ref.

Descriptors: *Disinfection, *Giardia, *Mathematical equations, *Mathematical models, *Regulations, *Standards, *Water treatment, Bacteria, Chlorination, Chlorine, Hydrogen ion concentration, Kinetics, Model studies, Surface Water Treatment Rule, Temperature, Viruses.

Under the auspices of the Safe Drinking Water Act (SDWA) the US EPA has promulgated the Surface Water Treatment Rule (SWTR) requiring public water systems using surface water to provide minimum disinfection to control Giardia lamblia, enteric viruses, and bacteria. The C X t concept (concentration of disinfectant in mg/L times time in minutes) is used to establish the appropriate criteria for a surface system to achieve at least 99.9% inactivation of Giardia lamblia, and 99.99% inactivation for viruses. In the SWTR, an empirical equation was developed based on water temperature, pH, concentration of chlorine, and inactivation level, to predict required disinfection criteria (C X t values). This paper describes the development of an equation, based on Chick-Watson kinetics, that provides equivalent information but is theoretically more consistent. The equation can be used to predict C X t values for achieving 0.5 to 4 logs of inactivation, within temperature ranges of 0.5 to 5 C, chlorine concentrations up to 4 mg/L, and pH levels of 6 to 8. (Author's abstract)
W91-02570

FILTRATION/ADSORPTION MEDIA FOR BACTERIA AND TURBIDITY REMOVAL.
Malnad Coll. of Engineering, Hassan (India). Dept. of Civil Engineering.
S. Jayadev, and M. Chaudhuri.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 998-1000, 1990. 3 fig, 5 ref.

Descriptors: *Adsorption, *Bacteria, *Filtration, *Turbidity, *Water treatment, Alum, Developing countries, Domestic water, Escherichia coli, Viruses.

In recent studies on the development of low cost filtration/adsorption media for the removal of bacteria and turbidity from water, alum-treated Giridih bituminous coal (alum-GBC) and ferric hydroxide-impregnated lignite (Fe-lignite) ranked highest among the coal/lignite-based media. However, a significant fraction of the sorbed bacteria remained viable and eluted in a desorption study. This technical note presents the results of Escherichia coli sorption/inactivation and sorption-desorption studies, and a down-flow column test to assess the usefulness of incorporating silver into alum-GBC and Fe-lignite in improving their performance. The results presented, together with the data on enteric (polio and rota) virus removal by alum-treated Giridih bituminous coal, suggest the potential usefulness of silver incorporated alum-treated bituminous coal as a medium for domestic water filtration in rural areas of developing countries. Further work is underway to standardize the method of medium preparation and to test its performance using raw water (surface and ground) from different sources. (Lantz-PTT)
W91-02579

GUIDANCE DOCUMENT FOR PROVIDING ALTERNATIVE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-02601

TECHNOLOGIES AND COSTS FOR THE TREATMENT OF MICROBIAL CONTAMINANTS IN POTABLE WATER SUPPLIES.
Pirnie (Malcolm), Inc., Paramus, NJ.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-175426. Price codes: A15 in paper copy, A01 in microfiche. October 1988. 315 p, 18 fig, 80 tab. EPA Contract 68-01-6989.

Descriptors: *Costs, *Drinking water, *Potable water, *Water treatment, Bacteria, Economic aspects, Giardia, Groundwater quality, Technology, Turbidity, Viruses, Water quality.

The best technologies taking costs into consideration, for inactivating or removing microbial contaminants from surface water and groundwater supplies of drinking water were examined. For municipal officials, engineers and others, the document provides a review of alternative technologies and their relative efficiency and cost, and addresses water treatment technologies that may be used by community and non-community water systems in removing turbidity, Giardia, viruses, and bacteria from water supplies. The US EPA is developing treatment regulations addressing these microbial concerns. A brief discussion of disinfection technologies and costs for groundwater supplies is also provided, since disinfection is the best available technology for groundwater systems to comply with coliform regulations. The information provided is intended to assist in reviewing available technologies for achieving the required reduction in turbidity and microorganisms. (Author's abstract)
W91-02614

INVESTIGATION OF REST AREA REQUIREMENTS: APPENDIX-PERTINENT REST ARE LITERATURE.
Texas Univ. at Austin. Center for Transportatio Research.
For primary bibliographic entry see Field 5E
W91-02620

GUIDANCE MANUAL FOR COMPLIANC WITH THE FILTRATION AND DISINFE TION REQUIREMENTS FOR PUBLIC WATE SYSTEMS USING SURFACE WATE SOURCES.
Pirnie (Malcolm), Inc., Paramus, NJ.
Available from the National Technical Informati Service, Springfield, VA 22161, as PB89-20704 Price codes: A16 in paper copy, A01 in microfich Draft Report, March 31, 1989. 361 p, 12 fig, 11 ta 169 ref, 15 append. EPA Contract 68-01-6989.

Descriptors: *Disinfection, *Filtration, *Manua *Standards, *Water quality, *Water suppl *Water treatment, Institutional constraints, Reg lations, Surface water, Water supply developme

This draft Guidance Manual compliments the p posed filtration and disinfection treatment requi ments for public water systems using surface wa sources (otherwise known as Surface Water Tre ment Requirements (SWTR)). The purpose of t manual is to provide guidance to the EPA regio offices, individual States, and affected utilities the implementation of the SWTR, and to h ensure that actions taken toward implementati are consistent. This manual is advisory in nat and is meant to supplement the criteria listed un the proposed SWTR. For example, the SWTR s treatment requirements which encompass a la range of source water conditions. The guida manual suggests design, operating and perfor ance criteria for specific surface water quality c ditions to provide the optimum protection public health through multiple barrier treatm These recommendations are presented as gui lines rather than an extension rule. They are fered to give the Primary Agency flexibility establishing the most appropriate treatment quirements for the waters within their jurisdicti In order to facilitate the use of this manual, it been structured to follow the framework of proposed SWTR as closely as possible. (Auth abstract)
W91-02623

DRINKING WATER QUALITY STANDAR AND STANDARD TESTS (JAN 72 - MAY CITATIONS FROM THE FOOD SCIENCE A TECHNOLOGY ABSTRACTS DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
Available from the National Technical Informa Service, Springfield, VA 22161, as PB89-862 Price codes: NO1 in paper copy, NO1 in mi fiche. June 1989, 112p.

Descriptors: *Bibliographies, *Drinking w *Water analysis, *Water quality standards, *W treatment, Distribution systems, Testing pr dures, Water distribution, Water sources.

This bibliography contains citations concer standards and standard tests for water qualit drinking water sources, reservoirs, and distribu systems. Standards from domestic and internati sources are presented. Glossaries and vocabul that concern water quality analysis, testing, evaluation are included. Standard test method individual elements, selected chemicals, sen properties, radioactivity, and other chemical physical properties are described. Discussion proposed standards on new pollutant material briefly considered. (Contains 290 citations) thor's abstract)
W91-02646

HEAVY METALS IN DRINKING WA STANDARDS, SOURCES, AND EFFECTS (78 - SEP 89). CITATIONS FROM THE SCIENCES COLLECTION DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.

Available from the National Technical Information Service, Springfield, VA 22161, as PB89-871339. Price codes: A01 in paper copy, A01 in microfiche. September 1989. 46p.

Descriptors: *Bibliographies, *Drinking water, *Heavy metals, *Public health, *Toxicity, *Water pollution effects, *Water pollution sources, *Water treatment, Acid rain, Corrosion, Groundwater pollution.

This bibliography contains citations concerning the public health aspects and documented studies of heavy metal pollutants in drinking water. Topics include human exposure studies and the toxicological effects incurred by ingestion. Prolonged exposure and quantification factors and effects, federal and state regulations and standards, and laboratory animal studies are discussed. Sources from landfill contamination of groundwater, acid precipitation contributions to groundwater pollution, and corrosion by-products in residential plumbing and public water supply transport systems are examined. (This updated bibliography contains 100 citations, 10 of which are new entries to the previous edition.) (Author's abstract)
W91-02647

WASTEWATER TREATMENT: OZONATION PROCESSES AND EQUIPMENT (JAN 77-APR 90). CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W91-02667

FINITE ELEMENT GROUNDWATER MODEL AS ESSENTIAL PLANNING TOOL: MICROBIOLOGICAL DENITRIFICATION OF A WELL FIELD AT BROICHHOF.
Lahmeyer International G.m.b.H., Frankfurt am Main (Germany, F.R.).
H. Lutkestratkotter, and W. Pelka.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 359-368, 8 fig.

Descriptors: *Denitrification, *Finite element method, *Germany, *Groundwater management, *Hydrologic models, *Model studies, *Nonpoint pollution sources, *Water pollution sources, *Water quality management, *Water treatment, *Well fields, Aerobic treatment, Drinking water, Field tests, Flow system, Graphical methods, Groundwater movement, Hydraulic properties, Rehabilitation, Water resources management.

Increased nitrate content in groundwater caused by mineral-based fertilizers calls for newly developed denitrification measures and processes. To develop such processes, it is necessary to combine theoretical research, field tests, and engineering activities. A research project was undertaken in Germany on rehabilitation of aquifers by controlled denitrification and final underground aerobic treatment. The aim of the project was to determine all relevant operational parameters for large scale application in waterworks. Groundwater flow and hydraulic parameters were tested in some detail. Research in the aquifer meant a number of impacts on both the hydraulic and quality conditions of the aquifer. A finite element model with linear triangular elements was applied. The flow regime was analyzed under the assumption of various boundary conditions and used as a basis to design and to optimize test wells and infiltration galleries. During model calibration a high degree of accuracy was reached resulting in only very small deviations between simulated and historically observed water table values for all cases compared. To facilitate the interpretation and comparison of results from the various simulations, the model directly produces graphic output comprising inter alia contour lines and flow vectors. It is planned to extend the model to simulate the transport of constituents in addition to pure groundwater flow. It was found that the finite element model proved to be a valuable tool, since field work in a multi-use aquifer had to be coordinated with regular waterworks operation and other activities. (See also W91-02672) (Fish-PTT)
W91-02703

MADRID MIOCENE AQUIFER AS A COMPONENT OF THE METROPOLITAN WATER SUPPLY SYSTEM.
MOPU, Madrid (Spain). Servicio Geologico.
For primary bibliographic entry see Field 4B.
W91-02718

ALLUVIAL AQUIFER OF THE GRAND GRAVIER (RHONE VALLEY, FRANCE) MODELLING AND PROTECTION.
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Lyon (France).
For primary bibliographic entry see Field 5G.
W91-02721

COST SUPPLEMENT TO TECHNOLOGIES AND COSTS FOR THE REMOVAL OF MERCURY FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192538. Price codes: A06 in paper copy, A01 in microfiche. January 1987. 109p, 7 fig, 24 tab, 3 append.

Descriptors: *Costs, *Economic aspects, *Heavy metals, *Mercury, *Potable water, *Water treatment, Activated carbon, Coagulation, Cost-benefit analysis, Filtration, Granular activated carbon, Lime, Reverse osmosis, Surface water, Water quality.

The cost estimates are a supplement to the cost section which appears in the December 30, 1984, report entitled, 'Technologies and Costs for the Removal of Mercury from Potable Water Supplies'. Because mercury is not commonly found in groundwaters, capital and operating costs for mercury removal technologies were only developed for surface water supplies. Cost estimates for the identified technologies have been developed based on information concerning waste disposal, capital costs and plant size. Costs were not developed for technologies identified as having future potential because additional testing and full-scale evaluations are necessary to determine design criteria and costs. The technologies for which updated costs were developed are: (1) coagulation/filtration, modified with powdered activated carbon for total mercury removal; (2) lime softening, modified for inorganic mercury removal; (3) granular activated carbon (GAC) for total mercury removal; (4) coagulation/filtration with activated carbon for total mercury removal (5) reverse osmosis for total mercury removal; (6) point-of-use treatment; (7) regionalization; and (8) alternate source. GAC was found to be the most economical treatment technology for new systems. (Lantz-PTT)
W91-02725

COST SUPPLEMENT TO TECHNOLOGIES AND COSTS FOR THE REMOVAL OF NITRATES AND NITRITES FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192488. Price codes: A05 in paper copy, A01 in microfiche. First Draft. February 1987. 72p, 7 fig, 17 tab, 3 append.

Descriptors: *Costs, *Economic aspects, *Groundwater quality, *Nitrates, *Nitrites, *Potable water, *Water treatment, Chlorination, Cost-benefit analysis, Ion exchange, Reverse osmosis, Water quality, Wells.

The cost estimates are a supplement to the cost section which appears in the September 30, 1985, report entitled, 'Technologies and Costs for the Removal of Nitrates and Nitrites from Potable Water Supplies. Since nitrates and nitrites are generally found in groundwater supplies, capital and operating costs for all technologies were developed. Cost estimates for the technologies identified and were developed for the following technologies: (1) ion exchange; (2) breakpoint chlorination (nitrites only); (3) reverse osmosis; (4) point-of-use; (5) modifying existing wall systems; (6) regionalization; and (7) alternate sources. The most economical method of treatment for systems with capacities between 0.01 and 0.3 million gallons per day (mgd) is to modify the existing well systems. For plant design capacities > 0.3 mgd, breakpoint chlorination is the most economical treatment technology for nitrites, and modifying existing well systems is the most economical for nitrates. (Lantz-PTT)
W91-02726

COST SUPPLEMENT TO TECHNOLOGIES AND COSTS FOR THE REMOVAL OF CHROMIUM FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192470. Price codes: A03 in paper copy, A01 in microfiche. First draft. February 1987. 131 p, 8 fig, 30 tab, 3 append.

Descriptors: *Chromium, *Costs, *Economic aspects, *Potable water, *Water treatment, Anion exchange, Coagulation, Cost-benefit analysis, Filtration, Heavy metals, Reverse osmosis, Water quality.

The cost estimates are a supplement to the cost section which appears in the January 31, 1985, report entitled 'Technologies and Costs for the Removal of Chromium from Potable Water Supplies'. Since chromium is generally found in surface water supplies, capital and operating costs for all technologies were developed. Cost estimates for the identified technologies were developed based on information concerning waste disposal, capital costs and plant size. Costs were not developed for technologies identified as having future potential because additional testing and full-scale evaluations were necessary to determine design criteria and costs. The technologies for which updated costs were developed include the following: (1) coagulation/filtration, modified for removal of chromium (VI); (2) coagulation/filtration, new for removal of total chromium; (3) anion exchange for removal of chromium (VI); (4) cation exchange for removal of chromium (III); (5) lime softening, modified for removal of chromium (III); (6) lime softening, new for removal of chromium (III); (7) two-bed ion exchange for removal of total chromium; (8) reverse osmosis for removal of total chromium; (9) point-of-use; (10) regionalization; and (11) alternate source. For chromium removal, the most economical treatment alternative was found to be anion exchange; and for total chromium removal, two-bed ion exchange was found to be the most economical. (Lantz-PTT)
W91-02727

COST SUPPLEMENT TO TECHNOLOGIES AND COSTS FOR THE REMOVAL OF SELENIUM FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192496. Price codes: A07 in paper copy, A01 in microfiche. First draft. February 1987. 137 p, 7 fig, 30 tab, 3 append.

Descriptors: *Costs, *Economic aspects, *Potable water, *Selenium, *Water treatment, Activated alumina, Coagulation, Cost-benefit analysis, Filtration, Heavy metals, Lime, Reverse osmosis.

The cost estimates are a supplement to the cost section which appears in the November 18, 1985, report entitled, 'Technologies and Costs for the Removal of Selenium from Potable Water Supplies'. Because selenium is not commonly found in groundwater, capital and operating costs for seleni-

um removal technologies were only developed for surface water supplies. Cost estimates for the identified technologies were developed based on information concerning waste disposal, capital costs, and plant size. Costs were not developed for technologies identified as having future potential because additional testing and full-scale evaluations were necessary to determine design criteria and costs. The technologies for which updated costs were developed include: (1) coagulation/filtration, modified for Se (IV) removal; (2) coagulation/filtration, new for Se (IV) removal; (3) activated alumina for Se (IV) and Se (VI) removal; (4) lime softening, modified for Se (IV) removal; (5) lime softening, new for Se (IV) removal; (6) reverse osmosis; (7) point-of-use treatment; (8) regionalization; and (9) alternate source. For Se (IV) removal, activated alumina was the most economical treatment alternative for design capacities < 40 million gallons per day (mgd). For systems > 40 mgd, coagulation/filtration was the most economical. Reverse osmosis was found to be the most economical alternative for the removal of Se (VI) and total Se. (Lantz-PTT)
W91-02728

COST SUPPLEMENT TO REMOVAL OF CADMIUM FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192462. Price codes: A07 in paper copy, A01 in microfiche. First draft. February 1987. 139p, 7 fig, 31 tab, 3 append.

Descriptors: *Cadmium, *Costs, *Potable water, *Water treatment, Coagulation, Corrosion control, Cost-benefit analysis, Economic aspects, Filtration, Heavy metals, Hydrogen ion concentration, Ion exchange, Lime, Reverse osmosis, Water quality.

The cost estimates presented a supplement to the cost section which appears in the April 1, 1985, report entitled 'Technologies and Costs for the Removal of Cadmium from Potable Water Supplies. Since cadmium is generally found in surface water supplies, capital and operating costs for all technologies were developed for surface waters. Cost estimates for the identified technologies have been developed based on information presented concerning waste disposal, capital costs and plant sizes. Costs were not developed for technologies identified as having future potential because additional testing and full-scale evaluations are necessary to determine design criteria and costs. The following cost estimates have been developed: (1) ion exchange; (2) coagulation/filtration, both modified and new; (3) lime softening, both modified and new; (4) reverse osmosis; (5) stabilization of corrosion waters; (6) pH adjustment; (7) corrosion inhibitors; (8) point-of-use; (9) regionalization; and (10) alternate source. The most economical method for treatment for systems with capacities of 0.1 million gallons per day and greater was found to be corrosion inhibitors. Of the cadmium removal technologies, ion exchange was found to be the most economical. (Lantz-PTT)
W91-02729

COST SUPPLEMENT TO TECHNOLOGIES AND COSTS FOR THE REMOVAL OF ASBESTOS FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192447. Price codes: A06 in paper copy, A01 in microfiche. First draft. February 1987. 115p, 7 fig, 23 tab, 3 append.

Descriptors: *Asbestos, *Costs, *Economic aspects, *Potable water, *Water treatment, Coagulation, Cost-benefit analysis, Diatomaceous earth, Filtration, Inhibition, Surface water, Technology.

The cost estimates are a supplement to the cost section which appears in the February 5, 1986, report entitled, 'Technologies and Costs for the Removal of Asbestos from Potable Water Supplies'. Since asbestos is generally found in surface water supplies capital and operating costs for all technologies were developed for surface waters. Cost estimates for the identified technologies have been developed based on information presented concerning waste disposal, capital costs, and plant size. Costs were not developed for technologies identified as having future potential because additional testing and full-scale evaluations are necessary to determine design criteria and costs. The technologies for which updated costs were developed fall into two groups. This grouping was established in the Technologies and Costs document for the removal of asbestos. Group I technologies have been identified as the best generally available treatment methods for reducing asbestos, and include: 1) coagulation/filtration, modified; (2) direct filtration, modified; (3) direct filtration, new; (4) stabilization of aggressive waters; and (5) inhibitors. Group II are more expensive than Group I, and include: (1) coagulation/filtration; (2) filtration, diatomite; (3) regionalization; and (4) alternate source. Direct filtration was found to be the most economical of the removal technologies, below 1 million gallons per day (mgd) design capacity and above 10 mgd. Between these values, diatomite filtration was found to be the most economical. (Lantz-PTT)
W91-02730

DRINKING WATER CRITERIA DOCUMENT FOR TOLUENE.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
For primary bibliographic entry see Field 5G.
W91-02731

DRINKING WATER CRITERIA DOCUMENT FOR 2(2,4,5-TRICHLOROPHENOXY) PROPIONIC ACID (2,4,5-TP).
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
For primary bibliographic entry see Field 5G.
W91-02732

DRINKING WATER CRITERIA DOCUMENT FOR TOXAPHENE.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
For primary bibliographic entry see Field 5G.
W91-02733

ADAPTATION OF A LEAD-TESTING PROGRAM.
Hackensack Water Co., Harrington Park, NJ.
For primary bibliographic entry see Field 5A.
W91-02765

EXPANDING THE ROLE FOR THE POU/POE INDUSTRY.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
M. B. Cook.
Environmental Geology and Water Sciences EGWSEI, Vol. 16, No. 2, p 133-134, 1990.

Descriptors: *Water quality, *Water quality control, *Water treatment, Chlorination, Marketing, Odor control, Organoleptic properties, Public health, Taste, Water quality standards.

The point-of-use/point-of-entry (POU/POE) industry, along with the bottled water industry, is growing rapidly and has the prospect for continuing high growth for many years into the future. The Environmental Protection Agency believes that POU/POE devices can meet a variety of needs: helping consumers deal with taste and odor problems associated with chlorine and other disinfectants in the water; and dealing with the contamination of private and small water system wells. POU/POE vendors need to enhance and protect their credibility, by ensuring that they know exactly what contaminants of concern exist and that their devices will actually remove such contaminants effectively, and by providing more technical training for its staff and operators. POU/POE vendors and utilities should support each others' roles, by discussing with each other how the industry might improve the quality of their sales techniques and marketing. The POU/POE industry would better serve public health by supporting the appropriate treatment of central water supplies to meet federal and state standards over the long run. (Fish-PTT)
W91-02817

ELIMINATION OF SURFACTANTS IN WATER TREATMENT BY ADSORPTION ONTO ACTIVATED CARBON.
Limoges Univ. (France). Lab. de Genie Chimique, Traitement des Eaux.
O. Dusart, S. Souabi, and M. Mazet.
Environmental Technology (Letters) ETLEDB, Vol. 11, No. 8, p 721-730, 1990. 10 fig, 1 tab, 13 ref.

Descriptors: *Activated carbon, *Adsorption kinetics, *Surfactants, *Water treatment, Adsorbents, Drinking water, Model testing, Nonionic surfactants, Organic pollutants, Phenols, Solutes, Water pollution.

Activated carbon adsorption is an effective process for the removal of organic micropollutants found in drinking water supplies. When two solutes are present in the solution with the adsorbent material, complex reactions will exist in the system. The adsorption characteristics of two solutes such as surfactants and phenols in micromolar range in water were determined in batch reactors, using powdered activated carbon as adsorbent. Phenol and equilibrium parameters were determined by use of Langmuir or Derylo-Jaroniec equations for a single adsorbate. In dilute mixture the adsorption is very strong with the carbon surface. For bisolute organic compound adsorption (anionic-nonionic surfactants, cationic-nonionic surfactant, or N-2-cationic surfactant mixture), experimental results were compared with two models from the literature. In all cases, the Derylo-Jaroniec model can not be conveniently calculated. Only the Jain-Snoeyink model gives relatively good concordance between calculated values and the experimental results. This model shows a part of the competitive sites for the two solutes and a part of the specific one for the compound which has the greater maximum adsorption capacity. It appears that an inhibition effect of a solute by another solute can exist on the specific sites when the coadsorbate is a relatively large molecule. For the evolution of the maximum capacity adsorption two models were tested: a concurrential equation and another which serves to calculate another parameter, characteristic of inhibition, no effect or promotion, on the specific adsorption sites. (Fish-PTT)
W91-02824

IMPACT OF NITROGEN ON THE ADSORPTIVE CAPACITY OF ACTIVATED CHARCOAL.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
G. Nakhla, J. Qubaih, N. Abu-Zaid, and M. Abdulappa.
Environmental Technology (Letters) ETLEDB, Vol. 11, No. 8, p 731-738, 1990. 5 fig, 2 tab, 17 ref.

Descriptors: *Activated carbon, *Nitrogen, *Surfactants, *Wastewater treatment, *Water treatment, Adsorbents, Adsorption, Anaerobic conditions, Anoxic conditions, Granular activated carbon, Solutes.

Many researchers have demonstrated the successful treatment of water and wastewaters using surface active media, most commonly activated carbon due to its superior microbial attachment properties and its excellent adsorption characteristics. The standard static-bottle procedure, which involves adding a stock solution of adsorbate to different amounts of activated carbon and mixing until equilibrium is attained, does not accurately simulate anoxic conditions which may be prevalent in anaerobic granular activated carbon (GAC) reactors as well as GAC contactors of sufficient depth and biological activity to deplete the dis-

solved oxygen. The effect of nitrogen on adsorptive capacity of activated charcoal was investigated. Adsorption isotherms for phenol on activated charcoal at neutral pH and room temperature (23 C) were conducted using the standard bottle-point technique and a modified method which involves purging the solution with nitrogen to insure exclusion of oxygen. The observed differences in adsorptive capacities between the two techniques were statistically significant. Nitrogen was observed to reduce the capacity of activated charcoal by as much as 50%. (Fish-PTT)
W91-02825

DEGRADATION OF BLUE GREEN ALGA, MICROCYSTIS AERUGINOSA BY FLAGELLATA, MONAS GUTTULA.
Ibaraki Prefecture Inst. of Public Health, Mito (Japan).
N. Sugiura, Y. Inamori, R. Sudo, T. Ouchiyama, and Y. Miyoshi.
Environmental Technology (Letters) ETLEDB, Vol. 11, No. 8, p 739-746, 1990. 7 fig, 25 ref.

Descriptors: *Algal control, *Biodegradation, *Biological wastewater treatment, *Cyanophyta, *Flagellates, *Microcystis, *Water treatment, Biological oxidation, Growth rates, Japan, Saturation index.

The occurrence of blue-green alga, Microcystis, in many eutrophic lakes and reservoirs is responsible for unpleasant odor, fish kills due to sharp decrease of oxygen, and death of wild birds and cattle due to ingestion of the toxin produced by some strains. Microcystis causes deterioration of coagulation, flocculation, filter-clogging, and acceleration of organic chlorides-formation in conventional water treatment processes. Characteristics of degradation of Microcystis aeruginosa by the small flagellata Mastigophora-Monas guttula were examined. Monoxenic M. guttula was isolated from sewage in the biological oxidation facility in the Kasumigaura Water Works, Japan. It was found that M. guttula could efficiently degrade viable algal cells in a short time. The removal of the cells by M. guttula was 90% at 48 hours cultivation. The specific growth rate and generation time of M. guttula were 4.1/day and 4.0 hours, respectively, while maximum specific growth rate and saturation coefficient of the microbe were 4.4/day and 2.4 mg/L with the Lineweaver-Burk equation. It was concluded that M. guttula could effectively utilize M. aeruginosa as a food for its strong affinity and reactivity. (Author's abstract)
W91-02826

LARGE-SCALE BIOLOGICAL NITRATE AND AMMONIA REMOVAL.
Anjou Recherche, Maisons-Laffitte (France).
F. Rogalla, P. Ravarini, G. De Larminat, and J. Couttelle.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 4, p 319-329, August 1990. 10 fig, 2 tab, 50 ref.

Descriptors: *Ammonia removal, *Biological treatment, *Drinking water, *Nitrates, *Water treatment, Aeration, Bacteria, Costs, Denitrification, Disinfection, Filtration, France.

In order to treat water containing nitrogen in excess of the European Drinking Water Guidelines an innovative, large scale biological, nitrogen-removal process has been used. After extensive pilot scale testing and a first full scale (80 cu m/h) demonstration, a 400 cu m/h installation, serving about 50,000 people, was built at Guernes-Dennemont, near Paris. The raw water source is a combination of percolation from agricultural plains and river bank infiltration, and contains both nitrate and ammonia. The plant consists of two fixed-bed biological reactors in series. An anoxic filter, using ethanol as a carbon source for heterotrophic bacteria, removes nitrates at filtration rates up to 10 m/h. The denitrified water is then polished on an aerated two layer filter, packed with activated carbon and sand. Excess carbon from the first stage, together with reduced nitrogen (ammonia and nitrates) is oxidized at this stage before ozonation of the water. A specific dosing method for biodegradable carbon was developed to monitor the efficiency of the post treatment. Special attention was paid to: (1) nitrate control through improved backwash, and (2) reducing the potential for bacterial contamination and after-growth in the distribution network. (Author's abstract)
W91-02843

SECONDARY DISINFECTION OF SERVICE RESERVOIRS.
Yorkshire Water Authority (England). Western Div.
T. M. Pearson.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 4, p 341-349, August 1990. 4 fig, 4 tab, 6 ref.

Descriptors: *Disinfection, *Secondary treatment, *Water quality, *Water quality control, *Water treatment, Bacteria, Case studies, Chemical treatment, Chlorination, Cost-benefit analysis, Hypochlorite, Potable water, Reservoirs, Ultraviolet radiation.

In order to comply with the European Community Directive on the quality of water intended for human consumption, which was embodied in the 1989 Water Act, a number of problems need to be addressed. One such problem is to identify a reliable method of secondary disinfection for service reservoirs which have a history of bacteriological failures. This paper considers the advantages and disadvantages of ultraviolet (UV) and chemical disinfection techniques (both hypochlorite dosing and on site generation of chlorine), together with the basic design features, and presents a case study examining capital and revenue costs. The collated information suggests that UV disinfection is a cost-effective secondary disinfection technique. This suggestion is supported not only by the cost benefits but also by the ease of operation, improved monitoring and control, and elimination of water quality problems associated with chemical techniques. (Author's abstract)
W91-02846

EVOLUTION OF AN OZONE PROCESS AT LITTLETON WATER-TREATMENT WORKS.
Bristol Waterworks Co. (England).
D. J. Smith.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 4, p 361-370, August 1990. 6 fig, 1 tab, 10 ref.

Descriptors: *Disinfection, *Drinking water, *Ozonation, *Ozone, *Water treatment, Biological treatment, Case studies, Costs, England, Granular activated carbon, Odor control, Organoleptic properties, Potable water, Taste.

Ozone is increasingly being considered as a means for improving the organoleptic quality of lowland surface waters, often in conjunction with granular activated carbon. The experiences of Bristol Water, who have recently introduced this process at Littleton water-treatment works to resolve long standing taste and odor problems, are described in this paper. The results of the pilot plant studies used to assess the effectiveness of the biological process promoted by ozone are reviewed. Performance requirements specified in the contract for the full scale plant are then outlined, together with a description of the civil works and equipment. Pilot plant studies demonstrated the effectiveness of ozone for disinfection, and that they did not produce unpleasant tastes and odors. Although the chemical revenue costs for ozone and superchlorination were similar, the capital costs of ozone installation were greater. The water quality benefits and operational effectiveness and costs of the ozone process will be evaluated over a 12-month period. (Lantz-PTT)
W91-02849

ANALYTICAL SOLUTION FOR ONE-DIMENSIONAL TRANSPORT IN HETEROGENEOUS POROUS MEDIA.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. R. Yates.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2331-2338, October 1990. 5 fig, 1 tab, 22 ref, append.

Descriptors: *Dispersion, *Groundwater movement, *Heterogeneity, *Hydrodynamics, *Porous media, *Solute transport, Aquifer characteristics, Aquifers, Diffusion, Dispersion coefficient, Estimating, Flow velocity, Mathematical analysis, Parameter estimation, Scaling.

An analytical solution for describing the transport of dissolved substances in heterogeneous porous media with a distance-dependent dispersion relationship can be used to characterize differences in the transport process relative to the classical convection-dispersion equation, which assumes that the hydrodynamic dispersion in the porous medium remains constant. The form of the hydrodynamic dispersion function used in the analytical solution $D(x)$ = distance-dependent dispersivity x average pore water velocity + diffusion. For models which differ only in how the dispersion function is expressed, erroneous model parameters may result from parameter estimation techniques which assume a constant hydrodynamic dispersion coefficient if the porous medium is more accurately characterized by a distance-dependent dispersion relationship. For such situations, the proposed model could be used to provide an alternate means for obtaining these parameters. The analytical solution should be useful for verifying the numerical accuracy of more comprehensive finite difference and finite element solutions to the transport equations as well as for investigating some aspects of the scale-dependent transport process. Using scale-dependent dispersion may provide an alternative means for obtaining aquifer parameters for situations where the dispersion coefficient is not spatially constant. (Brunone-PTT)
W91-02863

5G. Water Quality Control

LARGE-LAKE RESPONSES TO DECLINES IN THE ABUNDANCE OF A MAJOR FISH PLANKTIVORE--THE LAKE MICHIGAN EXAMPLE.
Michigan Univ., Ann Arbor. Center for Great Lakes and Aquatic Sciences.
For primary bibliographic entry see Field 2H.
W91-02073

INFLUENCE OF THE HERBICIDE PARAQUAT 'GRAMAXON' ON GROWTH AND METABOLIC ACTIVITY OF THREE CHLOROPHYTES.
Institute of Oceanography and Fisheries, Cairo (Egypt). Lab. of Aquatic Plants.
For primary bibliographic entry see Field 4A.
W91-02085

STIMULATION OF BIOLOGICALLY ACTIVE ZONES (BAZ'S) IN POROUS MEDIA BY ELECTRON-ACCEPTOR INJECTION.
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. E. Odencrantz, W. Bae, A. J. Valocchi, and B. E. Rittmann.
Journal of Contaminant Hydrology JCOHE6, Vol. 6, No. 1, p 37-52, July 1990. 5 fig, 1 tab, 18 ref. University of Illinois Water Resources Center Grant No. S109, Illinois Hazardous Waste Research and Information Center Project No. HW88.026.

Descriptors: *Biofilms, *Bioremediation, *Cleanup operations, *Groundwater pollution, *Nitrates, *Porous media, *Water pollution treatment, Acetates, Computer models, Microbial degradation, Organic compounds, Organic solvents, Solute transport, Solvents, Substrates.

In situ bioreclamation is a promising new technique for enhancing the cleanup rate of aquifers contaminated with organic pollutants, and involves injecting the materials necessary to increase the microbiological activity in the subsurface. A methodology involving laboratory-column experiments

and computer modeling was utilized to investigate the formation of denitrifying biologically active zones (BAZs) in a porous medium, when a limiting electron acceptor NO3(-) is injected along the flow path. Laboratory experiments conducted in a unique one-dimensional porous-medium column demonstrated the relationship between lateral injection of NO3(-) and the location and extent of BAZs when acetate was present as the sole carbon source. The phenomena of BAZ formation and the utilization of limiting and non-limiting substrates were expressed quantitatively in a computer model that coupled principles of one-dimensional solute transport and steady-state biofilm kinetics. A new, highly efficient solution algorithm was developed to solve directly for the steady-state profiles of the limiting substrate and biofilm mass, as well as for the non-limiting substrate. The predictive ability of the model was verified by successful simulation of particular laboratory experiments using independently determined kinetic parameters for acetate. Research results indicate that injection of limiting substrate along the groundwater flow path is a viable means of establishing spatially distributed BAZs for enhanced in situ bioreclamation. (Author's abstract)
W91-02161

TRANSFORMATION KINETICS OF TRACE-LEVEL HALOGENATED ORGANIC CONTAMINANTS IN A BIOLOGICALLY ACTIVE ZONE (BAZ) INDUCED BY NITRATE INJECTION.
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
W. Bae, J. E. Odencrantz, B. R. Rittmann, and A. J. Valocchi.
Journal of Contaminant Hydrology JCOHE6, Vol. 6, No. 1, p 53-68, July 1990. 5 fig, 4 tab, 19 ref. Illinois Hazardous Waste Research and Information Center Project No. HW88.026, University of Illinois Water Resources Center Grant No. S109.

Descriptors: *Biofilms, *Bioremediation, *Biotransformation, *Cleanup operations, *Groundwater pollution, *Halogenated hydrocarbons, *Kinetics, *Nitrates, *Water pollution treatment, Acetates, Computer models, Microbial degradation, Organic compounds, Organic solvents, Porous media, Solute transport, Solvents, Substrates.

Halogenated organic compounds are widely used as industrial solvents, dry cleaning solvents, metal degreasing agents, and pesticides. In situ bioreclamation is a promising approach to clean up aquifers contaminated with these compounds. When the compound is present in a very low concentration that is insufficient to meet the minimum energy requirements needed to maintain a steady-state biomass, the compound may be degraded by a secondary utilization mechanism. Laboratory experiments and numerical modeling were conducted to evaluate the secondary utilization of eight trace-concentration halogenated solvents in a denitrifying biologically active zone (BAZ) induced by nitrate injection into an acetate-fed porous-medium column. Results of column experiments indicated that carbon tetrachloride was removed most completely by the denitrifying BAZ, while bromoform, dibromoethane, tetrachlorethane, trichloroethene, 1,2-dichlorobenzene and 1,3-dichlorobenzene were removed, but to lesser degrees. 1,1,1-trichloroethane removal was slight. Compounds were removed to higher degrees when the BAZ contact time was increased. The steady-state, one-dimensional solute transport equation was solved using an iterative finite difference scheme and by employing a quasilinearization technique for the biofilm reaction term. The model solved directly for the steady-state profiles of secondary substrates. One set of experimental results was used to obtain best-fit values of kinetic parameters which were then used to predict the removal at different liquid flow velocities. The model predictions correctly described all experimental trends: removal of the halogenated compounds only in the BAZ, greater removal with increased BAZ contact time, and reduced specific removal rates caused by diffusion limitation in the biofilm. (Tappert-PTT)
W91-02162

DETECTION OF ORGANOPHOSPHORUS PESTICIDE DETOXIFYING BACTERIAL COLONIES, USING UV-PHOTOGRAPHY OF PARATHION-IMPREGNATED FILTERS.
Texas A and M Univ., College Station. Dept. of Biochemistry and Biophysics.
For primary bibliographic entry see Field 5B.
W91-02200

ECOLOGY OF A SOUTHERN OHIO STREAM RECEIVING FLY ASH POND DISCHARGE: CHANGES FROM ACID MINE DRAINAGE CONDITIONS.
American Electric Power Service Corp., Columbus, OH. Environmental Engineering Div.
For primary bibliographic entry see Field 5C.
W91-02208

USE OF THE INDEX OF BIOTIC INTEGRITY TO ASSESS THE IMPACT OF LAND MANAGEMENT ACTIVITIES ON LOW ORDER STREAMS IN NORTHERN IDAHO.
Idaho Univ., Moscow. Dept. of Fish and Wildlife.
D. H. Bennett, and T. R. Fisher.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-240052/AS. Price codes: A05 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Moscow, Completion Report, October 1989. 79p, 16 tab, 11 fig, 31 ref, 10 append. USGS Contract no. 14-08-0001-G1419. USGS Project No. G1419-06.

Descriptors: *Bioindicators, *Idaho, *Index of biotic integrity, *Land management, *Land use, Fish, Stream biota, Stream fisheries, Stream profiles, Streams, Water quality.

The Index of Biotic Integrity (IBI) was adapted to the faunal characteristics of northern Idaho headwaters streams. Stream biota was sampled from June 1987 through September 1987. The original Index of Biotic Integrity, as developed for midwestern U.S. streams, was unsuitable for use in northern Idaho. Only four of the 12 metrics included in the original IBI reflected changes in the biotic integrity of northern Idaho streams. The original IBI, although significantly correlated with measures of stream quality, was too insensitive and classified lower quality streams as being in 'good to excellent' health. The original IBI was modified to contain eight metrics to reflect the health of the fish, amphibian, and aquatic macroinvertebrate communities. Also, expectation criteria of three metrics were adjusted for relative stream size. Our modified IBI seems to assess the health of northern Idaho headwater streams adequately. The modified IBI detected changes in stream health, as index scores were significantly correlated with road density and percent harvest of the drainages. Also, the modified IBI was more highly correlated with measures of impact and less significantly with measures of stream size than Shannon diversity of fishes by biomass of numbers, the Index of Well Being, Brillouin diversity of both fishes and aquatic macroinvertebrates. The modified Index of Biotic Integrity offers managers a technique to evaluate stream health with limited vertebrate and invertebrate sampling. Because the index was developed from data collected in northern Idaho streams with generally nonerosive rock types, it is not known how well this index would classify stream health in other regions of Idaho or other streams in the Pacific Northwest. (USGS)
W91-02242

AGRICULTURAL PESTICIDES AND GROUNDWATER IN NORTH CAROLINA: IDENTIFICATION OF THE MOST VULNERABLE AREAS.
North Carolina Water Resources Research Inst., Raleigh.
D. H. Moreau, and L. E. Danielson.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-235359/AS. Price codes: A03 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute Report No. 252, May 1990. 31p, 12 fig, 6 tab, 11 ref, append.

Descriptors: *Agricultural chemicals, *Groundwater, *Groundwater pollution, *Monitoring, *North Carolina, *Pesticides, *Water pollution control, *Water pollution sources, Cost efficiency, Design criteria.

This report describes the methods and findings of research aimed at targeting areas in North Carolina where groundwater is vulnerable to contamination by agricultural pesticides. Areas that are most likely to be contaminated are identified by combining county-level estimates of pesticide use with indices of groundwater vulnerability. Results reported are intended as guides for more detailed research activities and for design of monitoring programs such as the one proposed by the North Carolina Interagency Working Committee on Groundwater Monitoring. The report presents results of research using the methods and criteria suggested. Estimates of quantities and spatial patterns of use are reported for the most heavily used pesticides that have the potential to leach into groundwater. Counties in North Carolina having the highest potential for groundwater contamination are identified. It is recommended that primary data on the sale and use of pesticides in North Carolina should be collected; that groundwater sampling should be implemented with a sustained funding base; and that indicators of vulnerability presented should be refined to pinpoint priority sites for monitoring. Several options for cost-effective information gathering about pesticide use in the state is suggested. (USGS)
W91-02245

STATE-OF-THE-ART OF HYDROLOGY AND HYDROGEOLOGY IN THE ARID AND SEMI-ARID AREAS OF AFRICA.
For primary bibliographic entry see Field 2A.
W91-02288

PROBLEMS OF MAINTENANCE OF WATER QUALITY IN ARID AND SEMI-ARID REGIONS OF WEST AFRICA.
Ghana Univ., Legon. Dept. of Botany.
C. M. Amoah.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 722-735, 3 fig, 4 tab, 13 ref.

Descriptors: *Africa, *Developing countries, *Sahel, *Sudan, *Water pollution control, *Water pollution sources, *Water quality management, Agriculture, Arid lands, Drinking water, Education, Human diseases, Path of pollutants, Potable water, Semiarid lands, Social aspects.

The ecological problems of the Sahelian and Sudanian zone (SSZ) of West Africa have received considerable attention. In the arid and semi-arid regions of Africa, as in most other places, most water bodies are put to multiple uses. Fresh water is used for drinking, for livestock, in agriculture, transport, power generation, irrigation, industry, and recreation. The great demand on a limited water supply leads to various forms of degradation. Possible causes of contamination were examined and mitigating measures considered. The physical, social, and economic problems of maintaining water quality were examined. Specific recommendations made are as follows: (1) inhabitants should be educated about some of the human habits that lead to water pollution, such as throwing used wash water back into rivers; (2) bathing should be discouraged in drinking water sources; (3) water for human consumption should be separated from that used for livestock; (4) people infected with guinea-worm and bilharzia should be educated not to enter the water; (5) water should be filtered and boiled before drinking to kill disease-causing organisms; (6) water-borne disease prevention should be considered when expanding water supplies; and (7) government housing policy should embody a supply of good drinking water. (See also W91-02288) (Rochester-PTT)
W91-02348

TELETRANSMISSION OF HYDROLOGICAL DATA WITHIN THE FRAMEWORK OF THE PROGRAMME TO COMBAT ONCHOCERCIASIS (TELETRANSMISSION DES DONNEES HYDROLOGIQUES DANS LE CADRE DU PROGRAMME DE LUTTE CONTRE L'ONCHOCERCOSE).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lome (Togo). Centre ORSTOM du Togo.
For primary bibliographic entry see Field 7B.
W91-02353

BIOLOGICALLY AVAILABLE PHOSPHORUS RETENTION BY THE KIS-BALATON RESERVOIR.
Ulster Univ., Coleraine (Northern Ireland). Limnology Lab.
For primary bibliographic entry see Field 2H.
W91-02375

FRY COMMUNITIES AS A BIOMANIPULATING TOOL IN A TEMPERATE LOWLAND RESERVOIR.
Lodz Univ. (Poland). Inst. of Environmental Biology.
For primary bibliographic entry see Field 2H.
W91-02381

PREDICTION ON EUTROPHICATION OF RESERVOIR YUQIAO.
Tianjin Inst. of Environmental Protection and Sciences (China).
X. Zhu, and R. Hou.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 783-792, 1990. 5 fig, 4 tab, 7 ref.

Descriptors: *Erosion control, *Eutrophication, *Limnology, *Model studies, *Nutrients, *Reservoir operation, *Reservoirs, *Soil erosion, *Stream erosion, *Water pollution control, *Water quality management, *Water quality trends, Agricultural practices, Agricultural runoff, China, Fertilizers, Nitrogen, Nonpoint pollution sources, Pesticides, Phosphorus, Yuqiao Reservoir.

The impact of P and N inputs from nonpoint sources of agricultural runoff on the eutrophication of Yuqiao Reservoir in China was investigated. The magnitude of nutrient input from the 2060 sq km drainage area of the reservoir was evaluated, based on the synchronous measure of water quality and quantity. Loading rates for N and P to the reservoir surface were 4.31 and 0.79 g/sq m/yr, respectively. The future trophic state of the reservoir under changed hydrologic conditions, i.e., after a project to divert water from the Luan River into the Tianjin, is predicted by the nutrient loading-eutrophication response model (the Dillon Model). The results indicate that P loading must be reduced by about 65% in the Yuqiao Reservoir for it to change from eutrophic to mesotrophic. Management strategies for maintaining water quality of the reservoir include: (1) contour farming to reduce erosion potential; (2) leaving buffer strips of trees and shrubs along streams to reduce soil erosion; (3) grass seeding or other vegetation planting to stabilize areas of stream and reservoir banks to reduce soil-particle flushing and erosion; (4) use of culverts and other engineering structures to control water flow and thereby reduce erosion; (5) nutrient management practices, including fertilizer formulation, application rate, application techniques, and timing of application; and (6) pesticide management practices, including application methodology, timing, and rate of application. (Author's abstract)
W91-02383

WATER QUALITY IN THE SANCE RESERVOIR (NORTH MORAVIA).
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
L. Simanov, C. Budejovice, and J. Kantorek.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 869-874, 1990. 2 fig, 4 tab, 6 ref.

Descriptors: *Czechoslovakia, *Drinking water, *Sance Reservoir, *Water quality, Bacteria, Industrial wastewater, Nitrates, Ostravice River, Phosphates, Pollution index, Recreation, Water pollution sources.

The Sance Reservoir was built in 1969 as a drinking water supply from the Ostravice River, Czechoslovakia. Before dam construction was begun, the water quality of the reservoir was predicted from a hydrobiological investigation of the territory. These water quality investigations were conducted from 1972 to 1976, and again from 1980 to 1984. Tributaries of the reservoir were found to have maintained excellent water quality since 1954. Only dissolved matter and bacterial counts showed a small increase. The Sance Reservoir has had very good water quality, in agreement with the predictions (oligotrophy, oligo-betamesosaprobity). Only bacterial counts, nitrates, phosphates, and the saprobic index have shown a slight increase. In the future, only two dangers appear to exist: an increase in air pollution from a nearby industrial agglomeration, and an increase in water pollution as a result of recreation in the drainage area. The reservoir itself does not contribute to the deterioration of the water quality in the Ostravice River below the dam. (Sand-PTT)
W91-02392

RELATIONSHIP OF RESERVOIR BIOGEOCHEMICAL PROCESSES TO THE STRUCTURAL INTEGRITY OF THE WORLD'S FIRST TOTALLY ROLLER COMPACTED CONCRETE DAM.
Army Engineer District, Portland, OR. Reservoir Regulation and Water Quality Section.
For primary bibliographic entry see Field 8F.
W91-02399

PATTERNS AND CONTROLS OF NITROGEN IN TALLGRASS PRAIRIE STREAMS.
Kansas State Univ., Manhattan. Div. of Biology.
For primary bibliographic entry see Field 2H.
W91-02405

SITING CONSIDERATIONS FOR RESOURCE RECOVERY FACILITIES.
STV, Inc., Pottstown, PA.
For primary bibliographic entry see Field 5E.
W91-02421

SEWAGE LAGOON TO SPLENDID LAKES.
D. O'Dell, M. J. Hood, B. L. Murray, and S. M. Saitta.
Public Works PUWOAH, Vol. 121, No. 10, p 105-106, September 1990. 1 fig.

Descriptors: *Boating, *Lake restoration, *Missouri, *Recreation, *Swimming, *Wastewater lagoons, Algal control, Environmental protection, Fish control agents, Lakes, Rotenone, Sludge, Twin Lakes Recreation Area, Watershed protection.

A former sewage lagoon has been turned into the Twin Lake Recreation Area, a 60 acre tract within the Columbia, Missouri city limits, that includes a 6-acre swimming lake with a sand beach and a 20-acre L-shaped lake where nonmotorized craft can take advantage of prevailing winds. The lakes were reclaimed from an abandoned sewage lagoon in the early 1980s. Sludge was removed after draining the lagoon. The sludge was evenly spread under the proposed parking area. To assure minimal environmental impact, the sludge was covered with 12-18 inches of clay soil that had also been removed from the lagoon bottom. As an extra precaution, the site grading was designed to separate the watershed areas, thus eliminating any chance of sewage pollution entering the lake sites. Fish problems in the lake were controlled by rotenone applications. Copper complex based products have been used to control algae. A floating spray fountain will be added to the swimming lake for additional algae control. By introducing additional oxygen to the water, some of the nutrients present should be oxidized and made unavailable to the algae. (Mertz-PTT)
W91-02425

DEGRADATION OF PESTICIDE WASTE TAKEN FROM A HIGHLY CONTAMINATED SOIL EVAPORATION PIT IN CALIFORNIA.
California Univ., Davis. Dept. of Environmental Toxicology.
W. Winterlin, J. N. Seiber, A. Craigmill, T. Baier, and J. Woodrow.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 18, No. 5, p 734-747, September 1989. 6 fig, 9 tab, 9 ref.

Descriptors: *Biodegradation, *California, *Clean-up operations, *Decontamination, *Evaporation ponds, *Land disposal, *Pesticide residues, *Soil contamination, *Toxic wastes, *Waste disposal, Acids, Hydrogen ion concentration, Lime, Nutrients, Organic matter, Soil amendments, Soil properties, Soil types, Soil water.

The primary method for disposing of liquid pesticide wastes in California has been the dumping of the liquid materials into soil evaporation pits, ditches, and ponds, most of which are unlined and have been in use for many years. An investigation was undertaken to determine the optimum conditions for degrading high concentrations of pesticides in the soil. Soils at a northern California site were removed from the evaporation pit and placed in trays. Additional trays were prepared which contained similar soil fortified with six pesticides (atrazine, trifluralin, malathion, diazinon, chlorpyrifos, and parathion) and which were subjected to various soil amendments, including organic matter, lime, acids, and nutrients, under moist and flooded conditions. The effects of the soil amendments on the pesticide-fortified soils were generally pesticide dependent. The pH of the soils was a major factor in degradation and there was a pH difference between the anaerobic and aerobic soils. Under anaerobic conditions, half lives of most pesticides were shorter in the soils with highest pH, while the opposite was true under aerobic conditions. Treatment with manure, ammonium phosphate, and lime was very effective in reducing the half lives of pesticides in soils from the evaporation pit (under both aerobic and anaerobic conditions); treatment with cornmeal and ammonium phosphate was less effective. Under alternating moist and flooded soil conditions, a heavy lime treatment combined with a source of organic substances (such as manure) should provide an effective degradation of the pesticides in a contaminated toxic waste site. (Author's abstract)
W91-02443

SHORT TERM RESPONSE TO EUTROPHICATION ABATEMENT.
Senter for Industriforskning, Oslo (Norway).
K. L. Seip, H. Sas, and S. Vermij.
Aquatic Sciences AQSCEA, Vol. 52, No. 3, p 199-220, 1990. 6 fig, 2 tab, 21 ref, append.

Descriptors: *Chlorophyll a, *Eutrophic lakes, *Lake restoration, *Limnology, *Model studies, *Phosphorus, Chlorophyll, Lakes, Mathematical studies, Regression analysis, Water chemistry.

Reduction of nutrient loadings to lakes is a common restoration measure for eutrophic lakes. On a chlorophyll-a/total phosphorus graph a positive response would be represented by a displacement towards the origin. The results of a new model for predicting the short term interannual changes in chlorophyll-a in lakes after reductions in total phosphorus were compared with predictions made by least squares regression models. In the new method, slopes of chlorophyll-a/total phosphorus graphs were depicted in frequency diagrams and used to extract information on the expected, short term chlorophyll-a/total phosphorus response. The short term response for nine shallow (< 10 m deep) and nutrient rich lakes to changes in total phosphorus was found to be: chlorophyll-a = 0.49(total phosphorus) + 17.3, and for nine deep, phosphorus-limited lakes: chlorophyll-a = 0.08(total phosphorus) + 3.5. If the total phosphorus-reduction was known to be greater than 10 mg/cu m, the expected slope increased to 0.58 for shallow lakes and to 0.26 for deep lakes. The slope, 0.58, was 8% lower than the slope for the long term response calculated by regression for the shal-

low lakes. For deep lakes the slope, 0.26, was 2 to 3 times higher than that calculated by regression, indicating that reductions in total phosphorus for deep lakes gave greater effects than least squares regression equations suggest. The reduction in total phosphorus gave about 80% probability that a reduction in chlorophyll-a would be observed next year. For shallow, phosphorus-limited lakes this reduction was about 30 mg/cu m (5% of average initial in-lake total phosphorus concentration), and for deep lakes about 14 mg/cu m (35% of average initial in-lake total concentration). (Mertz-PTT)
W91-02447

POSSIBILITIES FOR REGENERATION OF FLOODPLAIN FORESTS WITHIN THE FRAMEWORK OF THE FLOOD-PROTECTION MEASURES ON THE UPPER RHINE, WEST GERMANY.
Institute for Floodplains Ecology, Rastatt (Germany, F.R.).
For primary bibliographic entry see Field 4A.
W91-02472

STREAMSIDE MANAGEMENT UNITS IN THE PACIFIC NORTHWEST.
Forest Service, Portland, OR. Pacific Northwest Region.
For primary bibliographic entry see Field 6B.
W91-02497

SENSITIVITY ANALYSIS OF NINE DIVERSITY AND SEVEN SIMILARITY INDICES.
National Park Service, Fort Collins, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W91-02534

EFFECTS OF WASTEWATER TREATMENT AND SEAWATER DILUTION IN REDUCING LETHAL TOXICITY OF MUNICIPAL WASTEWATER TO SHEEPSHEAD MINNOW (CYPRINODON VARIEGATUS) AND PINK SHRIMP (PENAEUS DUORARUM).
Environmental Research Lab.-Narragansett, Newport, OR. Pacific Div.
For primary bibliographic entry see Field 5D.
W91-02535

OPERATIONAL WATER QUALITY MANAGEMENT: CONTROL OF STORM SEWAGE AT A WASTEWATER TREATMENT PLANT.
For primary bibliographic entry see Field 5D.
W91-02541

REVISION OF THE SAPROBIC SYSTEM (EINE REVISION DES SAPROBIENSYSTEMS).
Landesamt fuer Wasser und Abfall Nordrhein-Westfalen, Duesseldorf (Germany, F.R.).
G. Friedrich.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 23, No. 4, p 141-152, August 1990. 5 tab, 27 ref. English summary.

Descriptors: *Benthos, *Bioindicators, *Limnology, *Monitoring, *Pollution index, *Saprobic index, *Water quality, Germany, Heterotrophic bacteria, Running waters, Statistical analysis, Water chemistry.

The saprobic system, originally established in 1902, and revised later on, has been screened and revised within the standardization of the German methods for the examination of water, wastewater and sludge. A working group, consisting of experienced limnologists, made use of the results from long-term biological water quality studies in West Germany, which included statistical data management and data from chemical analysis of water. The revision of the list of indicators was based upon the following criteria: only benthic organisms are included, pertinent to the current investigation; organisms should be widespread over Central Europe; organisms should be identifiable with available keys; photoautotrophic species are excluded, according to the definition of saproby as the intensity of the heterotrophic activity, and in order to avoid overlapping with the indication of trophy; and benthic organisms included should have as narrow as possible a saprobic valance. A 20 point distribution is used to characterize the saprobic valency between oligosaprobic and polysaprobic. The indicator values (g) are graduated 1, 2, 4, 8, and 16 in order to discriminate between species with narrow saprobic valency and those with broader valency. The range of validity and use of the saprobic index are limited to permanent or temporary running waters. The difficulties arising in alpine or quasi standing waters are recognized as well. The revision of the saprobic index will be completed as DIN 38410 part 2. (Author's abstract)
W91-02546

TOXICOLOGICAL RISK/BENEFIT-ASPECTS OF DRINKING WATER CHLORINATION AND OF ALTERNATIVE DISINFECTION PROCEDURES.
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
For primary bibliographic entry see Field 5F.
W91-02547

MONITORING PROGRAM ASSESSES WATER QUALITY PROGRESS.
Milwaukee Metropolitan Sewerage District, WI.
For primary bibliographic entry see Field 5D.
W91-02561

TOXIC-SUBSTANCE CONTROL FOR THE OHIO RIVER.
Ohio River Valley Water Sanitation Commission, Cincinnati.
P. Tennant, A. Vicory, C. Norman, and P. McConocha.
Water Environment & Technology WAETEJ, Vol. 2, No. 10, p 59-63, October 1990. 5 fig.

Descriptors: *Environmental policy, *Interstate commissions, *Ohio River, *Toxic wastes, *Water pollution control, *Water quality control, Data collections, Interagency cooperation, Nonpoint pollution sources, Water analysis, Water pollution prevention, Water quality, Water treatment.

Before the widespread application of pollution abatement technology, the Ohio River and its tributaries suffered severe water quality degradation as a consequence of the basin's economic growth. In 1948, eight states signed a compact pledging cooperation to restore and maintain the quality of the valley's waters. The Ohio River Valley Water Sanitation Commission (ORSANCO) was created to oversee the compact's implementation and consists of three members from each state and three members representing the federal government. In the commission's early years, the major challenge was to provide some degree of treatment for the many waste discharges to the Ohio River and its tributaries. In the late 1970s, concerns over the presence of toxic substances in water caused the commission to appoint a task force to develop a toxics-control strategy. For the Ohio River as a whole, the most frequently detected toxic substances were zinc, copper, and chloroform, each of which was found in over 70% of the samples analyzed. It was decided to initiate investigations of each of the 10 segments used in the initial report completed in 1987. Investigations have been completed for the 117-mile segment from Wheeling to Parkersburg, WV, and the 87-mile segment from Pittsburgh, PA to Wheeling, WV. A third segment investigation, covering the 100 miles from Cincinnati to Louisville has been initiated. Results from the first two segment investigations indicate that nonpoint sources of toxics including runoff and groundwater contributions may be as significant as point-source discharges in determining levels of toxics in the Ohio river. Future field studies under the commission's toxic substances control program will make greater use of sediment sampling and will address smaller study areas in order to better use limited funds for laboratory analysis. (Ver-Nooy-PTT)
W91-02564

MODELING INACTIVATION OF GIARDIA LAMBLIA.
Environmental Protection Agency, Cincinnati, OH. Risk Reduction Engineering Lab.
For primary bibliographic entry see Field 5F.
W91-02570

SEDIMENT OXYGEN DEMAND MODEL: METHANE AND AMMONIA OXIDATION.
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
For primary bibliographic entry see Field 2H.
W91-02576

ACCURATE METHOD FOR CALCULATION OF SATURATION DO.
Wuxi Pearl Lustre Pigment Factory (China).
H. Hua.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 116, No. 5, p 988-990, 1990. 2 tab, 3 ref.

Descriptors: *Dissolved oxygen, *Mathematical analysis, *Mathematical equations, *Water quality, Monitoring, Oxygen, Precision, Water quality control.

Dissolved oxygen (DO) concentration is an important water quality index. In calculating the reaeration rate, an accurate saturated DO value is crucial. Engineers have been seeking a reliable method for the accurate calculation of the saturated DO concentration. Based on a careful study of the mechanism of gaseous solubility, a new formula for calculating the saturation DO is deduced. According to this study, it is assumed that two physical processes exist between the gaseous and the liquid phases: (1) the dissolution of gas, which depends on its diffusion rate; and (2) the vaporization of the gaseous component, which has already dissolved in the liquid phase. When the vaporization rate is equal to the diffusion rate, a dynamic equilibrium between the gaseous phase and liquid phase is established. Based on these assumptions, the gaseous solubility equation is created. Based on this equation, a new formula for calculating the saturation value of oxygen was obtained which is applicable to both seawater and fresh water from O C to 50 C. The new formula gives an accuracy higher than that obtained by previous equations. The average relative error is only 0.31%, and the average absolute error is 0.03 mg/L. (Lantz-PTT)
W91-02577

GUIDANCE DOCUMENT FOR PROVIDING ALTERNATIVE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-167969. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/540/G-87/006, February 1988. 3 fig, 3 tab, 19 ref, append.

Descriptors: *Decision making, *Water quality, *Water supply development, Drinking water, Potable water, Remedies, Superfund, Water quality control, Water supply.

EPA has developed guidelines for providing information, when it becomes necessary, to develop or obtain alternate water supplies where releases of hazardous substances or pollutants have resulted in the closing of drinking water wells, or has contaminated a principal drinking water supply. This information was prepared to assist Superfund contractors and on-scene Federal, State and local officials with the planning and implementation of alternate water supplies at uncontrolled hazardous waste sites. Guidance is specifically provided for those sites that do not require a time critical removal action, but do require provision of an alternate water supply as either a non-time-critical removal action of 6 months or more, or a remedial action before implementation of a final remedy can be achieved (actions performed at National Priority List sites where short-term threats to the human population exist). These remedial actions are used to provide faster responses than can be achieved

with normal remedial actions. The decision making process used in this document discusses the determination of water supply needs, screening and evaluating alternatives, and remedy implementation. (Author's abstract)
W91-02601

INFORMATION COLLECTION REQUEST FOR: NATIONAL PRIMARY DRINKING WATER REGULATIONS FOR INORGANIC CHEMICALS.
Miller (Wade) Associates, Inc., Arlington, VA.
For primary bibliographic entry see Field 7B.
W91-02602

EVALUATION OF THE NUTTING LAKE DREDGING PROGRAM.
Baystate Environmental Consultants, Inc., East Longmeadow, MA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-181895. Price codes: A10 in paper copy, A01 in microfiche. February, 1987. 117 p, 32 fig, 3 tab, 16 ref, 3 append.

Descriptors: *Dredging, *Lake restoration, *Nutting Lake, *Water quality, Dissolved oxygen, Domestic wastes, Lake sediments, Performance evaluation, Recreation, Sediment control, Wastewater disposal, Water quality control.

The Nutting Lake Program was conceived as a means to both develop and demonstrate an effective inland dredging method, and to restore recreational utility to a suburban lake. Between 1978 and 1986 an estimated total of 361,000 cubic yards (276,000 cu m) of soft sediment was removed from Nutting Lake by hydraulic dredging. Except for occasional sanitary sewer overflows and diminishing residual inputs from onsite wastewater disposal systems, the influence of domestic wastewater on Nutting Lake has been eliminated. However, the dredging operation was not as successful. Considerable quantities of soft sediment remain in the lake, and the actual volume of sediment removed by dredging may be as low as 224,000 cu yds. Stormwater inputs and dredging activities appear to have destabilized the system during the project; therefore, water quality is more variable and not appreciably better than before the program commenced. The only statistically significant change in water quality was an increase in the dissolved oxygen saturation level at the surface of the east basin and throughout the west basin of Nutting Lake. Future monitoring will be needed to evaluate long-term trends in water quality, but at this time the water quality benefits of the program appear negligible. However, reduction of macrophyte nuisances in selected areas has fostered increased use of Nutting Lake for swimming and boating. (Lantz-PTT)
W91-02617

VOLUNTEER LAKE MONITORING PROGRAM, 1988. VOLUME VI: SOUTHWESTERN ILLINOIS REGION.
Southwestern Illinois Metropolitan and Regional Planning Commission, Collinsville.
For primary bibliographic entry see Field 7B.
W91-02618

BUGLE LAKE PROTECTION AND REHABILITATION PROJECT.
Independence Public Inland Lake Protection and Rehabilitation District, WI.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-209084. Price codes: A05 in paper copy, A01 in microfiche. Final Report, March 1982. 86 p, 5 append. EPA Grants 0000567701 and 0080574201.

Descriptors: *Bugle Lake, *Erosion control, *Lake rehabilitation, *Lake restoration, *Sediment control, *Watershed management, Bank stabilization, Dredging, Lake sediments, Shore protection, Wisconsin.

Bugle Lake, Wisconsin, had an average depth of three feet due to sedimentation caused by upland and streambank erosion. A restoration project consisting of: implementing the best management practices on the watershed; streambank and shore stabilization; and sloping and seeding to control erosion. In addition, the lake was dredged to a depth of 6 feet. Lake recreation was enhanced subsequent to the project's completion. This report also includes the initial feasibility study. (Lantz-PTT)
W91-02621

ECONOMIC BENEFIT CONSIDERATIONS IN SELECTING WATER QUALITY PROJECTS. INSIGHTS FROM THE RURAL CLEAN WATER PROGRAM.
Economic Research Service, Washington, DC. Resources and Technology Div.
S. Piper, R. S. Magleby, and C. E. Young.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-194385. Price codes: A03 in paper copy, A01 in microfiche. May 1989. 28 p, 3 fig, 8 tab, 60 ref.

Descriptors: *Cost-benefit analysis, *Project planning, *Rural Clean Water Program, *Rural areas, *Water pollution prevention, *Water quality, Agricultural runoff, Agriculture, Bacteria, Land use, Nutrients, Sediments, Water quality control, Water use.

Runoff from agricultural land carries sediment, nutrients, bacteria, and pesticides into lakes, rivers, and streams. Elevated levels of these pollutants can harm recreation, water supplies, commercial fishing, and wildlife. The Rural Clean Water Program (RCWP) was initiated in 1980 by the US Department of Agriculture and the US EPA to demonstrate the effectiveness of agricultural best management practices (BMP's) in improving water quality and reducing the offsite effects of nonpoint source water pollution. The RCWP projects most likely to generate the highest offsite benefits are those aimed at preserving or improving water quality in a heavily used lake or estuary within or immediately adjacent to the project area. The extent of the benefits generated will depend on the level of the use impairment and the improvement in water quality. The RCWP projects with nutrient or bacteria problems frequently have a larger number of impaired water uses and potentially higher benefits than do projects with sediment problems. The cost of treating bacteria, nutrients, and sediment with structural practices such as animal waste storage systems and terraces is high compared with the cost of treating sediment and nutrient runoff through low-cost management practices such as conservation tillage. When benefits are potentially very high, more expensive structural practices and improvements appear justifiable, particularly if need to bring water quality to threshold levels where user benefits are generated. About a third of the RCWP projects have strong prospects for offsite economic benefits exceeding costs. Another third have the potential for positive net benefits if additional benefits can be generated by becoming part of larger regional programs that successfully sustain or expand uses of downstream major water resources. A few projects would have had better prospects for net benefits if costs had been reduced by greater reliance on management practices rather than structures such as terraces. (Lantz-PTT)
W91-02622

GUIDANCE MANUAL FOR COMPLIANCE WITH THE FILTRATION AND DISINFECTION REQUIREMENTS FOR PUBLIC WATER SYSTEMS USING SURFACE WATER SOURCES.
Pirnie (Malcolm), Inc., Paramus, NJ.
For primary bibliographic entry see Field 5F.
W91-02623

DRINKING WATER QUALITY STANDARDS AND STANDARD TESTS (JAN 72 - MAY 89). CITATIONS FROM THE FOOD SCIENCE AND TECHNOLOGY ABSTRACTS DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5F.
W91-02646

HEAVY METALS IN DRINKING WATER: STANDARDS, SOURCES, AND EFFECTS (JAN 78 - SEP 89). CITATIONS FROM THE LIFE SCIENCES COLLECTION DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5F.
W91-02647

CONTAINMENT OF ORGANIC LEACHATES FROM LEAKING UNDERGROUND STORAGE TANKS USING TAILORED SOILS AS LINERS.
Argonne National Lab., IL. Energy and Environmental Systems Div.
R. W. Peters, F. Cadena, and M. W. Page.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-013180. Price codes: AO3 in paper copy, AO1 in microfiche. 35 p, 10 fig, 4 tab, 28 ref. DOE Contract W-31-109-Eng-38.

Descriptors: *Liners, *Soil liners, *Storage tanks, *Underground storage, *Water pollution control, *Water pollution prevention, Adsorption, Benzene, Clays, Model studies, Organic pollutants, Solute transport.

The technical feasibility of using tailored soils for containment of hazardous organic pollutants has been demonstrated. The adsorptive properties of soils for benzene are dramatically improved using organophilic coatings. Tailoring of the soils results in a highly selective adsorbent, which has a great capacity to remove benzene, toluene, and xylene (BTX) compounds. All four soils studied showed significant adsorptive capacity improvement after tailoring with tetramethylammonium ions (TMA+). The optimum TMA+;CEC (cation exchange capacity) ratio was between 0.6 and 1.5. Soils tailored at TMA+ doses as low as 50% of the CEC of the soil removed significant amounts of benzene from solution. pH plays a secondary role in the adsorption of benzene on the tailored soils. The capacities for benzene removal under dynamic column conditions were about 40-75% lower than those predicted from batch adsorption studies. The holdup of benzene increases with increasing clay content of the soils. The breakthrough curves for the pollutant movement through the soil columns can be predicted using conventional one-dimensional solute transport models. (Author's abstract)
W91-02648

SUPERFUND RECORD OF DECISION: TODTZ, LAWRENCE FARM, IA. FIRST REMEDIAL ACTION--FINAL.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-229553/AS. Price codes: AO4 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R07-89/022. November 1988. 59p, 10 fig, 6 tab.

Descriptors: *Cleanup operations, *Groundwater pollution, *Iowa, *Landfills, *Site remediation, *Superfund, Arsenic, Benzene, Chromium, Costs, Heavy metals, Lead, Toluene, Volatile organic compounds.

The 2.7-acre Dupont Impoundment of the Todtz Farm site is part of the 12-acre parcel of land known as the Todtz Farm Landfill, which is located on a 120-acre farm 1.25 miles west of Camanche, Iowa. Originally a sand and gravel mine, the landfill received municipal waste from 1969 to 1975. In 1971, Dupont constructed the impoundment in the northwest corner of the landfill and disposed of an estimated 4,300 tons of wet end cellophane process wastes from 1971 until its closure in 1975. Impoundment wastes are periodically in direct contact with the groundwater beneath the site, which flows southeasterly toward the Mississippi River. Domestic wells and the municipal water supply wells for Camanche located downgradient of the site may be affected by contamination from the site. In addition, several ponds and lakes in the vicinity are potential receptors for contaminated runoff and recharge. The primary contaminants of concern affecting the groundwater

are volatile organic carbons (VOCs) including toluene and benzene, and metals including arsenic, lead, and chromium. The selected remedial action for this site includes installation of a soil cover over the Dupont Impoundment; implementation of institutional controls including deed and land use restrictions; provision of an alternate water supply for an affected residence by relocating an existing well; and groundwater monitoring. EPA has determined that further remedial actions will be immediately implemented if groundwater trigger levels provided in the Record of Decision (ROD) are met or exceeded. If groundwater monitoring indicates that contaminant levels exceed the less stringent chemical-specific action levels provided in the ROD, groundwater pumping and treatment will be implemented; if the more stringent action levels are exceeded, a treatability study of the impoundment waste will be conducted and either a permanent treatment remedy of the impoundment material or a cap and slurry wall containment system will be implemented. The estimated present worth cost for this remedial action is $1,030,000. (Author's abstract)
W91-02649

IN-SITU AQUIFER RESTORATION OF CHLORINATED ALIPHATICS BY METHANOTROPHIC BACTERIA.
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, L. Semprini, G. D. Hopkins, D. Grbic-Galic, and P. L. McCarty.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-219992/AS. Price codes: A11 in paper copy, AO1 in microfiche. Report No. EPA/600/2-89/033. July 1989. 232p, 123 fig, 43 tab, 166 ref.

Descriptors: *Aliphatic hydrocarbons, *Biodegradation, *Biological treatment, *Cleanup operations, *Groundwater pollution, *In situ treatment, *Methane, *Methane bacteria, *Water pollution treatment, Aerobic conditions, Biotransformation.

The potential of enhanced in-situ biotransformation of chlorinated aliphatic solvents by a bacterial community grown on methane under aerobic conditions was examined. The target chlorinated compounds were trichloroethene (TCE), cis-, and trans -1,2-dichloroethene (DCE), and vinyl chloride (VC). Laboratory studies were conducted to improve understanding of the microbial growth and transformation rates and to characterize important transport properties. In field experiments, biostimulation was accomplished by introducing methane and oxygen into a shallow, confined, sand and gravel aquifer to encourage the growth of a native bacterial community. Methane utilization commenced within ten days in the first biostimulation attempt, and within one day in subsequent biostimulation episodes. Biotransformation of the target organic compounds ensued immediately after commencement of methane utilization, and reached steady-state values within three weeks. The approximate extents of transformation were as follows: VC, 95%; trans-DCE, 85%; cis-DCE, 40%; and TCE, 20%. Mathematical modeling of the transport and transformation process confirmed that the behavior observed in the field demonstration was consistent with the results of the laboratory research and theoretical expectations. This technology has been demonstrated to be effective in continuous operation under carefully controlled conditions in a real subsurface environment at small scale. (Author's abstract)
W91-02650

SUPERFUND RECORD OF DECISION: BERKS SAND PIT, PA. FIRST REMEDIAL ACTION-FINAL.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-206361/AS. Price codes: AO3 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R03-88/060. September 1988. 38p, 7 fig, 8 tab.

Descriptors: *Cleanup operations, *Groundwater pollution, *Site remediation, *Superfund, *Water pollution treatment, Costs, Pennsylvania, Volatile organic compounds, Water supply.

The three to four-acre Berks Sand Pit site is located in Longswamp Township, Berks County, Pennsylvania. There are at least 20 single family homes within the investigation area, including one on top of the actual sand pit. The immediate vicinity of the site is zoned for low density residential use. The Berks Sand Pit was created by the removal of sand and gravel, but reportedly was used by area residents for refuse disposal. Industrial waste also was alleged to have been disposed of in the area around the pit. Houses were constructed and private wells installed at the location beginning in 1978, after the pit was backfilled. The site first came to the attention of EPA in January 1982 when area residents detected groundwater contamination. Emergency actions were undertaken by EPA in the summer of 1983. The pit was partially excavated and backfilled with clean fill, but no pocket of contamination was discovered. The primary contaminants of concern affecting the groundwater, surface water, and sediments are volatile organic carbons (VOCs) including 1,1,1-TCA, 1,1,-DCA, PCE, and 1,1-DCE. The selected remedial action for this site included: excavation of contaminated sediments with offsite treatment by incineration; groundwater pump and treatment using air stripping and vapor phase carbon absorption with reinjection of treated water back into the aquifer; provision of an alternate water supply system, surface and groundwater monitoring; and restrictions to prevent installation of drinking water wells in the contaminated aquifer. The estimated present worth cost for this remedy is $10,773,100, with annual operating and maintenance costs of $459,200. (Author's abstract)
W91-02651

SUPERFUND RECORD OF DECISION: MOTOROLA (52ND STREET PLANT), AZ. FIRST REMEDIAL ACTION.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-204861. Price codes: AO3 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R09-88/024. September 1988. 48p, 2 fig.

Descriptors: *Arizona, *Cleanup operations, *Groundwater pollution, *Organic solvents, *Site remediation, *Soil contamination, *Superfund, *Water pollution treatment, Costs, Phoenix, Scrubbers, Storage tanks, Trichloroethane, Underground storage.

The Motorola 52nd Street site is located in the eastern part of the City of Phoenix, Maricopa County, Arizona. The site is bounded by the Phoenix Military Reservation and mixed residential and commercial neighborhoods. The site is currently owned by Motorola, Ind., which operates a manufacturing facility at the site using solvents for various manufacturing processes. In January 1983, Motorola tested some underground storage tanks used to store virgin solvents for leaks and determined that a 5,000-gallon tank containing 1,1,1-trichloroethane (TCA) was leaking. Subsequently, Motorola conducted a preliminary investigation, which indicated soil and groundwater contamination on the plant site and groundwater contamination offsite to the west. Motorola initiated an onsite groundwater treatment program in 1986, which included treatability testing, design and installation of a Pilot Treatment Plant (PTP), treatment of groundwater, and beneficial use of the effluent in the plant's air fume scrubbers. The PTP is still in operation. The selected remedy for this Record of Decision (ROD) requires partial cleanup of onsite and offsite organic solvents contamination in the soil and alluvium groundwater. A subsequent remedial action will address cleanup of all onsite and offsite contamination in the soil, alluvium groundwater, and the bedrock underlying the alluvium. The primary contaminant of concern affecting the soil and groundwater is TCA. The selected remedial action for this site includes: onsite soil-gas extraction and treatment using granular activated carbon systems; pump and treatment of on-site and off-site groundwater with treatment onsite and use of the treated groundwater in site manufacturing processes; and groundwater monitoring. The estimated present worth cost for this remedial action is $7,600,000 with annual O&M costs of $700,000. (Author's abstract)
W91-02652

SUPERFUND RECORD OF DECISION: SELMA PRESSURE TREATING COMPANY, CA. FIRST REMEDIAL ACTION--FINAL.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-204853/AS. Price codes: AO6 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R09-88/025. September 1988. 123p, 5 fig, 2 tab.

Descriptors: *California, *Chemical wastes, *Cleanup operations, *Groundwater pollution, *Site remediation, *Soil contamination, *Superfund, *Water pollution treatment, Arsenic, Chromium, Costs, Dioxins, Heavy metals, Pentachlorophenol, Remediation measures.

The Selma Pressure Treating Company is located in Selma, California, 15 miles south of the city of Fresno. The site encompasses approximately 18 acres, including a 3 to 4-acre wood treatment facility and 14 acres of adjacent vineyards that were used for site drainage. Land use in the vicinity of the site includes agricultural, residential and industrial areas, with 12 residences and businesses located within 0.25 mile. The groundwater resources in the area have been classified as a Sole-Source Aquifer and a current drinking water source with other beneficial uses. Wood preserving activities using pentachlorophenol (PCP) were conducted at the site from 1942 until 1965 under a series of owners. In 1965, a new facility was constructed converting operations to a pressure treating process using chemical preservatives. Prior to 1982, wastes generated from spent retort fluids and sludges were discharged to drainage and percolation ditches, dry wells, and an unlined pond and sludge pit, as well as onto open ground and the adjacent vineyards. An inspection conducted by EPA in 1981 raised concerns about the potential for groundwater contamination, and as a result the company was required to modify its operations to minimize the potential for contamination. The total volume of soil requiring remediation is approximately 16,000 cu yds. The primary contaminants of concern affecting the groundwater and soil are organics including dioxin and phenols, and metals including arsenic and chromium. The selected remedial action for this site includes: groundwater pump and treatment using precipitation, coagulation, and flocculation with reinjection into the aquifer or offsite discharge; soil excavation and solidification/stabilization with replacement in excavated areas and capping fixed soil with RCRA cap; groundwater and soil monitoring for approximately 30 years; and long-term access and land use restrictions for fixed areas and short-term institutional controls for groundwater use. The estimated present worth cost for this remedial action is $11,280,000 with an annual operation and maintenance of $1,300,000. (Author's abstract)
W91-02654

SUPERFUND RECORD OF DECISION CANNON ENGINEERING, MA. FIRST REMEDIAL ACTION--FINAL.
Environmental Protection Agency, Washington DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-225577/AS. Price codes: A11 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R01-88/031 March 1988. 228p, 3 fig, 9 tab, 3 append.

Descriptors: *Cleanup operations, *Industrial wastes, *Massachusetts, *Site remediation, *Soil contamination, *Superfund, Benzene, Costs, Monitoring, Polychlorinated biphenyls, Polycyclic aromatic hydrocarbons, Remediation measures, Storage tanks, Vinyl chloride, Volatile organic compounds.

The Cannon Engineering Corporation (CEC) facility is located in a small industrial park in the western part of the Town of Bridgewater, Plym

uth County, Massachusetts. The four-acre site is ordered by industrial developments to the north nd east and a wooded lowland to the south and vest. A wetland area lies south and west of the te. CEC, which has owned the property since 974, handled, stored, and incinerated chemical vaste onsite from 1974 to 1980. EPA conducted te investigations between 1980 and 1982, and in October 1982, Massachusetts contracted for the emoval of sludge and liquid waste from onsite nks and drums. In January 1988, EPA provided or the removal and disposal of numerous hazard- us materials abandoned at the site. This remedial ction addresses three discrete areas of soil and ediment contamination located in the northwest- rn and southern portions of the site, and the uildings, tanks, and other contaminated structures nsite. The volume of contaminated soil is estimat- d to be 325 cu yds. The primary contaminants of oncern affecting the groundwater, soil, and debris e VOCs including benzene, TCE, and vinyl chlo- de, and other organics including PCBs and AHs. The selected remedial action for this site cludes: access restrictions; excavation and onsite eatment of VOC-contaminated soil by thermal ration, and excavation and offsite treatment of CB-contaminated soil by incineration; decontami- ation, removal, and disposal of contaminated uildings, tanks, and structures; additional soil sam- ing to assess effectiveness; groundwater monitor- g and implementation of a water quality monitor- g program to assess natural attenuation of con- minants; and institutional controls to restrict nsite groundwater use. The estimated present orth cost for this remedial action is between ,400,000, and $4,505,000 with present worth op- ation and maintenance of $700,000. (Author's stract)
91-02655

UPERFUND RECORD OF DECISION: AVTEX BERS, VA. FIRST REMEDIAL ACTION.
nvironmental Protection Agency, Washington, C.
vailable from the National Technical Information rvice, Springfield, VA 22161, as PB89-206197/ S. Price codes: AO5 in paper copy, AO1 in crofiche. Report No. EPA/ROD/R03-88/055. ptember 1988. 80p, 5 fig, 10 tab.

escriptors: *Cleanup operations, *Groundwater llution, *Industrial wastes, *Site remediation, uperfund, *Virginia, *Water pollution treatment, senic, Costs, Fly ash, Heavy metals, Lead, enols, Polyester, Polypropylene, Rayon, Reme- ation measures.

e 440-acre Avtex Fibers site is located in arren County, Front Royal, Virginia. The facili- is bounded to the west and northwest by the enandoah River and to the south, northwest, d east by residential areas. Approximately i,300 ople live within one mile of the site. The western rt of the site lies within the limits of the Shenan- ah River's 100-year floodplain. The Avtex ers site has produced rayon fibers since 1940, lyester between 1970 and 1977, and polypropyl- since 1985. During this 48-year period, byprod- s from the rayon manufacturing process were posed of in onsite surface impoundments. These roducts included sodium cellulose xanthate- ed viscose and zinc-hydroxide sludge. Fly ash om incinerator exhaust air pollution control de- es) and boiler house solids were disposed of in e other surface impoundments. Land disposal of cose waste ceased in 1983; since that time, the ste has been routed directly to an onsite stewater treatment plant. In 1982, carbon disul- , a constituent of viscose waste, was identified groundwater samples from residential wells lo- ed across the Shenandoah River from the site. response to the results of a groundwater investi- ion Avtex implemented interim measures, ich included purchasing 23 subdivision proper- on the west side of the river that had contami- ed domestic wells, and initiating a groundwater np and treatment program. This Record of De- on (ROD) is the first of two operable units and resses groundwater remediation and interim re- dial measures for the viscose basins responsible groundwater contamination. A subsequent re- dial action will address source control and vis- cose basin remediation. The primary contaminants of concern affecting the groundwater are phenols, and metals including arsenic and lead. The selected remedial action for this site includes: groundwater and basin liquid pump and treatment in the existing onsite activated sludge wastewater treatment plant, following completion of necessary upgrades, modifications, and construction of pretreatment units, with offsite discharge of treated water to the Shenandoah River; monitoring on-site and off-site groundwater, surface water, and basin fluids; and placing deed restrictions prohibiting the use of groundwater on the affected properties. The estimated present worth cost for this remedial action is $9,122,000. (Author's abstract)
W91-02656

SUPERFUND RECORD OF DECISION: FINDETT, MO. FIRST REMEDIAL ACTION.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-229538/ AS. Price codes: AO3 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R07-89/023. December 1988. 43p, 8 fig, 3 tab.

Descriptors: *Cleanup operations, *Groundwater pollution, *Industrial wastes, *Missouri, *Site remediation, *Soil contamination, *Superfund, *Water pollution treatment, Air stripping, Costs, Groundwater pumping, Polychlorinated biphenyls, Remediation measures, Volatile organic compounds.

The Findett/Hayford Bridge Road Groundwater site is located just north of the City of St. Charles, in St. Charles County, east-central Missouri. The site lies 3.2 miles south of the Mississippi River and is within the floodplain. Land use in the site vicinity is primarily agriculture, but also includes a small industrial park containing Findett Corporation, Cadmus Corporation, and several other commercial and light industrial establishments. In addition, there are several residences within approximately 1,000 feet northeast and 1,500 feet south of the site. The Elm Point Wellfield, the primary drinking water supply for St. Charles, is located 1,800 feet northeast of the site. Until 1980, Findett Corporation reclaimed heat transfer fluids or oils, some of which contained PCBs, and received waste solvents for reclamation or recycling. Subsequently, Findett has custom blended or manufactured organic chemicals for other companies. The Findett site originally came to EPA's attention when Findett Corporation reported handling PCBs at the site. There is PCB-contaminated soil at the Findett facility as well as the adjacent Cadmus Corporation Facility. The Elm Point Well Field is also at risk of contamination by releases from the site. Findett conducted several voluntary PCB soil cleanups pursuant to EPA Administrative Orders in 1981 and 1982; however, PCBs as well as VOCs remain in the soil in concentrations above recommended levels. In addition, groundwater investigations revealed substantial VOC contamination in the shallow aquifer near the contaminant sources and in the deep aquifer tapped by the nearby well field as a drinking water source. The primary contaminants of concern affecting the soil and groundwater are VOCs, and other organics including PCBs. The selected remedial action for this site includes onsite groundwater pumping and treatment using air stripping with discharge to the publicly owned treatment works (POTW); and excavation of contaminated soil with either offsite disposal or treatment. The estimated present worth cost for this remedial action is $8,306,000 with an annual operation and maintenance cost of $398,000. (Author's abstract)
W91-02657

SUPERFUND RECORD OF DECISION: SOUTH VALLEY/EDMUNDS STREET, NM. SECOND REMEDIAL ACTION.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-225528/ AS. Price codes: AO3 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R06-88/037. June 1988. 47p, 3 fig, 2 tab.

Descriptors: *Cleanup operations, *Groundwater pollution, *Industrial wastes, *New Mexico, *Site remediation, *Superfund, *Water pollution treatment, Air stripping, Albuquerque, Costs, Groundwater pumping, Remediation measures, Volatile organic compounds.

The South Valley/Edmunds Street site is a large area in the southern part of the City of Albuquerque, New Mexico, surrounding the municipal water well known as San Jose 6. Within this large area are a number of industrial properties owned and operated by different groups and individuals. This remedial action addresses the Edmunds Street Ground Water operable unit of the South Valley site; the Edmunds Street property is located in the southeastern corner of the site. The focus of this operable unit is the area around the monitoring well SV-10, referred to as the drainage pit area, on the Edmunds Street property. This area is the low spot of the property and receives much of the property drainage. Analyses of this area have shown significant levels of industrial solvents in the soil, and a plume of contaminated groundwater starting at the drainage pit area and extending to the east. The groundwater source will be treated as a sole-source aquifer because there are no alternate sources available to the City of Albuquerque. The contaminated groundwater currently poses a direct threat to Albuquerque's water supply by moving toward the city's well fields. The primary contaminants of concern affecting the groundwater include VOCs such as PCE and TCE. The selected remedial action for this site includes ground water pumping and treatment using air stripping (packed tower aeration) with reinjection of the treated water into the aquifer through infiltration galleries; and groundwater and air monitoring. The present worth cost for this remedial action is $874,000, with present worth operation and maintenance costs estimated at $280,000. (Author's abstract)
W91-02658

SUPERFUND RECORD OF DECISION: COMMENCEMENT BAY/NEAR SHORE, WA. FIRST REMEDIAL ACTION.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-225544/ AS. Price codes: AO6 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R10-88/011. December 1987. 109p, 8 fig, 5 tab, 3 append.

Descriptors: *Cleanup operations, *Coal gasification, *Groundwater pollution, *Industrial wastes, *Site remediation, *Soil contamination, *Superfund, *Washington, Benzene, Costs, Lead, Monitoring, Polychlorinated biphenyls, Polycyclic aromatic hydrocarbons, Remedial measures.

The Tacoma Tar Pits site covers approximately 30 acres within the Commencement Bay-Nearshore/ Tideflats site in Tacoma, Pierce County, Washington. The tar pits lie between the Puyallup River, the city, and Wheeler-Osgood Waterways. These bodies of water are not used as a water supply, but support extensive fish and shellfish populations. Currently there is concern for the site's impact on surface water quality and many local industries that use groundwater from onsite wells. In 1924, a coal gasification plant began operations, and continued until 1956, at which time they were terminated due to the availability of natural gas. During these years, waste materials from the coal gasification process were disposed of onsite. Contained in the waste materials, were a wide variety of organic compounds and heavy metals. From 1965 to 1966, the plant was dismantled and demolished. Most of the metal structures were removed from the site; however, all demolition debris and below grade structures were left in place, including tanks and pipelines containing tars. In 1967, a metal recycling company began operating at the site. Recycling of automobile batteries introduced acid, heavy metals, lead, and PCBs to the soil. Several studies conducted by EPA and the Washington State Department of Ecology between 1981 and 1988 found contaminants derived from the coal gasification

process. The primary contaminants of concern affecting surface water and soil included: benzene, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls, and lead. The selected remedial action for this site includes: excavation of all contaminated soils exceeding 1% total PAHs and all surface soils exceeding a 0.000001 lifetime cancer risk level with stabilization of all excavated soils in a polymer/cement mixture; capping of the stabilized matrix with asphalt; channeling and managing of surface waters; groundwater monitoring; and removal and treatment of ponded water. The estimated present worth cost for this remedial action is $3,400,000. (Author's abstract)
W91-02659

SUPERFUND RECORD OF DECISION: MASON COUNTY LANDFILL, MI. FIRST REMEDIAL ACTION.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-206213/AS. Price codes: AO6 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R05-88/080. September 1988. 115p, 18 fig, 8 tab.

Descriptors: *Cleanup operations, *Groundwater pollution, *Industrial wastes, *Michigan, *Site remediation, *Superfund, Aerators, Aquifers, Benzene, Costs, Gas vents, Landfills, Monitoring, Remediation measures, Volatile organic compounds, Xylenes.

The Mason County Landfill site is located three miles south of the City of Ludington, Mason County, Michigan. The site occupies approximately 18 acres of a predominantly rural area in Pere Marquette Township. Approximately 10 acres of the site were used as a landfill. Less than 500 feet from the landfill there is a wetland area which drains into Babbin Pond, the headwaters of Iris Creek. There are 14 residential wells within a 0.5 mile radius of the landfill. The population within a 3-mile radius of the site is estimated to be 1,112. The Mason County Department of Public Works (DPW) leased the property in 1971 and entered into an agreement with Acme Disposal, Inc. to operate the site as a sanitary landfill. Although the Michigan Department of Natural Resources (MDNR) documented that slurry and sludge wastes from local industries were being dumped at the landfill, the site's license was renewed annually until it was closed in August 1978 after reaching capacity. Public concerns over the water quality in Iris Creek prompted the DPW and MDNR to review closure activities. In 1983, a clay cap was installed over the landfill and berms and storm drains were constructed to improve site drainage. Two surface aerators were installed in Babbin Pond to facilitate biodegradation of organic matter and 15 gas vents were placed in the top of the landfill. The site has been separated into two operable units; one for the landfill contents and one for the groundwater. This source control remedial action addresses the landfill contents. Contamination of the shallow and deep aquifer will be addressed in a subsequent remedial action. Site investigations indicate that contamination of surface water, surface sediment, soil, and offsite air quality are not sufficient to warrant remedial action. The primary contaminants of concern affecting the groundwater are VOCs including benzene, PCE, TCE, and xylene. The selected remedial action for this site includes: construction of a RCRA cap over the landfill; access restrictions; deed restrictions on and near the site to prohibit use of the shallow aquifer; and groundwater monitoring. The estimated present worth cost for this remedial action if $2,800,000, with present worth operating and management costs of $1,000,000 over 30 years. (Author's abstract)
W91-02660

SUPERFUND RECORD OF DECISION: UNITED NUCLEAR CORPORATION, NM. FIRST REMEDIAL ACTION.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-206171/AS. Price codes: AO7 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R06-88/044. September 1988. 130p, 11 fig, 10 tab, 18 ref.

Descriptors: *Cleanup operations, *Groundwater pollution, *Mine wastes, *New Mexico, *Nuclear wastes, *Site remediation, *Superfund, *Uranium, *Water pollution treatment, Arsenic, Costs, Evaporation, Groundwater pumping, Metals, Monitoring, Radionuclides, Radium, Remediation measures.

The United Nuclear Corporation (UNC) site is located approximately 17 miles northeast of Gallup, New Mexico, in McKinley County. The site operated as a State-licensed uranium mill facility from June 1977 to May 1982. It includes an ore processing mill (about 25 acres) and an unlined tailings pond area (about 100 acres). The surrounding area is sparsely populated, with the nearest residence located 1.5 miles from the site. In July 1979, approximately 23 million gallons of tailings and pond water were released to a nearby river as a result of a dam breach in the tailings pond area. The site damage was repaired; however, attention was focused on groundwater contamination resulting from tailings seepage. Consequently, UNC implemented a groundwater pumping system that withdrew groundwater from the aquifers underlying the site and sent it to an onsite borrow pit for evaporation. UNC also conducted tailings neutralization from late 1979 to early 1982. Nevertheless, the offsite migration of radionuclides and chemical constituents from uranium milling byproduct materials into the groundwater, as well as to surface water and air, are still principal threats at the site. This remedial action will address onsite groundwater contamination. Source control and onsite surface reclamation will be implemented under the direction of the Nuclear Regulatory Commission and integrated with this groundwater operable unit. The primary contaminants of concern affecting the groundwater are metals including arsenic and radioactive substances including radium-226/228 and gross alpha. The selected remedial action for this site includes: implementation of a groundwater monitoring program to detect any increases in the areal extent or concentration of groundwater contamination outside the tailings disposal area; groundwater pump and treatment using existing and/or new extraction wells to control and remove tailings seepage and remediate contaminated groundwater, with discharge to an enhanced mister/pond evaporation system; and implementation of a performance monitoring and evaluation program. The estimated present worth cost for this remedial action is $17,000,000 over a 10-year period, with estimated annual operation and management of $1,000,000. (Author's abstract)
W91-02661

SUPERFUND RECORD OF DECISION: SOUTHERN MARYLAND WOOD, MD. FIRST REMEDIAL ACTION--FINAL.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-206387/AS. Price codes: AO5 in paper copy, AO1 in microfiche. Report No. EPA/ROD/RO3-88/051. June 1988. 85p, 5 fig, 15 tab.

Descriptors: *Cleanup operations, *Industrial wastes, *Maryland, *Site remediation, *Superfund, *Water pollution sources, *Water pollution treatment, Activated carbon, Cylinder sludges, Groundwater pumping, Monitoring, Remediation measures, Retort sludges, Sedimentation, Surface water pumping, Volatile organic compounds.

The Southern Maryland Wood Treating (SMWT) site is located in Hollywood, St. Mary's County, Maryland. The site is situated within a wetland area in a drainage divide such that runoff from the site discharges into Brooks Run and McIntosh Run tributaries, which flow into the Potomac River. The area surrounding the site is predominantly used for agricultural and residential purposes. From 1965 to 1975, SMWT operated as a pressure treatment facility for wood preservation. Currently, part of the site is being used as a retail outlet for pretreated lumber and crab traps. The waste generated a the site included retort and cylinder sludges, process wastes, and material spillage. These wastes were in six onsite unlined lagoons. An onsite freshwater pond became contaminated during the facility's active and inactive periods with VOCs, polynuclear aromatics (PNAs), and base/neutral extractables due to contaminated groundwater and surface runoff. Cleanup actions were initiated in 1982 following legal actions by the Maryland Department of Health and Mental Hygiene. Liquids removed from the six lagoons were spray irrigated onto the nearby woods. The six lagoons were excavated, backfilled, and graded, and the freshwater pond was partially excavated. The excavated sludges were mixed with composited sludge and topsoil, and spread in a level treatment area located on the property. The primary contaminants of concern affecting the onsite groundwater soil, surface water, sediments, and debris include: VOCs, PNA, and base/neutral acid extractables. The selected remedial action for this site includes: excavation/dredging of soils, sediments, tank liquids, and cement, and treatment using onsite incineration with onsite disposal of non-hazardous residual ash, backfilling, regrading, and revegetating, where necessary; installation of a slurry wall; dewatering of the slurry wall area by a groundwater and surface water pumping system, and treatment using activated carbon adsorption or hydrogen peroxide and irradiation with discharge to the onsite pond; installation of a geotextile silt fence, sedimentation basins, and/or diversion; and groundwater, surface water, environmental, organic vapor, and dust monitoring. (Author's abstract)
W91-02662

SUPERFUND RECORD OF DECISION: M.W. MANUFACTURING, PA. FIRST REMEDIAL ACTION.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-229587/AS. Price codes: AO4 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R03-89/067. March 1989. 51p, 2 fig, 7 tab.

Descriptors: *Cleanup operations, *Copper, *Groundwater pollution, *Industrial wastes, *Pennsylvania, *Site remediation, *Soil contamination, *Superfund, Costs, Incineration, Lead, Remedial measures, Solvents, Volatile organic compounds.

The M.W. Manufacturing site is a former copper recovery facility located in Montour County, Pennsylvania, two miles north of Danville. The Pennsylvania Department of Transportation (PennDOT) maintains a storage area immediately north of the site, and farmlands and wooded lots are adjacent to the site on the west and south. Mauses Creek flows in a southerly direction past the site. Several private residences, motels, gas stations, restaurants, and a Head Start School are located just north of the PennDOT storage area and rely on private groundwater wells for drinking water. M.W. Manufacturing was engaged in secondary copper recovery from scrap wire, using both mechanical and chemical processes. Granular carbon wastes generated by the chemical process were dumped onsite, and spent solvents and acids were allegedly disposed of onsite. In 1972, M.W. Manufacturing filed for bankruptcy and the Philadelphia National Bank acquired the property. Warehouse 81 Inc. acquired the site in 1976. and subsequently formed a limited partnership with Domino Salvage, Inc. to recover wire at the site using mechanical recovery only. The initial remedial investigation revealed several areas posing potential threats to public health: the carbon waste pile, four wire-fluff waste piles, a surface impoundment, buried lagoon and contaminated soils, drums and storage tanks. This remedial action addresses the concerns for direct contact with and migration to groundwater of contaminants from the carbon waste pile. The remaining areas are the subject of a long-term remedial investigation and feasibility study. The primary contaminants of concern affecting the soil are VOCs including PCE and TCE; organics including PCBs; and metals including lead. The selected remedial action for this site

includes excavating the carbon waste pile (approximately 875 cu yds of contaminated waste and contaminated underlying soils) and transporting the waste offsite to an incinerator facility and disposing of the ash in an offsite RCRA hazardous waste landfill. The estimated capital cost for this remedial action is $2,061,000. Since onsite remediation activities are anticipated to require less than one year, there are no operation and maintenance costs. (Author's abstract)
W91-02663

SUPERFUND RECORD OF DECISION: SOUTH VALLEY/SJ-6, NM. THIRD REMEDIAL ACTION.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-204804/AS. Price codes: AO4 in paper copy, AO1 in microfiche. Report No. EPA/ROD/R06-88/041. September 1988. 62p, 3 fig, 1 tab, 3 append.

Descriptors: *Cleanup operations, *Groundwater pollution, *Industrial wastes, *New Mexico, *Site remediation, *Soil contamination, *Superfund, Costs, Monitoring, Remediation measures, Solvents, Volatile organic compounds.

The South Valley/SJ-6 site is located on the southern margin of Albuquerque, New Mexico, just north of South Valley. The total site encompasses the SJ-6 municipal well, and six industrial facilities and their surrounding properties within an approximately one square mile radius. Land use is primarily industrial and agricultural with residential areas located immediately north of the site. Industrial development began in the South Valley area just prior to the 1940s. Metal parts were manufactured in the area starting around 1948. By the 1960s, organic chemicals were being handled and packaged on the site. Currently, petroleum fuels and various chlorinated organics are stored, handled and used within the South Valley areas. Groundwater contamination was first suspected in 1973 when foul tastes and odors were noted in groundwater from a private well on the Edmunds property in South Valley. Subsequent sampling revealed the presence of several VOCs in three municipal wells including SJ-6. One of the wells was resampled in 1988 and found to be free of contaminants, another well was taken out of service because of mechanical problems, and SJ-6 was shut down in 1980 due to the continual detection of low levels of solvents. This Record of Decision (ROD) addresses only the source and extent of groundwater contamination in the vicinity of JS-6. Principle threats at the site (i.e., the source and remanating plumes of contamination from surrounding areas) are being addressed through remedial actions initiated by EPA in separate RODs. The primary contaminants of concern affecting the groundwater are VOCs including 1,1-DCE, PCE and TCE. The selected remedial action for this site includes: removal and disposal of 100 cu yds of contaminated sediments at the base of the SJ-6 borehole; sealing abandoned wells; groundwater monitoring; and access restrictions. The estimated present worth cost for this remedial action is $4,000,000 with estimated an annual operation and maintenance of $300,000. (Author's abstract)
W91-02664

APPLICATION OF A SIMPLE SHORT-TERM BIOASSAY FOR THE IDENTIFICATION OF GENOTOXINS FROM HAZARDOUS WASTES.
Environmental Health Research and Testing, Inc., Research Triangle Park, NC.
For primary bibliographic entry see Field 5A.
W91-02665

SUPERFUND RECORD OF DECISION: MIDDLETOWN AIR FIELD, PA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-211684/AS. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/R03-88/039, December 1987. 47p, 3 fig, 9 tab.

Descriptors: *Cleanup operations, *Groundwater pollution, *Pennsylvania, *Site remediation, *Superfund, *Volatile organic compounds, Air stripping, Costs, Drinking water, Groundwater pumping, Monitoring, Potable water, Remediation measures, Trichloroethene, Water pollution treatment.

The Middletown Air Field site covers what is now the Harrisburg International Airport (HIA), located between the town of Middletown and Highspire, Dauphin County, Pennsylvania. The airport is owned and operated by the Commonwealth of Pennsylvania Department of Transportation. Thearea surrounding the base is characterized as mixed residential/industrial. Between 1898 and 1962, the property was owned by the U.S. Government and used by the military. HIA and several other entities occupy what was referred to as the Olmsted Air Force Base. In March 1983, trichloroethene (TCE) contamination caused six of the ten onsite production wells supplying HIA to be taken out of service. Studies initiated under the Department of Defense Installation Restoration Program indicate that while groundwater contamination due to volatile organic compounds exists, the exact source(s) of contamination cannot be clearly defined. Groundwater contamination may result from one or more, possible current, sources in the 'industrial area'. To date, HIA has been able to temporarily meet the water requirements of the facility by taking the most contaminated well offline as a potable water source, and by blending potable water from a number of wells. The most prevalent contaminants of concern affecting the groundwater are VOCs including TCE and PCE. The selected remedial action for this site includes: provision of a potable water supply; construction of a central treatment plant; groundwater pump and treatment using air stripping; and groundwater monitoring. The estimated capital cost for this remedial action is $3,750,000 with annual operation and maintenance of $160,000. (Author's abstract)
W91-02669

GROUNDWATER MANAGEMENT: QUANTITY AND QUALITY.
For primary bibliographic entry see Field 4B.
W91-02672

ROLE OF GROUNDWATER QUALITY IN THE DECISION-MAKING PROCESS FOR WATER RESOURCES.
Universidad Politecnica de Cataluna, Barcelona (Spain). Escuela Tecnica Superior de Ingenieros de Caminos, Canales y Puertos.
E. Custodio.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 87-99, 19 ref.

Descriptors: *Groundwater management, *Groundwater pollution, *Groundwater quality, *Water pollution control, *Water pollution sources, *Water quality management, *Water resources management, Aeration zone, Decision making, Forecasting, Groundwater movement, Monitoring, Saline water intrusion, Saturated zone.

The quality of aquifer water is a complex result of climatic, pedalogical, and lithological influences, modified by a set of interactions and reactions in the ground, both in the saturated and unsaturated zone. Many natural circumstances affect groundwater quality. Also man-induced changes in the flow system may alter it significantly, as is the case of seawater intrusion. Man's activities introduce an enormous variety of substances into the ground and this may lead to water contamination. The decision-making process has to consider these sources, the long transit times, the delayed and modified responses, and the difficulties involved in monitoring and forecasting. Prevention is generally more effective, feasible, and cheaper than repair and restoration. (See also W91-02672) (Author's abstract)
W91-02680

MANAGEMENT OF GROUNDWATER-INDUCED RIVER SALINITY DUE TO LAND CLEARING IN THE MURRAY BASIN, SOUTHEASTERN AUSTRALIA.
South Australian Dept. of Mines and Energy, Adelaide.
S. R. Barnett.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 101-109, 5 fig, 1 tab, 8 ref.

Descriptors: *Groundwater management, *Groundwater quality, *Irrigation effects, *Model studies, *Recharge, *Saline water, *Surface-groundwater relations, *Water pollution control, Australia, Computer models, Drainage equilibrium, Groundwater pollution, Groundwater recharge, Land clearing, Murray River, River basin development, Saline groundwater, Vegetation effects, Vegetation regrowth, Water quality management, Water resources management, Water table rise.

Widespread clearing of native vegetation and extensive irrigation in the Murray Basin in southeastern Australia has dramatically increased recharge and caused a major change to the hydrodynamic equilibrium of the basin. The resultant rising water table has caused widespread salinization with an estimated annual cost of $100 million. Computer modeling has been used to estimate the effects on the salinity of the Murray River of the increase of saline groundwater discharge which will result from the rising water table. An increase of at least 70 EC units (70 microSiemen/cm) could occur 50 years after the water table begins to respond to the increased recharge. Selective broadscale revegetation in critical areas adjacent to the river will reduce groundwater inflows by reducing recharge, but may prove uneconomic. (See also W91-02672) (Author's abstract) (Fish-PTT)
W91-02681

NITRATE IN GROUNDWATER.
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
For primary bibliographic entry see Field 5B.
W91-02689

HAZARDOUS WASTE CONTAINMENT USING CLAY LINERS.
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W91-02690

STOCHASTIC CONTROL OF CONTAMINANT TRANSPORT PROBLEMS.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
R. Andricevic, and P. K. Kitanidis.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 271-284, 4 fig, 1 tab, 12 ref. National Science Foundation grants CEE-8420664 and ECE-8517598.

Descriptors: *Groundwater movement, *Hydrologic models, *Model studies, *Path of pollutants, *Site remediation, *Solute transport, *Water pollution control, *Water pollution treatment, *Water quality management, Algorithms, Aquifers, Cost analysis, Mathematical models, Optimization, Parametric hydrology, Pumping, Stochastic models, Uncertainty, Water resources management.

The design of effective remediation schemes is a major technological challenge. A major difficulty is the tremendous spatial variability in the soil properties in the geological environment in which these reactions take place. Geohydrological parameters, needed for the prediction of single-phase hydrological transport and fate of contaminants, often vary over orders of magnitude within the same site. In practice there is seldom enough information to specify with certainty all the parameters of the groundwater flow and transport system. An

optimization methodology to determine the most cost-effective pumping pattern and schedule has been developed which accounts for parameter uncertainty. It shows that, in an average sense, the cost consists of two parts: one which depends only on the best estimates and another which increases with the error in parameter estimation. A policy which minimizes the sum of the two parts was developed and applied to a simple case. Comparison with an optimization method which neglects uncertainty in parameter estimation determined the superiority of the proposed algorithm. The optimal policy may be one which focuses on reducing predictive uncertainty during the initial stages. It is reasonable that the more accurate the site characterization, the more cost-effective the remediation strategy which can be designed. On the other hand, in deciding how to reduce uncertainty, one must take into account how this will improve the decontamination effort. The major advantage of the methodology developed is that it selects the solution after weighing the estimation and the control objectives, and could be used for the 'optimal sampling' problem. (See also W91-02672) (Fish-PTT)
W91-02696

MANAGEMENT MODEL FOR AQUIFER RECHARGE WITH NON-CONSERVATIVE POLLUTANTS.
Baghdad Univ. (Iraq). Coll. of Engineering.
For primary bibliographic entry see Field 4B.
W91-02698

OPTIMAL GROUNDWATER QUALITY MANAGEMENT UNDER UNCERTAINTY: INCORPORATING THE EFFECTS OF SPATIAL VARIABILITY OF HYDRAULIC CONDUCTIVITY.
Stanford Univ., CA. Dept. of Applied Earth Sciences.
B. J. Wagner.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 419-430, 5 fig, 7 ref.

Descriptors: *Groundwater management, *Groundwater movement, *Hydraulic conductivity, *Hydrologic models, *Model studies, *Path of pollutants, *Water pollution treatment, *Water quality management, *Water resources management, Aquifers, Flow models, Groundwater pollution, Solute transport, Stochastic models.

In recent years, groundwater quality management models have been developed to aid the reclamation design process. These management models combine groundwater flow and contaminant transport simulation with optimization to design for the optimal remediation of contaminated aquifer systems. Unfortunately, there are a number of potential sources of error associated with all groundwater flow and contaminant transport simulation models. Uncertainty due to spatial variability of hydraulic conductivity was explicitly incorporated into a procedure for the optimal design of aquifer remediation strategies. The management procedure is based on the stochastic approach to groundwater flow and contaminant transport modeling, in which the hydraulic conductivity is represented as a random field. The remediation design procedure begins with the solution of the stochastic inverse model. Maximum Likelihood and Gaussian conditional mean estimation are used to characterize the random conductivity field based on hydraulic conductivity and hydraulic head measurements. Next, the nonlinear groundwater quality management problem is simultaneously solved for a sampling of hydraulic conductivity realizations. An example showed that reclamation design based on as few as thirty conductivity realizations can provide reliable remediation strategies. (See also W91-02672) (Author's abstract)
W91-02708

FINITE ELEMENT COMBINED SURFACE WATER/GROUNDWATER MODEL FOR THE RIVER RHINE, KEHL/STRASBOURG RESERVOIR.
Lahmeyer International G.m.b.H., Frankfurt am Main (Germany, F.R.).
W. Pelka, and R. Horst.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 523-532, 9 fig, 4 ref.

Descriptors: *Dam design, *Germany, *Groundwater management, *Groundwater resources, *Model studies, *Reservoir design, *Rhine River, *Surface-groundwater relations, *Water resources management, *Water supply development, Channel flow, Cost analysis, Finite element method, Flow models, Groundwater level, River basins, Three-dimensional model, Watershed management.

River engineering measures in the Upper Rhine from Basel to Strasbourg (France and Germany) were completed by putting the River Strasbourg power plant into operation. To mitigate negative environmental effects and especially to maintain a certain water level in the original river bed to support the groundwater level, a barrage was constructed. To optimize the depth of diaphragm walls of the large retarding reservoirs upstream of the barrage, a mathematical model has been developed and implemented, combining a three-dimensional finite element groundwater flow model and a finite element channel flow model. The influence of the water level in the channels on the groundwater flow is introduced by leakage boundary conditions. The reference water level of the surface water results from the channel flow model. The parameters calibrated were permeability and leakage factors for the groundwater model and roughness for the channel flow model. To maintain the required water level depth in the villages, for each diaphragm depth the cross-sections and slope of the drainage system had to be increased to a certain extent and several pump stations of varying capacity became necessary. For each diaphragm depth the costs of the expansion and correction of the drainage system were evaluated and compared with the costs of the related diaphragm wall. The optimum depth satisfying economic as well as environmental and safety requirements is about 20 m. For construction projects of this or similar dimension, the costs of even the most complicated and advanced numerical models are several orders of magnitude less than the costs which may arise without their application. (See also W91-02672) (Fish-PTT)
W91-02716

ALLUVIAL AQUIFER OF THE GRAND GRAVIER (RHONE VALLEY, FRANCE) MODELLING AND PROTECTION.
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Lyon (France).
A. Durbec, and C. Leduc.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 581-593, 6 fig, 1 tab, 5 ref.

Descriptors: *Aquifer management, *France, *Groundwater management, *Groundwater resources, *Lyon, *Metropolitan water management, *Potable water, *Surface-groundwater relations, *Water pollution prevention, *Water resources management, *Water supply development, Case studies, Environmental impact, Geohydrology, Grand Gravier Aquifer, Groundwater level, Groundwater movement, Groundwater recharge, Low flow, Model studies, Numerical analysis, Path of pollutants, River basins, Urban areas, Wells.

The water supply of the entire urban area of Lyon, France, depends on groundwater. The heavy industrialization of the region generates a permanent risk of serious pollution. On the site of the Grand Gravier pumping station, especially representative of this context, a detailed hydrogeological study has allowed numerical modeling to be done of groundwater flow. Exchanges with the River Rhone have been quantified during low water flood. Direct recharge by the river exceeds 80%. Different solutions of hydraulic management have been simulated and their impact on water catchment operations predicted. A numerical model of pollutant transport permits the efficiency of sanitary protection of well fields to be tested and points out the contamination risk. The regime of the Rhone banks is currently being studied. Using the efficient methodology drawn up on this aquifer, the relationships between the Rhone and its alluvium throughout the valley can be accurately determined. The resource vulnerability will be evaluated. On the entire basin scale, scientists and politicians have to provide information to predict and to face pollution accidents, where necessary, with suitable protection measures. (See also W91-02672) (Fish-PTT)
W91-02721

DRINKING WATER CRITERIA DOCUMENT FOR TOLUENE.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192298. Price codes: A12 in paper copy, A01 in microfiche. EPA Final Report ECAO-CIN-408, March 1987. 267p, 20 tab, 205 ref.

Descriptors: *Drinking water, *Regulations, *Standards, *Toluene, *Water quality standards, *Water treatment, Carcinogens, Classification, Organic solvents, Public health, Toxicity, Volatile organic compounds.

Toluene is a relatively volatile organic solvent with a low water solubility, so that in aqueous solution it would be expected to evaporate into the environmental air. Because of its predisposition to exist as a vapor in the environment, most toluene exposure in humans is by inhalation. Absorption of toluene is rapid by inhalation or from the GI tract; absorption from the GI tract appears to be complete, while 50% of the inhaled toluene is absorbed through the lungs. In humans, the major effects of toluene are central nervous system dysfunction and narcosis. Applying EPA guidelines for the assessment of carcinogenic risk, toluene may be classified as group D: Not classified as to human carcinogenicity. This classification reflects the inadequate nature of the available data, thus preventing the development of a more definite statement regarding carcinogenic potential. The noncarcinogenic effects of toluene in laboratory animals and humans have been utilized for derivation of health advisories and a drinking water equivalent level (DWEL). The 1-day health advisory value, based on a human 8-hr no-observed-adverse-effect level (NOAEL), is 18 mg/L for a 10 kg child. The proposed 10-day and longer term health advisory for a 10 kg child is 3 mg/L. The longer term health advisory for a 70 kg adult adopted the DWEL of 10 mg/L as a conservative estimate of exposure. The DWEL was derived from a NOAEL for male and female F344 rats exposed to toluene by inhalation at 300 ppm for 106 wks. The resultant DWEL for toluene is 10 mg/L. (Lantz-PTT)
W91-02731

DRINKING WATER CRITERIA DOCUMENT FOR 2(2,4,5-TRICHLOROPHENOXY) PROPIONIC ACID (2,4,5-TP).
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192330. Price codes: A07 in paper copy, A01 in microfiche. EPA Final Report ECAO-CIN-419, September 1987. 132p, 14 tab, 120 ref.

Descriptors: *Drinking water, *Halogenated pesticides, *Herbicides, *Regulations, *Silvex, *Water quality standards, *Water treatment, Carcinogens, Organic acids, Public health, Standards, Toxicity, Water quality control.

2,4,5-Trichlorophenoxypropionic acid (2,4,5-TO), Silvex, is a commonly used systemic herbicide for both agricultural and nonagricultural purposes.

The commercial herbicide is contaminated with 2,3,7,8-TCDD, a highly toxic tetra-chlorinated dibenzo-p-dioxin. Human studies have shown some positive evidence that exposure to phenoxy herbicides together with 2,3,7,8-TCDD as a contaminant correlates with an increase in soft tissue sarcomas and non-Hodgkins lymphomas. The EPA has given this mixture of compounds a B1 weight-of-evidence ranking, which indicates that this mixture is probably carcinogenic for humans. Neither 2,4,5-TP nor 2,3,7,8-TCDD alone can, be shown to have this carcinogenic potential, however. The quantification of toxicological effects of 2,4,5-TP involved the identification of doses at which adverse health effects are anticipated for both chronic and acute exposures in adults and children consuming 2 L or L water/day. The 10-day health advisory of 0.2 ng/L (1.4 mg/day) was derived for a child exposed to 2,4,5-TP in water. A drinking water equivalent level (DWEL) of 0.26 mg/L was derived for lifetime exposure for an adult. The EPA has taken significant regulatory action on 2,4,5-TP as an herbicide product. As of February 1987, the result of the actions taken should be to reduce the availability of 2,4,5-TP, and hence its discharge into the environment, to virtually a nil level. The exception to this would be a situation where the storage of 2,4,5-TP in controlled or uncontrolled dump sites or related scenarios might result in a discharge to the environment. The regulatory action against herbicide uses began in February 1979 when 2,4,5-TP use in forestry, rights of way, pasture, home and garden, and ornamental gardening was suspended. Between 1979 and February 1985 all other registrations for 2,4,5-TP uses were cancelled by the US EPA. From February 1985 through February 1986, existing 2,4,5-TP stocks only were allowed into commerce only for highly limited use. As of February 1986 all sales of 2,4,5-TP ceased. (Lantz-PTT)
W91-02732

RINKING WATER CRITERIA DOCUMENT OR TOXAPHENE.
nvironmental Protection Agency, Cincinnati, H. Environmental Criteria and Assessment ffice.
vailable from the National Technical Information rvice, Springfield, VA 22161, as PB89-192306. ice codes: A07 in paper copy, A01 in microfiche. PA Report ECAO-CIN-426, February 1987. 8p, 29 tab, 216 ref.

escriptors: *Carcinogens, *Drinking water, *Halenated pesticides, *Regulations, *Standards, oxaphenes, *Water quality standards, *Water atment, DDT, Insecticides, Lethal limit, Organcompounds, Public health, Toxicity.

xaphene is a broad spectrum, chlorinated terioid pesticide introduced in the US as a contact ecticide in 1948. Together with methoxychlor, xaphene has been the chief replacement for DT when the use of DDT was banned. A varieof guidelines or standards have been published protect against toxaphene in aquatic media. That ional interim primary drinking water standard is nicrogm/L. The FDA mandated level for bot- water is also 5 microgram/L. These standards based upon organoleptic effects. The water lity criterion for the protection of human health s originally set at 0.5 microgram/L for a 0001 cancer risk level. This criterion was subsently revised to 7.1 ng/L for a risk of 0.00001. If sumption of aquatic organisms is considered ne, the corresponding risk level is 7.3 ng/L. xaphene has caused convulsions and nausea in nans when exposure has occurred by ingestion, contact or inhalation. The acute oral LD50, mated from accidental poisonings was found to y between 29 and 100 mg toxaphene/kg body ght. Mixtures of toxaphene with DDT (2:1, by ght) are more acutely toxic than either compot alone. The recommended criterion for chronxposure to toxaphene in drinking water, not sidering intake from other sources, is 3.1, 0.31 0.031 micrograms/L to maintain individual cer risk less than 0.0001, 0.00001, and 0.000001, pectively. The sufficient level of carcinogenic dence in experimental animals, together with inadequate level of human evidence meets the RC Group 2B criteria for weight of evidence that a chemical is likely to be a human carcinogen. The assignment of a Group 2B designation by IARC means that the chemical is probably carcinogenic in humans. (Lantz-PTT)
W91-02733

APPLICATION OF DIRECT PLAQUE ASSAY FOR DETECTION AND ENUMERATION OF BACTERIOPHAGES OF BACTEROIDES FRAGILIS FROM CONTAMINATED-WATER SAMPLES.
Malaga Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W91-02770

SECONDARY DISINFECTION OF SERVICE RESERVOIRS.
Yorkshire Water Authority (England). Western Div.
For primary bibliographic entry see Field 5F.
W91-02846

LOW FLOW ESTIMATION BASED ON RIVER RECESSION RATE.
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 2E.
W91-02847

EC BATHING WATERS DIRECTIVE AS APPLIED TO SCOTLAND.
Forth River Purification Board, Edinburgh (Scotland).
W. Halcrow, and T. M. Leatherland.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 4, p 356-360, August 1990. 3 tab, 7 ref.

Descriptors: *Bacteria, *Recreation, *Regulations, *Scotland, *Swimming, *Wastewater disposal, *Water quality, Coliforms, Monitoring, Ocean dumping, Outfall sewers, Standards, Wastewater outfall, Wastewater pollution, Water quality control.

Monitoring of the bacteriological quality of potential bathing waters has been carried out in Scotland since the publication of the EC bathing waters Directive 14 years ago. However, it has only been since 1987 that 23 beaches in Scotland have been officially recognized as having bathing waters which should meet the environmental quality standards (EQS) laid down by the Directive. Results of the first three years' monitoring are outlined and the cost of this work has been estimated. Treatment of effluents through solids removal, trade effluent control at source, and dispersion from a long sea outfall is the most appropriate form of sewage disposal in the majority of coastal situations. All future coastal sewage disposal schemes should be sited so as to make provisions for additional works to meet possible new standards. The need to monitor both indicator and target organisms is questioned, and studies are cited suggesting that the present mandatory coliform standards may not be sufficiently stringent. (Lantz-PTT)
W91-02848

SLUDGE DISPOSAL STRATEGY FOR DUMFRIES AND GALLOWAY REGIONAL COUNCIL.
For primary bibliographic entry see Field 5E.
W91-02850

EUROPEAN ENVIRONMENTAL DIRECTIVES--IMPLICATIONS FOR NORTHERN IRELAND.
D. R. Saville.
Journal of the Institution of Water and Environmental Management JIWMEZ, Vol. 4, No. 4, p 379-385, August 1990. 9 tab, 8 ref.

Descriptors: *Economic aspects, *Northern Ireland, *Regulations, *Waste disposal, *Water quality, Compliance, Drinking water, Municipal wastewater, Ocean dumping, Outfall sewers, Recreation, Swimming, Wastewater outfall, Wastewater treatment, Water quality control.

The current level of compliance in Northern Ireland with the European Community (EC) Directives on drinking water quality, bathing water quality, sewage sludge to land and the draft Directive on the disposal of sewage sludge to the sea, is discussed. The cost implications of full compliance are examined, taking account of works already programmed, and concluding that additional funding will be required over the next ten years amounting to almost 250 million pounds. A large portion of this sum will be required for improvements relating to the drinking water directive. Compliance with the Directives are compulsory. A description of the increase in estimated additional funding to approximately 440 million pounds, due to general inflation and other factors, is included. These other factors include: the new draft municipal wastewater treatment Directive, together with the March 1990 announcement by the UK Environment Minister committing the UK to the cessation of sewage sludge dumping at sea, and the provisions of sewage treatment for coastal outfalls. (Author's abstract)
W91-02851

DIVERSION CAPACITY OF CAPILLARY BARRIERS.
Disposal Safety, Inc., Washington, DC.
For primary bibliographic entry see Field 5E.
W91-02887

LACK OF THEORETICAL BASIS FOR PREDICTING RATE AND PATHWAYS OF RECOVERY.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
J. Cairns.
Environmental Management EMNGDC, Vol. 14, No. 5, p 517-526, 1990. 1 tab, 32 ref.

Descriptors: *Habitat restoration, *Lotic environment, *Rehabilitation, *Stream improvement, *Water pollution treatment, Ecology, Ecosystems, Prediction, Running waters, Theoretical analysis.

An inadequate basis for precisely predicting the outcome of lotic ecosystem recovery, whether due to unaided natural processes or management techniques or both, exists because: (1) the field of ecology has not yet matured as a rigorous predictive science; (2) the precise sequence of events, including climatic occurrences, affecting the recovery process may be unique events and thus rarely or never repeated; and (3) even when attempts are made to control the recolonization process through introduction of species and such, the interaction of these species may not follow deterministic models. Lotic ecosystems are influenced strongly by exports from the surrounding land mass and, under certain circumstances, this may be the overriding influence on the recovery process. Therefore, unless the boundary conditions are determined realistically, the recovery process may not follow desirable pathways. Despite the lack of a robust theoretical support base for lotic ecosystem recovery, some remarkable and rapid recoveries have occurred to either a close approximation of the original condition or to a condition ecologically superior to the damaged condition. In some cases, the recovery was due entirely to natural processes and often followed relatively straightforward management practices. There is evidence indicating that lotic ecosystem restoration is both cost-effective and likely to produce satisfying results fairly rapidly. It is both fortunate that this is the case, since society is likely to support such efforts when the results have been extraordinarily successful, and unfortunate since restoration ecology needs a predictive capability. (Author's abstract)
W91-02895

INDICATORS OF ECOSYSTEM RECOVERY.
Cornell Univ., Ithaca, NY. Ecosystems Research Center.

J. R. Kelly, and M. A. Harwell.
Environmental Management EMNGDC, Vol. 14, No. 5, p 527-545, 1990. 5 fig, 4 tab, 46 ref. Cornell University and EPA Cooperative Agreement No. CR81268501.

Descriptors: *Bioindicators, *Ecosystems, *Lotic environment, *Monitoring, *Rehabilitation, *Stream improvement, *Surveys, Data acquisition, Ecological effects, Streams, Stress.

The assessment of ecological changes relative to disturbance, either natural or human induced, confronts a fundamental problem. Ecosystems are complex, variable and diverse in nature; consequently, the need for simplification to essential features that would characterize ecosystems adequately, is generally acknowledged. Yet there is no firm prescription for what to measure in order to describe the response and recovery of ecosystems to stress. Initial focus is provided by identifying relevant ecological endpoints, such as ecological changes of particular relevance to humans. Furthermore, it is suggested that generic purposes and criteria be considered when making choices for ecological indicators that relate to those endpoints. Suites of indicators, with a variety of purposes, are required to assess response and recovery of most ecosystems and most stresses. Measures of certain ecosystem processes may provide special insight on the early stages of recovery; the use of functional indicators as complimentary to other biotic indicators is highlighted in an extended example for lotic ecosystems. (Author's abstract)
W91-02896

RECOVERY OF LOTIC COMMUNITIES AND ECOSYSTEMS FROM DISTURBANCE--A NARRATIVE REVIEW OF CASE STUDIES.
Environmental Research Lab., Duluth, MN.
J. D. Yount, and G. J. Niemi.
Environmental Management EMNGDC, Vol. 14, No. 5, p 547-569, 1990. 170 ref.

Descriptors: *Case studies, *Ecosystems, *Habitat restoration, *Lotic environment, *Rehabilitation, *Stream improvement, Ecological effects, Flushing, Life history studies, Literature review, Restoration, Stream biota, Water quality.

A narrative account is given of case studies of the recovery of flowing water systems from disturbance, focusing on conclusions about recovery time and the factors contributing to recovery. Attention is restricted to case studies in which the recovery of some biological property of the system has been examined, excluding those that deal only with physical or chemical properties. Although natural processes and rates of recovery are emphasized, studies of restoration or reclamation of damaged ecosystems are included where they contribute to an understanding of recovery processes. For the majority of studies examined, the systems recovered quite rapidly. The most commonly cited reasons for short recovery times were: (1) life history characteristics that allowed rapid recolonization and repopulation of the affected areas; (2) the availability and accessibility of unaffected upstream and downstream areas and internal refugia to serve as sources of organisms for repopulation; (3) the high flushing rates of lotic systems that allowed them to quickly dilute or replace polluted waters; and (4) the fact that lotic systems are naturally subjected to a variety of disturbances and the biota have evolved life history characteristics that favor flexibility or adaptability. In general, longer recovery times were observed in disturbances, such as channelization, that resulted in alterations to physical conditions. This review also indicates that much of the knowledge of recovery in lotic ecosystems is fragmented and uncoordinated. In addition to establishing the bounds of recovery time, this review identifies some research gaps that need to be filled. (Author's abstract)
W91-02897

OVERVIEW OF CASE STUDIES ON RECOVERY OF AQUATIC SYSTEMS FROM DISTURBANCE.
Minnesota Univ.-Duluth. Natural Resources Research Inst.
G. J. Niemi, P. DeVore, N. Detenbeck, D. Taylor, and A. Lima.
Environmental Management EMNGDC, Vol. 14, No. 5, p 571-587, 1990. 9 fig, 14 tab, 39 ref.

Descriptors: *Aquatic environment, *Case studies, *Ecosystems, *Habitat restoration, *Rehabilitation, *Stream biota, *Water pollution effects, DDT, Ecological effects, Fish, Literature review, Lotic environment, Macrophytes, Periphyton, Phytoplankton, Streams, Stress, Water quality.

An extensive review of the published literature identified more than 150 case studies in which some aspect of resilience in freshwater systems was reported. Approximately 79% of systems studied were lotic and the remainder lentic. Most of the stressor types were chemical with DDT (N = 29) and rotenone (N = 15) the most common. The most common nonchemical stressors were logging activity (N = 16), flooding (N = 8), dredging (N = 3), and drought (N = 7). The variety of endpoints to which recovery could be measured ranged from sparse data for phytoplankton (N = 13), periphyton (N = 6), and macrophytes (N = 8), to relatively more data for fish (N = 412) and macroinvertabrates (N = 698). Unfortunately the same characteristics were rarely measured consistently among sites. For example, with respect to fish, more than 30 different species were studied and recovery was measured in many ways, most commonly on the basis of: (1) first reappearance of the species, (2) return time of predisturbance densities, and (3) return time of predisturbance average of individual size. Based on these criteria, all systems in these studies seem to be resilient to most disturbances with most recovery times being less than 3 years. Exceptions included when: (1) the disturbance resulted in physical alteration of the existing habitat; (2) residual pollutants remained in the system; or (3) the system was isolated and recolonization was suppressed. (Author's abstract)
W91-02898

APPLIED LAND CLASSIFICATION FOR SURFACE WATER QUALITY MANAGEMENT: I. WATERSHED CLASSIFICATION.
National Chunghsing Univ., Taichung (Taiwan). Graduate Inst. of Urban Planning.
S. L. Huang, and J. J. Ferng.
Journal of Environmental Management JEVMAW, Vol. 31, No. 2, p 107-126, September 1990. 4 fig, 8 tab, 33 ref. National Science Council, Executive Yuan of the Republic of China (Grant No. NSC77-0301-H005-03Z).

Descriptors: *Land classification, *Land use, *Taiwan, *Water quality management, Classification, Land management, Model studies, Multivariate analysis, Spatial distribution, Water pollution effects, Watersheds.

A land classification scheme for water quality management was developed for the Tanshui River Basin, Taiwan, using the watershed as the basis for classification. Seventy-eight third order watersheds were grouped into five watershed zones representing varied assimilative capacities and relative societal properties of water quality management. Multivariate techniques (factor analysis, cluster analysis, and discriminant analysis) were used for this purpose. The results indicate that the detection of spatial patterns having ecological significance is possible through multivariate techniques. Also, the assimilative capacity and potential effects of pollution due to inadequate land measurement can be assessed through the incorporation of watershed characteristics such as topography, soil, land cover, etc. The significance of this study is its potential usefulness for integrating land and water quality management. (See also W91-02948) (Medina-PTT)
W91-02947

APPLIED LAND CLASSIFICATION FOR SURFACE WATER QUALITY MANAGEMENT: II. LAND PROCESS CLASSIFICATION.
National Chunghsing Univ., Taichung (Taiwan). Graduate Inst. of Urban Planning.
S. L. Huang, and J. J. Ferng.
Journal of Environmental Management JEVMAW, Vol. 31, No. 2, p 127-141, September 1990. 6 fig, 2 tab, 21 ref. National Science Council, Executive Yuan of the Republic of China (Grant No. NSC77-0301-H005-03Z).

Descriptors: *Land classification, *Numerical analysis, *Taiwan, *Water pollution sources, *Water quality management, Classification, Land management, Land use, Soil erosion, Surface runoff, Surface water, Watersheds.

A land process classification system was developed through assessment of sensitive areas for management of water quality in the Tanshui River Basin, Taiwan. A grid approach was used to identify environmentally sensitive areas for the control of non-point sources of pollution. Surface runoff, surface erosion, and distance to stream were used as variable inputs for taxonomic classification. Using a numerical approach, the Tanshui River Basin was divided into four land classes which represented various sensitivities of land resource effects on water quality. The approach and results demonstrated in this study refined the spatial variation of land characteristics within a classified watershed area and also revealed the interrelationships between watershed characteristics and water quality through land process responses. The classification scheme can serve as a basis for local land use control to minimize adverse effects on surface water resulting from incompatible land uses and inadequate land management practices. Land use performance can also be established according to the sensitive characteristics of each class zone. (See also W91-02947) (Medina-PTT)
W91-02948

STATE OF THE CHESAPEAKE BAY.
G. B. Mackiernan.
Water Environment & Technology WAETEJ, Vol. 2, No. 9, p 60-67, September 1990. 4 fig

Descriptors: *Administrative agencies, *Aquatic habitats, *Chesapeake Bay, *Ecosystems, *Estuaries, *Water pollution, *Water resources management, Algal growth, Anadromous fish, Anoxia, Bays, Biomass, Degradation, Governmental interrelations, Hydrocarbons, Submerged plants, Trace metals, Wastewater disposal.

Chesapeake Bay, the largest estuary in the USA, is a system under threat as a result of population growth and development in the area, alteration of habitats, and discharge of pollutants. Prompted by public concern, the U.S. Environmental Protection Agency (EPA) undertook a study of this troubled estuary in 1977. In 1983, the EPA released reports of widespread ecosystem degradation and warned that trends would continue as development increased unless effective management actions were implemented. The reports concluded that much of the bay was overenriched with nitrogen and phosphorus; levels of chlorophyll a found in algal biomass were increasing in most regions; the volume of water exhibiting hypoxia or anoxia had increased significantly in the preceding 30 years; elevated levels of trace metals and polyaromatic hydrocarbons were present in water, sediments, and in the tissue of bay organisms; there had been an unprecedented bay-wide loss of submerged vegetation; landings of anadromous finfish and oysters had declined significantly; and there were accompanying failures of recruitment in many species. These findings and subsequent recommendations led to the establishment of a federal and state Chesapeake Bay Restoration Program, linking Maryland, Virginia, Pennsylvania, and the District of Columbia in an effort to improve and protect the water quality and living resources of the Chesapeake Bay estuarine system. The initial agreement in 1983 outlined actions to reduce nutrient input, control toxic materials, and to enhance bay species and their habitats. A cooperative bay-wide monitoring program was also initiated to evaluate environmental trends and to track progress. In 1987, specific commitments and deadlines were established including a basin-wide 40 reduction of both P and N from both point and nonpoint sources by the year 2000; reduction of inputs of toxicants bay-wide, consistent with the 1987 Water Quality Act; and restoration, protec

ion, and enhancement of fishery resources and abitats. (Medina-PTT)
W91-02956

WO DECADES OF PROGRESS.
Fairfax County Dept. of Public Works, Lorton, A. Wastewater Treatment Div.
. Hogge, and R. Soltis.
Water Environment & Technology WAETEJ, Vol. 2, No. 9, p 68-71, 234-235, 237, September 990. 2 tab.

Descriptors: *District of Columbia, *Potomac iver, *Virginia, *Wastewater facilities, Wastewater treatment, *Water pollution control, Water pollution sources, *Water quality, Admin-trative agencies, Algal blooms, Bacterial analysis, uman diseases, Sport fishing, Vegetation re-owth, Wastewater disposal, Water quality stand-ds.

apid development and population surge in the ashington D.C. area in recent years have caused creased water-quality degradation in the Poto-ac River, one of the areas's major water bodies. ue to elevated bacterial levels and the danger of tching water-borne diseases, the U.S. Public ealth Service, as early as 1925, declared the otomac River unsafe for swimming. The greatest ater-quality concerns were centered on the sec-n of the Potomac flowing through the metropol-n area which receives the greatest volume of gional wastewater discharges. This caused nox-us algae blooms, high bacterial counts, and very w dissolved oxygen (DO), noticeable during the mmer months. However, today, the low DO els have essentially disappeared, and submerged getation has reappeared and spread, reflecting tremendous progress made during the mid 70s and 1980s. Recreational fishing has returned d summer bacterial levels have begun to approx-ate the established water-quality standards. Peri-c violations of bacterial standards occur be-se of untreated combined sewer outflows and npoint source runoff during heavy rains. An mate is also given for the operational cost and grading of these Virginia treatment plants by the r 2000. (Medina-PTT)
1-02957

WATER RESOURCES PLANNING

. Techniques Of Planning

ALYSIS BY FUNCTIONS APPLIED TO HY-OMETRY (L'ANALYSE PAR FONCTIONS PLICATION A 'HYDROMETRIE).
nce Financiere de Bassin Seine-Normandie, s (France).
primary bibliographic entry see Field 7C.
1-02050

PROVED METHODS FOR REGIONAL OOD FREQUENCY ANALYSIS.
orado State Univ., Fort Collins. Dept. of Civil ineering.
primary bibliographic entry see Field 2E.
-02243

SOURI RIVER MANAGEMENT PROJECT: RNING TO COOPERATE.
Smith.
Indian Water Rights and Water Resources agement. Proceedings of a Symposium. Amer-Water Resources Association, Bethesda, yland. 1989. p 11-19.

riptors: *Governmental interrelations, *Indian r rights, *Missouri River, *Regional planning, ter resources management, *Water rights, ter use, Competing use, Federal jurisdiction, n reservations, Riparian rights, State jurisdic-

century has brought phenomenal change to Missouri River. Six mainstem dams, operated by the Army Corps of Engineers, have been constructed in its upper reaches for flood control and commercial navigation. Other than the annual adoption of an operating plan by the Corp of Engineers, there is little attempt being made by the basins citizens, Indian tribes, states and federal government, to coordinate and plan for the basin's future. Basin water allocation issues which involve Indian reserved water rights and industrial marketing of water, have made their way to the US Supreme Court twice in the last two years. The dearth of the Missouri River Basin coordination and planning has motivated the Northern Lights Institute, located in Montana, to initiate in 1985, the Missouri River Management Project. This project, now in its fourth year, seeks to democratically involve the basin's three sovereigns and its citizenry in a cooperative approach to reshape river management policies to reflect contemporary public values in a manner that is compatible with the riparian environment. Through this project, it has been found that the fundamental deterrent to sound water management in the Missouri River Basin is a lack of trust and cooperation. (See also W91-02262) (Lantz-PTT)
W91-02264

INDIAN WATER RIGHTS SETTLEMENTS: THE ROLE OF LOCAL REPAYMENT AND OPERATING ENTITIES RESPONSIBLE FOR FEDERAL RECLAMATION PROJECTS.
Central Arizona Water Conservation District, Phoenix.
For primary bibliographic entry see Field 6E.
W91-02265

INSTITUTIONAL ECONOMICS AND INDIAN WATER PROJECTS-DOES THE FRAMEWORK MAKE A DIFFERENCE.
Cornell Univ., Ithaca, NY.
D. J. Allee.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 53-62, 18 ref.

Descriptors: *Economic aspects, *Indian reservations, *Indian water rights, *Institutional constraints, *Project planning, *Water resources management, *Water rights, Social aspects.

Better options are, in part, a function of the analytical framework that is brought to resource management. Neoclassical economics has been used to structure cost-benefit analysis of water projects. Rules based on related financial concepts limit the degree of subsidy. Very different results in the formulation and evaluation of projects appear likely if concepts from institutional economics are applied as a supplement to those based solely on more conventional economics. In particular, the differences in the Anglo and Indian cultures can be more explicitly taken into account. The results may make water projects more effective instruments for capacity building. Concepts of instrumental efficiency compliment the conventional economic and financial concepts and provide conceptual limits for the adjustment of the rules based on those conventional concepts. The results may have application to subsets of the non-Indian society as well. (See also W91-02262) (Author's abstract)
W91-02268

IMPROVING THE PROSPECTS OF NEGOTIATED SETTLEMENT OF AMERICAN INDIAN WATER RIGHTS DISPUTES.
Colorado Univ. at Denver. Graduate School of Public Affairs.
For primary bibliographic entry see Field 6E.
W91-02273

FROM ZERO TO 20 MGD IN TEN MONTHS.
Indianapolis Water Co., IN.
For primary bibliographic entry see Field 5F.
W91-02422

APPROACH TO THE INVENTORY OF FORESTED WETLANDS FOR TIMBER-HARVESTING IMPACT ASSESSMENT.
North Carolina State Univ. at Raleigh. School of Forest Resources.
For primary bibliographic entry see Field 4C.
W91-02485

APPLICATION OF THE ANALYTIC ELEMENT METHOD FOR NATIONAL GROUNDWATER MANAGEMENT IN THE NETHERLANDS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
W. J. DeLange.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 285-293, 5 fig, 1 tab, 3 ref.

Descriptors: *Alternative planning, *Groundwater management, *Hydrologic models, *Model studies, *Planning, *Water quality management, *Water resources management, Analytical methods, Cropland, Marsh management, Policy making, Water policy, Water supply development.

In the Netherlands a national integral water management program controls both groundwater and surface water management with all their aspects. A complex system of instruments has therefore been developed including an instrument for groundwater management. This recently-developed instrument was used in a background analysis of management alternatives. Three causes of drying up of crops and vegetation in the Drenthe Plateau were analyzed: (1) extraction of wells, (2) polder level manipulations in the valleys, and (3) changes in the drainage resistance in the valleys. It appeared that all three cause important effects stretched out over large domains, but at different places and with different magnitudes. One of the scenarios for regeneration of wet nature domains suggested reallocation of wells. Because the groundwater model is based on the analytical element method, it meets the requirements for flexibility in the use of scales and for nationwide comparability of the results. Effects on groundwater of the alternatives concerning large domains can be presented in a clear and accurate way to policymakers. (See also W91-02672) (Fish-PTT)
W91-02697

AQUIFERS AS COMPONENTS OF WATER RESOURCES SYSTEMS.
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
For primary bibliographic entry see Field 4B.
W91-02709

REGIONALIZATION SCHEMES FOR THE MANAGEMENT OF LARGE WATER RESOURCES SYSTEMS.
Universidad Politecnica de Cataluna, Barcelona (Spain). Escuela Tecnica Superior de Ingenieros de Caminos, Canales y Puertos.
For primary bibliographic entry see Field 4B.
W91-02711

ROLE OF GROUNDWATER IN ISRAEL'S INTEGRATED WATER SYSTEM.
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
For primary bibliographic entry see Field 4B.
W91-02714

6B. Evaluation Process

DESIGN AND MANAGEMENT OF RURAL WATER SUPPLY PROJECTS: LESSONS LEARNED FROM COMPARATIVE STUDY OF USAID PROJECTS IN BURKINA FASO AND TOGO.
Water and Sanitation for Health Project, Arlington, VA.
For primary bibliographic entry see Field 5F.
W91-02362

Group 6B—Evaluation Process

STREAMSIDE MANAGEMENT UNITS IN THE PACIFIC NORTHWEST.
Forest Service, Portland, OR. Pacific Northwest Region.
G. W. Swank.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 419-424, June 1990. 1 tab.

Descriptors: *Forest ecosystems, *Forestry, *Forests, *Oregon, *Riparian areas, *Streamside Management Unit, *Washington, *Water quality, *Water quality management, Fisheries, Management planning, Resources management, Riparian waters, Streams.

The riparian areas in the Pacific Northwest are an extremely important social, economic, and environmental part of the Regional and National Forest land base. These multi-use sites, however, support fish-bearing streams, lakes and resevoirs, wetlands and floodplains, wildlife habitats, recreational sites, cow and sheep forage, and timber production which often compete with each other. The Streamside Management Unit (SMU) Policy in the National Forests of Oregon and Washington addresses one of these concerns--the water quality and fisheries including the area in and immediately adjacent to streams. The SMU concept is a stream classification system based on water use with specific water quality objectives established for each of the four classes of streams. The underlying premise is that the land immediately adjacent to streams is the key to protecting water quality. Through the use of SMUs, this land can be effectively monitored and managed not only to protect the riparian habitats but also, in most cases, to retain a reasonable return on other resource values. (D'Agostino-PTT)
W91-02497

GUIDELINES FOR DEVELOPING A PROJECT.
Freese and Nichols, Inc., Fort Worth, TX.
R. R. Longoria, D. C. Lewis, and D. Hargesheimer.
Water Environment & Technology WAETEJ, Vol. 2, No. 10, p 71-76, October 1990. 8 tab.

Descriptors: *Management planning, *Project planning, *Reclaimed water, *Water reuse, *Water supply development, Data requirements, Potable water, Public participation, Texas, Water quality standards, Water resources data, Water resources management, Water treatment.

A four-phase planning effort was used in the development of a water reclamation/reuse project initiated in 1988 to indirectly augment potable water supplies for Abilene, TX, by increasing the flows into the surface water supply reservoir. The four work phases focused on project definition and formation, creation of baseline data, treatment process evaluation and selection, and implementation. Under this management approach, each phase is nearly independent, with distinct orientation meetings and schedules. Phase 1 involves formation of the project team, including a public advisory committee (PAC), and requires the project to develop, in detail, the specific goals and objectives of the project. In Phase 2, the project team compiles fact sheets of relevant baseline information on a specific subject. Because available data may be incomplete or of questionable validity, supplemental data should be acquired. In Phase 3, fundamental technical information is developed. Water quality standards are identified, computer modeling is conducted to determine the impact of the standards on the receiving water, and treatment alternatives are developed and evaluated. By the onset of Phase 4, the major technical memoranda are completed and the project team should be ready to draft the summary report. At this stage, estimated costs should be considered in planning budget estimates. The water quality monitoring program should be continued through Phase 4 to provide data needed to evaluate the impact of the reuse improvements. Financing options for a reclamation project are similar to those for conventional wastewater treatment systems. In addition, the development of a public information and acceptance program (for reused water) should begin with the study and continue throughout the implementation phase. (VerNooy-PTT)
W91-02567

EVALUATION OF THE NUTTING LAKE DREDGING PROGRAM.
Baystate Environmental Consultants, Inc., East Longmeadow, MA.
For primary bibliographic entry see Field 5G.
W91-02617

FEASIBILITY STUDY ON THE GROUNDWATER DEVELOPMENT FOR THE WATER SUPPLY OF AN OIL SHALE PROCESSING PLANT IN CENTRAL JORDAN.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
For primary bibliographic entry see Field 4B.
W91-02720

APPLIED LAND CLASSIFICATION FOR SURFACE WATER QUALITY MANAGEMENT: I. WATERSHED CLASSIFICATION.
National Chunghsing Univ., Taichung (Taiwan). Graduate Inst. of Urban Planning.
For primary bibliographic entry see Field 5G.
W91-02947

APPLIED LAND CLASSIFICATION FOR SURFACE WATER QUALITY MANAGEMENT: II. LAND PROCESS CLASSIFICATION.
National Chunghsing Univ., Taichung (Taiwan). Graduate Inst. of Urban Planning.
For primary bibliographic entry see Field 5G.
W91-02948

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

INDIAN WATER RIGHTS SETTLEMENTS: THE ROLE OF LOCAL REPAYMENT AND OPERATING ENTITIES RESPONSIBLE FOR FEDERAL RECLAMATION PROJECTS.
Central Arizona Water Conservation District, Phoenix.
For primary bibliographic entry see Field 6E.
W91-02265

TRANSACTION COSTS AND RESOLUTION OF RESERVED RIGHTS CLAIMS.
Utah State Univ., Logan. Dept. of Economics.
For primary bibliographic entry see Field 6E.
W91-02267

INSTITUTIONAL ECONOMICS AND INDIAN WATER PROJECTS-DOES THE FRAMEWORK MAKE A DIFFERENCE.
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 6A.
W91-02268

FORESTED-WETLAND TRENDS IN THE UNITED STATES: AN ECONOMIC PERSPECTIVE.
Southern Forest Experiment Station, New Orleans, LA.
For primary bibliographic entry see Field 2H.
W91-02486

TECHNOLOGIES AND COSTS FOR THE TREATMENT OF MICROBIAL CONTAMINANTS IN POTABLE WATER SUPPLIES.
Pirnie (Malcolm), Inc., Paramus, NJ.
For primary bibliographic entry see Field 5F.
W91-02614

ECONOMIC BENEFIT CONSIDERATIONS IN SELECTING WATER QUALITY PROJECTS. INSIGHTS FROM THE RURAL CLEAN WATER PROGRAM.
Economic Research Service, Washington, DC. Resources and Technology Div.
For primary bibliographic entry see Field 5G.
W91-02622

MODELS FOR A RATIONAL UTILIZATION OF HIGH QUALITY GROUNDWATER RESOURCES.
Dortmund Univ. (Germany, F.R.). Inst. for Environmental Protection.
For primary bibliographic entry see Field 3E.
W91-02715

COST SUPPLEMENT TO TECHNOLOGIES AND COSTS FOR THE REMOVAL OF MERCURY FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
For primary bibliographic entry see Field 5F.
W91-02725

COST SUPPLEMENT TO TECHNOLOGIES AND COSTS FOR THE REMOVAL OF NITRATES AND NITRITES FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
For primary bibliographic entry see Field 5F.
W91-02726

COST SUPPLEMENT TO TECHNOLOGIES AND COSTS FOR THE REMOVAL OF CHROMIUM FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
For primary bibliographic entry see Field 5F.
W91-02727

COST SUPPLEMENT TO TECHNOLOGIES AND COSTS FOR THE REMOVAL OF SELENIUM FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
For primary bibliographic entry see Field 5F.
W91-02728

COST SUPPLEMENT TO REMOVAL OF CADMIUM FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
For primary bibliographic entry see Field 5F.
W91-02729

COST SUPPLEMENT TO TECHNOLOGIES AND COSTS FOR THE REMOVAL OF ASBESTOS FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
For primary bibliographic entry see Field 5F.
W91-02730

PRETEST ANALYSES OF WATER DEMAND IN THIRTY COMMUNITIES.
Texas A and M Univ., College Station. Dept. o Agricultural Economics.
For primary bibliographic entry see Field 6D
W91-02855

REGIONAL SLUDGE MANAGEMENT PLANNING IN VERMONT.
Dufresne-Henry, Inc., North Springfield, VT.
For primary bibliographic entry see Field 5E.
W91-02954

6D. Water Demand

DEVELOPMENT OF TURKEY'S ELECTRI ENERGY.
State Hydraulic Works, Ankara (Turkey).
For primary bibliographic entry see Field 8C.
W91-02110

FRESHWATER WITHDRAWALS IN TEXA 1985.
Geological Survey, Austin, TX. Water Resourc Div.
For primary bibliographic entry see Field 7C.

W91-02228

ESTIMATED DEMAND FOR AGRICULTURAL WATER FOR USE IN NEW JERSEY, 1990.
Geological Survey, Trenton, NJ. Water Resources Div.
E. O. Titus, R. M. Clawges, and C. L. Qualls.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-156, 1990. 53p, 2 fig, 12 tab, 6 ref.

Descriptors: *Drought, *Hydrologic budget, New Jersey, *Soil moisture deficiency, *Water use, Agricultural water, Irrigation water.

As part of an effort to determine if an adequate supply of agricultural water for irrigation use will be available to farmers, the U.S. Geological Survey prepared preliminary estimates of demand for agricultural water for irrigation use for the year 1990 on the basis of six possible scenarios. These scenarios incorporate normal and drought climatic conditions and three alternative estimates of the total acreage of farmland that may be irrigated in 1990. Preliminary estimates of water demand based on soil-moisture deficits were made using methods for calculating climatic water budgets. These estimates ranged from 3.0 billion gal/growing season (May through September), under normal climatic conditions and a 2% annual decline in irrigated acreage since 1984, to 28.9 billion gal/growing season, under drought conditions and a 2% annual increase in irrigated acreage since 1984. Preliminary estimates of water demand made for the 1986 growing season reasonably approximate reported water use for that period. (USGS)
W91-02246

MISSOURI RIVER MANAGEMENT PROJECT: LEARNING TO COOPERATE.
For primary bibliographic entry see Field 6A.
W91-02264

WATER TRANSFERS AND PAPER RIGHTS IN THE TRUCKEE AND CARSON RIVER BASINS.
Environmental Defense Fund, Oakland, CA.
For primary bibliographic entry see Field 6E.
W91-02266

NON-INDIAN WATER USERS' GOALS: MORE IS BETTER, ALL IS BEST.
Jennings, Strouss and Salmon, Phoenix, AZ.
For primary bibliographic entry see Field 6E.
W91-02270

SALT RIVER PIMA-MARICOPA INDIAN COMMUNITY WATER RIGHTS SETTLEMENT ACT OF 1988.
Department of the Interior, Phoenix, AZ. Office of the Field Solicitor.
For primary bibliographic entry see Field 6E.
W91-02271

ANALYSIS OF THE SALT RIVER PIMA-MARICOPA INDIAN COMMUNITY WATER RIGHTS SETTLEMENT.
For primary bibliographic entry see Field 6E.
W91-02272

GROUNDWATER OWNERSHIP AND CONTROL IN INDIAN COUNTRY.
Lu Bey Law Firm, Seattle, WA.
For primary bibliographic entry see Field 6E.
W91-02277

SALMON AND THE SNAKE: MEETING FISH FLOW OBJECTIVES IN A SEMI-ARID RIVER BASIN.
Watershed Resources, Inc., Santa Fe, NM.
J. Tolisano.
In: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 175-186, 1 fig, 23 ref.

Descriptors: *Competing use, *Fish migration, *Fisheries, *Indian water rights, *River flow, *Salmon River, *Snake River Basin, *Water resources management, Hydroelectric powerplants, Idaho, Irrigation, Water resources development, Water use.

The primary uses of water in the upper Snake River basin in Idaho are for irrigation and hydropower production. Present water resource management strategies in the basin have emphasized these users to the detriment of other resources, especially anadromous fish. In the era before water resources development, anadromous fish were carried to the ocean during the juvenile life phase by the relatively high flows of the spring and summer natural runoff, completing the journey in as little as 4 days. Migration can now take more than 1.5 months with resultant significant mortalities. An analysis of the hydrology and water use characteristics within the basin indicates that more than 3 million acre-feet (MAF) of additional water could be made available for anadromous fish migrations, especially during the critical juvenile out-migration period, without curtailing existing uses. These opportunities for improved flows for fish include new storage and changes to existing operations for reservoir releases, irrigation diversions, and water rights transfers in Idaho. (See also W91-02262) (Author's abstract)
W91-02279

WATER LOSSES IN THE NILE BASIN.
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
For primary bibliographic entry see Field 2A.
W91-02298

WATER CONSERVATION IN DROUGHT-STRICKEN SANTA BARBARA COUNTY--RESPONSE IS SLOW.
Lawrance, Fish and McFarland, Inc., Santa Barbara, CA.
For primary bibliographic entry see Field 3D.
W91-02423

MAYA UTILIZATION OF KARST GROUNDWATER RESOURCES.
Pennsylvania State Univ., University Park.
G. Veni.
Environmental Geology and Water Sciences EGWSEI, Vol. 16, No. 1, p 63-66, 1990. 11 ref.

Descriptors: *Groundwater management, *History, *Karst hydrology, *Life history studies, *Water resources development, *Water resources management, Belize, Caves, Groundwater pollution, Guatemala, Honduras, Mexico, Semiarid lands, Springs, Surface water availability.

Much of the Maya civilization in pre-Columbian Meso-America was established on karst terrain that included parts of what are now Belize, Guatemala, northern Honduras and southern Mexico. By definition, little surface water exists in karst, so for the Maya to flourish on that terrain they had to effectively and efficiently utilize all their water resources. Access to groundwater was by means of springs and caves. Maya life, urban and rural, lay and elite, religious and secular, was often a function of groundwater exploitation and surface water development. The Maya's use of groundwater was predominantly to supplement enhanced surface water supplies and was used more often in semiarid zones than in humid zones. The pattern of Maya settlements, especially in the semiarid zones, occurred in areas with greater access to the groundwater. Maya groundwater retrieval methods were primitive, inefficient, labor intensive, and uninnovative, as compared to their other technologic achievements. Groundwater contamination, from human effluent, could have resulted in widespread disease and contributed to the Maya's downfall. (Author's abstract)
W91-02813

PRETEST ANALYSES OF WATER DEMAND IN THIRTY COMMUNITIES.
Texas A and M Univ., College Station. Dept. of Agricultural Economics.
R. C. Griffen, and C. Chang.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2251-2255, October 1990. 2 fig, 6 tab, 24 ref.

Descriptors: *Pricing, *Texas, *Water costs, *Water demand, *Water use, Capital costs, Climates, Model studies, Seasonal variation, Sewage rate, Water rates.

Using three years of monthly data for 30 carefully selected Texas communities, several characteristics of community water demand, including pricing structures, are investigated using a demand model containing six variables: per capita residential and commercial water consumption, average price of water paid by an average 2.84 person household, marginal price of water paid by an average 2.84 person household, annual personal income per capita, percent of the population with Spanish origin, and a climate variable. Average price versus marginal price specifications demonstrate the superiority of the average price approach. More original contributions identify the need to include sewer rates in water demand models, the importance of studying seasonal demand rather than annual demand, seasonal variations in the price elasticity of demand, and an index for relating monthly community water demand to monthly climatic conditions. Results clearly indicate summer price elasticities which are about 50% higher than winter elasticities. Coupled with the fact that capital expenditures to create peak load capacities represent a large proportion of utility costs, time of year rates are favored. (Brunone-PTT)
W91-02855

6E. Water Law and Institutions

STREAMFLOW DATA AND SURFACE-WATER RESOURCE ASSESSMENT - A QUANTITATIVE DEMONSTRATION OF NEED FOR ADEQUATE INVESTMENT IN DATA COLLECTION IN DEVELOPING COUNTRIES.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W91-02141

INDIAN WATER RIGHTS AND WATER RESOURCES MANAGEMENT.
Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. 188p. Edited by William B. Lord and Mary G. Wallace.

Descriptors: *Indian reservations, *Indian water rights, *Legal aspects, *Symposium, *Water law, *Water rights, Administration, Competing use, Social aspects, Water resources management, Water use.

Indian water rights have come to be one of the Nation's most important water resource issues. Indian water rights claims are presently being adjudicated in almost every Western state. These claims are usually very senior and also unquantified. How these claims will be satisfied will affect water use and management in most of the West. The parties affected by these conflicts have different objectives. Tribes look to securing and using water rights as a major hope for achieving self-sufficiency, furthering tribal sovereignty, and maintaining cultural pluralism. Non-Indian water users seek to safeguard long established water uses and remove uncertainties about future water entitlements. States wish to assert state responsibility and authority for water allocation and to preserve the integrity of state water laws and administrative systems. The federal government has many interests, ranging from its trust responsibilities to Indian tribes through such specific responsibilities as environmental protection, and fulfilling commitments to users of federal project water, to its general responsibility to minimize the financial burdens placed upon the Nation's taxpayers. Resolving Indian water rights conflicts within this context of

multiple aspirations and viewpoints has been extremely difficult. Litigation has produced very few settlements, and negotiation and legislation have been only slightly more successful. All parties share a common interest in finding better and more lasting ways of settling these disputes. The purpose of this symposium is to assess the collective experience in resolving Indian water rights conflicts, to examine all possibilities for solutions, and to forge new conceptual bases for moving from the win-lose situations which preclude easy settlement to win-win situations from which all can benefit. (See W91-02263 thru W91-02279) (Lantz-PTT)
W91-02262

INDIAN WATER CLAIMS NEGOTIATIONS: CONFLICTING FEDERAL ROLES.
Department of the Interior, Washington, DC. Office of Program Analysis.
B. Simon.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 1-10, 1 tab, 6 ref.

Descriptors: *Conflicting use, *Federal jurisdiction, *Indian reservations, *Indian water rights, *Legal aspects, *Water rights, Political aspects, Water law, Water resources management.

In recent years the Federal government has attempted to negotiate rather than litigate Indian water claims, and has found that negotiations are not a panacea. To obtain effective settlements, the Government needs to take full advantage of all available mechanisms (including litigation) for settling Indian water claims. But there are cases that are well suited to negotiations. Much of the success of the negotiation process depends on the effectiveness of the Federal government, a major player in all Indian water rights negotiations. Past negotiations have shown that: (1) effective negotiations require solid organization with high level support from political leadership. If high level support is lacking, Federal negotiators are at a decided disadvantage in any negotiation; (2) even if all ideal conditions are present, the Federal government can be expected to appear indecisive at times because it is subject to internal conflict; and (3) important precedents concerning federal financing of settlements and protection of existing water users have been established by the cases settled during the last 6 years which can be used as a base of guidance for future negotiations. (See also W91-02262) (Lantz-PTT)
W91-02263

INDIAN WATER RIGHTS SETTLEMENTS: THE ROLE OF LOCAL REPAYMENT AND OPERATING ENTITIES RESPONSIBLE FOR FEDERAL RECLAMATION PROJECTS.
Central Arizona Water Conservation District, Phoenix.
D. K. Miller.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 21-31, 2 fig.

Descriptors: *Cost allocation, *Federal jurisdiction, *Indian reservations, *Indian water rights, *Legal aspects, *Water resources management, *Water rights, Competing use, Costs, Economic aspects, Land reclamation, Salt River Pima-Maricopa Indian Community.

The role of the repayment contractor and operator of a major federal reclamation project, in the negotiation and settlement of a significant Indian Water Rights claim was examined. The example used is the settlement of the water rights claims of the Salt River Pima-Maricopa Indian Community, recently authorized by Congress. In this case, the Central Arizona Water Conservation District (CAWCD) participation in the settlement process established an important principle of consultation. Repayment and operating agencies responsible for federal reclamation projects must determine their appropriate role in Indian water rights negotiations and the extent to which their resources should be devoted to the settlement of Indian water rights claims. If participation is judged to be appropriate, the agencies must then evaluate the impact of the settlement on: (1) project water supplies; (2) project water users; (3) system capacity; (4) project power supplies; (5) operation, maintenance and repair costs; and (6) the repayment of project costs. Vigorous and sustained participation in settlement negotiations will be necessary to protect the agency's interests. Frequent consultation among staff of the agency, its governing body, and its water users concerning the progress of negotiations will be required in order to avoid mistakes and to gain political support for eventual compromises. (See also W91-02262) (Lantz-PTT)
W91-02265

WATER TRANSFERS AND PAPER RIGHTS IN THE TRUCKEE AND CARSON RIVER BASINS.
Environmental Defense Fund, Oakland, CA.
D. Yardas.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 33-42, 2 fig, 1 tab, 31 ref.

Descriptors: *Carson River Basin, *Conflicting use, *Indian water rights, *Legal aspects, *Truckee River Basin, *Water resources management, *Water rights, *Water transfer, *Water use, Indian reservations, Pyramid Lake, Regulations, Wetlands.

Federal regulatory actions in Nevada's Truckee and Carson River Basins have resulted in a painful environmental choice between water for Pyramid Lake and water for the Stillwater and other Lahontan Valley wetlands. Water rights acquisitions have become a leading policy alternative in efforts to avoid this environmental tradeoff, the roots of which can be found in turn-of-the-century reclamation efforts which ignored the needs of both resources. Recent and contemplated acquisitions involving 'inactive' water rights threaten to perpetuate the conflict, however, while attempts to limit such purchases are frustrated by unresolved legal and equity issues over the status of inactive entitlements. An overview of the controversy, including the disparate interests of Newlands Project farmers and the Pyramid Lake Paiute and Fallon Paiute-Shoshone Tribes, illuminates the importance of developing an acquisition oriented activity standard that is cognizant of those claims. If water rights acquisitions are to diffuse the environmental conflicts, however, an activity standard must come into play. (See also W91-02262) (Author's abstract)
W91-02266

TRANSACTION COSTS AND RESOLUTION OF RESERVED RIGHTS CLAIMS.
Utah State Univ., Logan. Dept. of Economics.
D. L. Snyder, and J. C. Andersen.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 43-52, 8 ref.

Descriptors: *Competing use, *Cost-benefit analysis, *Costs, *Indian water rights, *Legal aspects, *Water rights, Economic aspects, Feasibility studies, Water resources management.

Transaction costs are an important consideration in transferring resources among competing uses. This concept is particularly relevant in the case of reserved water rights. Beginning with Winters vs. US in 1906, the US Supreme Court has consistently ruled that water rights exist on federal reservations consistent with the purpose for which each reservation was established. While ruling that such rights existed, the Court did not provide any usable means whereby those rights could be quantified. However, a basis for quantification has emerged in subsequent cases; that of Practicably Irrigable Acreage or PIA. An essential element of PIA is economic feasibility as measured by a cost-benefit ratio greater than one. Considerable controversy and transaction costs surround the application of PIA and economic feasibility as applied to the quantification of reserved water rights. The use of economic feasibility, however, as a decision rule encourages abuse of the economic concepts, and methods of analysis become subject to distortion and bias. The real implications of the application of economic feasibility have either not been addressed by those involved or have been ignored. As long as the implications are ignored, little useful information can be derived from any analysis of economic feasibility. (See also W91-02262) (Lantz-PTT)
W91-02267

STATE GOALS IN INDIAN WATER RIGHTS DISPUTES.
P. W. Sly.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 63-71.

Descriptors: *Governmental interrelations, *Indian reservations, *Indian water rights, *Legal aspects, *State jurisdiction, *Water resources management, *Water rights, Federal jurisdiction, Institutional constraints, Regulations.

State goals in Indian water rights litigation and legislation fall within four general areas: (1) regulatory and adjudicatory simplicity, (2) protection of state proprietary and fiscal interests, (3) protection of water rates based on state law against rights based on federal law, and (4) interstate goals. All states seek regulatory simplicity and predictability. Some are pursuing relative certainty by direct negotiation with Indian tribes. State proprietary and interstate interests are site specific, depending on the hydrology of each reservation and affected non-Indian areas. State 'representative federalism' against Indian rights depends on hydrology, population and landholding patterns within and near reservations, and the water institutions within the state. The strong state interest in certainty of rights to a limited water resource has led states to explore negotiation with Indian tribes. Ultimate self-determination for states and tribes may be best served by negotiations which can tailor an agreement to meet existing needs without the costs, friction and delay of litigation. (See also W91-02262) (Lantz-PTT)
W91-02269

NON-INDIAN WATER USERS' GOALS: MORE IS BETTER, ALL IS BEST.
Jennings, Strouss and Salmon, Phoenix, AZ.
J. B. Weldon.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 73-85.

Descriptors: *Indian reservations, *Indian water rights, *Legal aspects, *Water resources management, *Water rights, *Water use, Competing use, Public policy, Water demand.

The doctrine of prior appropriation has governed water use by non-Indians in most Western states for over a century. Under the doctrine, a water user is entitled to that amount of water which the water user has diverted and put to a beneficial use. The following goals have been proposed for water appropriation: (1) establish the validity of one's own water rights claims against those of all competing water users; (2) obtain a permanent quantification of federal reserved and Indian water rights in order to (a) provide certainty with respect to the division of the water supply, (b) to permanently settle upon specific water right entitlement for each Indian tribe in order to avoid continued expansion of that entitlement due to technological improvements or changing legal doctrines, (c) remove potential damages claims by or on behalf of the tribe for interference with their water rights, and (d) force consideration of federal/state water policy changes to allow parties to live with the outcome; and (3) create opportunities to build cooperative relationships between Indian and non-Indian communities, including negotiated resolution of water rights conflicts where all parties can be considered winners. (See also W91-02262) (Lantz-PTT)
W91-02270

SALT RIVER PIMA-MARICOPA INDIAN COMMUNITY WATER RIGHTS SETTLEMENT ACT OF 1988.
Department of the Interior, Phoenix, AZ. Office of the Field Solicitor.
W. H. Swan.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 87-93.

Descriptors: *Arizona, *Indian water rights, *Legal aspects, *Legislation, *Salt River, *Water resources management, *Water rights, *Water use, Competing use, Groundwater, Indian reservations, Phoenix, Riparian rights, Salt River Pima-Maricopa Indian Community,Salt River Project.

Following years of negotiations, Congress approved the Salt River Indian Water Rights Settlement Act in October 1988. This settlement is the first Indian water rights settlement which involves the major urban area of the State of Arizona, the Phoenix metropolitan area, and also the major water developer-user in the state, the Salt River Project. Basically, the settlement provides that the Community will have the use of 122,400 acre ft/yr developed from the following components: (1) Kent Decree water, with storage provided via Central Arizona Project (CAP) storage space; (2) Contribution of stored water from Salt River Project (SRP)--9,074 acre ft; (3) Bartlett Dam agreement water--20,000 acre ft; (4) CAP entitlement--13,300 acre ft; (5) Contribution from the Roosevelt Water Conservation District--8,000 acre ; (6) Contribution from the Roosevelt Irrigation District--10,000 acre ft; (7) Contribution from alley cities in the amount of 20,000 acre ft from ity lands within the SRP area; and (8) Developed roundwater on the reservation--23,250 acre ft. he Salt River settlement provides an important recedent with regard to other potential Indian ater rights settlements in Arizona and in other ates. Many of the remaining Indian water rights isputes in Arizona present situations of similar omplexity, and therefore it is important that the on-Indian participants now recognize that settleents such as these can be accomplished with fficient dedication of time, attention and creativi-. (See also W91-02262) (Lantz-PTT)
/91-02271

NALYSIS OF THE SALT RIVER PIMA-MARCOPA INDIAN COMMUNITY WATER IGHTS SETTLEMENT.
. H. Starler, and K. G. Maxey.
N: Indian Water Rights and Water Resources anagement. Proceedings of a Symposium. Amerin Water Resources Association, Bethesda, aryland. 1989. p 95-113, 2 Tab.

escriptors: *Indian reservations, *Indian water ghts, *Legislation, *Salt River, *Water resources anagement, *Water rights, *Water use, Arizona, ompeting use, Evaluation, Federal jurisdiction, oenix, Riparian rights, Salt River Pima-Maricoa Indian Communit, Salt River Project.

late 1988, Public Law 100-512 was enacted thorizing the implementation of a water rights ttlement agreement among the Salt River Pimaaricopa Indian Community (SRPMIC), local n-Indian public agencies in Arizona, and the ederal Government. The most difficult issues that ere addressed during the negotiation of the settlent agreement and the implementing legislation ere the appropriate level and division of Federal d local cost sharing for the settlement, and how measure those contributions. During the latter ges of the negotiations, these issues became criti-, and shaped much of the character of the tlement. This paper presents three different anal-es used to evaluate the relative contributions of settlement participants. One analysis represents initial position adopted by the non-federal paripants in their analysis of the relative contribuns to the settlement. A second analysis repreits the Federal re-analysis of those proposed ntributions, the identification and measurement other financial effects, and a summation of the al settlement cost sharing. Last, an additional deral analysis of the settlement is presented based on the relative legal exposure of the non-Indian settlement participants compared to that of the Federal government. It should be recognized that the Federal government is far from a homogeneous entity in this situation. Ultimately, the negotiated cost sharing between Federal and non-Federal parties came down to both a subjective and objective calculation of risk, liability and equity parameters involved. (See also W91-02262) (Lantz-PTT)
W91-02272

IMPROVING THE PROSPECTS OF NEGOTIATED SETTLEMENT OF AMERICAN INDIAN WATER RIGHTS DISPUTES.
Colorado Univ. at Denver. Graduate School of Public Affairs.
L. Burton.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 115-125, 15 ref.

Descriptors: *Indian reservations, *Indian water rights, *Legislation, *Water demand, *Water rights, Federal jurisdiction, Governmental interrelations, Management planning, Planning, Water resources management.

Current efforts to compel American Indian tribes to negotiate the settlement of their water rights claims are fundamentally flawed, because of both a serious and irreconcilable conflict of interest within the Interior Department (which is purporting to sponsor these negotiations), and Congress' historic failure to fully honor such agreements once made. The negotiation process could be made more fair by establishment of an American Indian Water Rights Commission, in which the department would participate but which it would not control. The functions of such a commission would include intergovernmental water resource planning, data base generation, model agreement drafting, the adoption of guidelines and principles for the negotiation process, and the empaneling of mediators and sponsorship of negotiations. In appropriated river basins, tribal claims may be honored in part by the voluntary market-based reallocation of existing supplies and the augmentation of existing supplies through state-of-the-art conservation techniques applied to existing irrigation facilities. Commission activities, reallocation, and conservation retrofitting can be financed by the interest from a trust fund created by a 10 year surcharge on the sale of water and power from Bureau of Reclamation-managed facilities. (See also W91-02262) (Author's abstract)
W91-02273

INDIAN WATER RIGHTS: NEGOTIATION; AGREEMENT; LEGISLATIVE SETTLEMENT.
Utah Univ., Salt Lake City. Dept. of Political Science.
D. McCool.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 127-134, 18 ref.

Descriptors: *Indian reservations, *Indian water rights, *Legislation, *Water resources management, *Water rights, Colorado Ute Indian Water Rights Settlement, Competing use, Regulations, Salt River Pima-Maricopa Indian Community, San Luis Rey Indian Water Rights Settlement, Water demand.

Three Indian water rights settlements were passed by Congress in 1988: the Colorado Ute Indian Water Rights Settlement Act, the San Luis Rey Indian Water Rights Settlement Act, and the Salt River Pima-Maricopa Indian Community Water Rights Settlement Act. Although each settlement act is unique, there are certain similarities and trends that can be discerned in the legislation. Themes are addressed which are common to these efforts to resolve Indian claims to water through a process which typically includes three stages: prolonged negotiation; an agreement signed by the principle parties; and the affirmation of that agreement via a legislative settlement act. (See also W91-02262) (Author's abstract)
W91-02274

CONSTRAINTS IN THE SALT RIVER PIMA-MARICOPA WATER RIGHTS SETTLEMENT ACT.
Arizona Univ., Tucson. Dept. of Agricultural Economics.
K. A. Rait.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 135-143, 1 fig, 12 ref.

Descriptors: *Indian reservations, *Indian water rights, *Water resources management, *Water rights, Legal aspects, Legislation, Marketing, Salt River Pima-Maricopa Water Rights Settlement, Water demand, Water use.

The Salt River Indian Community's water rights were quantified through the Salt River Pima-Maricopa Water Rights Settlement Act. Two aspects of the Act which constrain the community's water use flexibility are discussed in this paper. The first deals with the per acre water allocation which is considerably less than the amount allotted to the neighboring farmers in the Phoenix Active Management Area. This raises the question as to whether the Reservation will be able to fulfil the purposes for its creation. Second, the Act expressly limits the community's opportunities for marketing its waters. Relaxation of these marketing-related legal constraints would make the Act more consistent with the evolving water marketing policies throughout the West which are responding to maturing water economies and acknowledgements of scarcity. Regional water marketing activity indicates that leasing could be a stable source of income to the community. The policy-makers involved with the Salt River Pima-Maricopa Water Rights Settlement Act should remove the constraints imposed by the acre-foot per acre allotment and introduce a leasing option. Through extension of the same property rights given to non-Indian water users, the sovereign Community could maximize the net social sand economic benefits of their waters. (See also W91-02262) (Lantz-PTT)
W91-02275

FLORIDA SEMINOLE INDIAN DISPUTE SETTLEMENT INCLUDING WATER RIGHTS COMPACT AND MANUAL.
Blain and Cone, Tampa, FL.
L. M. Blain.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 145-151.

Descriptors: *Florida, *Indian reservations, *Indian water rights, *Legislation, *Seminole Indians, *Water resources management, *Water rights, Competing use, Governmental interrelations, Manuals, Permits, Regulations, State jurisdiction, Water demand, Water supply.

The Seminole Tribe of Florida filed suit in 1978 against the State of Florida and South Florida Water Management District, claiming that the state had granted flowage easements over Indian lands without sufficient congressional approval or compensation. Value of the claims for ejectment, damages, inverse condemnation, and breach of trust, was uncertain but had an estimated potential of ten million dollars. Florida has a highly developed regional water management system. The districts operate drainage and water supply facilities, regulate consumptive use of water and surface water management through a permit system, and other environmental protection. The South Florida Water Management District operates and maintains two large canals which transverse tribal and adjacent lands, supplying irrigation water and providing drainage facilities. One of the many components suggested in attempting to negotiate settlement of the Seminole's claims was the formation of a water rights compact among the tribe, the State, and the water management district to establish the tribe's water rights within the framework of Flor-

ida's water management system. Approving State legislation was necessary but before it could be enacted the water rights compact and its accompanying criteria manual had to be completed and agreements between the tribe and adjacent landowners had to be entered into. (See also W91-02262) (Author's abstract)
W91-02276

GROUNDWATER OWNERSHIP AND CONTROL IN INDIAN COUNTRY.
Du Bey Law Firm, Seattle, WA.
G. D. Parker.
IN: Indian Water Rights and Water Resources Management. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1989. p 153-164, 63 ref.

Descriptors: *Groundwater resources, *Indian reservations, *Indian water rights, *Water rights, *Water supply, Federal jurisdiction, Groundwater quality, Legal aspects, Public policy, Regulations.

Current Federal Indian policy recognizes and supports Indian tribal claims to groundwater resources. Tribal claims to reservation groundwater may be asserted under the reserved water right doctrine, and as tribal proprietary rights. Indian tribes can strengthen tribal claims to groundwater by establishing tribal ownership of groundwater in the same way that tribes assert ownership of other natural resources within the exterior boundaries of Indian reservations--through tribal proclamations, laws and contracts. Tribal governmental action to protect the quantity and quality of groundwater is supported by current federal law and policy. A tribe's ownership interest would be further enhanced through enactment of tribal resolutions proclaiming the tribe's sovereign and proprietary ownership of groundwater, and a demonstration that such waters are necessary to fulfill the purposes of the reservation. A tribe's groundwater rights should not be limited by a narrow application of the Winters doctrine. A tribes ownership interest in groundwater goes beyond an amount determined to be necessary to meet the purposes for which the reservation was created. The ability of a tribe to survive and become economically independent, depends on the resources of the reservation. In many instances, the quality and quantity of the groundwater resource is a key to the health of the reservation population and the quality of the reservation environment. Tribal governments must take action to protect their interests before groundwater reserves are polluted, diminished or exhausted. (See also W91-02262) (Lantz-PTT)
W91-02277

ADVANCES TOWARDS WATER RESOURCES DEVELOPMENT THROUGH HYDROLOGICAL TRAINING AND EDUCATION.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
G. Kienitz.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 68-89, 2 fig, 3 tab, 4 ref.

Descriptors: *Africa, *Developing countries, *Education, *Hydrology, *Training, *Water resources development, Financing, Management planning.

In Africa, the unfavorable spatial and temporal distribution of rainfall necessitates human intervention in the hydrological regime to provide protection against flooding and for counteracting droughts. The basis of water resources development is a thorough knowledge of the hydrological regime and of the involved laws of nature. An adequate number of experts in water resources development combined with a proper knowledge of hydrology is a preliminary to general economic development in a country. The systematic measurement of hydrological elements should be regarded by any administration as an indispensable basic task carried out for the sake of future developments. Most African countries lacked an adequate number of hydrologists at the time of gaining their independence and hydrological knowledge was scarce. Both local efforts and external assistance have sought to overcome these problems. The two most favored methods of rectifying the situation have been the sending of high-level hydrologists to African countries for specific tasks and the granting the fellowships to Africans for high-level training in developed countries, on the other hand. Both these approaches offer benefits for the persons involved. Less effort was directed toward local training for hydrological personnel. The appropriate planning of hydrological training and education should be conceived as (1) defining a country's required number of hydrologists of different levels for the foreseeable period based on long-term development objectives, (2) planning the training facilities required in the country and taking steps for their realization, including external assistance, (3) seeking highest level hydrological education, including post-graduate training, in developed countries for a limited number of selected personnel. Setting up a staff of local hydrologists using aid from developed countries is important. (See also W91-02288) (Author's abstract)
W91-02293

POST GRADUATE COURSE IN HYDROLOGY AND HYDROGEOLOGY (FORMATION POST-UNIVERSITAIRE EN HYDROLOGIE ET HYDROGEOLOGIE).
Ecole Inter-Etats d'Ingenieurs de l'Equipement Rural, Ouagadougou (Burkina Faso).
A. Kapfer.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 911-918, 2 append. English summary.

Descriptors: *Africa, *Civil engineering, *Developing countries, *Education, *Geohydrology, *Hydrology, Burkina Faso, Engineering personnel, Groundwater, Rural areas, Surface water, Water resources development.

Since 1984 the EIER (Ecole Inter-Etats d'Ingenieurs de l'Equipement Rural) has offered a 1-yr postgraduate course in water resources engineering at Ouagadougou, Burkina Faso. The course is intended for engineers with at least 2 yr professional experience in the water sector. Both surface water and groundwater engineering are included covering the following subjects: qualitative and quantitative assessment of surface and groundwater resources; planning, design, and follow-up of hydraulic structures (e.g., dams, river intakes, pumping stations, wells, and drillings); fitting of structures to their intended purpose; and technical and sanitary maintenance of structures. Theoretical lectures, tutorials, and experiments are combined with hands on construction of works in connection with contractors. Site visits and study tours are included in the course. Participating students come from different countries and have a wide range of background and professional experience. The course is divided in two equal parts dealing with surface water and groundwater. It is adapted to the students' diverse backgrounds. In 1988, CAMES granted the course an equivalence with a DESS (Diplome d'Etude Superieur Specialise). Staff is partly in-house within EIER and partly visiting staff from various African and European institutions. This course, which is supported by UNESCO (ANSTI) is intended to train about 10 specialists per year in Africa who are directly involved in practical aspects of water resources engineering. (See also W91-02288) (Author's abstract)
W91-02363

HYDROLOGICAL EDUCATION AT THE AGRHYMET CENTRE (LA FORMATION EN HYDROLOGIE AU CENTRE AGRHYMET).
Agrhymet Centre, Niamey (Niger).
H. A. Maiga.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 919-932. 1 fig, 2 tab, 9 ref. English summary.

Descriptors: *Civil engineering, *Developing countries, *Education, *Niger, AGRHYMET, Agricultural hydrology, Geology, Hydrology, Instrumentation, Meteorology, Sahel, Training.

The Regional Training Center for Agrometeorology and Operational Hydrology in Niamey (Republic of Niger) is one of the rare institutions in Africa that has specialized in hydrological education. The Center forms part of the AGRHYMET project covering the nine CILSS (Comite Permanent Inter-Etats de Lutte contre Secheresse au Sahel) countries. The project was conceived to teach hydrology and hydrometeorology for use in agriculture and it has developed in three phases. Training in agrometeorology and hydrology always has been an important part of the project. Between 1975 and 1987, 198 students received diplomas: 91 in agrometeorology, 71 in hydrology, and 36 in hydrometeorological instrumentation. Besides basic courses, specialized courses in agrometeorology and informatics have been offered, particularly during the second project phase. Hydrological education is split into two branches, one for higher technicians, the other for civil engineers. The study programs include basic instruction and special hydrological subjects. The curriculum foresees theoretical lessons, written exercises, practical training, and field work. (See also W91-02288) (Author's abstract)
W91-02364

STATE WETLAND PROTECTION LEGISLATION AFFECTING FORESTRY IN THE NORTHEASTERN UNITED STATES.
Southern Forest Experiment Station, New Orleans, LA.
W. C. Siegel, and T. K. Haines.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 239-252, June 1990. 21 ref.

Descriptors: *Environmental protection, *Forest ecosystems, *Forestry, *Land use, *Legislation, *Resources management, *Wetland forests, *Wetlands, Agriculture, Policy making, Regulations.

A number of significant developments in wetland protection and water resource legislation have occurred in the United States in recent years that affect forestry operations, both at the federal and state levels. An historical review indicates that while control of water pollution and the protection of wetlands was first addressed in 1972 by the Federal Water Pollution Control Act Ammendments (FWPCA), to date, most forestry regulation in the eleven northeastern states is carried out in response to specific situations and areas, rather than through state-wide programs. Until recently, most regulation was not very restrictive except in certain limited circumstances. Furthermore, many of the laws are conflicting, inconsistent, and overlapping, causing confusion among woodland owners and loggers. In some cases the requirements are so rigid and complex that forestry operations are also needlessly expensive. All indications point to the conclusions that nonpoint source water pollution prevention and wetland protection will continue as both important national and state priorities. As the northeastern states begin to address renewed efforts under Section 319 of the 1987 Amendments to the FWPCA, the forestry community in the northeast should be aware that the current regulatory trend could be only the tip of the iceberg. It will be important, therefore, that forest landowners, woodland managers, and timber operators in the northeast work closely with lawmakers in the development and modification of water resource and wetland protection legislation. Legislators and policy makers need to be informed of the potential effects of overly aggressive and poorly formulated statutes on forest management. They should also be made aware of the interacting and conflicting provisions of current federal, state and local water and wetlands laws affecting forestry. Coordination in these efforts will be essential if forest owners and managers do not continue to be

onfronted with a labyrinth of inconsistent, confus-ng, and overly restrictive regulations. Forest ector input will be crucial to retaining a reasona-le operating environment while, at the same time, nsuring that water quality and wetlands are ade-uately protected. (D'Agostino-PTT)
V91-02487

EDERAL LEGISLATION AND WETLANDS ROTECTION IN GEORGIA: LEGAL FOUN-ATIONS, CLASSIFICATION SCHEMES, AND NDUSTRY IMPLICATIONS.
Georgia Univ., Athens. School of Forest Re-ources.
. W. Cubbage, L. K. Kirkman, L. R. Boring, T. . Harris, and C. E. Deforest.
orest Ecology and Management FECMDW, Vol. 3/3, No. 1/4, p 271-286, June 1990. 2 fig, 2 tab, 9 ef.

escriptors: *Environmental protection, *Forest-y, *Land use, *Legislation, *Regulations, *Wet-nd forests, *Wetlands, Dredging, Federal juris-iction, Fill permits, Georgia, Legal aspects, Per-its.

ederal legislation regarding wetland protection egan with the enactment of the 1972 Amendments the Federal Water Pollution Control Act. Sec-on 404 of the Act states that any activities that eposit dredged or fill material in the nation's aters or wetlands would be subject to regulation y the U.S. Army Corps of Engineers which cur-ntly determines permit requirements subject to PA review. All dredge-and-fill activities require ermits, excepting rare specific cases, and other perations, such as road building and timber pro-uction, must follow best management practice uidelines for exemption. At the regional level, lequate classification methods are necessary to elineate those areas which warrant protection. In e southeastern states such as Georgia, such delin-ation schemes are usually based on the evaluation three ecological parameters unique soils, vegeta-on adapted to wet conditions, and the presence of ater. To date, most forest operations in progress ave not been seriously affected by the dredge-d-fill permit requirements. Much forest land, ven in the southern coastal plain, would not be assed as wetlands under the Corps delineation ethods. Some bottomland hardwoods, cypress vamps, and pocosins would fall within the wet-nds definition. This constitutes about 10-20% of e total forest area in the South, but much of the nds are not viable for commercial timber produc-on. Most commercial southern pine-forest types ould not be classed as wetlands, and thus not bject to Section 404 regulation. In most southern ates, federal wetlands regulations have affected ily a fraction of the commercial timber-growing perations. Several areas do, however, have poten-l for much greater effects. These include much the Mississippi Delta, southern Louisiana, Flori-, the Carolina pocosins, and other large swamps. the pervasive national sentiment for preserving etlands and vigorous enforcement by the Corps d EPA prevail, many of these lands will have to managed in their natural state, or not at all. D'Agostino-PTT)
91-02488

PPLICATION OF A DIGITAL GEOGRAPHIC ATA BASE TO IRRIGATION WATER IGHTS MANAGEMENT.
ureau of Reclamation, Denver, CO. Engineering d Research Center.
P. Verdin, M. P. Crane, and G. P. Lyford.
N: Remote Sensing Applications for Consumptive se (Evapotranspiration). Papers Presented at 21st nnual AWRA Conference and Symposium, ugust 11-16, 1985, Tucson, Arizona. AWRA onograph Series No. 6, (1985). p 35-49, 9 fig, 3 b.

escriptors: *Databases, *Digital map data, *Geo-raphic information systems, *Irrigation water, Mapping, *Water resources management, *Water ghts, Carson River, Computer programs, Data quisition, Data interpretation, Hydrologic data ollections, Nevada, Newlands Project, Remote nsing, Truckee River.

Located in west-central Nevada in the vicinity of the town of Fallon, the Newlands Project utilizes water from the Carson and Truckee Rivers to irrigate Nevada's most productive agricultural region. As a result of recent court decisions, the Bureau of Reclamation is responsible for developing operating criteria and procedures (OCAP) for the Newlands Project. A key provision of the OCAP is the annual establishment of the quantity of irrigation water diversions to the project. Annual diversions are based on the number of acres of land possessing legal water rights that are actually under irrigation. The specific entitlement per acre is dependent on whether land is designated as bench land or bottom land, a soil-type distinction. To facilitate the OCAP water allocation effort, a digital geographic database was developed by the Bureau's remote sensing section. Several critical information layers, including water righted lands, bench and bottom lands, and irrigation lands were entered into the database to portray conditions in the project area during the 1984 growing season. The information layers had as their sources both map and remote sensing data. Computer software was then used to derive section by section summaries of irrigated, water righted bench and bottom lands, and irrigated lands without water rights. A set of custom 7-1/2 min quadrangle maps and map overlays was produced with a computer-driven drum pen plotter to portray the information layers. Techniques for the rapid update of the irrigated lands information layer using satellite imagery and airborne video technology were also developed for application in subsequent years. (Author's abstract)
W91-02598

6F. Nonstructural Alternatives

SYSTEMS ENGINEERING APPROACH TO SOLUTIONS OF DROUGHT IN DEVELOPING COUNTRIES: THE CASE OF TANZANIA.
New Tech International Inst., Dar es Salaam (Tanzania).
For primary bibliographic entry see Field 2A.
W91-02361

6G. Ecologic Impact Of Water Development

QUANTIFYING THE WATER BALANCE OF DRYLAND MILLET IN NIGER USING STATE OF THE ART EVAPORATION TECHNIQUES.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 3F.
W91-02316

ENVIRONMENTAL AND AGRICULTURAL IMPLICATIONS OF DAM CONSTRUCTION IN THE NIGER VALLEY OF MALI.
Gesamthochschule Paderborn (Germany, F.R.).
H. K. Barth.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 857-869, 5 fig, 6 ref.

Descriptors: *Dam effects, *Deltas, *Environmental impact, *Mali, Farming, Fish, Floods, Flow augmentation, Gania floodplain, Interior Delta, Niger River, Rice, Sedimentation, Soil genesis, Vegetation.

The Niger/Bani drainage system is highly complex with regard to catchment area, discharge, and runoff characteristics. The most critical part of the river's drainage basin is the Interior Delta of the Niger. Due to extremely variable discharge rates and in conformity with its geomorphology, this vast delta is flooded seasonally with a significant shift in flooding phases between Ke-Macina and Tombouctou. Due to the high sensitivity of the complex hydrologic system of the delta region, building dams in the upstream parts of the river interferes seriously with the natural hydrologic conditions of the Interior Delta. In the Gania floodplain (upper delta) the annual flooding occurs through a functioning network of old river channels or, in most cases, by overflowing the system of embankments. Soil development is influenced by the sedimentation processes during floods. Vegetational pattern reflects the differences in soils and flooding regime in different parts of the Delta. Although the Selingue Dam originally was designed to provide artificial floods, this could not be maintained, leading to failure to inundate vast areas of the floodplains over the last 5 yr. Growth of natural 'bourgou' grass was reduced substantially, with attendant reductions in feeding and breeding of fish. Rice production also fell. More than a million people were impacted by these effects. (See also W91-02288) (Rochester-PTT)
W91-02359

IMPACT OF HYDROLOGY ON HYDRAULIC PROJECTS IN BURKINA (IMPACT DE L'HYDROLOGIE SUR LES PROJETS HYDRAULIQUES AU BURKINA).
Ministry of Water Resources, Ouagadougou (Burkina Faso). Service de l'Hydrologie.
S. Traore.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 870-888, 6 ref. English summary.

Descriptors: *Burkina Faso, *Dam effects, *Dams, *Drought, *Water resources management, Artificial lakes, Data acquisition, Diversion, Economic aspects, Hydrologic data, Irrigation water, Monitoring, Regulations, Water quality control.

The threat of drought has forced Burkina Faso to undertake intensive water resources development. Digging of dams has assumed great importance thanks to hydraulic organizations in place since the droughts of 1972-1974 and 1983-1984. This activity enabled irrigated cultivation on a large scale. There are 712 dams and 3 international great basins in the territory. These different hydraulic works have undoubtedly affected the natural hydrologic network of the country, through the profound changes brought about in the basin by the creation of artificial lakes and the diversion of rivers (totally or partially) to create water sources. This increasing number of projects necessitates a respect for scientific rules in their realization and necessitates strict respect for the water law in Burkina Faso, which was enacted on 1 April 1983 to regulate human intervention in water resources. The success of the projects and the effective administration of water resources is strictly related to the quality and reliability of hydrologic data. This makes it essential to maintain and reinforce the hydrometric network. The administration of a hydrometric station is very difficult co pared to the financial resources available to the National Hydrologic Service. It is time that all users contribute materially to the acquisition of basic data for a better national hydrometric network administration in the common interest in order to safeguard water resources in the Sahel countries. (See also W91-02288) (Author's abstract)
W91-02360

INFLUENCE OF IMPOUNDMENTS ON PHYTOSESTON BIOMASS OF TWO SMALL LOWLAND RIVERS-SKIERNIEWKA AND RAWKA IN 1983.
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
For primary bibliographic entry see Field 2H.
W91-02390

PRESENT SITUATION OF THE EUROPEAN FLOODPLAIN FORESTS.
Institute for Floodplains Ecology, Rastatt (Germany, F.R.).
For primary bibliographic entry see Field 4C.
W91-02471

EDUCATED GUESSES: HEALTH RISK ASSESSMENT IN ENVIRONMENTAL IMPACT STATEMENTS.
For primary bibliographic entry see Field 4C.
W91-02508

WETLANDS AND GROUNDWATER: NEW CONSTRAINTS IN GROUNDWATER MANAGEMENT.
Universidad Complutense de Madrid (Spain). Dept. of Geodynamics.
M. R. Llamas.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 595-604, 2 fig, 13 ref.

Descriptors: *Aquifer management, *Case studies, *Drainage effects, *Groundwater management, *Groundwater resources, *Irrigation effects, *Spain, *Water resources management, *Water supply development, *Wetlands, Agricultural watersheds, Coastal areas, Ecological effects, Geohydrology, Groundwater potential, Irrigation, Legal aspects, Political aspects, Water demand, Wetland restoration.

A great percentage of the wetlands in many countries has been destroyed over the last century through different causes, mainly because of drainage for agricultural reclamation. The role of groundwater in the behavior of wetlands has usually been recognized in a general way but detailed studies on the hydrogeology of wetlands are still scarce. Documented cases about the adverse impacts of groundwater exploitation on wetlands are almost nonexistent. The problems in two wetlands in Spain were analyzed. Both sites have intense legal protection; however, the sizes, hydrogeological, and ecological characteristics and the legal and social aspects of both sites are somewhat different as are their respective degrees of deterioration. Nonetheless, the main cause of such deterioration is the depletion of the water table caused by groundwater withdrawal for water supply and/or irrigation purposes. In the regions where there is a strong demand for water it is going to be difficult to conserve the ecosystems situated in discharge areas of aquifers containing fresh water owing to the economic value of groundwater. If these ecosystems are to be conserved, much more decisive prior action is required both in terms of the hydrogeological education of the government officials involved, politicians and the public in general, and also in terms of seeking financial compensation for those who are adversely affected by this conservation. (See also W91-02672) (Author's abstract)
W91-02722

GROUNDWATER FLOW AND QUALITY STUDIES IN SZIGETKOZ REGION, NORTHWEST HUNGARY.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
L. Ujfaludi, and J. Maginecz.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 623-633, 5 fig, 10 ref.

Descriptors: *Aquifer management, *Dam effects, *Danube River, *Environmental impact, *Groundwater management, *Groundwater resources, *Hungary, *Water resources management, Case studies, Dispersivity, Environmental tracers, Flow models, Groundwater level, Groundwater movement, Groundwater quality, Infiltration, Model studies, Reservoirs, Surface-groundwater relations, Tracers, Tritium.

A dam currently being built in the Danube River in northwestern Hungary is being studied to determine its effects on the flow and quality of groundwater in its environment. The present pre-project state was examined first; for its simulation a model was developed which consists of a flow, a transport, and a chemical model. Regional dispersivity values, necessary for the transport simulation, were determined by detecting dispersive transport of the natural tritium isotopes in the groundwater. Transport processes were simulated by the random walk method while chemical reactions were simulated using a previously-developed chemical model. The model-system calibrated for the pre-project state is to be used to predict groundwater quality for the post-project state. Simulation of the Szigetkoz groundwater quality is now at an intermediate stage. In spite of this, some previous results indicate that in the post-project condition, a reduction of discharge in the Danube main channel will occur. It causes a considerable change in the main direction of groundwater flow, while the quantity of water increases due to infiltration from the enlarged area of impounded water surface in the reservoir. A series of recharge facilities to compensate for the descending water table were tested by electrical analog. The results showed that a combined canal system would cause the elevation of the water table to an acceptable level for agriculture and other activities. The water quality of the reservoir is expected to be different from that of the present Danube water. These effects together will probably result in an essential change of the groundwater quality. (See also W91-02672) (Fish-PTT)
W91-02724

MULTIPLE DEMANDS ON WETLANDS.
Florida Univ., Gainesville. Dept. of Forestry.
For primary bibliographic entry see Field 2H.
W91-02779

MODEL TO PREDICT AND ASSESS THE EFFECTS OF GROUNDWATER WITHDRAWAL ON THE VEGETATION IN THE PLEISTOCENE AREAS OF THE NETHERLANDS.
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
N. J. M. Gremmen, M. J. S. M. Reijnen, J. Wiertz, and G. van Wirdum.
Journal of Environmental Management JEVMAW, Vol. 31, No. 2, p 143-155, September 1990. 3 fig, 2 tab, 40 ref.

Descriptors: *Groundwater management, *Groundwater mining, *Model studies, *Pleistocene aquifers, *The Netherlands, *Water conservation, *Water resources management, Flora, Plant populations, Policy making, Soil aeration, Soil analysis, Soil water, Species composition, Water depth.

A model to predict the effects of groundwater withdrawal on the local flora was developed to provide a method to evaluate policy constraints regarding water use and water management in the Netherlands. It consists of five submodels, each dealing with a single or complex factors, namely: (1) soil moisture supply, (2) soil aeration, (3) soil nitrogen availability, (4) environmental dynamics, and (5) depth of open water. Plant species response to changes on the value of these factors was shown in the measurement of their moisture and nitrogen content and also in their environmental stability classification. The use of this model requires data on the soil and hydrology of the area, species composition of the vegetation, and changes in groundwater depth and moisture availability resulting from groundwater withdrawal. The end result is a list indicating the probability that the species in the area studied will disappear. This list would therefore serve as a basis to evaluate the impact of groundwater withdrawal when dealing with the conservation value of a study area. Sensitivity analysis of the model gave satisfactory results although comparison of field data and simulation studies was unsatisfactory. This was attributed mainly to incomplete and inaccurate field data. (Medina-PTT)
W91-02949

PROPOSED FRAMEWORK AND DATABASE FOR EIA AUDITING.
Murdoch Univ. (Western Australia). School of Biological and Environmental Sciences.
For primary bibliographic entry see Field 7B.
W91-02950

7. RESOURCES DATA

7A. Network Design

STREAMFLOW DATA AND SURFACE-WATER RESOURCE ASSESSMENT - A QUANTITATIVE DEMONSTRATION OF NEED FOR ADEQUATE INVESTMENT IN DATA COLLECTION IN DEVELOPING COUNTRIES.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
A. J. Adeloye.
Aqua AQUAAA, Vol. 39, No. 4, p 225-236, August 1990. 6 fig, 5 tab, 34 ref.

Descriptors: *Data acquisition, *Data collections, *Developing countries, *Reservoir design, *Statistical analysis, *Streamflow data, *Streamflow forecasting, *Water resources data, *Water resources development, *Water supply, Cost analysis, Economic aspects, Monte Carlo method, Reservoirs, Stream discharge, Stream gages.

In most developing countries the need to design reservoirs when little or no streamflow data exist for the purpose is commonplace, with the result that such designs are frequently in error and fail to deliver projected yields. A Monte Carlo simulation experiment has been performed to quantify the distortion due to short data record length associated with capacity estimates obtained from limited streamflow data records. The analysis was made more relevant to developing economies by limiting it to direct supply impounding reservoirs prevalent in such regions. Streamflow data from three European rivers were used to simulate a large number of equally likely synthetic time series of streamflow data, which were analyzed for the hydrological parameter of interest. The synthetic trace was extended to 1000 years to generate an estimate of the 'true' reservoir capacity, then broken down into sequences of shorter length (4 to 50 years). The resulting series of the hydrological parameter is then analyzed to determine its distribution, risk of failure, and other statistical characteristics. The simulation routing was done on a monthly time scale to accommodate both within-year and over-the-year storage requirements. The results show that streamflow data record length does have significant influence on reservoir capacity estimates; with a 6-year data record the error in capacity estimates averages about 30%, and with a 20-year record the error in capacity estimates averages about 15%. The financial implications of these large errors should help convince politicians in the developing world to invest more in basic hydrological data collection. (Tappert-PTT)
W91-02141

APPROXIMATION OF CONFIDENCE LIMITS ON SAMPLE SEMIVARIOGRAMS FROM SINGLE REALIZATIONS OF SPATIALLY CORRELATED RANDOM FIELDS.
Illinois State Water Survey Div., Champaign. Ground-Water Section.
For primary bibliographic entry see Field 7C.
W91-02187

AGRICULTURAL PESTICIDES AND GROUNDWATER IN NORTH CAROLINA: IDENTIFICATION OF THE MOST VULNERABLE AREAS.
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 5G.
W91-02245

TOWARDS A REGIONAL WATER RESOURCE STUDY OF ARID AND SEMI-ARID AFRICA.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2A.
W91-02295

HYDROLOGICAL NETWORK, DATA BANKS, AND TELETRANSMISSION (RESEAUX HY-

DROLOGIQUES, BANQUES DE DONNEES INFORMATISEES ET TELETRANSMISSION).
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France).
For primary bibliographic entry see Field 7B.
W91-02352

MPACT OF CLIMATIC CHANGES ON SURFACE WATER RESOURCES IN WEST AND CENTRAL AFRICA (IMPACT DES CHANGEMENTS CLIMATIQUES SUR LES RESOURCES EN EAU DE SURFACE EN AFRIQUE DE L'OUEST ET CENTRALE: L'EXPERENCE DE L'OSTROM).
nstitut Francais de Recherche Scientifique pour le Developpement en Cooperation, Paris.
. Sircoulon.
N: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 964-975, 4 tab, 30 ref. English summary.

Descriptors: *Africa, *Climatology, *Drought, Network design, *Sahel, *Surface water, *Water resources data, Climates, Data acquisition, Economic aspects, History, Hydrologic data, Institutional aspects, Low flow, Niger River, River flow, Runoff, Senegal River, Surface runoff.

urface water resources in Africa exhibit great terannual fluctuations due to the climatic variions occurring in this area. The assessment of the source encounters numerous problems in relation the difficult conditions of operating the networks, accessibility of measurement stations, and nancial means. The historical growth of these tworks is discussed. ORSTOM's commitment in e sahelian countries, sustained by the Inter-African Committee for Hydrologic studies, has made it ssible to establish a basic understanding of hydrometeorological phenomena and useful synthes. The drought of the last 20 yr is the most severe the century. The water yields to the sahelian ne have fallen 40%. The major rivers, such as e Senegal and the Niger, have been affected amatically, with very weak floods and severe w flows, whereas the runoff distribution on small helian watersheds seems to be unchanged, sugsting that the dry period favors increased surface noff. (See also W91-02288) (Author's abstract)
91-02368

IVENTORY TECHNOLOGY: 'EBB TIDES', LASH FLOODS', AND 'WHIRLPOOLS'.
orest Service, Washington, DC. Timber Management Staff.
G. Lund.
orest Ecology and Management FECMDW, Vol. /3, No. 1/4, p 559-579, June 1990. 19 ref.

escriptors: *Data acquisition, *Data storage and trieval, *Forest ecosystems, *Forestry, *Reurces management, *Wetland forests, *Wetlands, assification, Data interpretation, International reements, Management planning, Remote sens-g, Surveys.

ue to the advent of new information and technoly, the present methods utilized for conducting rest resource inventories are currently being aluated by the USDA Forest Service. There is a essing need for more specific and effective data llection techniques, as well as more cost-effece methods, including coordinated inventories d data sharing. Some changes regarding informan requirements, integrated inventories, planning d monitoring capabilities are already taking ce as a result of remote sensing devices, comter technology and improved field techniques. is technology can ultimately provide improved ource inventories for the classification and deeation of all types of ecosystems, including ored wetlands. It is suggested that the policy ecting these resources must be managed on an ernational level in order to ensure the survival forested wetlands. Four courses which should considered are: (1) Take a holistic approach to ource inventories; (2) Develop an international definition and classification system for wetlands; and (3) Have an international group champion the monitoring of forested wetlands on a global basis. (D'Agostino-PTT)
W91-02502

TEMPORAL VARIABILITY OF WATER QUALITY AND THE IMPLICATIONS FOR MONITORING PROGRAMMES IN IRISH LIMESTONE AQUIFERS.
Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
C. Coxon, and R. H. Thorn.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 111-120, 4 fig, 2 tab, 8 ref.

Descriptors: *Groundwater management, *Groundwater pollution, *Groundwater quality, *Network design, *Sampling, *Water quality management, *Water resources management, Aquifers, Geohydrology, Groundwater movement, Ireland, Karst hydrology, Limestone, Monitoring, Path of pollutants, Pollution load, Temporal distribution, Water pollution sources, Water sampling.

The first step in designing a groundwater sampling program must be to determine the degree of temporal variation, as the greater this is the more samples are required to obtain the same degree of precision. Contaminated sites show greater temporal variations; the degree of variation determined at clean sites may not be applicable to contaminated sites within the same hydrogeological setting. The hydrogeological situation must be determined, because temporal variability increases with the transition from intergranular flow to fissure flow. In the case of karst aquifers, the range of behavior is such that generalizations from one site to another should not be made. An investigation has been made of temporal changes in water quality in some Irish limestone aquifers. Twenty-two groundwater sources in aquifers ranging from intergranular flow in limestone sand and gravel aquifers to conduit/fissure flow in karst aquifers were sampled every two weeks for one year. The results show that the groundwater sources with the greatest water quality variability are either those that are contaminated or those situated in the mature karst aquifers. The results have clear implications for monitoring since they show that the usual guidelines for sampling groundwater are not necessarily appropriate in limestone aquifers. (See also W91-02672) (Fish-PTT)
W91-02682

EVALUATION OF REGIONAL FLOOD FREQUENCY ANALYSIS WITH A REGION OF INFLUENCE APPROACH.
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-02856

7B. Data Acquisition

REMOTE SENSING APPLIED TO GLACIER SUPERVISION IN THE FRENCH ALPS (YEARS 1986, 1987 AND 1988)(TELEDETECTION APPLIQUEE AU SUIVI DES GLACIERS DES ALPES FRANCAISES (ANNEES 1986, 1987 ET 1988)).
Grenoble-1 Univ. (France). Lab. de la Montagne Alpine.
J. P. Dedieu, and L. Reynaud.
Houille Blanche HOBLAB, Vol. 1990, No. 5, p 355-358, 1990. 2 fig, 7 ref. English summary.

Descriptors: *Alps, *Glaciers, *Glaciohydrology, *Remote sensing, *Satellite technology, France.

Satellite images enable changes in the volume of a glacier to be studied. Satellite images were used to study the St. Solin, Quirles, and Sarenne glaciers of Grandes Rousses. Results from seven French glaciers indicate a good homogeneity between changes in volume and the altitude of the firn line, providing a record of the variations in volume over all of the French Alps. (King-PTT)
W91-02051

GLACIAL MASS BALANCE DETERMINATION IN THE ACCUMULATION ZONE BY IN SITU MEASUREMENTS OF TCHERNOBYL RADIOACTIVITY (DETERMINATION DU BILAN GLACIAIRE EN ZONE D'ACCUMULATION PAR MESURE IN SITU DE LA RADIOACTIVITE DUE A TCHERNOBYL).
Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 2C.
W91-02052

TOXICITY TEST FOR WATER AND WASTE WATER: ALDEHYDE DEHYDROGENASE INHIBITION TEST IN CUVETS AND MICROTITER PLATES (TOXIZITAETSTESTS FUER WASSER UND ABWASSER: KUEVETTEN- UND MIKROTITERPLATTENTEST MIT ALDEHYDDEHYDROGENASE).
Wasserforschung Mainz G.m.b.H. (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W91-02056

SORPTION LAYERS IMPREGNATED WITH AMMONIUM MOLYBDATE FOR THE THIN LAYER CHROMATOGRAPHY IN ORDER TO EVALUATE PHENOL CONTAMINATED WATERS (AMMONIUMMOLYBDATIMPAEGNIERTE SORPTIONSCHICHTEN FUER DIE DUENNSCHICHTCHROMATOGRAPHIE ZUR BEURTEILUNG PHENOLKONTAMINIERTER WAESSER).
Kreiskrankenhaus Treuenbrietzin (German D.R.).
For primary bibliographic entry see Field 5A.
W91-02059

SOLUBLE FLUORESCENCE: EFFECTS ON CHLOROPHYLL DETERMINATION AT DIFFERENT SALINITIES.
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 2L.
W91-02065

MEASURING EPILITHIC BACTERIAL PRODUCTION IN STREAMS.
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-02070

EFFECTS OF WATER ACIDITY, CALCIUM, AND ALUMINUM ON WHOLE BODY IONS OF BROOK TROUT (SALVELINUS FONTINALIS) CONTINUOUSLY EXPOSED FROM FERTILIZATION TO SWIM-UP: A STUDY BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS.
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-02104

SOIL WATER DIFFUSIVITY DETERMINATION BY A MODIFIED ONE-STEP OUTFLOW METHOD.
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W91-02140

EFFECTS OF FLOW DISTURBANCES ON THE ACCURACY OF TURBINE-TYPE WATER METERS.
P. Harrison.
Aqua AQUAAA, Vol. 39, No. 4, p 250-257, August 1990. 8 fig, 3 tab, appendix.

Descriptors: *Flow measurement, *Pipe flow, *Water metering, Design standards, Hydraulics, Performance evaluation, Testing procedures.

The accuracy of a water meter when installed in a pipe is affected by disturbances in the flow of water passing through it. Installing the meter in a sufficient length of straight pipe will eliminate the effects of the disturbance, but the necessary lengths for particular disturbance patterns, and for the different meter types and sizes, are not known. A research program, initiated by the Eureau EU10 committee and given financial assistance by the Community Bureau of Reference of the European Community, was implemented to determine if existing meter installation stipulations were valid for modern turbine-type water meters. Meters tested were single jet meters, multi-jet meters, and Woltmann-type meters. The tests were carried out by eleven laboratories in five countries, and utilized eleven different water meters in seven sizes. In-line flow disturbance devices were developed and used by all the laboratories to create identical 'standardized' flow disturbances. The two types of disturbances studied were velocity profile distortion and swirl. The establishment of valid comparisons between each laboratory was based on the use of 'round-robin' tests on individual meters, and the tests carried out to investigate the effects of flow disturbances. Virtually all of the meters tested failed to comply with the installation provisions. The Committee considered that the straight lengths of pipe called for in the Document were already as long as was commercially practical, and that it was necessary to require manufacturers to supply new designs for water meters. (Tappert-PTT)
W91-02143

ANALYSIS OF THE IN SITU CONSTANT-HEAD PERMEABILITY TEST IN CLAYS.
McGill Univ., Montreal (Quebec).
F. Tavenas, M. Diene, and S. Leroueil.
Canadian Geotechnical Journal CGJOAH, Vol. 27, No. 3, p 305-314, June 1990. 15 fig, 14 ref.

Descriptors: *Clays, *Data acquisition, *Permeability, *Permeability coefficient, *Piezometric head, *Soil tests, *Soil water, Clogging, Finite element method, Mathematical analysis, Quebec, Soils.

The in situ measurement of soil permeability has become an important part of geotechnical engineering. Tests in boreholes and piezometers are often adversely affected by the possible remolding of the soil and clogging of the probe during installation. New self-boring equipment has made the execution of in situ constant-head tests in fine-grained soils simple and reliable. However, the theories used for the interpretation of constant-head tests in low-permeability soils still present some shortcomings, most notably a failure to properly account for the clay behavior or the effect of probe geometry. A finite element analysis of the constant-head test in clays was developed to evaluate the various expressions of shape factor published in the literature, and to provide a basis for extrapolating transient state observations to steady state conditions from which the permeability may be computed. A method was developed that determined an acceptable linear relationship for flow-time data and proposed a shape factor to account for vertical flow near the end sections of the probe in isotropic media. The resulting method of interpreting in situ permeability tests was applied to a series of field results obtained from a Champlain clay deposit. The field results confirm the finite element analysis and validate the method for interpreting constant-head tests. (Tappert-PTT)
W91-02148

FIELD FROST HEAVE MEASUREMENT AND PREDICTION DURING PERIODS OF SEASONAL FROST.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
For primary bibliographic entry see Field 2C.
W91-02150

METHODS FOR MEASURING THE SATURATED HYDRAULIC CONDUCTIVITY OF TILLS.
Norges Landbrukshoegskole, Aas.
P. D. Jenssen.
Nordic Hydrology NOHYBB, Vol. 21, No. 2, p 95-106, 1990. 3 fig, 1 tab, 36 ref.

Descriptors: *Data acquisition, *Glacial sediments, *Groundwater movement, *Hydraulic conductivity, *Saturated flow, *Till, Geologic fractures, Sediment sorting, Sedimentation.

The texture of tills excludes many of the traditional methods for measurement of the saturated hydraulic conductivity (K). The hydraulic conductivity is scale dependent, and for massive, relatively homogeneous till a representative sample volume of 10,000 to 100,000 cubic centimeters is suggested; for very heterogeneous sediments and sediments with large fracture spacing larger samples may be needed. There are no ideal methods for measuring K in till and type of method and equipment should be carefully selected. The main sources of uncertainty in laboratory methods include representativity of the sample (due to size, structure, and density) and interfacial flow along the tube/sediment interface. Field methods are considered to give better estimates of K than laboratory or correlative methods because the test sediment is less disturbed and a larger volume is utilized. Studies comparing and evaluating different test methods for use in till are few, and comparative studies should be carried out. In the unsaturated zone a variant of the inverse auger hole method using a constant head and a lined pit is recommended over cylinder infiltrometers. In the saturated zone measurements in dug wells are considered the most representative method. A greater number of methods are suitable for use in clayey/silty till than in sandy/gravelly till, due to the higher stone content in the latter. Correlative methods can only be used for very approximate predictions of the saturated hydraulic conductivity in till. (Tappert-PTT)
W91-02166

UNSATURATED HYDRAULIC CONDUCTIVITY DETERMINED BY THE HOT AIR METHOD FOR SOME DANISH TILL SOILS.
Department of Soil Tillage, Soil Physics and Irrigation, Tinglev (Denmark).
For primary bibliographic entry see Field 2G.
W91-02169

EXAMS 2: EXPOSURE ANALYSIS MODELING SYSTEM.
Bayreuth Univ. (Germany, F.R.). Chair of Ecological Chemistry and Geochemistry.
K.-W. Shramm.
Toxicological and Environmental Chemistry TXECBP, Vol. 26, No. 1/4, p 73-82, 1990. 2 fig, 1 tab, 4 ref.

Descriptors: *Computer models, *Computer programs, *EXAMS 2 model, *Model studies, *Path of pollutants, *Population exposure, *Toxicology, Aquatic environment, Limnology, Organic compounds, Pollution load, Water quality.

EXAMS 2 was developed for rapid evaluation of the behavior of organic chemicals in aquatic ecosystems. EXAMS 2 inputs include the chemistry and relevant transport and physicochemical properties of the compound and the ecosystem. Model outputs are (1) expected environmental concentrations, (2) the fate of chemicals due to transport and transformation processes, and (3) the persistence of chemicals in the system once chemical loadings terminate. The program is interactive and allows the user to define and store the properties of chemicals and the environment. Loadings, transport, and transformations are combined into a set of differential equations assuming conservation of mass. Chemical mass entering from and leaving to the environment is treated as the algebraic sum of external loadings, transport processes that export chemicals from the system, and transformation processes that convert chemicals to their transformation products. Water bodies can be made up of a set of distinct environmental zones, such as benthic, epilimnic, hypolimnic, and littoral compartments. EXAMS 2 accepts standard water quality and limnological parameters. The program will support up to 999 environmental compartments. Although EXAMS 2 is combined with terrestrial models the present version is not able to model chemical concentrations in the air above the water surface. Thus, simple contamination of the water by the atmosphere cannot be modeled. (Author's abstract)
W91-02174

DETECTION OF ORGANOPHOSPHORUS PESTICIDE DETOXIFYING BACTERIAL COLONIES, USING UV-PHOTOGRAPHY OF PARATHION-IMPREGNATED FILTERS.
Texas A and M Univ., College Station. Dept. of Biochemistry and Biophysics.
For primary bibliographic entry see Field 5B.
W91-02200

EVALUATION OF THE CONTINUOUS SEISMIC-REFLECTION METHOD FOR DETERMINING THE THICKNESS AND LITHOLOGY OF STRATIFIED DRIFT IN THE GLACIATED NORTHEAST.
Geological Survey, Hartford, CT. Water Resources Div.
F. P. Haeni.
IN: The Northeast Glacial Aquifers. Regional Aquifer Systems of the United States. Papers presented at AWRA Symposium on Monitoring, Modeling, and Mediating Water Quality, May 17-20, 1987, Syracuse, New York. AWRA Monograph Series No. 11, 1988. p 63-82, 13 fig, 1 tab, 24 ref.

Descriptors: *Continuous seismic reflection, *Data acquisition, *Geohydrology, *Geophysical surveys, *Glacial aquifers, *Groundwater resources, *Lithology, *Regional Aquifer-Systems Analysis, *Stratified drift, Aquifers, Connecticut, Connecticut River, Geophysics, Maine, New Hampshire, River sediments, Saco River, Seismic reflection.

Continuous seismic-reflection methods have been used for several years in shallow water to determine depth to bedrock or thickness of alluvial and glacial deposits. Acquisition of data in narrow, shallow waterways has been difficult, but recent development of improved sound sources and data collection methods has enabled collection of high quality field data, even in rivers only a few feet deep and a few hundred feet wide. Evaluation of data collected at localities where extensive drill hole control was available and under variable field conditions has shown that the results of this technique are highly dependent on site conditions. Where the riverbed sediments and the glacial drift are primarily fine grained, detailed depositional features of the drift can be detected. Where the riverbed sediments and the glacial drift are primarily coarse grained, however, only major stratigraphic boundaries, such as the stratified drift/till or drift/bedrock contacts, can be detected. In several localities on the Connecticut River in Connecticut, and on the Saco River in maine and New Hampshire, the distribution of coarse-grained and fine-grained stratified drift, thick till, and bedrock, delineated from seismic-reflection records, agreed closely with nearby drill hole data. Along the Farmington River in Connecticut, very thick fine-grained stratified drift deposits overlying bedrock were initially delineated by continuous seismic-reflection methods and subsequently verified by test drilling. (See also W91-02280) (Author's abstract)
W91-02284

CONTINUOUS SEISMIC-REFLECTION PROFILING OF GLACIAL DRIFT ALONG THE SUSQUEHANNA, CHEMUNG, AND CHENANGO RIVERS, SOUTH-CENTRAL NEW YORK AND NORTH-CENTRAL PENNSYLVANIA.
Geological Survey, Albany, NY. Water Resources Div.
R. J. Reynolds, and J. H. Williams.
IN: The Northeast Glacial Aquifers. Regional Aquifer Systems of the United States. Papers presented at AWRA Symposium on Monitoring, Modeling, and Mediating Water Quality, May 17-20, 1987, Syracuse, New York. AWRA Monograph Series No. 11, 1988. p 83-103, 9 fig, 1 tab, 32 ref.

Descriptors: *Chemung River, *Chenango River, *Continuous seismic reflection, *Data acquisition, *Geohydrology, *Geophysical surveys, *Glacial aquifers, *Glacial drift, *Groundwater resources, *Regional Aquifer-Systems Analysis, *Susquehanna River, Aquifers, Geophysics, New York, Pennsylvania, Sand, Silt, Stratigraphy, Surveys.

Continuous, high-resolution seismic-reflection profiling was used to define the stratigraphy of glacial drift along reaches of the Susquehanna, Chemung, and Chenango rivers in south-central New York and north-central Pennsylvania as part of an investigation into the application of continuous seismic-reflection profiling to studies of glacial valley aquifers. Approximately 18 miles of the Susquehanna and Chemung Rivers between Waverly, NY, and North Towanda, PA, were surveyed, along with approximately 9.5 miles of the Susquehanna and Chenango Rivers near Binghamton and Endicott, NY. Surveys conducted in areas where the stratigraphic section consists chiefly of lacustrine silt and clay beneath thin deposits of gravelly alluvium and outwash achieved excellent signal penetration and defined in detail the upper surface of glacial deposits beneath the silt and clay as well as the underlying bedrock surface. From Waverly, NY, to North Towanda, PA, where this stratigraphy is typical, the surveys revealed two types of lacustrine deposits--a thick upper unit of laminated silt and clay that is virtually reflection free, and a discontinuous basal lacustrine unit of interbedded fine sand and silt that displays a draped, parallel-bedded structure over till or ice-contact deposits. Surveys conducted in areas where the stratigraphic section consists predominantly of coarse-grained outwash or ice contact deposits with little or no interbedded lacustrine material were characterized by poor signal penetration and multiple reflections from the river bottom or shallow sub-bottom. This was the general case with surveys conducted along the Susquehanna River from Endicott to Binghamton and along the lowest reach of the Chenango River. Signal penetration and resolution increased markedly in an adjacent upstream reach of the Chenango River valley, where the stratigraphic section includes thick, fine-grained presence or absence of multiple reflections appear to be a result of the relative grain size and thickness of the glacial drift. (See also W91-02280) (Author's abstract)
W91-02285

USE OF OXYGEN-18 AND DEUTERIUM MASS-BALANCE ANALYSIS TO EVALUATE INDUCED RECHARGE TO STRATIFIED-DRIFT AQUIFERS.
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02287

ELECTRONICS AND INFORMATICS FOR THE ACQUISITION OF HYDROMETEOROLOGICAL DATA: A GREAT TOOL FOR WATER RESOURCE MANAGEMENT IN THE SAHEL (ELECTRONIQUE ET INFORMATIQUE POUR L'ACQUISITION DES DONNEES HYDROMETEOROLOGIQUES, UN OUTIL PRODIGIEUX POUR LA GESTION DES RESSOURCES EN EAU DANS LE SAHEL).
Laboratoire General de Recherches, Brussels (Belgium).
E. Tilman.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 202-210, 2 fig. English summary.

Descriptors: *Africa, *Computers, *Data acquisition, *Hydrologic data, *Meteorological data collection, Automation, Climates, Cost analysis, Sahel.

Electronic and informatic techniques were developed for the acquisition of hydrometeorological data. These techniques have proven effective in a number of countries and could contribute to better and more rational water management in the Sahelian countries. Two techniques are employed: 'off-line' and 'on-line.' In the off-line system, data on temperature, relative humidity, insolation, water level, rainfall, and wind speed and direction are recorded by a portable data acquisition instrument, which can be connected by RS-232 cable for transferring data to a central processing location. In the on-line system, data are transmitted to a relay, which routes the data to a central station (PC-compatible or Macintosh microcomputer). Considerable improvements in the economical use of resources may be anticipated from the use of these techniques. (See also W91-02288) (Rochester-PTT)
W91-02303

REVIEW OF WATER RESOURCES INVESTIGATION AND DEVELOPMENT USING SATELLITE REMOTELY SENSED DATA OF THE NAZINGA GAME AREA, BURKINA FASO.
Council for Scientific and Industrial Research, Kumasi (Ghana). Building and Road Research Inst.
D. O. K. Kuma.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 211-221, 5 fig, 17 ref.

Descriptors: *Arid lands, *Burkina Faso, *Remote sensing, *Satellite technology, *Semiarid lands, *Water resources development, Aerial photography, Damsites, Nazinga Game Reserve, Sissili River, Site selection.

The Nazinga Game Reserve is situated along the Sissili River, between Po and Leo in the Republic of Burkina Faso. The ranch aims to contribute to the development of meat production within the Sahel countries and to teach the local population the advantages of animal conservation and environmental protection. Recent applications of aerial photographs and satellite remotely sensed data for identifying and locating potential dam sites and natural impoundment areas are reviewed. These reservoirs are intended to provide adequate water supply for game and wildlife within the ranch area. Aerial photographs and satellite remotely sensed Landsat (MSS) and SPOT images are useful for the overall assessment of surface water movement and planning and development of water impoundment within the Nazinga game reserve area and in the arid/semi-arid zones in particular. Aerial photographs and satellite remotely sensed data are useful sources of information for inventorying of surface water potential and the selection of dam sites where climatic and terrain factors favor the use of remotely sensed data. (See also W91-02288) (Rochester-PTT)
W91-02304

QUANTIFYING THE WATER BALANCE OF DRYLAND MILLET IN NIGER USING STATE OF THE ART EVAPORATION TECHNIQUES.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 3F.
W91-02316

INVESTIGATION OF GROUNDWATER RECHARGE MECHANISMS IN BURKINA FASO.
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 2F.
W91-02320

EXPLORATION OF KARSTIFIED JOINTS IN PRECAMBRIAN LIMESTONE AQUIFERS OF THE GONDO PLAIN (MALI) WITH ELECTROMAGNETIC HORIZONTAL-LOOP METHODS (LOCALISATION DES FRACTURES KARSTIFIEES DES CALCAIRES PRECAMBBRIENS DANS LA PLAINE DU GONDO (MALI) PAR LA PROSPECTION ELECTROMAGNETIQUE BIPOLE).
Neuchatel Univ. (Switzerland). Center of Hydrology.
For primary bibliographic entry see Field 2F.
W91-02321

ELECTRIC METHOD IN VILLAGE HYDRAULIC PROJECTS IN BENIN: THE CASE OF CRYSTALLINE FORMATIONS (GRANITE-SANDSTONE) (LA METHODE ELECTRIQUE EN HYDRAULIQUE VILLAGEOISE: CAS DES FORMATIONS CRISTALLINES (GRANITE-GNEISS)).
Universite Nationale du Benin, Cotonou. Dept. de Physique.
For primary bibliographic entry see Field 2F.
W91-02322

PROSPECTING FOR AQUIFER FRACTURES IN THE CRYSTALLINE BASEMENT BY SOIL RADON ANALYSIS (PROSPECTION DES FRACTURES AQUIFERES DU SOCLE CRISTALLIN PAR DOSAGE DU GAZ RADON CONTENU DANS LE SOL).
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 2F.
W91-02324

GEOPHYSICAL PROSPECTING FOR GROUND WATER EXPLORATION IN DISCONTINUOUS AQUIFERS FOR RURAL WATER SUPPLY PROJECTS IN THE SAHEL.
C.M. Consulting and Management, Rome (Italy).
For primary bibliographic entry see Field 2F.
W91-02325

NEW INSTRUMENTS FOR ELECTRICAL AND AUDIOMAGNETOTELLURIC PROSPECTING (CARACTERISTIQUES DES EQUIPEMENTS MODERNES DE PROSPECTION GEOPHYSIQUE PAR METHODS ELECTRIQUE OU AUDIOMAGNETOTELLURIQUE).
Bureau de Recherches Geologiques et Minieres, Orleans (France).
J. Bernard, and P. Valla.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 456-467, 8 fig. English summary.

Descriptors: *Aquifers, *Data acquisition, *Geophysical exploration, *Groundwater mining, *Measuring instruments, Computers, Conductivity, Electrical properties, Geologic fractures, Magnetism, Rock properties, SAMTEC 1, SAMTEC 2.

Geoelectrical methods are widely used in groundwater investigations, both in crystalline basements and sedimentary formations. These methods are successful because the electrical conductivity of rocks depends on their water content. In the field of direct current methods, the recent improvement in electronic techniques have lead to a new generation of microprocessor-controlled resistivity meters yielding high quality measurements, displaying the apparent resistivity values directly at the end of the measurement, and capable of storing data in an internal memory. Two field applications described here illustrate the use of electrical methods in groundwater investigations: (1) the search for fracture zones in a crystalline basement using a profiling procedure, and (2) the detection of an aquifer layer at depth using a sounding procedure. For audiomagnetotelluric methods, in which natural currents induced in the ground are detected by measurement of electrical and magnetic components, the Bureau de Recherches Geologiques et Minieres (Orleans, France) has developed two receivers: SAMTEC 1 and SAMTEC 2. Their quality of measurement and ease of use now permit this method to be used in the detection of deep aquifer layers in situations where the use of long-line, direct-current conventional sounding would require high survey costs. (See also W91-02288) (Author's abstract)
W91-02326

GEOPHYSICAL RECONNAISSANCE IN A FISSURED STRUCTURE: EXAMPLE IN LIPTAKO, REP. NIGER (RECONNAISSANCE

GEOPHYSIQUE EN MILIEU FISSURE: EXEMPLE AU LIPTAKO, REP. NIGER).
Niamey Univ. (Niger).
For primary bibliographic entry see Field 2F.
W91-02327

GEOPHYSICAL METHODOLOGY APPLIED TO RURAL WATER SUPPLY IN BEDROCK ENVIRONMENT: PRELIMINARY RESULTS (METHODOLOGIE GEOPHYSIQUE APPLIQUEE A L'HYDRAULIQUE VILLAGEOISE EN ZONE DE SOCLE: RESULTATS PRELIMINAIRES).
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Geophysique.
For primary bibliographic entry see Field 2F.
W91-02328

GROUNDWATER RESOURCES IN A POORLY TRANSMISSIVE SANDSTONE IN A SEMI-ARID ENVIRONMENT: 2. REGIONAL INVESTIGATION OF GEOLOGICAL STRUCTURES.
Sveriges Geologiska A.B., Lulea (Sweden).
B. Mannstrom, J. Bromley, L. Carlsson, A. Jamtlid, and D. Nisca.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 540-548, 2 fig, 8 ref.

Descriptors: *Botswana, *Geohydrology, *Geophysical exploration, *Groundwater resources, *Remote sensing, *Sandstones, *Semiarid lands, Aerial surveys, Aquifers, Kalahari Desert, Regional analysis, Tectonics.

The eastern end of the Kalahari Desert (Botswana) is a sand-covered plateau devoid of any permanent surface water. The region has a mean annual rainfall of 447 mm and a yearly potential evapotranspiration estimated at more than 1220 mm. The main aquifer is the Ntane (formerly Cave) sandstone formation. The regional geological structure of this sandstone aquifer covered by 60 m of Kalahari sand was investigated by a low-level (average altitude 20 m a.g.s.) airborne geophysical survey comprising magnetic and electromagnetic measurements. The results exceeded all expectations. Geological structures such as graben, horsts, dikes, and faults were identified easily. The key to the success of the approach lay in the presence of magnetic units covering the aquifer and intruding below the Kalahari sand. The results enable those areas suitable for future groundwater investigation to be identified with certainty. In such a structurally complex area, surface geophysical studies would have furnished a much more crude and uncertain picture. (See also W91-02288, W91-02332, and W91-02334) (Rochester-PTT)
W91-02333

UTILIZATION OF THE ARGOS SYSTEM WITHIN THE FRAMEWORK OF THE HYDROMETRIC NETWORK OF BENIN (L'UTILISATION DU SYSTEME ARGOS DANS LE CADRE DU RESEAU HYDROMETRIQUE BENINOIS).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Niamey (Niger). Mission ORSTOM au Niger.
G. Ale, and L. Le Barbe.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 627-635, 1 ref. English summary.

Descriptors: *Benin, *Data acquisition, *Hydrologic data, *Satellite technology, *Telemetry, ARGOS System, Performance evaluation.

Within the framework of classical hydrometric networks, data collection necessitates frequent visits for maintenance and calibration of the stations. The rapid diffusion of data is hampered by the time needed for its evaluation and transformation to conform to automation requirements as well as its critical assessment. Benefitting from the ARGOS installations combined with the OCP and HYDRONIGER projects, the Hydrological Service of Benin decided to install an automated data gathering and transmission system throughout the country. Measuring instruments and teletransmission devices are mounted on ARGOS buoys. Data are transmitted to an ARGOS satellite and from there to a receiving station in Cotonou. The teletransmitted data are fed automatically into the data bank and the results can be made available to users much more rapidly. The great stability of the buoys and the possibility of observing their operation from a great distance permits a considerable extension of the interval between visits. The time spent in touring the hydrologic network has been reduced to 84 days/yr compared to 222 days/yr under the previous system. (See also W91-02288) (Author's abstract)
W91-02340

INFLUENCE OF CONTINENTAL RIFTING ON THE HYDROGEOLOGY OF THE BAHI DRAINAGE BASIN, DODOMA PROVINCE, CENTRAL TANZANIA.
Cooperative Inst. for Research in Environmental Science, Boulder, CO. Center for the Study of Earth from Space.
For primary bibliographic entry see Field 2F.
W91-02342

STUDY OF PIEZOMETRIC DEPRESSIONS BY ENVIRONMENTAL ISOTOPES: FIRST DATA ON EXAMPLES IN MALI (ETUDE DES DEPRESSIONS PIEZOMETRIQUES PAR LES ISOTOPES DE L'ENVIRONNEMENT: PREMIERES DONNEES SUR DES EXEMPLES AU MALI).
Projet AIEA, Dakar (Senegal).
For primary bibliographic entry see Field 2F.
W91-02343

HYDROLOGICAL NETWORK, DATA BANKS, AND TELETRANSMISSION (RESEAUX HYDROLOGIQUES, BANQUES DE DONNEES INFORMATISEES ET TELETRANSMISSION).
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France).
B. Pouyaud.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 783-790, 4 ref. English summary.

Descriptors: *Africa, *Data acquisition, *Data processing, *Hydrologic data, *Network design, *Satellite technology, *Water resources development, ARGOS System, Hydrologic budget, METEOSTAT, Telemetry.

The systematic collection of hydrological data in reference stations of a base hydrometric network permits the evaluation of surface water resources and their annual variations. An exact knowledge of the hydrologic balance of flow maxima and minima is essential for each water resource development. Whatever the nature of the project (e.g., hydropower, water supply for agriculture, urban water supply, bridges, railways, or streets), the adequacy of the existing network needs to be checked to be sure it meets requirements. Systems such as ARGOS and METEOSTAT use teletransmission via satellite to communicate hydrologic data. The hydrologic data is collected by networks of sensors affixed to buoys and transmitted to satellites four to six times a day. From the satellites, the data is transmitted to central receiving stations. (See also W91-02288) (Rochester-PTT)
W91-02352

TELETRANSMISSION OF HYDROLOGICAL DATA WITHIN THE FRAMEWORK OF THE PROGRAMME TO COMBAT ONCHOCERCIASIS (TELETRANSMISSION DES DONNEES HYDROLOGIQUES DANS LE CADRE DU PROGRAMME DE LUTTE CONTRE L'ONCHOCERCOSE).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Lome (Togo). Centre ORSTOM du Togo.
J. C. Bader, L. Le Barbe, and E. Servat.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 791-799, 1 fig, 2 ref. English summary.

Descriptors: *Africa, *Data acquisition, *Human diseases, *Hydrologic data, *Network design, *Onchocerciasis, *Satellite technology, *Telemetry, ARGOS System, Computer programs, Flood forecasting, Insecticides, Model studies, Public health, World Health Organization.

A World Health Organization program for onchocerciasis control, Onchocerciasis Control Program (OCP), was launched in 1975 in West Africa. Insecticides were sprayed on rivers where vector larvae (Simulium damnosum) reside. About 3,000 to 15,000 km are being treated weekly. To make the campaign efficient without ecological damage it is necessary to know the river discharge at the moment of its treatment. After a pilot study in northern Togo, the OCP decided to employ the ARGOS satellite system in the data acquisition stage. A network of 80 instrument buoys and 2 independent receiver stations has been established. It also was necessary to establish methods for following precisely the propagation of floods and for forecasting the discharge between two buoys and between two messages transmitted. The network and the software used for short-term forecasting of discharge are described. Different forecasting models have been used with this system, E. G. the propagation model (tested with the pilot network in northern Togo), an autorecessive model (also tested on the data from northern Togo) and a model based on the decline in river level. (See also W91-02288) (Rochester-PTT)
W91-02353

INTEGRATED APPROACH FOR THE EVALUATION OF GROUNDWATER RESOURCES: A CASE STUDY IN YATENGA (APPROCHE INTEGREE POUR L'EVALUATION DES RESSOURCES EN EAU SOUTERRAINES: ETUDE DE CAS AU YATENGA).
Ministry of Water Resources, Ouagadougou (Burkina Faso).
For primary bibliographic entry see Field 2F.
W91-02356

IMPACT OF HYDROLOGY ON HYDRAULIC PROJECTS IN BURKINA (IMPACT DE L'HYDROLOGIE SUR LES PROJETS HYDRAULIQUES AU BURKINA).
Ministry of Water Resources, Ouagadougou (Burkina Faso). Service de l'Hydrologie.
For primary bibliographic entry see Field 6G.
W91-02360

MEASUREMENT AND CALCULATION OF DINITROGEN FIXATION IN WATER BODIES.
Humboldt-Univ. zu Berlin (German D.R.). Sektion Biologie.
For primary bibliographic entry see Field 2K.
W91-02378

LIQUID CHROMATOGRAPHY-MASS SPECTROMETRY: AN EMERGING TECHNOLOGY FOR NONVOLATILE COMPOUNDS.
Environmental Protection Agency, Cincinnati, OH. Chemistry Research Div.
For primary bibliographic entry see Field 5A.
W91-02417

PYROLYSIS-GC-MS FOR INVESTIGATING HIGH-MOLECULAR-WEIGHT THM PRECURSORS AND OTHER REFRACTORY ORGANICS.
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).

For primary bibliographic entry see Field 5F.
W91-02418

SAMPLING INTENSITY AND SPECIES RICHNESS: EFFECTS ON DELINEATING SOUTHWESTERN RIPARIAN PLANT COMMUNITIES.
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 2H.
W91-02492

PC-BASED ANALYTICAL STEREOPLOTTER FOR WETLAND INVENTORIES: AN EFFICIENT AND ECONOMICAL PHOTOGRAMMETRIC INSTRUMENT FOR FIELD OFFICES.
Norges Landbrukshoegskole, Aas. Inst. for Georesources and Pollution Research.
V. S. Warner.
Forest Ecology and Management FECMDW, Vol. 33/3, No. 1/4, p 571-581, June 1990. 3 fig, 1 tab, 18 ref.

Descriptors: *Aerial photography, *Data acquisition, *Instrumentation, *Mapping, *Photogrammetry, *Surveys, *Wetlands, Analytical methods, Computers, Data interpretation, Land management.

Aerial photography is one of the most valued sources of information for wetland identification and inventory. Highly flexible photogrammetric systems, controlled entirely by PC technology, are currently available to collect primary data and make 3-dimensional measurements directly from the photographs. This study demonstrates the particular suitability of the PC-based analytical plotter, the Carto AP190. It is simple to use, low in cost (US $30,000), accurate (20 microns), flexible to operate (from simple 3-D measurements to GIS data entry), compatible with available software packages and portable for easy installation. This analytical stereoplotter for wetland inventories is an efficient and economical instrument for field office use. (D'Agostino-PTT)
W91-02503

CLASSIFICATION OF MANGROVE FOREST BY USING 1:40,000-SCALE AERIAL PHOTOGRAPHS.
Pertanian Malaysia Univ., Serdang. Faculty of Forestry.
For primary bibliographic entry see Field 2H.
W91-02504

USE OF HIGH-ALTITUDE AERIAL PHOTOGRAPHY FOR INVENTORYING FORESTED WETLANDS IN THE UNITED STATES.
Fish and Wildlife Service, Newton Corner, MA.
For primary bibliographic entry see Field 2H.
W91-02505

SYNOPTIC INVENTORY OF RIPARIAN ECOSYSTEMS: THE UTILITY OF LANDSAT THEMATIC MAPPER DATA.
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 2H.
W91-02506

BINDING OF TRIAZINE HERBICIDES TO ANTIBODIES IN ANHYDROUS ORGANIC SOLVENTS.
Gesellschaft fuer Biotechnologische Forschung m.b.H., Brunswick (Germany, F.R.). Dept. of Enzyme Technology.
For primary bibliographic entry see Field 5A.
W91-02512

DETERMINATION OF COBALT BY ADSORPTIVE STRIPPING VOLTAMMETRY USING COBALT(II)-NIOXIME-NITRITE CATALYTIC SYSTEM.
Academy of Mining and Metallurgy, Krakow (Poland). Inst. of Material Science.
For primary bibliographic entry see Field 5A.
W91-02513

RELATING SOIL COLOR TO SOIL WATER TABLE LEVELS.
Ohio State Univ., Columbus. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W91-02533

ANALYTICAL PROPERTIES OF 4,4'-BIAZOBENZENEDIAZOAMINOBENZENE AND ITS APPLICATIONS IN SPECTROPHOTOMETRY.
China National Environmental Monitoring Centre, Beijing.
For primary bibliographic entry see Field 5A.
W91-02548

DETERMINATION OF TRACE AMOUNTS OF ACETALDEHYDE USING A NOVEL CHEMILUMINESCENCE REACTION.
University of Science and Technology of China, Hefei. Dept. of Applied Chemistry.
X. Lu, M. Lu, and F. Yin.
Analytical Letters ANALBP, Vol. 23, No. 7, p 1191-1199, July 1990. 3 fig, 1 tab, 9 ref.

Descriptors: *Acetaldehyde, *Chemical analysis, *Luminescence, *Pollutant identification, *Wastewater analysis, *Water analysis, Analytical techniques, Chemical reactions, Detection times, Kinetics, Selectivity, Trace levels, Water pollution.

Chemiluminescent systems have exhibited considerable advantages for the determination of many metal ions and some inorganic compounds, but determination of organic compounds has received much less attention. The chemiluminescent reaction of isopropyl alcohol with ClO(-)-H2O2 (oxychloride-hydrogen peroxide) was found to be enhanced by acetaldehyde. A new chemiluminescent (CL) method for the determination of trace amounts of acetaldehyde was developed. The full chemiluminescent intensity versus time curve, i.e., CL kinetic curve, was recorded. After 4 seconds following the last injection of H2O2 into the reaction cell, the CL intensity reached a maximum and after 8.2 seconds, the CL intensity fell to 50% of the maximum value. Experimental results showed a maximum and constant CL intensity was obtained when the pH of the ClO(-) solution was within 13.2 to 13.6. The detection limit is 0.08 ng/mL acetaldehyde and the linear dynamic range is 0.5 ng/mL to 1000 ng/mL. This method results in good selectivity and has been satisfactorily applied to the determination of traces of acetaldehyde in waste water samples. (VerNooy-PTT)
W91-02549

USING PROGRAMMABLE LOGIC CONTROLLERS.
Central Contra Costa County Sanitary District, Martinez, CA.
For primary bibliographic entry see Field 5D.
W91-02566

REMOTE SENSING APPLICATIONS FOR CONSUMPTIVE USE (EVAPOTRANSPIRATION).
Papers Presented at 21st Annual AWRA Conference and Symposium, August 11-16, 1985, Tucson, Arizona. AWRA Monograph Series No. 6, (1985). 72p. Edited by A. I. Johnson and A. Rango.

Descriptors: *Consumptive use, *Data acquisition, *Evapotranspiration, *Remote sensing, *Soil-water-plant relationships, Agriculture, Evaporation, Hydrologic cycle, Symposium, Transpiration.

Consumptive use is defined by the American Geophysical Union as the quantity of water per annum used by either cropped or natural vegetation in transpiration or in the building of plant tissue, together with water evaporated from the adjacent soil, snow or from intercepted precipitation. It is sometimes termed evapotranspiration. In August of 1985, a special session on remote sensing applications for consumptive use was held as part of the 21st Annual Conference of the American Water Resources Association. This monograph contains six papers that were presented at that session. (See W91-02595 thru W91-02600) (Lantz-PTT)
W91-02594

COMBINED SIMULATION OF CANOPY REFLECTANCE AND THERMAL RESPONSE FOR ESTIMATING EVAPOTRANSPIRATION.
Maryland Univ., College Park. Remote Sensing Systems Lab.
For primary bibliographic entry see Field 2D.
W91-02595

ESTIMATING AREAL EVAPOTRANSPIRATION BY COMBINING REMOTE AND GROUND-BASED DATA.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2D.
W91-02596

ESTIMATES OF CONSUMPTIVE USE AND EVAPOTRANSPIRATION IN PALO VERDE VALLEY, CALIFORNIA, 1981 AND 1983.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2D.
W91-02597

USING SATELLITE DATA FOR MAPPING AND MONITORING VEGETATION RESOURCES.
For primary bibliographic entry see Field 7C.
W91-02599

AGRICULTURAL WATER USE MONITORING THROUGH LANDSAT SURVEILLANCE.
Earth Technology Corp., Long Beach, CA.
For primary bibliographic entry see Field 3F.
W91-02600

INFORMATION COLLECTION REQUEST FOR: NATIONAL PRIMARY DRINKING WATER REGULATIONS FOR INORGANIC CHEMICALS.
Miller (Wade) Associates, Inc., Arlington, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192413. Price codes: A03 in paper copy, A01 in microfiche. 6 fig, append. EPA Contract No. 68-03-3348.

Descriptors: *Data acquisition, *Drinking water, *Inorganic compounds, *National Primary Drinking Water Regulat, *Regulations, *Water quality, Asbestos, Barium, Cadmium, Chromium, Copper, Lead, Mercury, Nitrates, Nitrites, Safe Drinking Water Act, Selenium.

The EPA, under the requirements of the Safe Drinking Water Act (Section 1401 and 1412, P.L. 99-339, as amended in 1986, has proposed a National Primary Drinking Water Regulation (NPDWR) pertaining to the contamination of public water systems by inorganic chemical contaminants. The proposed inorganic chemical (IOC) Rule includes information collection requirements for eight inorganic chemicals: asbestos, barium, cadmium, chromium, mercury, nitrate, nitrite, and selenium. This information collection request analyzes the information burden posed on public water systems and States as a result of the regulation. EPA is proposing only to regulate source-related inorganics under this rule, as opposed to inorganics which predominantly occur as corrosion by-products, and naturally occurring copper and lead are analyzed for lead and corrosion by-products. The EPA has already promulgated a NPDWR for fluoride. (Author's abstract)
W91-02602

VOLUNTEER LAKE MONITORING PROGRAM, 1988. VOLUME VI: SOUTHWESTERN ILLINOIS REGION.
Southwestern Illinois Metropolitan and Regional Planning Commission, Collinsville.

S. E. Andres.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-194740. Price codes: A04 in paper copy, A01 in microfiche. April 1989. 43 p, 28 fig, 20 tab.

Descriptors: *Hydrologic data collections, *Illinois, *Lakes, *Monitoring, *Public participation, *Water quality, Aquatic weeds, Coulterville Lake, Data collections, Dunlap Lake, Field tests, Governor Bond Lake, Highland Silver Lake, Holiday Shores Lake, Seasonal variation, Spatial variation, Tower Lake, Transparency, Washington County Lake, Waterloo Reservoir.

This regional report volume is a compilation of lake monitoring data for 11 lakes in the Southwestern Illinois region. Data and analyses are given for those Southwestern Illinois 1988 Volunteer Lake Monitoring Program (VLMP) lakes which were monitored during eight or more sampling periods for the season: Dunlap, Highland Silver, Holiday Shores and Tower Lakes in Madison County; Coulterville Lake in Randolph County; Governor Bond Lake in Bond County; Washington County Lake in Washington County; and Waterloo Reservoir in Monroe County. For each lake, transparency data and field observations are presented and discussed in terms of spatial and seasonal variations. Aquatic weed growth, management activities, and weather conditions are also discussed. Annual transparency trends and management strategies/recommendations are provided. Additional water quality data for Governor Bond and Tower Lakes are provided. Ambient Lake Monitoring Program data are presented and summarized for Highland Silver Lake. (See also W90-05827) (Lantz-PTT)
W91-02618

INSTALLATION OF A MULTIPORT GROUND-WATER SAMPLING SYSTEM IN THE 300 AREA.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5A.
W91-02670

COMBINING SURFACE GEOELECTRICS AND BOREHOLE MEASUREMENTS FOR CONTAMINATION CONTROL.
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W91-02685

METHOD FOR THE QUANTITATIVE EVALUATION OF FISH MOVEMENTS IN SALT PONDS BY ACOUSTIC TELEMETRY.
Centre de Recherche en Ecologie Marine et Aquaculture, Nieul sur Mer (France).
J. P. Lagardere, J. J. Ducamp, L. Favre, J. M. Dupin, and M. Sperandio.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 141, No. 2,3, p 221-236, September 18, 1990. 9 fig, 4 tab, 15 ref. Ministere de la Recherche et de la Technologie (84-R-1535 and 87-H-0313).

Descriptors: *Acoustic telemetry, *Data acquisition, *Data interpretation, *Fish behavior, *Salt marshes, Aquatic habitats, Ponds, Telemetry.

In order to study the activity rhythm and adaptations of fish in a salt marsh under conditions of extensive culture, it was found necessary to use acoustic telemetry. Due to the effective miniaturization of ultrasonic transmitters, it is possible to fit them to relatively small fish. The pulse signals, which are delivered by the transmitter attached to the fish, are picked up by at least three separate hydrophones. As the relative arrival times of the signals transmitted by the fish to the three hydrophones (0, 1 and 2) are recorded, two different propagation times (t1 -t0, t2-t0) are obtained, which allow the position of the fish tagged with the transmitter to be determined. In fact, on a plane surface, the place where the points correspond to a constant difference in time is a hyperbola of which the foci are the two receptive hydrophones. Therefore, the two measured differences in time correspond to two hyperbolae of which one of the points of intersection determines the position of the transmitter in two dimensions. Because the area where experimentation took place was not very deep, < 1.5 m, all movements and positions were recorded in two dimensions. This simplification does not result in any major errors as far as the determination of positions is concerned. Experimental evaluation of the constant of error, as allocated per unit area, enabled estimation of the maximal error in the distance travelled and provided accurate comparison of the swimming activities of different specimens. The tracking system can be satisfactorily used to study fish behavior in ponds, with special reference to habitat utilization and levels of swimming activity linked to natural variations in the environment. (Brunone-PTT)
W91-02782

PERIPHYTON ASH WEIGHT ESTIMATION FROM RESIDUE NOT DIGESTED AFTER HACH METHOD OF KJELDAHL PROTEIN NITROGEN ANALYSIS.
Victoria Univ. (British Columbia). Dept. of Biology.
A. P. Austin, M. J. R. Clark, W. P. Lucey, and C. I. Ridley-Thomas.
Water Research WATRAG, Vol. 24, No. 11, p 1323-1324, November 1990. 1 tab, 6 ref. Science Council of British Columbia Grant No. 90, RC-15 and the National Sci. and Engineering Res. Council of Canada Grant A9537.

Descriptors: *Analytical techniques, *Kjeldahl procedure, *Periphyton, *Proteins, *Wastewater analysis, Ash weight, Chemical analysis, Comparison studies, Hach method, Statistical analysis.

Periphyton ash weight is commonly analyzed as an estimate of entrapped inorganic particulate mass, with the organic component estimated by subtracting the ash weight from the dry weight of the sample. Usually ash weight is determined through ashing of a sample in a muffle furnace. Sometimes, however, the quantity of biomass available for collection is insufficient to permit analysis by muffle-furnace ashing. The portion of a periphyton sample not digested after acid/peroxide digestion during the Hach method of the Kjeldahl procedure for protein nitrogen determination was examined as an estimator of ash weight. This method, used on periphyton biofilms grown in artificial streams and having ash weights in the 200-300 mg/g range, was found to yield results similar but statistically higher and less precise than the ashing technique traditionally employed for ash weight determination. Student's t comparison of paired analyses by the two methods showed no difference at a significance level of alpha = 0.05, provided a constant of 7.6 mg/g is subtracted from results of the digestion method. It is suggested that the technique may be useful where there would otherwise be insufficient sample for ash weight determination. (White-Reimer-PTT)
W91-02785

NEW LIQUID-JUNCTION FREE PROBE FOR THE IN SITU DETERMINATION OF PH, PH2S AND REDOX VALUES.
Kinneret Limnological Lab., Tiberias (Israel).
W. Eckert, T. Frevert, and H. G. Truper.
Water Research WATRAG, Vol. 24, No. 11, p 1341-1346, November 1990. 5 fig, 1 tab, 25 ref.

Descriptors: *Hydrogen ion concentration, *Hydrogen sulfide, *Measuring instruments, *Oxidation-reduction potential, *Water analysis, Comparison studies, Israel, Performance evaluation, Potentiometry, Reference electrodes.

An alternative to the common methods for the in situ determination of pH, pe and pH2S values is presented. The mechanical and electrochemical problems associated with liquid-junction type reference cells for pH and pe measurements can be avoided by using an alkali glass electrode as a reference. The probe was calibrated by comparing it to a precision laboratory pH electrode for a number of lake water samples that were collected at representative depths at the time of the field measurements. Different pe and pH values were adjusted by saturating the test solution with quinhydrone and by the addition of 1 N HCl p.a. A regulated temperature and continuous stirring of the tested solution provided constant conditions during the calibration procedure. The short response time of the pH cell (</= 5s) was attributed to the absence of a liquid-junction, to the favorable sodium conditions and to the direct amplification of the measurement signal. The probe displayed EMF readings irrespective of hydrostatical pressure, temperature gradients and the presence of hydrogen sulfide when it was deployed in Lake Kinneret, Israel. (White-Reimer-PTT)
W91-02788

SIMPLE METHOD TO DISTINGUISH BETWEEN POLYPHOSPHATE AND OTHER PHOSPHATE FRACTIONS OF ACTIVATED SLUDGE.
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 5D.
W91-02790

STABILITIES OF CARBOXYLIC ACIDS AND PHENOLS IN LOS ANGELES RAINWATERS DURING STORAGE.
California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
For primary bibliographic entry see Field 5A.
W91-02800

VELOCITY-DISCHARGE RELATIONSHIPS IN THREE LOWLAND RIVERS.
Sheffield Univ. (England). Dept. of Geography.
A. D. Knighton, and R. Cryer.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 6, p 501-512, September 1990. 5 fig, 3 tab, 18 ref.

Descriptors: *Discharge measurement, *Flow discharge, *Flow velocity, *River flow, *Routing, *Stream discharge, *Stream gaging, Cross-sections, England, Flow models, Hydrologic models.

The use of different functional forms to describe the variation of velocity with discharge was explored for four cross-sections, nine short reaches (100-250 m), and three long reaches (2-7 km) in three lowland rivers in Lincolnshire, England. The traditional log-linear relationship applied to more than half the cases, the degree of correlation never falling below 0.9. Although probably more valid from a physical standpoint, the log-quadratic relationship was only moderately successful, one problem being the position of the vertex relative to bankfull discharge. Alternative formulations based on a kinematic routing model and a partitioned log-linear model were found to have restricted application. Rates of change of velocity with discharge were relatively high in these lowland rivers, not only at-a-station, but also downstream. One explanation is that velocity becomes particularly sensitive to local slope and within-channel vegetation conditions as discharge decreases, resulting in rather low velocities at small discharges. Cross-sectional and reach-based results were compared for neighboring stretches of river. Velocities in short reaches did not differ appreciably from those at nearby cross-sections or from those in long reaches with a length of less than 3 km. By integrating within-reach variability and avoiding the need to choose a representative cross-section, velocity measurement over short reaches is probably preferable to that at cross-sections as a basis for at-a-station hydraulic geometry. (Author's abstract)
W91-02807

LIQUID WATER CONTENT AND PRECIPITATION CHARACTERISTICS OF STRATIFORM CLOUDS AS INFERRED FROM SATELLITE MICROWAVE MEASUREMENTS.
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W91-02835

PASSIVE MICROWAVE REMOTE SENSING OF CLOUD LIQUID WATER OVER LAND REGIONS.
Cooperative Inst. for Research in the Atmosphere, Fort Collins, CO.
For primary bibliographic entry see Field 2B.
W91-02836

ESTIMATES OF DAILY RAINFALL OVER THE AMAZON BASIN.
Wisconsin Univ.-Madison. Space Science and Engineering Center.
For primary bibliographic entry see Field 2B.
W91-02842

CALIBRATION OF TIME DOMAIN REFLECTOMETRY FOR WATER CONTENT MEASUREMENT USING A COMPOSITE DIELECTRIC APPROACH.
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 2G.
W91-02857

COMPUTER-CONTROLLED 36-CHANNEL TIME DOMAIN REFLECTOMETRY SYSTEM FOR MONITORING SOIL WATER CONTENTS.
Amsterdam Univ. (Netherlands). Lab. for Physical Geography and Soil Science.
For primary bibliographic entry see Field 2G.
W91-02861

INDICATORS OF ECOSYSTEM RECOVERY.
Cornell Univ., Ithaca, NY. Ecosystems Research Center.
For primary bibliographic entry see Field 5G.
W91-02896

COMPUTER-CONTROLLED AUTOMATED RAIN SAMPLER (CCARS) FOR RAINFALL MEASUREMENT AND SEQUENTIAL SAMPLING.
Battelle Pacific Northwest Labs., Richland, WA.
S. D. Tomich, and M. T. Dana.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 7, No. 4, p 541-549, August 1990. 5 fig, 3 tab, 1 ref.

Descriptors: *Air pollution, *Automation, *Chemistry of precipitation, *Measuring instruments, *Rain gages, *Water sampling, Computers, Data acquisition, Meteorologic data, Sensors.

Sequential sampling of precipitation events, or subevent sampling, is often desirable for obtaining data relating to the processes whereby pollutants are removed from the atmosphere by precipitation. The Computer-Controlled Automated Rain Sampler (CCARS) is a combination of rain gage and sequential sampler for precipitation chemistry measurements. The primary objectives of the design are low cost, versatility of operational mode, and remote siting using battery power. The three major components of the device are the measuring valve (rain gage), sequential distribution valve, and onboard computer that also serves as a controller and data recorder. The measuring valve uses an electromagnetically-operated plunger and optical sensors to divide rain events into adjustable rainfall increments (nominally 0.01 in). The distribution valve, using a stepping motor and a rotating channeled gear, delivers programmed volumes to nine sequential stages. The computer records rain and stage increment timing and can be programmed to sample on a time or volume basis. (Author's abstract)
W91-02914

OBSERVATIONS ON THE DEVELOPMENT OF PORE-WATER STRESSES DURING PIEZOCONE PENETRATION IN CLAYS.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
P. W. Mayne, F. H. Kulhawy, and J. N. Kay.
Canadian Geotechnical Journal CGJOAH, Vol. 27, No. 4, p 418-428, August 1990. 5 fig, 2 tab, 69 ref. Electric Power Research Institute (EPRI) Contract RP1493-4.

Descriptors: *Clays, *Compaction, *Geologic fractures, *Instrumentation, *Interstitial water, *Penetrometers, *Piezocone penetration, *Piezometers, *Pore water, Mathematical models.

Piezocone data from 83 clay sites were reviewed to investigate first-order trends between measured penetration pore-water stresses (u-t and u-bt) and corrected cone-tip resistance (q-t). The presence of fissures in clay deposits and of fissured crusts significantly affected the pore water stress response. Commercially available piezocones favored the location of the porous element either on the tip or face (u-t) or just behind the tip (u-bt). U-t provided optimal profiling while u-bt was required for correcting measured cone-tip resistances for pore-water stress effects acting on unequal areas of the cone. The available data indicated that q-t predominantly reflected penetration pore-water stresses (u-t) with measured ratios of u-t/q-t on the cone face averaging in the order of 0.73 for most intact clays, 0.64 specifically for Leda clays, and 0.46 for fissured clays. Behind the cone tip, the ratio of u-bt/q-t averaged about 0.53 for intact clays, 0.58 specifically for Leda clays, and near zero or slightly negative for heavily overconsolidated fissured clays. (Author's abstract)
W91-02938

SIMULATION OF DOWNHOLE AND CROSSHOLE SEISMIC TESTS ON SAND USING THE HYDRAULIC GRADIENT SIMILITUDE METHOD.
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
L. Yan, and P. M. Byrne.
Canadian Geotechnical Journal CGJOAH, Vol. 27, No. 4, p 441-460, August 1990. 29 fig, 1 tab, 40 ref, 2 append.

Descriptors: *Anisotropy, *Earthquake engineering, *Mathematical models, *Model studies, *Seismic properties, *Seismic waves, *Seismology, *Soil dynamics, *Soil physics, *Stress, Electrical equipment, Model testing, Piezometers, Sand.

A method of simulating downhole and crosshole seismic shear-wave tests in a model under controlled stress conditions is presented. The downhole and shear wave in horizontal plane (SH) crosshole shear waves were generated and received along the principal stress axes using piezoceramic bender elements. The K-(o) in situ stress conditions, including loading and unloading stress paths, were simulated by the hydraulic gradient similitude method, which allow stresses simulating field conditions to be obtained. The horizontal stress during the tests was directly measured by a lateral total-stress transducer. The test data were used to evaluate various published empirical equations that related shear-wave velocity and soil stress state. Although the various empirical equations could predict the in situ shear-wave velocity profile reasonably well, only the equation that relates the shear-wave velocity to the individual principal stresses in the directions of wave propagation and particle motion could predict the variation of the velocity ratio between the downhole and SH crosshole tests. Also, the stress ratio had some effects on the downhole (or shear wave in vertical plane (SV) crosshole) shear-wave velocity, but not on the SH crosshole shear-wave velocity. Comparison between the downhole and SH crosshole showed that structure anisotropy was in the order of 10%. In addition, K-o values were predicted from shear-wave measurement and compared with measured ones. The difficulties in obtaining K-(o) values from shear-wave measurement are also presented. (Author's abstract)
W91-02939

PROPOSED FRAMEWORK AND DATABASE FOR EIA AUDITING.
Murdoch Univ. (Western Australia). School of Biological and Environmental Sciences.
J. Bailey, and V. Hobbs.
Journal of Environmental Management JEVMAW, Vol. 31, No. 2, p 163-172, September 1990. 2 fig, 9 ref.

Descriptors: *Assessments, *Auditing, *Australia, *Data storage and retrieval, *Databases, *Decision making, *Environmental impact, Canals, Environmental policy, Marinas.

Environmental impact assessment (EIA) is intended to provide decision-makers with an understanding of the probable environmental consequences of a proposed project or course of action, and thereby facilitate the making of better environmental decisions. Recently, there has been an upsurge of interest in examining the effectiveness of EIA, and a recognition of the need to introduce feedback into the process to learn from experience. This process is known as auditing, one of the fastest growing areas in the field of EIA. A framework for EIA auditing which focuses on the overall process of EIA rather than the separate analysis of particular stages is presented. The framework was developed through auditing several canal and marina developments in Western Australia and is closely linked to this area's procedures. Data obtained from EIA documentation was used to construct a database of four files which summarize the EIA concepts of proposed actions, imposed environmental conditions, predicted impacts, and observed impacts. The database can be used to undertake an implementation audit, a project impact audit, or a predictive techniques audit. It also allows individual audits to be evaluated within the wider context of the overall effectiveness of the EIA system. The database has applications at both the academic and practical levels of EIA auditing. (Medina-PTT)
W91-02950

7C. Evaluation, Processing and Publication

ANALYSIS BY FUNCTIONS APPLIED TO HYDROMETRY (L'ANALYSE PAR FONCTIONS APPLICATION A 'HYDROMETRIE).
Agence Financiere de Bassin Seine-Normandie, Paris (France).
F. Guerber.
Houille Blanche HOBLAB, Vol. 1990, No. 5, p 363-374, 1990. 2 fig, 3 tab, 5 ref, 2 append. English summary.

Descriptors: *Data interpretation, *Data storage and retrieval, *Hydrometry, *Information exchange, Armancon Basin, France, Mathematical analysis, Network design, Project planning.

Quantified information is becoming more and more necessary for knowing and restoring the natural environment. This information must be gathered during long observation periods, and used by various institutions with various objectives. This is why it is difficult to rationalize the production, storage and diffusion of environmental information. Analysis by function is one method which contributes to this effort of rationalization, by defining the concepts of fields and functions. This method is described, and illustrated with a case using hydrometric data. The method resutls in some quantification, which may help measurement networks and data banks to become better able to satisfy the needs of their users. Applied to the concrete case of the Armancon basin, the method helps to justify, both technically and financially, project plans to develop a hydrometric measure network. (Author's abstract)
W91-02050

RATIOS IN AQUATIC SCIENCES: STATISTICAL SHORTCOMINGS WITH MEAN DEPTH AND THE MORPHOEDAPHIC INDEX.
Toronto Univ. (Ontario). Dept. of Zoology.
D. A. Jackson, H. H. Harvey, and K. M. Somers.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 9, p 1788-1795, September 1990. 5 fig, 1 tab, 40 ref.

Descriptors: *Lake morphometry, *Model studies, *Morphoedaphic index, *Statistical analysis, Abundance, Biomass, Fish populations, Productivity, Water depth.

Researchers in aquatic sciences frequently employ empirically derived models to predict productivity, yield and abundance of fish. Three normally distributed variables, each with a mean of 100 and standard deviation of 30, were generated, and common ratios (biomass versus total lake area, biomass per unit area (BPUA) vs. lake area, BPUA vs. lake mean depth, BPUA vs. the inverse of mean depth, and log BPUA vs. log mean depth) were calculated. Pearson product-moment correlations and Spearman rank correlations were used to assess the strength of the associations between variables. To determine the probability of rejecting the null hypothesis for each of these correlations, randomization tests were used. Ten data sets were selected from the literature for ratio generation and comparison with the simulations. Predictive models employing ratios of standardized biomass and lake morphometric variables are biased by spurious correlations due to mathematical transformations and the use of inappropriate null models. Studies incorporating ratios like mean depth or the morphoedaphic index require cautious interpretation. Future research should focus on more appropriate analytical approaches such as regression-based models (the analysis of covariance). Alternatively, where ratios are employed and spurious correlations are likely, statistical evaluations must incorporate randomization tests to assess the significance of such results. (Brunone-PTT)
W91-02069

SOLUTE TRANSPORT THROUGH SATURATED SOILS: A STUDY OF THE PHYSICAL NON-EQUILIBRIUM MODEL.
Claremont Graduate School, CA. Dept. of Mathematics.
For primary bibliographic entry see Field 5B.
W91-02090

MODELLING PHYTOPLANKTON PRODUCTIVITY IN TURBID WATERS WITH SMALL EUPHOTIC TO MIXING DEPTH RATIOS.
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-02115

RANGE PROFILING OF THE RAIN RATE BY AN AIRBORNE WEATHER RADAR.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2B.
W91-02128

SIMPLIFIED METHOD TO ESTIMATE REGIONAL 24-H EVAPOTRANSPIRATION FROM THERMAL INFRARED DATA.
Winand Staring Centre for Integrated Land, Soil and Water Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 2D.
W91-02129

MESIP: MODELLING ENVIRONMENTAL SCENARIOS IN PONDS.
Bayreuth Univ. (Germany, F.R.). Chair of Ecological Chemistry and Geochemistry.
K. W. Shramm, and K. U. Goss.
Toxicological and Environmental Chemistry TXECBP, Vol. 26, No. 1/4, p 123-128, 1990. 5 fig, 2 tab.

Descriptors: *Biodegradation, *Computer models, *Fate of pollutants, *MESIP model, *Model studies, *Organic chemicals, *Path of pollutants, *Ponds, Advection, Chemical processes, Diffusion, Dissolved oxygen, Solute transport.

MESIP is a fugacity model which can predict the fate of organic chemicals in aquatic ecosystems. Aquatic ecosystems are divided into air, water, suspended matter, 4 sediment layers, and biological growth on the pond walls. All compartments are considered to be well-mixed. Two types of transport phenomena are considered. Mass exchange between compartments is assumed to be a diffusion type process. The transport kinetics across the interphases are dependent upon the corresponding transfer coefficients and the fugacity differences represent the driving forces between the compartments. Advection is assumed to be responsible for import and export of substances into and out of each compartment. Degradation/transformation processes are important aspects of the model. Photolytic, hydrolytic, biological, and oxidation/reduction processes are assumed to be a pseudo first-order kinetic. The constants are corrected by additional time dependent parameters which characterize the different conditions in each compartment, including light intensity, pH, ATP/DOC, and oxygen concentration. Comparison of the calculated and measured fate of a fluorescent whitening compound in an artificial outdoor pond indicated an underestimation of transport due to the presence of a biological film on the top sediment layer. (Tappert-PTT)
W91-02176

NEW METHOD TO DETERMINE REGIONAL EVAPOTRANSPIRATION.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2D.
W91-02184

APPROXIMATION OF CONFIDENCE LIMITS ON SAMPLE SEMIVARIOGRAMS FROM SINGLE REALIZATIONS OF SPATIALLY CORRELATED RANDOM FIELDS.
Illinois State Water Survey Div., Champaign. Ground-Water Section.
J. M. Shafer, and M. D. Varljen.
Water Resources Research WRERAQ, Vol. 26, No. 8, p 1787-1802, August 1990. 21 fig, 1 tab, 39 ref.

Descriptors: *Confidence limits, *Correlation analysis, *Environmental data, *Geostatistics, *Network design, *Statistical analysis, *Statistical methods, Spatial distribution, Uncertainty.

A fundamental requirement for geostatistical analyses of spatially correlated environmental data is the estimation of the sample semivariogram to characterize spatial correlation. Selecting an underlying theoretical semivariogram based upon the sample semivariogram is an extremely important and difficult task that is subject to a great deal of uncertainty. Current standard practice does not involve consideration of the confidence associated with semivariogram estimates, largely because classical statistical theory does not provide the capability to construct confidence limits from single realizations of correlated data, and multiple realizations of environmental fields are not found in nature. The jackknife method is a nonparametric statistical technique for parameter estimation that may be used to estimate the semivariogram. When used in connection with standard confidence procedures, it allows for the calculation of closely approximate confidence limits on the semivariogram from single realizations of spatially correlated data. The accuracy and validity of this technique was verified using a Monte Carlo simulation approach which enabled confidence limits about the semivariogram estimate to be calculated from many synthetically generated realizations of a random field with a known correlation structure. The synthetically derived confidence limits were then compared to jackknife estimates from single realizations with favorable results. Finally, the methodology for applying the jackknife method to a real-world problem and an example of the utility of semivariogram confidence limits were demonstrated by constructing confidence limits on seasonal sample variograms of nitrate-nitrogen concentrations in shallow groundwater in an approximately 12 square mile region in northern Illinois. In this application, the confidence limits on sample semivariograms from different time periods were used to evaluate the significance of temporal change in spatial correlation. This capability is quite important as it can indicate when a spatially optimized monitoring network would need to be reevaluated and thus lead to more robust monitoring strategies. (Author's abstract)
W91-02187

CURIOUS BEHAVIOR OF A GROUNDWATER FLOW MODEL.
Butler Univ., Indianapolis, IN. Dept. of Mathematical Sciences.
For primary bibliographic entry see Field 2F.
W91-02190

GEOCHEMISTRY OF BATCH-EXTRACT WATERS DERIVED FROM SPOIL MATERIAL COLLECTED AT THE CORDERO COAL MINE, POWDER RIVER BASIN, WYOMING.
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-02222

ANALYSIS OF WATER SURFACE AND FLOW DISTRIBUTION FOR THE DESIGN FLOOD AT A PROPOSED HIGHWAY CROSSING OF THE SABINE RIVER NEAR TATUM, TEXAS.
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-02226

FRESHWATER WITHDRAWALS IN TEXAS, 1985.
Geological Survey, Austin, TX. Water Resources Div.
D. L. Lurry, and N. L. Barber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4044, 1990. 1 sheet, 1 tab, 9 ref.

Descriptors: *Groundwater resources, *Selective withdrawal, *Texas, *Water resources data, *Water use, Maps, Surface water.

Freshwater withdrawal data was compiled for the 254 counties in Texas for 1985. Major categories of withdrawal are presented by county on maps of the State. Withdrawals are also shown by source, aquifer, and major river basin. Total freshwater withdrawals in Texas during 1985 were about 20,100 million gal/day. Surface-water withdrawals were about 12,900 million gal/day or 64% of the total, and groundwater withdrawals were about 7,190 million gal/day or 36% of the total. More water was withdrawn for irrigation than for any other purpose, accounting for 40% of total freshwater withdrawals and for 75% of groundwater withdrawals. (USGS)
W91-02228

MASS-CONSERVING METHOD OF CHARACTERISTICS FOR STREAMFLOW MODELING.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-02234

U. S. GEOLOGICAL SURVEY APPLIED RESEARCH STUDIES OF THE CHEYENNE RIVER SYSTEM, SOUTH DAKOTA: DESCRIPTION AND COLLATION OF DATA, WATER YEARS 1987-88.
Geological Survey, Rapid City, SD. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-02235

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN KANSAS--FISCAL YEARS 1987 AND 1988.
Geological Survey, Lawrence, KS. Water Resources Div.
L. J. Combs.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-592, 1989. 96p, 11 fig, 6 tab, 46 ref.

Descriptors: *Data acquisition, *Data collections, *Groundwater data, *Hydrologic data collections,

*Kansas, *Water resources data, Information exchange, Surface water data, Water quality data.

The principal mission of the U.S. Geological Survey, Water Resources Division, in Kansas is to investigate the occurrence, quantity, quality, distribution, and movement of surface and groundwater throughout the State. Primary activities include the systematic collection, analysis, and interpretation of hydrologic data, evaluation of water demands, and water resources research. Hydrologic investigations are conducted through four types of studies: (1) data collection programs; (2) statewide or regional investigations; (3) local or area investigations; and (4) research. These studies are funded through cooperative agreements with State and local agencies, transfer of funds from other agencies, and direct Federal funds. Thirty-six water related studies were ongoing during fiscal years 1987 and 1988 in Kansas. This report describes for each study the problem that initiated the study, the objectives of the study, the approach designed to achieve the objectives, and significant milestones and publications that resulted during fiscal years 1987 and 1988. Information on more than 2,100 data collection stations in Kansas is presented in maps and tables. A list of 46 reports and abstracts published or released by the U.S. Geological Survey, its cooperators, or technical and scientific organizations during 1987 and 1988 is provided. (USGS)
W91-02236

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1989, VOLUME 3B: SOUTHWEST FLORIDA GROUND WATER.
Geological Survey, Tampa, FL. Water Resources Div.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-244773. Price codes: A15 in paper copy; A02 in microfiche. USGS Water Data Report FL-89-3B. USGS/WRD/HD-90/267, 1990, 327p. Prepared in cooperation with the State of Florida and other agencies.

Descriptors: *Florida, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Data collections, Elevation, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water level, Water temperature, Water wells.

Water resources data for the 1989 water year for Florida consist of continuous or daily discharge for 295 streams, periodic discharge for 36 streams, miscellaneous discharge for 75 streams, continuous or daily stage for 154 streams, continuous daily tide stage for 12 sites, periodic stage for 13 streams, peak discharge for 57 streams, and peak stage for 30 streams; continuous or daily elevations for 73 lakes, periodic elevations for 72 lakes; continuous groundwater levels for 514 wells, periodic groundwater levels for 798 wells and miscellaneous water level measurements for 2687 wells; quality of water data for 149 surface-water sites and 827 wells. The data for southwest Florida include records of stage, discharge, and water quality of streams; stage, contents, water quality of lakes and reservoirs, and water levels and water quality of groundwater wells. Volume 3B contains records for continuous groundwater elevations for 200 wells; periodic groundwater elevations at 126 wells; miscellaneous groundwater elevations at 47 wells; and water quality at 167 groundwater sites. These data represent the national Water Data System records collected by the U.S. Geological Survey and cooperating local, state, and federal agencies in Florida. (USGS)
W91-02240

WATER RESOURCES DATA FOR UTAH, WATER YEAR 1989.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-239849/AS. Price codes: A17 in paper copy; A03 in microfiche. USGS Water Data Report UT-89-1. USGS/WRD/HD-90/272, 1990, 383p. Prepared in cooperation with the State of Utah and with other agencies.

Descriptors: *Groundwater, *Hydrologic data, *Surface water, *Utah, *Water quality, Chemical analysis, Data collections, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water level, Water temperature, Water wells.

Water resources data for the 1989 water year for Utah consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water quality of groundwater. This report contains discharge records for 185 gaging stations; stage and contents for 22 lakes and reservoirs; water quality for 21 hydrologic stations and 217 wells; miscellaneous temperature measurements and field determinations for 147 stations; and water levels for 29 observation wells. Additional water data were collected at various sites not involved in the systematic data collection program, and are published as miscellaneous measurements. These data represent the national Water Data System records collected by the U.S. Geological Survey and cooperating State and Federal agencies in Utah. (USGS)
W91-02241

PREPARATION OF AVERAGE ANNUAL RUNOFF MAP OF THE UNITED STATES, 1951-80.
Geological Survey, Madison, WI. Water Resources Div.
W. R. Krug, W. A. Gebert, and D. J. Graczyk.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-535, 1990. 414p, 2 tab, 8 ref.

Descriptors: *Data collections, *Hydrologic data, *Maps, *Runoff, *Stream discharge, Correlation analysis, Gaging stations.

Average annual runoff was computed or estimated for 2,148 hydrologic cataloging units in the United States and Puerto Rico, for the period 1951-80. Runoff was computed from the recorded streamflow at 5,951 U.S. Geological Survey gaging stations. The runoff at more than 3,000 of these stations was estimated by correlation with other nearby stations to adjust for missing data. These runoff data were used to draw a map depicting the variation of runoff throughout the nation. Average annual runoff varied from less than 0.01 inch in parts of the Great Basin (Utah, parts of Nevada, Oregon, and California) to more than 240 inches in southeastern Alaska. (USGS)
W91-02247

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1990.
Geological Survey, Little Rock, AR. Water Resources Div.
P. W. Westerfield.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-377, 1990. 62p, 5 fig, 16 tab, 42 ref.

Descriptors: *Arkansas, *Data collections, *Groundwater level, *Hydrologic data, Aquifers, Well hydrographs.

Groundwater level measurements were made in 553 wells in Arkansas in the spring of 1990. These data are listed in tables by aquifer; then by county. For each surface, the altitude of the land surface, the data measured, the depth to the water surface, and the altitude of the water surface are reported. Also reported are the net changes in water levels between 1989 and 1990 and between 1985 and 1990. This report also contains maps showing the average water level change, by county, between the years 1985 and 1990 for the aquifers in the Quaternary deposits and the Sparta and Memphis Sands. Hydrographs are included for selected wells completed in the aquifers in the Quaternary deposits and the Sparta and Memphis Sands. (USGS)
W91-02250

FATHOMETER DATA FROM BART LAKE AND LAKE DOROTHY NEAR JUNEAU, ALASKA, 1988-89.
Geological Survey, Anchorage, AK. Water Resources Div.
H. R. Seitz, and D. S. Thomas.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-152, 1990. 14p, 11 fig, 5 ref.

Descriptors: *Alaska, *Bathymetry, *Hydroelectric power, *Lakes, *Water resources data, Fathometers, Juneau, Water depth.

Lake Dorothy is located about 20 miles southeast of Juneau, Alaska in an undeveloped area south of Taku Inlet. It occupies a linear, glacially eroded depression at an altitude of 2,400 ft. Several studies have assessed the feasibility of hydropower generation by a tap of Lake Dorothy. One of the proposed alignments, a tunnel to transmit water from lake Dorothy to a powerhouse at tide water on Taku Inlet, crosses Bart Lake, a cirque lake at 986 ft altitude. Fathometer surveys show that Bart Lake is a relatively symmetrical bowl-shaped depression with a maximum depth of 543 ft, and Lake Dorothy is a north-south elongated depression with steep sides and a maximum depth of 569 ft. (USGS)
W91-02254

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER OF SEPTEMBER 1986 AND SEPTEMBER 1988 IN SOUTHERN MARYLAND.
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, D. C. Andreasen, S. E. Curtin, and J. C. Wheeler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4039, 1990. 1p, 1 fig.

Descriptors: *Aquia Aquifer, *Artesian aquifers, *Coastal plains, *Maps, *Maryland, *Potentiometric level, Anne Arundel County, Calvert County, Charles County, Groundwater level, Prince Georges County, St Marys County.

A map was prepared that shows the net change in the potentiometric surface of the Aquia aquifer (in the Paleocene Aquia Formation) in southern Maryland from the fall of 1986 to the fall of 1988. The map, based on water level measurements from 74 observation wells, shows that during the 2 year period the potentiometric surface declined less than 6 ft in most of southern Maryland but 10 ft or more in the Lexington Park and Solomons Island areas. (USGS)
W91-02255

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER OF SEPTEMBER 1986 AND SEPTEMBER 1988 IN SOUTHERN MARYLAND.
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, D. C. Andreasen, S. E. Curtin, and J. C. Wheeler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4038, 1990. 1p, 1 fig.

Descriptors: *Artesian aquifers, *Coastal plains, *Magothy Aquifer, *Maps, *Maryland, *Potentiometric level, Anne Arundel County, Calvert County, Charles County, Groundwater level, Maryland Coastal Plain, Prince Georges County.

A map was prepared that shows the net change in the potentiometric surface of the Magothy aquifer (in the Cretaceous Magothy Formation) in southern Maryland from the fall of 1986 to the fall of 1988. The map, based on water level measurements from 79 observation wells, shows that during the 2 year period the potentiometric surface declined less than 5 ft in most of the northern part of the study area and more than 10 ft in a 4-sq-mi area in

northern Charles County. Net water-level rises of as much as 2 ft were measured in central Charles County. (USGS)
W91-02256

POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND DURING SEPTEMBER 1988.
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, D. C. Andreasen, S. E. Curtin, and J. C. Wheeler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4037, 1990. 1p, 1 fig.

Descriptors: *Aquia Aquifer, *Artesian aquifers, *Coastal plains, *Maps, *Maryland, *Potentiometric level, Anne Arundel County, Calvert County, Charles County, Groundwater level, Maryland Coastal Plain, Prince Georges County.

A map showing the potentiometric surface of the Aquia aquifer in the Paleocene Aquia Formation in southern Maryland during the fall of 1988 was constructed on the basis of water level measurements made at 84 observation wells. The potentiometric surface was above sea level near the northwestern boundary and outcrop area of the aquifer in topographically high areas of Anne Arundel and Prince Georges Counties; it was below sea level in the remainder of the study area. The hydraulic gradient generally was to the southeast toward an extensive cone of depression centered around well fields near Lexington Park and Solomons Island. Water levels were more than 60 ft below sea level in a 50 sq-mi area near the center of the cone and were more than 100 ft below sea level at two of the wells near the center of the cone. (USGS)
W91-02257

WATER RESOURCES ACTIVITIES IN FLORIDA, 1989-90.
Geological Survey, Tallahassee, FL. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-169, 1990. 92p, 6 fig. Edited by M. E. Glenn.

Descriptors: *Projects, *Publications, Data collections, Handbooks, Hydrologic data.

This report contains 62 summary statements of water resources activities in Florida conducted by the Water Resources Division of the U.S. Geological Survey in cooperation with Federal, State, and local agencies during 1989-90. These activities are part of the Federal program of appraising the Nation's water resources. (USGS)
W91-02258

ACTIVITIES OF THE ALASKA DISTRICT, WATER RESOURCES DIVISION, U. S. GEOLOGICAL SURVEY, 1990.
Geological Survey, Anchorage, AK. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-157, 1990. 21p. E. F. Snyder, compiler.

Descriptors: *Alaska, *Data collections, *Hydrologic data, *Water resources data, Bibliographies, Groundwater, Hydrology, Project planning, Surface water, Water quality.

Thirteen projects of the U.S. Geological Survey, Water Resource Division active in Alaska in 1990 are described. Each description includes information on period of project, chief, funding sources, location, purpose, current status, and published or planned reports. The compilation also contains a bibliography of reports published by the Alaska District from 1987 through January 1990. (USGS)
W91-02259

WATER RESOURCES DATA FOR ARKANSAS, WATER YEAR 1989.
Geological Survey, Little Rock, AR. Water Resources Div.
M. A. Moore, J. E. Porter, P. W. Westerfield, and K. Young.
Available from the National Technical Information Service, Springfield, VA 22161 as PB90-266339. Price codes: A25 in paper copy, A04 in microfiche. USGS Water-Data Report WDR-AR-89-1. WRD/HD-90/261, 1990. 581p. Prepared in cooperation with the State of Arkansas and with other agencies.

Descriptors: *Arkansas, *Data collections, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Sampling sites, Sediments, Water analysis, Water level, Water temperature.

The Water Resources Division of the U.S. Geological Survey, in cooperation with State, Federal, and other local governmental agencies, obtains a large amount of data pertaining to the water resources of Arkansas each water year. These data, accumulated during many water years, constitute a valuable data base for developing an improved understanding of the water resources of the State. Water resources data for the 1989 water year for Arkansas consist of records of gage height, discharge, and water quality of streams; water quality of lakes; water levels, and water quality of observation wells. This report contains discharge records for 54 gaging stations; water-quality data for 160 regular water-quality stations, 65 partial-record water-quality stations, 4 observation wells, and 1 precipitation station; water-level measurements for 89 observation wells. Also included are data for 81 crest-stage partial-record surface-water stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as low-flow and miscellaneous measurements. These data represent that part of the National Water Information System operated by the U.S. Geological Survey in cooperation with State and Federal agencies in Arkansas. (See also W90-06282) (USGS)
W91-02261

HYDROLOGICAL MODELLING FOR WATER MANAGEMENT IN ARID AND SEMI-ARID AREAS OF AFRICA.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2A.
W91-02291

CIEH'S CONTRIBUTION TO THE DEVELOPMENT OF HYDROLOGY IN ARID AND SEMI-ARID AREAS IN AFRICA (CONTRIBUTION DU CIEH AU DEVELOPPEMENT DE L'HYDROLOGIE DANS LES ZONES ARIDES ET SEMI-ARIDES D'AFRIQUE).
Comite Interafricain d'Etudes Hydrauliques, Ouagadougou (Burkina Faso). Dept. of Hydrology.
For primary bibliographic entry see Field 2A.
W91-02292

FRACTAL APPROACH TO SPATIAL VARIABILITY OF WEST AFRICAN RAINFALL EVENTS (APPROCHE FRACTALE DE LA VARIABILITE SPATIALE DES EPISODES PLUVIEUX DE L'AFRIQUE DE L'OUEST).
Ecole Nationale Superieure des Mines de Paris (France).
For primary bibliographic entry see Field 2B.
W91-02301

ANALYSIS OF NON-STATIONARITY OF WEST AFRICAN RAINFALL AND HYDROLOGICAL SERIES (ANALYSE DE LA NON STATIONNARITE DES SERIES PLUVIOMETRIQUES ET HYDROLOGIQUES D'AFRIQUE DE L'OUEST).
Paris-6 Univ. (France). Dept. de Geologie Dynamique.
For primary bibliographic entry see Field 2B.
W91-02302

PROBLEM OF WATER BALANCE MODELLING UNDER SEMI-ARID CONDITIONS.
Oslo Univ. (Norway). Inst. of Geophysics.
E. Langsholt, and L. Gottschalk.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 242-254, 6 fig, 1 tab, 11 ref.

Descriptors: *Botswana, *Hydrologic budget, *Hydrologic models, *Model studies, *Semiarid lands, Comparison studies, Mahalapswe catchment, Mathematical models, Rainfall-runoff relationships, Spatial variation, Temporal variation.

Analyses were conducted of hydrological data from the Mahalapswe catchment in Botswana in an attempt to see how conceptual models developed mainly under humid conditions perform in semi-arid climates and how the characteristics of precipitation influence modeling accuracy. Meteorological and hydrological variables in semi-arid areas are characterized by extreme temporal and spatial variability, but quantitative knowledge about this variability is rather poor. The accuracy in estimated areal precipitation was determined from the distance correlation of rain events, showing the relation between absolute mean square error and the density of the observation station network. The analysis was carried out for time periods of different length. A model study was conducted using precipitation and runoff data from the same catchment to study the effect of the above factors on model calculations of runoff. Several conceptual water balance models with different degrees of complexity in model structure and spatial averaging of precipitation were used. The results seem to support the principle that when information available is not limited with respect to quantity and quality it may not pay to try to describe the true complexities present in a given situation. (See also W91-02288) (Author's abstract)
W91-02307

SOME EXAMPLES OF IMPORTANT PROBLEMS CONNECTED TO RAINFALL-RUNOFF MODELLING IN SEMI-ARID ZONE.
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
J. Niemczynowicz.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 255-266, 4 fig, 14 ref.

Descriptors: *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Semiarid lands, *Tunisia, Climates, Evaporation, Mathematical models, Rural areas, Soils, Topography, Urban areas.

Several hydrological research projects have been conducted in Tunisia in cooperation between the Ministry of Higher Education in Tunis, Tunisia, and the University of Lund, Sweden. Mathematical modeling of rainfall-runoff processes on both urban and rural catchments was an important part of these projects. Problems that occurred forced the questioning of assumptions and mathematical formulations behind rainfall-runoff models originally developed for application in a humid climate. A second question confronted was how to modify and adapt these models to climatological, geological, topographical, and hydrological conditions specific for the semi-arid zone. One conclusion drawn from trying to apply these models to the semi-arid climate of Tunis was that an obvious improvement in the applicability of the model to semi-arid regions can be achieved by refining the mathematical formulation of the processes that are most important to the region. Existence of differences in soil type, topography, and rainfall pattern suggest that such processes as infiltration, soil moisture storage, rainfall spatial distribution, evaporation, and groundwater recharge must be studied carefully to find governing relationships and thus enable improvement of the mathematical formulation of these processes. (See also W91-02288) (Author's abstract)

W91-02308

UTILIZATION OF THE LAW OF GAPS FOR THE DESCRIPTION OF THE PLUVIOMETRIC REGIME (L'UTILISATION DE LA LOI DES FUITES POUR LA DESCRIPTION DES REGIMES PLUVIOMETRIQUES).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Niamey (Niger). Mission ORSTOM au Niger.
For primary bibliographic entry see Field 2B.
W91-02345

GLOBAL MODELLING OF THE RAINRUNOFF RELATIONSHIP: A TOOL FOR EVALUATION OF WATER RESOURCES (MODELISATION GLOBALE DE LA RELATION PLUIE DEBIT: DES OUTILS AU SERVICE DE L'EVALUATION DES RESSOURCES EN EAU).
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Abidjan (Ivory Coast). Centre ORSTOM d'Adiopodoume.
For primary bibliographic entry see Field 2E.
W91-02349

USE OF PERSONAL COMPUTERS FOR THE ANALYSIS AND MANAGEMENT OF HYDROMETEOROLOGICAL AND GROUNDWATER DATA.
Institute of Hydrology, Wallingford (England).
F. A. K. Farquharson, and C. S. Green.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 772-782, 4 fig, 1 ref.

Descriptors: *Africa, *Computer programs, *Data processing, *Groundwater data, *Hydrologic data, Microcomputers, *Water resources management, Arid lands, GRIPS, HYDATA, Hydrometeorology, Performance evaluation, Semiarid lands.

Much of Africa has an arid or semi-arid climate and experiences wide variations in annual rainfall and river discharges. Much of the current groundwater abstraction is of fossil water, which is not being renewed by recharge. Better management of the fragile water resources within this region requires very careful monitoring and analysis of the hydrometeorological and hydrological data. Modern personal computers (PCs) are relatively cheap but are surprisingly reliable and offer considerable data storage and computing power. Two software systems were developed for analysis of water resources data on PCs. HYDATA is designed for storage and analysis of data on rainfall, climate, river level and flow, reservoir storage and general information, such as evaporation and temperature. GRIPS (GRoundwater Information Processing System) is for storage and analysis of all types of data encountered in hydrogeological studies (station locations, water levels, lithology, pumping tests, water chemistry, isotopes, etc.). The software was developed by hydrologists and hydrogeologists who have years of first-hand, practical experience working in Africa. The software is designed to be robust, error free, and easy to use by the unskilled and poorly trained staff who may never have seen or used a computer before. The two software systems have been fully tested and HYDATA has been used in 16 countries, whereas the GRIPS has been used in six countries. (See also W91-02288) (Author's abstract)
W91-02351

ARRIVAL OF A GENERATION OF FIELD EXPERT SYSTEMS (L'AVENEMENT D'UNE GENERATION DE SYSTEMES EXPERTES DE TERRAIN).
HYDROLOG S.A., Gentilly (France).
J. Poyet, and M. Detay.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 800-811, 39 ref. English summary.

Descriptors: *Africa, *Cameroon, *Computers, *Developing countries, *Expert systems, *Sampling, *Water supply development, *Wells, Drilling, Field tests, HYDROLAB, Rural areas, Surveys.

A first field expert system for village water supply has been developed to operate on portable personal computers. HYDROLAB embodies the major techniques used by experts in the field and draws on a considerable wealth of practical knowledge gained from numerous drilling campaigns that were carried out in Africa, particularly in North Cameroon. For any case, the system can make a diagnosis about the user's situation, give advice in order to increase his average success, estimate the drilling risk, and evaluate the hydrodynamic characteristics of the proposed well. (See also W91-02288) (Author's abstract)
W91-02354

INTEGRATED APPROACH FOR THE EVALUATION OF GROUNDWATER RESOURCES: A CASE STUDY IN YATENGA (APPROCHE INTEGREE POUR L'EVALUATION DES RESSOURCES EN EAU SOUTERRAINES: ETUDE DE CAS AU YATENGA).
Ministry of Water Resources, Ouagadougou (Burkina Faso).
For primary bibliographic entry see Field 2F.
W91-02356

ESTIMATES OF EVAPOTRANSPIRATION WITH A ONE- AND TWO-LAYER MODEL OF HEAT TRANSFER OVER PARTIAL CANOPY COVER.
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2D.
W91-02408

PHYSICAL, CHEMICAL AND HYDROGRAPHIC INVESTIGATIONS OF AN UPLAND STREAM: A CONTRIBUTION ON THE STANDARDIZATION OF SMALL WATERCOURSES (PHYSIKALISCHE, CHEMISCHE UND HYDROGRAPHISCHE UNTERSUCHUNGEN EINESC MITTELGEBIRGSBACHES: EIN BEITRAG ZUR TYPISIERUNG KLEINER FLIESSGEWASSER).
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2E.
W91-02449

ESTIMATING THE FORESTED-WETLAND RESOURCE IN THE SOUTHEASTERN UNITED STATES WITH FOREST SURVY DATA.
Southeastern Forest Experiment Station, Asheville, NC.
For primary bibliographic entry see Field 4C.
W91-02484

WATERSHED DELINEATION WITH TRIANGLE-BASED TERRAIN MODELS.
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-02525

COONGIE LAKES CONTROL ZONE--A MAP AND NOTE FOR THE SURFACE GEOLOGY AND TERRAIN.
For primary bibliographic entry see Field 2H.
W91-02531

SUPERCOMPUTERS AND THEIR USE IN MODELING SUBSURFACE SOLUTE TRANSPORT.
Western Australia Univ., Nedlands. Centre for Water Research.
D. A. Barry.
Reviews of Geophysics RVGPB4, Vol. 28, No. 3, p 277-295, August 1990. 2 fig, 128 ref.

Descriptors: *Computer models, *Computers, *Groundwater movement, *Hydrologic models, *Literature review, *Model studies, *Simulation analysis, *Solute transport, *Supercomputers, Algorithms, Data interpretation, Mathematical models, Numerical analysis, Stochastic hydrology.

A literature review of recent applications of supercomputers to solute transport problems is presented. These applications are based mostly on the assumption of a dilute solute, allowing the governing equations to be decoupled. An application of supercomputers is the simulation of solute transport in large heterogeneous spatial domains by both direct solution of the governing equations and by particle-tracking methods. One impetus for this research has been the rapid increase in predictive dispersion models based on analytical stochastic theory. Up until now, relatively few applications have incorporated algorithms designed with a targeted supercomputer in mind, with the result that the machine's potential has not been exploited fully. Since many numerical problems are reduced to solutions of algebraic systems when they are implemented on computers, algorithms for linear algebraic systems of equations suitable for vector and parallel machines are discussed in some detail. Data analysis, necessary both for evaluating emerging theories and for more routine applications such as determining model parameters, is identified as another general area that is ably handled by supercomputers. In particular, supercomputers offer a way to become less dependent on parametric assumptions and constraints, substituting instead raw computational power. Visualization techniques and associated facilities have flourished alongside the development of supercomputer centers. These offer the possibility for real-time viewing of solute transport processes, both real and simulated, although little has been produced thus far. It is expected that many more researchers involved with subsurface solute transport will make use of supercomputers in the future. (Author's abstract)
W91-02543

TESTING EXPERT SYSTEM FOR ACTIVATED SLUDGE PROCESS CONTROL.
A.T. and T. Bell Labs., Naperville, IL.
For primary bibliographic entry see Field 5D.
W91-02573

BOUNDED IMPLICIT ENUMERATION FOR WASTEWATER-TREATMENT SYSTEMS.
North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-02574

APPLICATION OF A DIGITAL GEOGRAPHIC DATA BASE TO IRRIGATION WATER RIGHTS MANAGEMENT.
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 6E.
W91-02598

USING SATELLITE DATA FOR MAPPING AND MONITORING VEGETATION RESOURCES.
R. H. Haas.
IN: Remote Sensing Applications for Consumptive Use (Evapotranspiration). Papers Presented at 21st Annual AWRA Conference and Symposium, August 11-16, 1985, Tucson, Arizona. AWRA Monograph Series No. 6, (1985). p 51-64, 5 fig, 6 tab, 12 ref. USGS Contract No. 14-08-0001-20129.

Descriptors: *Landsat images, *Mapping, *Satellite technology, *Vegetation, Data acquisition, Data interpretation, Monitoring, Remote sensing, Resources management, Spectral analysis, Wyoming.

Landsat multispectral scanner data are being used to map vegetation at a level useful to natural resource managers. A study conducted in the Big Horn Basin of north-central Wyoming demon-

strates techniques that are helpful in producing a Landsat derived land cover map. Spectral stratification was used to gain precision in the use of the satellite data for mapping natural terrestrial vegetation in a hierarchical physiognomic classification framework. Landsat spectral data were readily registered to a map base, and became an information source for this geographic information system application. Procedures were developed for mapping range capability classes with the Landsat derived vegetation and digitized soils data. The study suggests that the soil/vegetation landscape polygon could be used for monitoring changes in vegetative cover. The resulting change detection could be used in monitoring the status of land cover on large areas at minimal cost. (See also W91-02594) (Author's abstract)
W91-02599

WATER RESOURCES FOR CALIFORNIA, WATER YEAR 1989, VOLUME 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER.
Geological Survey, Sacramento, CA. Water Resources Div.
S. W. Anderson, T. C. Hunter, and J. R. Mullen.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-258112/AS. Price codes: A19 in paper copy, A03 in microfiche. USGS Water-Data Report CA-89-3 (USGS/WRD/HD-90/284), 1990. 417p. Prepared in cooperation with the California Department of Water Resources and with other agencies.

Descriptors: *California, *Data collections, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water temperature.

Water resources data for the 1989 water year for California consist of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 3 contains discharge records for 182 gaging stations; stage and water contents for 47 lakes and reservoirs; water quality for 37 stations; and 3 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W91-02624

WATER RESOURCES FOR FLORIDA, WATER YEAR 1989, VOLUME 2A. SOUTH FLORIDA - SURFACE WATER.
Geological Survey, Miami, FL. Water Resources Div.
W. J. Haire, and C. Price.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-263906. Price codes: A10 in paper copy; A02 in microfiche. USGS Water-Data Report FL-89-2A (USGS/WRD/HD-90/248), 1990. 204p. Prepared in cooperation with the State of Florida and other agencies.

Descriptors: *Data collections, *Florida, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Elevation, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water level, Water temperature, Wells.

Water resources data for the 1989 water year in Florida consists of continuous or daily discharge for 295 streams, periodic discharge for 36 streams, miscellaneous discharge for 75 streams, continuous or daily stage for 154 streams, periodic stage for 13 streams, peak discharge for 57 streams, continuous daily tide stage for 12 streams, and peak stage for 30 streams, continuous or daily elevations for 72 lakes, periodic elevations for 72 lakes; continuous groundwater levels for 514 wells, periodic groundwater levels for 514 wells, and miscellaneous water level measurements for 2,678 wells; quality of water data for 149 surface water sites and 827 wells. The data for South Florida include continuous or daily discharge for 61 streams, continuous or daily stage for 80 streams, continuous elevation for 1 lake; continuous groundwater levels for 220 wells, periodic groundwater levels for 320 wells, and miscellaneous water level measurements for 329 wells; quality-of-water for 3 surface-water sites and 545 wells. This data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, state and federal agencies in Florida. (USGS)
W91-02625

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1989, VOLUME 2B. SOUTH FLORIDA - GROUND WATER.
Geological Survey, Miami, FL. Water Resources Div.
W. J. Haire, and C. Lietz.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-258930. Price codes: A18 in paper copy, A03 in microfiche. USGS Water-Data Report FL-89-2B (USGS/WRD/HD-90/246), 1990. 403p. Prepared in cooperation with the State of Florida and other agencies.

Descriptors: *Data collections, *Florida, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Elevation, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water level, Water temperature, Wells.

Water resources data for the 1989 water year in Florida consist of continuous or daily discharge for 295 streams, periodic discharge for 36 streams, miscellaneous discharge for 75 streams, continuous or daily stage for 154 streams, periodic stage for 13 streams, peak discharge for 57 streams, continuous daily tide stage for 12 streams, and peak stage for 30 streams, continuous or daily elevations for 72 lakes, periodic elevations for 72 lakes; continuous groundwater levels for 514 wells, periodic groundwater levels for 514 wells, and miscellaneous water level measurements for 2,678 wells; quality of water data for 149 surface water sites and 827 wells. The data for South Florida include continuous or daily discharge for 61 streams, continuous or daily stage for 80 streams, continuous elevation for 1 lake; continuous groundwater levels for 220 wells, periodic groundwater levels for 320 wells, and miscellaneous water level measurements for 329 wells; quality-of-water for 3 surface-water sites and 545 wells. This data represent that the National Water Data System records collected by the U.S. Geological Survey and cooperating local, state and federal agencies in Florida. (USGS)
W91-02626

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1989, VOLUME 3A: SOUTHWEST FLORIDA SURFACE WATER.
Geological Survey, Tampa, FL. Water Resources Div.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-262296. Price codes: A14 in paper copy, A02 in microfiche. USGS Water-Data Report FL-89-3A (USGS/WRD/HD-90/266), 1990. 306p. Prepared in cooperation with the State of Florida and other agencies.

Descriptors: *Data collections, *Florida, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Elevation, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water level, Water temperature, Wells.

Water resources data for the 1989 water year in Florida consists of continuous or daily discharge for 295 streams, periodic discharge for 36 streams, miscellaneous discharge for 75 streams, continuous or daily stage for 154 streams, continuous daily tide stage for 12 sites, periodic stage for 13 streams, peak discharge for 57 streams and peak stage for 30 streams; continuous or daily elevations for 73 lakes, periodic elevations for 72 lakes; continuous groundwater levels for 514 wells, periodic groundwater levels for 798 wells, and miscellaneous water level measurements for 2,687 wells; quality-of-water data for 149 surface water sites and 827 wells. The data for Southwest Florida include records of stage, discharge and water quality of streams; stage, contents, water quality of lakes and reservoirs; and water levels and water quality of groundwater wells. Volume 3A contains continuous or daily discharge for 59 streams, periodic discharge for 4 streams, miscellaneous discharge for 3 streams, continuous daily stage for 24 streams, continuous daily tide stage for 10 sites, periodic stage for 1 stream, peak discharge for 30 streams, continuous elevation for 21 lakes and periodic elevation for 16 lakes, and quality of water for 71 surface water sites. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, state and federal agencies in Florida. (USGS)
W91-02627

WATER RESOURCES FOR CALIFORNIA, WATER YEAR 1989, VOLUME 4: NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE.
Geological Survey, Sacramento, CA. Water Resources Div.
S. W. Anderson, J. R. Mullen, and W. F. Shelton.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-266289. Price codes. A15 in paper copy, A02 in microfiche. Water-Data Report CA-89-4 (USGS/WRD/HD-90/301), 1990. 315p. Prepared in cooperation with the California Department of Water Resources and with other agencies.

Descriptors: *California, *Data collections, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water temperature.

Water resources data for the 1989 water year for California consist of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 4 contains discharge records for 177 gaging stations; stage and water contents for 34 lakes and reservoirs; precipitation data for 3 stations; and water quality for 9 stations. Also included is one low-flow partial-record station. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (See also W90-06302) (USGS)
W91-02628

WATER RESOURCES DATA FOR MASSACHUSETTS AND RHODE ISLAND, WATER YEAR 1988.
Geological Survey, Boston, MA. Water Resources Div.
R. A. Gadoury, R. S. Socolow, R. W. Bell, and T. J. Calderini.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-266297/AS. Price codes: A11 in paper copy; A02 in microfiche. Water-Data Report MA-88-1 (USGS/WRD/HD-90/245), 1990. 231p. Prepared in cooperation with the States of Massachusetts and Rhode Island and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Massachusetts, *Rhode Island, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water temperature.

Water resources data for the 1988 water year for Massachusetts and Rhode Island consist of stage, discharge and water quality of streams; contents of lakes and reservoirs; and groundwater levels. This report contains discharge records for 94 gaging stations, monthend contents for 20 lakes and reservoirs, water quality for 9 gaging stations and water levels for 108 observation wells. Also included are data for one crest-stage partial-record station. Additional water data were collected at various sites, not part of the systematic data-collection program and are published as miscellaneous measurements.

A few pertinent stations in bordering states are also ncluded in this report. These data represent that portion of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Massachusetts and Rhode Island. (USGS)
W91-02629

WATER RESOURCES DATA FOR MISSOURI, WATER YEAR 1989.
Geological Survey, Rolla, MO. Water Resources Div.
L. A. Waite, J. V. Davis, H. L. Reed, D. O. Hatten, and T. J. Perkins.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-262601. Price codes: A16 in paper copy, A02 in microfiche. Water-Data Report MO-89-1 (USGS/WRD/HD-90/300), 1990. 353p. Prepared in cooperation with the State of Missouri and other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Missouri, *Surface water, Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Sites, Water analysis, Water temperature.

The U.S. Geological Survey, Water Resources Division, in cooperation with local, State, and Federal agencies and organizations, obtains a large quantity of data pertaining to the water resources of Missouri each water year. These data, accumulated during many water years, constitute a valuable data base for developing an improved understanding of the water resources of Missouri. Water resources data for the 1989 water year for Missouri consist of records of stage, discharge and water quality of lakes and reservoirs. This report contains records for water discharge at 109 gaging stations; stage and contents at 11 lakes and reservoirs; water level records for 49 groundwater monitoring wells; water quality at 52 surface water sampling stations (including 2 lakes); and data for 19 crest-stage stations. (USGS)
W91-02630

WATER RESOURCES DATA FOR MONTANA, WATER YEAR 1989.
Geological Survey, Helena, MT. Water Resources Div.
R. R. Shields, J. R. Knapton, M. K. White, T. M. Crosten, and J. H. Lambing.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-252362. Price codes: A25 in paper copy. A04 in microfiche. Water-Data Report MT-89-1 (USGS/WRD/HD-90/253), 1990. 562p. Prepared in cooperation with the State of Montana and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Montana, *Surface water, Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water temperature.

Water resources data for water year 1989 for Montana consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 6 gaging stations; stage/contents for 9 lakes and reservoirs; water quality for 109 stations, 3 lakes; water levels for 276 observation wells and 8 long-term observation wells equipped with continuous recorders. Also included are 53 smaller reservoirs. Additional water year 1989 data collected at crest-stage gage and miscellaneous measurement sites were collected but are not published in this report. These data are stored within the district office files in Helena and are available on request. These data represent part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana. (USGS)
W91-02631

WATER RESOURCES DATA FOR NEW JERSEY, WATER YEAR 1989, VOLUME 1: ATLANTIC SLOPE BASINS, HUDSON RIVER TO CAPE MAY.
Geological Survey, West Trenton, NJ. Water Resources Div.
W. R. Bauersfeld, E. W. Moshinsky, E. A. Pustay, and W. D. Jones.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-252347. Price codes: A16 in paper copy. A02 in microfiche. Water-Data Report NJ-89-1 (USGS/WRD/HD-90/289), 1990. 345p. Prepared in cooperation with the New Jersey Department of Environmental Protection and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *New Jersey, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water temperature.

Water resources data for water year 1989 for New Jersey consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality of groundwater. This volume of the report contains discharge records for 73 gaging stations; tide summaries for 1 station; stage and contents for 15 lakes and reservoirs; water quality for 61 surface-water sites and 116 wells; and water levels for 69 observation wells. Also included are data for 39 crest-stage partial record stations, 11 tidal crest-stage gages, and 58 low flow partial record stations. Additional water data were collected at 54 sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in New Jersey. (See also W90-06440 and W91-02633) (USGS)
W91-02632

WATER RESOURCES DATA FOR NEW JERSEY, WATER YEAR 1989, VOLUME 2: DELAWARE RIVER BASIN AND TRIBUTARIES TO DELAWARE BAY.
Geological Survey, West Trenton, NJ. Water Resources Div.
W. R. Bauersfeld, E. W. Moshinsky, E. A. Pustay, and W. D. Jones.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-252370. Price codes: A11 in paper copy; A02 in microfiche. Water-Data Report NJ-89-2 (USGS/WRD/HD-90/290), 1990. 215p. Prepared in cooperation with the New Jersey Department of Environmental Protection and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *New Jersey, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water temperature.

Water resources data for water year 1989 for New Jersey consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality of groundwater. This volume of the report contains discharge records for 24 gaging stations; tide summaries for 3 stations; stage and contents for 18 lakes and reservoirs; water quality for 30 surface-water sites and 50 wells; and water levels for 55 observation wells. Also included are data for 23 crest-stage partial record stations, 2 tidal crest-stage gages, and 18 low-flow partial-record stations. Additional water data were collected at 10 sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in New Jersey. (See W90-06441 and W91-02632) (USGS)
W91-02633

WATER RESOURCES DATA FOR NEW YORK, WATER YEAR 1989, VOLUME 2: LONG ISLAND.
Geological Survey, Syosset, NY. Water Resources Div.
A. G. Spinello, J. H. Nakao, R. Busciolano, R. B. Winowitch, and V. K. Eagen.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-262619. Price codes: A10 in paper copy, A02 in microfiche. Water-Data Report NY-89-2 (USGS/WRD/HD-90/296), 1990. 196p. Prepared in cooperation with the State of New York and other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *New York, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Sampling sites, Sediments, Sites, Water analysis, Water temperature.

Water resources data for water year 1989 for New York consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality of groundwater wells. This volume contains discharge records for 17 gaging stations; water quality at 17 gaging stations, and 7 wells; and water levels at 225 observation wells. Also included are data for 74 low-flow partial-record stations. Additional water data were collected at various sites not involved in the systematic data collection program, and are published as miscellaneous measurements and analyses. These data, together with the data in Volumes 1 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey in cooperation with State, Federal and other agencies in New York. (USGS)
W91-02634

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1989. VOLUME 2: SUSQUEHANNA AND POTOMAC RIVER BASINS.
Geological Survey, Harrisburg, PA. Water Resources Div.
W. C. Loper, T. E. Behrendt, and W. P. Schaffstall.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-252271/AS. Price codes: A13 in paper copy; A02 in microfiche. Water-Data Report PA-89-2 (USGS/WRD/HD-90/283), 1990. 289p. Prepared in cooperation with the State of Pennsylvania and other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Pennsylvania, *Surface water, *Water quality, Chemical analysis, Data collection sites, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Streamflow, Water analysis, Water temperature.

Water resources data for water year 1989 for Pennsylvania consist of records of discharge and water quality of streams; contents and elevations of lakes and reservoirs; and water levels and water quality of groundwater wells. This report, Volume 2, includes records from the Susquehanna and Potomac River basins. Specifically, it contains: (1) discharge records for 90 continuous-record streamflow-gaging stations and 108 partial-record stations; (2) elevation and contents records for 13 lakes and reservoirs; (3) water quality records for 17 streamflow-gaging stations, for 10 ungaged streamsites, and for 14 wells or springs; and (4) water level records for 39 observation wells. Location of these sites are shown. Additional water data were collected at various sites not involved in the systematic data collection program and are published as miscellaneous measurements and analyses and represent 20 special study and miscellaneous streamflow sites. These data together with the data in Volumes 1 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey in cooperation with State, Federal and other agencies in Pennsylvania. (USGS)
W91-02635

WATER RESOURCES DATA FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS, WATER YEAR 1989.
Geological Survey, San Juan, PR. Water Resources Div.
R. E. Curtis, Z. Aquino, R. J. Vachier, and P. L. Diaz.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-258880. Price coes: A18 in paper copy, A03 in microfiche.

Water-Data Report PR-89-1 (USGS/WRD/HD-90/242), 1990. 420p. Prepared in cooperation with the State of Puerto Rico, the Government of the U.S. Virgin Islands and other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Puerto Rico, *Surface water, *Virgin Islands (US), *Water quality, Aquifers, Chemical analysis, Flow rates, Gaging stations, Lakes, Sediments, Streamflow, Water analysis, Water level.

Water resources data for surface water, quality of water, groundwater records for the 1989 water year for Puerto Rico and the U.S. Virgin Islands, consist of records of discharge, water quality of streams, and water levels of wells. This report contains discharge records for 60 streamflow-gaging stations; 91 partial-record or miscellaneous streamflow stations; stage records for 7 reservoirs; 1 crest-stage, partial-record streamflow station; water quality records for 16 streamflow-gaging stations, 42 ungaged streamsites, 11 lake sites, 2 lagoons, and 1 bay; and water level records for 76 observation wells. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating local and federal agencies in Puerto Rico and the U.S. Virgin Islands. (USGS)
W91-02636

WATER RESOURCES DATA FOR SOUTH CAROLINA, WATER YEAR 1989.
Geological Survey, Columbia, SC. Water Resources Div.
C. S. Bennett, T. W. Cooney, K. H. Jones, B. W. Church, and G. L. Murray.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-262304. Price codes, A25 in paper copy, A04 in microfiche. Water-Data Report SC-89-1 (USGS/WRD/HD-90/263), 1989. 585p. Prepared in cooperation with the State of South Carolina and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *South Carolina, *Surface water, *Water quality, Aquifers, Chemical analysis, Flow rates, Gaging stations, Lakes, Sediments, Streamflow, Water analysis, Water level.

Water resources data for the 1989 water year for South Carolina consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and levels of groundwater wells. This volume contains records for water discharge at 116 gaging stations, stage only at 23 gaging stations, stage and contents at 12 lakes and reservoirs, water quality at 61 gaging stations, and water levels at 56 observation wells. Also included are data for 41 crest-stage partial-record stations and discharge measurement information at 4 locations. Locations of these sites are shown. Additional water data were collected at various sites not involved in the systematic data collection program. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in South Carolina. (USGS)
W91-02637

WATER RESOURCES DATA FOR SOUTH DAKOTA, WATER YEAR 1989.
Geological Survey, Huron, SD. Water Resources Div.
M. J. Burr, R. D. Benson, and D. S. Hansen.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-262593. Price codes: A17 in paper copy, A03 in microfiche. Water-Data Report SD-89-1 (USGS/WRD/HD-90/294), 1990. 383p. Prepared in cooperation with the State of South Dakota and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *South Carolina, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Streamflow, Water analysis, Water level, Water temperature.

Water resources data for the 1989 water year for South Dakota consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 147 streamflow-gaging stations; stage and contents records for 10 lakes and reservoirs, stage for 7 streams and 4 lakes; water quality records for 16 streamflow-gaging stations, 3 daily-sediment stations, 3 wells, 6 ungaged streamsites, 1 lake, 1 sewage lagoon, and 1 precipitation site; water levels for 30 wells; daily precipitation records at 38 sites; and 9 partial-record crest-stage gage sites. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in South Dakota. (USGS)
W91-02638

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1989. VOLUME 2: SAN JACINTO RIVER, BRAZOS RIVER, SAN BERNARD RIVER BASINS AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
H. D. Buckner, W. J. Shelby, and H. J. Davidson.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-268574/AS. Price codes: A18 in paper copy; A03 in microfiche. Water-Data Report TX-89-2 (USGS/WRD/HD-90/292), 1990. 412p. Prepared in cooperation with the State of Texas and with other agencies.

Descriptors: *Data collections, *Hydrologic data, *Surface water, *Texas, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Sampling sites, Sediments, Streamflow, Water analysis, Water level.

Water resources data for the 1989 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States also are included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (See also W91-02640) (USGS)
W91-02639

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1989. VOLUME 3: COLORADO RIVER, LAVACA RIVER, GUADALUPE RIVER, NUECES RIVER, RIO GRANDE BASINS AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
H. D. Buckner, W. J. Shelby, and H. J. Davidson.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-268582/AS. Price codes: A19 in paper copy; A03 in microfiche. Water-Data Report TX-89-3 (USGS/WRD/HD-90/293), 1990. 425p. Prepared in cooperation with the State of Texas and with other agencies.

Descriptors: *Data collections, *Flow rates, *Hydrologic data, *Surface water, *Texas, *Water quality, Chemical analysis, Gaging stations, Lakes, Sampling sites, Sediments, Streamflow, Water analysis, Water level.

Water resources data for the 1989 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States also are included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (See also W91-02639) (USGS)
W91-02640

WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1989.
Geological Survey, Tacoma, WA. Water Resources Div.
M. B. Miles, W. D. Wiggins, G. P. Ruppert, R. L. Blazs, and L. L. Reed.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-252354. Price codes: A21 in paper copy, A03 in microfiche. Water-Data Report WA-89-1 (USGS/WRD/HD-90/285), 1990. 467p. Prepared in cooperation with the State of Utah and with other agencies.

*Utah, *Hydrologic data, *Data collections, *Surface water, *Groundwater, *Water quality, Streamflow, Lakes, Gaging stations, Chemical analysis, Sediments, Water analysis, Water levels, Flow rates, Sampling sites.

Water resources data for the 1989 water year for Washington consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels of wells. The report contains discharge records for 203 gaging stations; stage only records for 5 gaging stations; and stage and (or) contents for 35 lakes reservoirs; water quality for 33 streamflow-gaging stations, and 7 ungaged streamsites; water levels for 77 observation wells; and water quality for 1 observation well. Also included are data for 5 crest-stage partial-record stations and 110 partial-record or miscellaneious streamflow stations. Locations of these sites are shown. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Washington. (USGS)
W91-02641

OIL SLICK SIZES AND LENGTH OF COASTLINE AFFECTED: A LITERATURE SURVEY AND STATISTICAL ANALYSIS--FINAL REPORT.
Minerals Management Service, Los Angeles, CA. Pacific OCS Region.
For primary bibliographic entry see Field 5B.
W91-02671

EVALUATION OF HYDROGEOLOGICAL PARAMETERS IN HETEROGENEOUS POROUS MEDIA.
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 2F.
W91-02673

ESTIMATION OF THE TRANSMISSIVITY OF THE SANTIAGO AQUIFER, CHILE, USING DIFFERENT GEOSTATISTICAL METHODS.
Pontificia Univ. Catolica de Chile, Santiago. Faculty of Engineering.
For primary bibliographic entry see Field 2F.
W91-02679

PREDICTION OF THE CONCENTRATION DISTRIBUTION OF GROUNDWATER POLLUTANTS.
Kyushu Univ., Fukuoka (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-02684

LIBRARY U. S. GEOLOGICAL SURVEY

OUTLIERS IN GROUNDWATER QUALITY TIME SERIES.
Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
Z. W. Kundzewicz, J. Ihringer, E. J. Plate, and J. Grimm-Strele.
IN: Groundwater Management: Quantity and Quality. Proceedings of the Symposium held at Benidorm, Spain, October 2-9, 1989. International Association of Hydrological Sciences, Washington, DC. 1989. p 161-169, 3 fig, 8 ref.

Descriptors: *Data interpretation, *Error analysis, *Groundwater quality, *Statistics, *Time series analysis, Databases, Forecasting, Groundwater data, Groundwater management, Hydrologic data collections, Water quality management, Water resources management.

The amount of groundwater quality data collected repetitively in several locations and pertaining to some dozens of parameters is very high. Therefore, in order to screen the data, a plausibility analysis of an incoming data point should be made before the point in question is accommodated into the data base. The problem of the detection of outliers in time series of non-equidistant groundwater quality data has been addressed. The operational check of data consistency, i.e., the procedure of judging if the newly acquired data element fits the temporal structure of the remainder of the data set, was used. This includes issuing the forecast of the variable in question, assessment of the variance of the forecast error, and checking if the newly incoming data point does not substantially depart from the forecast value. The methodology used is based on a modified exponential smoothing method which, in the problem considered, was more feasible than Kalman filtering and the geostatistics of temporal fields. Plausibility analysis of groundwater quality data is an important step in the building of databases necessary for decision making on water resources. (See also W91-02672) (Author's abstract)
W91-02687

NTERACTIVE GROUNDWATER MODELING: COLOUR GRAPHICS, ICAD AND AI.
nternational Inst. for Applied Systems Analysis, axenburg (Austria).
or primary bibliographic entry see Field 2F.
V91-02699

NTEGRATED FINITE DIFFERENCE MODEL OR GROUNDWATER FLOW AND QUALITY IMULATION.
ologna Univ. (Italy). Facolta di Ingegneria.
or primary bibliographic entry see Field 2F.
V91-02700

ELEVANCE OF THE TRANSPORT PARAMTERS IN PREDICTIVE MODELLING OF ROUNDWATER CONTAMINATION.
Vaterloo Univ. (Ontario). Inst. for Ground Water esearch.
or primary bibliographic entry see Field 5B.
V91-02701

OCALIZED ADJOINT METHODS: APPLICAION TO ADVECTION DOMINATED FLOWS.
Universidad Nacional Autonoma de Mexico, lexico City. Inst. de Geofisica.
or primary bibliographic entry see Field 2F.
V91-02702

INITE ELEMENT COMBINED SURFACE VATER/GROUNDWATER MODEL FOR THE IVER RHINE, KEHL/STRASBOURG RESEROIR.
ahmeyer International G.m.b.H., Frankfurt am lain (Germany, F.R.).
or primary bibliographic entry see Field 5G.
V91-02716

PPLICATION OF GROUNDWATER MODELING IN WATER RESOURCES MANAGEIENT IN DENMARK.
iljoestyrelsen, Copenhagen (Denmark).
For primary bibliographic entry see Field 5B.
W91-02719

MODELLING STREAMWATER CHEMISTRY AS A MIXTURE OF SOILWATER END-MEMBERS--A STEP TOWARDS SECOND-GENERATION ACIDIFICATION MODELS.
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W91-02753

MODELLING STREAMWATER CHEMISTRY AS A MIXTURE OF SOILWATER END-MEMBERS-AN APPLICATION TO THE PANOLA MOUNTAIN CATCHMENT, GEORGIA, U. S. A.
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-02754

REGIONAL MODEL OF ACIDIFICATION IN WALES.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5B.
W91-02759

ANALYSIS OF LONG-TERM SALINITY PATTERNS IN THE LOUISIANA COASTAL ZONE.
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2L.
W91-02762

PROBABILITY MODEL FOR ACID RAIN DATA.
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W91-02787

SENSITIVITY OF THE SURFACE HYDROLOGY TO THE COMPLEXITY OF THE LAND-SURFACE PARAMETERIZATION SCHEME EMPLOYED.
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
A. Henderson-Sellers, A. J. Pitman, and R. E. Dickinson.
Atmosfera ATMSEF, Vol. 3, No. 3, p 183-201, July 1990. 10 fig, 30 ref.

Descriptors: *Atmospheric circulation, *Climatology, *Data interpretation, *Hydrologic models, *Model studies, *Parametric hydrology, Carbon dioxide, Climatic changes, Diurnal variation, Hydrologic cycle, Precipitation, Solar radiation.

The sensitivity of surface hydrology to the parameterization scheme incorporated in three different atmospheric general circulation models (AGCMs) was investigated. It was found that the simulations of the surface hydrology by the NCAR Community Climate Model (CCM0) and GFDL models (which incorporate the bucket-type hydrological parameterization) differ markedly from the CCMiB model (which incorporates the Biosphere Atmosphere Transfer Scheme, BATS). The AGCMs which incorporate the simpler parameterizations of the land surface simulate a number of physical phenomena unrealistically. Many of these gross problems in the land surface climatology are eliminated in the CCM1B model which incorporates BATS. When present-day and doubled CO2 scenarios were compared, the differences between model results incorporating different surface schemes were greater than the differences between 1 x and 2 x CO2. The implications of these results are that the surface hydrological fields from AGCMs, and their predictions of climatic change at the land surface, are likely to be unreliable. Investigations of the impact of climatic change consequent upon changes in the land surface climatology should employ one of the advanced parameterizations of the land surface coupled into the general circulation model, and develop and validate those components of the atmospheric model, such as the surface radiative forcing, regional precipitation patterns, and the diurnal cycle within the planetary boundary layer, that are most important for deriving land surface processes. (Author's abstract)
W91-02804

MODELING TRANSIENT SUBSTRATE LOADS IN COMPLETELY MIXED AERATION BASINS AT HYDRAULIC STEADY STATE.
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W91-02822

RELIABILITY ESTIMATION IN MODELING WATERSHED RUNOFF WITH UNCERTAINTIES.
Rutgers - The State Univ., Piscataway, NJ. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W91-02858

AQUIFER THERMAL ENERGY STORAGE: A NUMERICAL SIMULATION OF FIELD EXPERIMENTS IN CHINA.
Nanjing Univ. (China). Dept. of Earth Sciences.
For primary bibliographic entry see Field 4B.
W91-02866

SOME ANOMALOUS FEATURES OF FLOW AND SOLUTE TRANSPORT ARISING FROM FRACTURE APERTURE VARIABILITY.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2F.
W91-02867

IDENTIFICATION OF LARGE-SCALE SPATIAL TRENDS IN HYDROLOGIC DATA.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
H. Rajaram, and D. McLaughlin.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2411-2423, October 1990. 7 fig, 2 tab, 36 ref. National Science Foundation Grants No. ECE-8514987 and 88-14615-CES.

Descriptors: *Hydrologic data, *Hydrologic properties, *Model studies, *Spatial distribution, *Statistical analysis, *Trend analysis, Algorithms, Estimating, Hydraulic conductivity, Hydrologic models, Scale factors.

Distinguishing different scales of variability in hydrologic properties such as hydraulic conductivity is often useful. In the simplest two-scale case, large-scale variations can be viewed as a trend, while small-scale fluctuations about this trend can be viewed as a random residual. This paper describes a method for estimating spatial trends from scattered field measurements. The basic concept is to treat both the trend and the residual as stationary random functions. these functions are distinguished by their spatial spectral (or covariance) properties, which may be estimated from available data or hypothesized. Two versions exist of a general algorithm for estimating spatial trends: (1) a discrete version which is useful in practical applications where data are limited and irregularly spaced and (2) a continuous version which can be used to study the effects of using incorrect spectral parameters. Applications of the discrete algorithm to both synthetically generated data and field measurements yield satisfactory trend estimates. An analysis based on the continuous algorithm shows that the estimation error lower bound for these applications depends on two dimensionless ratios, that is, the scale disparity (ratio of the trend and residual correlation scales) and the signal-to-noise ratio (ratio of the trend and residual variances). These ratios may be used to evaluate the feasibility of trend estimation before field samples are actually collected. Multiscale approaches to modeling and data collection can provide a practical and very flexible way to deal with natural variability. (Author's abstract)
W91-02870

SOLUTION OF A NONLINEAR ABSORPTION MODEL OF MIXED SATURATED-UNSATURATED FLOW.
La Trobe Univ., Bundoora (Australia). Dept. of Mathematics.
For primary bibliographic entry see Field 2G.
W91-02872

MODELING INFILTRATION INTO A SEALING SOIL.
Texas Agricultural Experiment Station, Lubbock.
For primary bibliographic entry see Field 2G.
W91-02878

COUPLED INVERSE PROBLEMS IN GROUNDWATER MODELING: 1. SENSITIVITY ANALYSIS AND PARAMETER IDENTIFICATION.
California Univ., Los Angeles. Dept. of Civil Engineering.
N. Z. Sun, and W. W. G. Yeh.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2507-2525, October 1990. 3 fig, 11 ref, 54 ref, 3 append. National Science Foundation Grant No. 8814888.

Descriptors: *Groundwater, *Groundwater movement, *Hydrological models, *Mathematical models, *Parameter estimation, *Sensitivity analysis, Experimental design, Hydraulic conductivity, Optimization, Parameterization, Solutes.

Because there are crossover effects between state variables and parameters, coupled inverse problems are different from single inverse problems in several aspects, especially in the selection of objective functions, identifiability, and experimental design. Parameter identification of coupled problems in groundwater modeling is defined as a vector optimization problem which can be solved by the weighting method. In order to obtain gradient vectors of objective functions as well as all sensitivity coefficients, the adjoint state method is extended to the case of coupled problems. Using derived rules, the adjoint equations of any nonlinear and transient coupled problem can be obtained. Sensitivity analyses based on the adjoint method are powerful tools for designing a reasonable experiment for solving the coupled inverse problem. The fact that hydraulic conductivities can be identified through the observation of solute concentration shows the possibility of using crossover effects in the solution of coupled inverse problems. (See also W91-02880) (Brunone-PTT)
W91-02879

COUPLED INVERSE PROBLEMS IN GROUNDWATER MODELING: 2. IDENTIFIABILITY AND EXPERIMENTAL DESIGN.
California Univ., Los Angeles. Dept. of Civil Engineering.
N. Z. SUn, and W. W. G. Yeh.
Water Resources Research WRERAQ, Vol. 26, No. 10, p 2527-2540, October 1990. 9 fig, 10 tab, 25 ref, append. National Science Foundation Grant No. CES 8814888.

Descriptors: *Experimental design, *Groundwater models, *Groundwater movement, *Hydrologic models, *Mathematical models, Estimating, Parameterization, Parameters, Resource management.

Three new definitions of extended identifiability for a distributed parameter system are presented: interval identifiability, prediction equivalence identifiability, and management equivalence identifiability. The uniqueness requirement of the inverse solution is relaxed by these definitions. An identified parameter is considered extendedly identifiable if it is able to satisfy an accuracy requirement in a specific application of the model. When a generalized least squares norm is used, the proposed identifiabilities are applicable to any coupled problems in which the state variables and parameters may have different order of magnitudes. A salient feature of the new definitions is that the extended identifiabilities are closely related to experimental design. Consequently, the sufficiency of an experimental design for assuring a given level of an extended identifiability can be estimated prior to field experiments. The methodology developed, linking experimental design, parameter identification, and management decisions can be used to determine the reliability of an experimental design even for nonlinear models. (See also W91-02879) (Author's abstract)
W91-02880

APPLICATION OF THE ARNOLDI ALGORITHM TO THE SOLUTION OF THE ADVECTION-DISPERSION EQUATION.
Manitoba Univ., Winnipeg. Dept. of Geological Engineering.
For primary bibliographic entry see Field 5B.
W91-02883

GAMMA-AUTOREGRESSIVE MODELS FOR STREAM-FLOW SIMULATION.
Pontificia Univ. Catolica de Chile, Santiago. Dept. of Hydraulic Engineering.
For primary bibliographic entry see Field 2E.
W91-02922

HYDROGEOLOGIC ASSESSMENT OF EXPOSURE TO SOLVENT-CONTAMINATED DRINKING WATER: PREGNANCY OUTCOMES IN RELATION TO EXPOSURE.
California Univ., San Francisco. Dept. of Epidemiology and Biostatistics.
For primary bibliographic entry see Field 5C.
W91-02935

DECONTAMINATION TECHNOLOGIES FOR RELEASE FROM BIOPROCESSING FACILITIES: PART VI. VERIFICATION OF WASTEWATER DECONTAMINATION.
Battelle Memorial Inst., Columbus, OH. Environmental Science Dept.
For primary bibliographic entry see Field 5D.
W91-02937

8. ENGINEERING WORKS

8A. Structures

ATATURK NEARS COMPLETION.
9 Eylul Univ., Izmir (Turkey).
U. Ozis, E. Basmaci, and N. Harmancioglu.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 9, p 12-16, September 1990. 10 fig, 21 ref.

Descriptors: *Dam construction, *Dams, *Hydroelectric plants, *Hydroelectric power, *Rockfill dams, Ataturk Dam, Embankments, Euphrates River, Hydrology, Spillways, Turkey, Water resources development.

The 184 m-high Ataturk rockfill dam is now almost complete. Impounding began in January 1990 and the first 300 megaWatt (MW) unit of the powerplant will go into operation in 1991. The last of the eight units is expected to begin operation before the end of 1993. The drainage area of the Euphrates at the Ataturk dam site is 92,338 sq km and the mean flow is estimated to be in the order of 830 cu m/s. The diversion of the Euphrates River during construction of the dam was accomplished by upstream and downstream cofferdams and three tunnels through the left bank. An overflow spillway of 16,800 cu m/s capacity has been constructed. The embankment volume of 84.5 million cu m and reservoir volume of 48.5 cu km make Ataturk the largest dam in Turkey. The rockfill dam has a central clay core and a height of 184 m. The unit capacity is 300 MW; the scheme's total capacity of 2400 MW and energy generation of 8.9 TWh/year make it the largest hydroelectric plant in Turkey. (MacKeen-PTT)
W91-02111

SIR DAM AND POWERPLANT.
9 Eylul Univ., Izmir (Turkey).
U. Ozis, H. Yanar, and M. Erdem.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 9, p 17-18,20-21, September 1990. 6 fig, 10 ref.

Descriptors: *Arch dams, *Concrete dams, *Dam construction, *Dams, *Hydroelectric plants, *Hydroelectric power, Ceyan River, Embankments, Hydrology, Sir Dam, Spillways, Turkey, Water resources development.

Sir dam, Turkey's third double curvature arch dam, is almost completed. The drainage area of the Ceyan River at the dam site is 12,950 sq km and the mean flow is estimated to be 130 cu m/s. The reservoir has a gross storage of 1.12 cu km and an active storage of 0.72 cu m. Diversion during construction was accomplished by the upstream and downstream cofferdams and a tunnel through the left bank. An overflow spillway has a capacity of 7460 cu m/s. The 120-m high double curvature concrete arch dam has a crest length of 325 m and a thickness of 5 m at the crest, 17.5 m at the foundation, and up to 25 m at the abutments. There are three intakes in the dam body, each serving a separate 66-m long penstock. The 55-m high powerhouse is designed for three 96.5 megaWatt units with an annual average generation capacity of 725 GWh/year. Impoundment began on 31 May 1990, and the first unit is expected to begin operation early in 1991. (MacKeen-PTT)
W91-02112

ADVANTAGES OF TURNKEY CONTRACTS IN HYDRO DEVELOPMENT.
P. Johannesson.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 9, p 29-30, 32, 35-38, September 1990. 14 fig, 10 tab, 4 ref.

Descriptors: *Contracts, *Cost analysis, *Dam construction, *Dams, *Hydroelectric plants, *Water resources development, California, Construction costs, Costs, Hydroelectric power, North Fork Stanislaus River Hydroelectric, Optimum development plans, Project planning, Sierra Nevada Mountains, Turnkey operations.

The Calaveras project, known formally as the North Fork Stanislaus River Hydroelectric Development Project, is in the Sierra Nevada Mountains, about 320 km east of San Francisco. It is a complex project involving seven tunnels (18 km total length), a 790 m shaft, two concrete gravity dams, one concrete-faced rockfill dam, one double curvature thin arch dam and two powerhouses. It was developed as a turnkey arrangement with Sierra Constructors as the contractor. Challenges at the bidding stage of the project included: increased concrete volume required at North Fork diversion dam; unfavorable rock foundation profile at saddle dam site; discovery of faults at saddle and main dam sites; lack of exploration at Beaver Creek dam, tunnel and penstock area; foundation problems at McKay's dam site; and problems drilling the Collierville shaft. It took the owner 20 years and about $16 million to obtain the FERC license, purchase the right-of-way, settle mitigation issues with Fish and Game and school recreational groups, and pay for legal services, engineering and environmental studies. The most unusual aspect of this turnkey project was the bidding phase, accomplished in only 6 mo. Construction time was fixed at 5 yr. A 2.5 yr time savings was realized, compared with estimates for conventional project development. Compared with conventional development costs, savings for turnkey development of Calaveras were $23.5 million in interest payments, $16.5 million for 2.5 yr early commissioning, and $89.2 million in construction costs. The total savings was about $120 million. (MacKeen-PTT)
W91-02114

USE OF THE GOULD PROBABILITY MATRIX METHOD OF RESERVOIR DESIGN IN ARID AND SEMI-ARID REGIONS.
Institute of Hydrology, Wallingford (England).
Y. P. Parks, F. A. K. Farquharson, and D. T. Plinston.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. Inter-

national Water Resources Association, Urbana, Illinois. 1990. p 233-241, 3 fig, 1 ref.

Descriptors: *Arid lands, *Botswana, *Reservoir capacity, *Reservoir design, *Semiarid lands, *Streamflow forecasting, Design criteria, Gabarone Reservoir, Gould matrix method, Probability, Reservoir storage, Reservoir yield, Simulation.

Many methods are available for reservoir storage-yield design, but they rely on long inflow sequences that are often scarce in arid and semi-arid regions. The Gould matrix method provides a technique that defines probability of failure and spill under specified withdrawal policies. The method does have some limitations, but it can provide much more sophisticated information that other commonly used techniques. In the case of the Gabarone (Botswana) reservoir, results employing the Gould matrix method show that if the reservoir is currently in a low zone at the start of the year, the likelihood of failure in the first few years is very high. As the initial reservoir water level increases, the short-term likelihood of failure is reduced. If the reservoir is at least half full, the probability of failure in the next few years progresses from zero to nearly 5%. It is possible to introduce rationing into the Gould procedure as part of the water balance. The results of five simulations based on an example from Great Britain show a decreasing yield as the probability of rationing increases with increase in return period of total failure. The same approach can be used to investigate the relationship between the return period of total failure with and without rationing, but with the same yield. (See also W91-02288) (Rochester-PTT)
W91-02306

HYDROLOGIC DESIGN AND DEVELOPMENT OF HYDRAULIC STRUCTURES.
Dar es Salaam Univ. (Tanzania).
J. I. Matondo, and D. G. Fontane.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 306-319, 6 fig.

Descriptors: *Africa, *Dam design, *Design criteria, *Hydraulic engineering, *Semiarid lands, *Storage reservoirs, *Water storage, Arid lands, Data collections, Developing countries, Hydraulic design, Sediment control, Sensitivity analysis, Simulation, Water resources management.

In semi-arid areas the design of adequate water storage structures and distribution systems (i.e., small earth dams) is essential to deal with present and future water resources problems. Hydrologic data are lacking in most developing countries in the arid and semi-arid regions of Africa. Techniques used in the design of hydraulic structures when data are inadequate include sensitivity analysis with design simulation models, transfer of existing data from other locations, and synthetic generation of data based on watershed characteristics. Because sediment trapped in reservoirs ultimately reduces their effectiveness, sediment control measures must be included in the design of dams and water diversion structures. Various sediment exclusion and ejection techniques exist (e.g., settling basins, guide walls and channel curvature, vortex tube, guide vanes, tunnel excluders, combination sluice tunnel-settling basin excluder, combined weeving weir and silt ejector, and combined tunnel-sluice vane ejector). Because economic difficulties exist in most countries in Africa, water resources projects must be planned and developed according to projected water needs. Techniques for optimal scheduling of projects have been developed. There is no substitute for collection of hydrology data. (See also W91-02288) (Author's abstract)
W91-02312

INTERFLUX DAMS: THEIR ADVANTAGE FOR SAHARAN AND SAHELIAN AFRICA (LES BARRAGES D'INFEROFLUX: LEUR INTERET POUR L'AFRIQUE SAHARIENNE ET SAHELIENNE).
Centre Univ. d'Avignon (France). Faculte des Sciences.
R. Guiraud.
IN: The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. 1990. p 320-329, 4 fig, 18 ref. English summary.

Descriptors: *Africa, *Arid lands, *Dam design, *Interflux dams, *Sahara, *Sahel, Alluvial fans, Climates, Design criteria, Developing countries, Groundwater recharge, Rural areas, Water resources development.

Interflux dams and several related topics are discussed. First, the principle of subsurface dams and their advantages for improving water resources and quality are described. Mechanisms of the deposition and the preservation of alluvial fan deposits are discussed for both exorheic and endorheic basins. Climate variation and glacio-eustatic phenomena dominated these processes over the past 20,000 yr. Underflow and its exploitation in arid regions are discussed and examples analyzed from the Sahel, northern Africa, East Africa, and southern Africa. It is concluded that numerous small dams can be constructed in the Saharan and Sahelian regions that will allow both the accumulation of underground reserves and their recharge. Increasing such dams would help to maintain rural settlement. (See also W91-02288) (Author's abstract)
W91-02313

PULSA SOLAR: SOLAR WATER OSCILLATION PUMPS FOR VILLAGE HYDRAULICS.
Fluxinos Italia S.R.L., Grosseto.
For primary bibliographic entry see Field 5F.
W91-02347

SCIENTIFIC AND TECHNICAL EVALUATION OF MATHEMATICAL MODELS IN THE PLANNING DESIGN AND OPERATION OF HYDROSYSTEMS IN AFRICA.
New Tech International Inst., Dar es Salaam (Tanzania).
For primary bibliographic entry see Field 2E.
W91-02350

WATER RESOURCES MANAGEMENT IN NIGERIA: THE RIVER BASIN APPROACH.
Ibadan Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 4A.
W91-02357

ENVIRONMENTAL AND AGRICULTURAL IMPLICATIONS OF DAM CONSTRUCTION IN THE NIGER VALLEY OF MALI.
Gesamthochschule Paderborn (Germany, F.R.).
For primary bibliographic entry see Field 6G.
W91-02359

IMPACT OF HYDROLOGY ON HYDRAULIC PROJECTS IN BURKINA (IMPACT DE L'HYDROLOGIE SUR LES PROJETS HYDRAULIQUES AU BURKINA).
Ministry of Water Resources, Ouagadougou (Burkina Faso). Service de l'Hydrologie.
For primary bibliographic entry see Field 6G.
W91-02360

SLIPLINING RESCUES SEWERS AND A SMALL BUDGET.
L. C. Green, and J. Douglas.
Public Works PUWOAH, Vol. 121, No. 10, p 104-105, September 1990. 1 fig.

Descriptors: *Conveyance structures, *Economic aspects, *Pipes, *Rehabilitation, *Sewer systems, Cost analysis, Costs, Pipelines, Sewers, South Carolina, Water conveyance.

Winnsboro, South Carolina sewer system serves 4,000 customers in the town, plus an additional 8,000 customers in surrounding Fairfield County. The sewer system, originally installed in the early 1930s, was showing signs of aging. The major problem was tree roots forcing their way into joints and cracks, causing more cracks, allowing excessive sand and stormwater to seep into the system. Trenchless sewer rehabilitation technology involving insertion lining of the sewers, also called sliplining, allowed the town to repair its sewer system on a very limited budget. Sliplining increased the sewer strength because liners withstand temperatures up to 250 F, most chemicals and acids, and cannot be penetrated by roots. A service life of 50-100 years and low maintenance due to smooth plastic walls which require less cleaning, routing, and other work will provide long-term financial savings. Few traffic disruptions were necessary during installation because the sliplining used lines already in place. To date, the project saved the town more than $300,000 over pipe replacement costs. The biggest savings will be time saved that would otherwise have been used to maintain and service the old system. (Mertz-PTT)
W91-02424

STUDY OF EMBANKMENT PERFORMANCE DURING OVERTOPPING AND THROUGHFLOW. REPORT 1: FEASIBILITY STUDY.
Colorado Univ., Boulder.
H.Y. Ko, R. J. Dunn, and E. Simantob.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A207755. Price codes: A05 in paper copy, A01 in microfiche. Miscellaneous Paper GL-89-5, April 1989. Report 1 of a Series. 76 p, 5 fig, 3 ref. Contract No. DACW39-83-C-0011.

Descriptors: *Embankments, *Flow profiles, *Model studies, *Overtopping, Banks, Clays, Dam failure, Data acquisition, Earth dams, Erosion, Hydrologic models, Performance evaluation, Photography.

Overtopping of earth dams and embankments has resulted in great damage to property and facilities, and in some cases loss of life as well. Due to the large costs and possible consequences of full-scale overtopping studies and the limited accuracy of reduced scale model testing at natural gravity levels, testing of models in a centrifuge at increased gravity levels seems to be a suitable method for studying overtopping and erosion of earth embankments. Tests on model earth and crushed rock embankments using the University of Colorado Geotechnical Centrifuge have indicated the feasibility of this method of testing. Failure modes in the models agreed well with those observed in actual overtopping events. In crushed rock embankment erosion began at the toe and progressed rapidly upstream, eventually leading to breaching failure of embankments. In clay embankments, erosion occurred over the entire downslope area below the spillway crest, with no breaching of the crest occurring for the duration of overtopping flow utilized in the tests. Embankment erosion in flight was recorded using a closed circuit video camera and video tape and a pair of 35 mm SLR cameras, mounted to produce stereo pair photos of the embankment. Contour maps of the embankment surface were produced from the stereo pairs. Photographic records were verified by manual measurements of the eroded surface. (See also W91-02608 and W91-02610) (Author's abstract)
W91-02603

HYDRAULIC FRACTURE IN EARTH AND ROCK-FILL DAMS.
University of Western Ontario, London. Faculty of Engineering Science.
K. Y. Lo, and K. Kaniaru.
Canadian Geotechnical Journal CGJOAH, Vol. 27, No. 4, p 496-506, August 1990. 13 fig, 1 tab, 20 ref. Natural Sciences and Engineering Research Council of Canada Grant No. OGP0007745.

Descriptors: *Dam failure, *Dam foundations, *Hydraulic fracturing, *Mathematical models, *Model studies, *Seepage, Consolidation, Saturation, Soil strength.

Unsatisfactory performance of earth and rock-fill dams involving excessive seepage, piping or failure has been attributed to hydrofracture of the core. Although the phenomenon has been reported for some time, important factors influencing hydraulic fracturing pressure, such as saturation and consolidation, have received relatively little attention; nor have results of laboratory tests or theoretical study been directly related to field performance. A laboratory testing program was made to determine the hydraulic fracturing pressure on compacted soil samples with grain-size distributions similar to those of the core materials used in construction of the dams in the case records. A simple theoretical expression for fracture pressure was developed involving only conventional soil strength parameters. The results showed that hydraulic fracture pressure is not a unique soil property; its value depends on the degree of saturation and consolidation. A comparison of the data deduced from case records with test results and theoretical predictions indicates general consistency. The field hydraulic fracturing pressures are bounded in the upper limit by results from saturated-consolidated tests and in the lower limit by results of saturated-unconsolidated hydraulic fracturing tests. The methodology presented may be useful in the assessment of risk of hydraulic fracturing of dams. (Author's abstract)
W91-02942

8B. Hydraulics

CHANGES IN SEASONAL SUCCESSION OF PHYTOPLANKTON INDUCED BY THE STORM-SURGE BARRIER IN THE OOSTERSCHELDE (S.W. NETHERLANDS).
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2L.
W91-02116

ENERGY RELATIONS IN TRANSIENT CLOSED-CONDUIT FLOW.
Toronto Univ. (Ontario). Dept. of Civil Engineering.
B. W. Karney.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 10, p 1180-1196, October 1990. 6 fig, 11 ref.

Descriptors: *Closed-conduit flow, *Energy conversion, *Flow rates, *Hydraulic properties, *Pipe flow, *Pipelines, *Unsteady flow, Compressibility, Elasticity, Energy, Flow models, Friction, Kinetic energy, Mathematical analysis, Mathematical equations.

When the rate of flow in a closed conduit is changed, large scale conversions of mechanical energy often occur, particularly if the pipeline is carrying water or some other slightly compressible liquid. Mathematical expressions describing these transient energy transformations are motivated from first principles and derived by mathematical manipulation of the governing continuity and momentum equations. The resulting expression accounts for the kinetic energy of the fluid, the internal energy associated with fluid compressibility and pipeline elasticity effects, the energy dissipated by friction, and the work done at the ends of the conduit. The energy approach provides an integrated view of transient conditions in the pipeline and is thus a simple, efficient, and logically consistent way of comparing the transient response of different systems and solution techniques. In particular, compressibility effects are shown to be negligible when the ratio of the change in internal energy to the change in kinetic energy is much less than one. This rule helps to distinguish the 'rigid water column' model of unsteady flow from the more complex water-hammer theory. (Author's abstract)
W91-02522

CONTROLLING MECHANISM OF LOCAL SCOURING.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering.
For primary bibliographic entry see Field 2J.
W91-02523

STUDY OF EMBANKMENT PERFORMANCE DURING OVERTOPPING AND THROUGH-FLOW. REPORT 1: FEASIBILITY STUDY.
Colorado Univ., Boulder.
For primary bibliographic entry see Field 8A.
W91-02603

NEW MADRID PUMPING STATION GRAVITY FLOW CONDUIT AND CONFLUENCE, NEW MADRID FLOODWAY, MISSOURI: HYDRAULIC MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. R. Leech.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report No. HL-90-12, September 1990. 112 p, 9 fig, 72 plates, 15 photos.

Descriptors: *Conduits, *Gravity flow, *Hydraulic models, *New Madrid Pumping Station, Channel flow, Channels, Hydraulic structures, Missouri, Pumping plants.

Site-specific hydraulic model studies of hydraulic structures and channels on the New Madrid Floodway, Missouri, were conducted to give three dimensional analyses of the open channels, to provide design information, and to minimize prototype cost. The proposed pumping station on the New Madrid Floodway consisted of a draft tube-type sump design, referred to as a formed suction inlet (FSI). The FSI has an advantage over conventional rectangular sumps by having a constantly decreasing cross-sectional area, which causes the flow to accelerate, eliminating vortices caused by geometry. A satisfactory FSI was developed by adding a cone section to the throat, which improved the dimensionless velocity contours. The riprap protection was found to be stable except for the area adjacent to the opening of the gravity flow intake. A plan was developed to correct the instability by replacing the original drop structure in the model, located at the confluence of the two channels, by a rip-rap lined channel, which provided satisfactory performance for all conditions tested. (Author's abstract)
W91-02605

YAZOO BACKWATER PUMPING STATION SUMP, WEST-CENTRAL MISSISSIPPI: HYDRAULIC MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Div.
B. P. Fletcher.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report No. HL-90-8, August 1990. 124 p, 9 fig, 2 tab, 83 plates, 2 photos.

Descriptors: *Hydraulic models, *Pumping plants, *Sumps, *Yazoo Backwater Pumping Station, Channel flow, Channels, Flow profiles, Hydraulic profiles, Hydraulic structures, Mississippi, Model studies, Vortices.

Numerical and physical hydraulic model tests were conducted to investigate the hydraulic performance of the Yazoo Backwater Pumping Station approach channel, sump abutments, and sump. The numerical model was used as a tool for evaluating and screening various approach channel designs prior to testing in the physical models. Physical model tests were conducted in a 1:12.5-scale section model and a 1:26-scale comprehensive model. A variety of operating conditions with various water surface elevations were evaluated. In the section model, tests indicated that the intensity of the floor vortices increased as the suction bell moved closer to the floor. Various configurations of approach training walls were evaluated in the section model. In the 1:26-scale model, comprehensive tests were initially conducted to investigate hydraulic performance in a 15-pump, 17,500-cfs-capacity pumping station. Asymmetrical pump operation generated lateral approaches in the approach channel, which generated an adverse flow distribution in the pump bays. Tests indicated that a streamlined pump intake design compensated for adverse flows in the approach. At the request of the US Army Engineer District, Vicksburg, the capacity of the pumping station was reduced from a 17,500 to a 10,000 cfs station. Tests were conducted to refine the design of the streamlined sump by investigating various pump bay widths. Test results indicated that the pump bay widths could be reduced from 28 to 23 ft if vortex suppressor beams were installed in the pump bays. The adopted design developed from the model study should provide satisfactory hydraulic performance for anticipated flow conditions. (Author's abstract)
W91-02606

STUDY OF EMBANKMENT PERFORMANCE DURING OVERTOPPING AND THROUGH-FLOW. REPORT 2: HYDRAULIC STUDY AND MODELING OF MODELS.
Colorado Univ., Boulder.
H. Y. Ko, J. Dunn, and E. Simantob.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A207756. Price codes: A04 in paper copy, A01 in microfiche. Miscellaneous Paper GL-89-5, April 1989. Report 2 of a Series. 65 p, 5 fig, 5 tab, 3 ref. DOA Contract DACW39-83-C-0011.

Descriptors: *Embankments, *Erosion, *Model studies, *Overtopping, Earth dams, Flow velocity, Hydraulic models, Performance evaluation.

An experimental program involving three rigid and three erodible model embankments is described. The rigid embankments are constructed of aluminum and are used to evaluate flow quantity, measure resulting water velocities, and perform a model study. Erodible embankment models were constructed of characteristic soils and were used to evaluate and document erosion in the scale models. The three scaling ratios used during this study were 1:24 scale, 1:49 scale, and 1:71 scale for both the rigid and erodible embankments. The system which delivered the overtopping water to the model is described along with other details of the centrifuge equipment, specimen preparation and testing techniques. A total of seven tests were performed during which erosion rates were documented and time scaling factors determined. This study confirmed that model behavior duplicated field behavior at least qualitatively in that erosion (as the result of overtopping) begins at the toe of the slope of an embankment then progresses upslope and through the crest as complete breach is observed. (See also W91-02603 and W91-02610) (Author's abstract)
W91-02608

STUDY OF EMBANKMENT PERFORMANCE DURING OVERTOPPING AND THROUGH-FLOW. REPORT 3: MODEL-PROTOTYPE COMPARISON STUDIES.
Colorado Univ., Boulder.
H. Y. Ko, R. J. Dunn, and T. Hollingsworth.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A207954. Price codes: A05 in paper copy, A01 in microfiche. Miscellaneous Paper GL-89-5, April 1989. Report 3 of a Series. 81 p, 39 fig, 3 ref, append. DOA Contract DACW39-83-C-0011.

Descriptors: *Embankments, *Erosion, *Model studies, *Overtopping, *Soil properties, Cohesive soils, Dam failure, Earth dams, Flow velocity, Hydraulic models, Performance evaluation.

An attempt was made to model two well documented embankment overtoppings: the Clarence Cannon and Bloomington Lake overtopping failures. The results of modeling in two dimensions versus modeling in three dimensions were investigated, along with a study of the effects of nonhomogeneous embankment cross sections on erosion. Centrifuge modeling of Clarence Cannon and Bloomington Lake overtopping events consisted of four tests each at 1:80 full scale. Materials used were fairly noncohesive and cohesive soils in an attempt to bracket prototype behavior rather than to duplicate a precise event. During testing, the centrifuge was repeatedly started and stopped in

order to take measurements of erosion resulting from overtopping. Agreement between scale models and documented prototype behavior was not especially good, but the study did confirm that noncohesive soils are considerably more erodible than cohesive materials in terms of their ability to withstand extended periods of overtopping without destruction. The attempt to evaluate the appropriateness of two-dimensional versus three-dimensional embankment modeling was inconclusive because of the interaction of the two dimensional models with the boundaries. The study did confirm that zoned embankment structures, once compromised, are much more erodible and susceptible to destruction than homogeneous structures. (See W91-02603 and W91-02608) (Author's abstract)
W91-02610

PLIT OF TWO-PHASE FLOW AT A HORI-ONTAL T-ANNULAR AND STRATIFIED LOW.
'KAEA Atomic Energy Research Establishment, arwell (England). Thermal Hydraulics Div.
. J. Azzopardi, D. Wagstaff, L. Patrick, S. B. lemory, and J. Dowling.
eport AERE R13059, May 1988. 56 p. 22 fig, 4 b, 22 ref.

escriptors: *Annular flow, *Hydraulic profiles, Pipe flow, *Stratified flow, Flow profiles, Hydraulics, Pressure, Split flow.

xperiments were carried out for wavy-stratified d annular flows approaching a horizontal T-nction, as well as flows at the boundary between ese two patterns. Data were obtained over an tire range of gas take-off pressures through the le arm. The effects of side arm diameter, system essure and gas momentum were studied system-cally, in addition to visualization experiments nich were carried out as the junction was viewed om several directions simultaneously. The data ere used to test some predictive methods. Study nclusions are that: (1) data on the flow split of nular and stratified flow by a horizontal junction ow regular and systematic trends; (2) the flow it depends strongly on the inertia (or momen-n) of the phases; and (3) the flow split is effected gas flow rate, liquid flow rate, gas density and ratio of the side arm to main tube diameter. antz-PTT)
91-02613

VIRONMENTAL RIVER ENGINEERING.
iversity of East Anglia, Norwich (England). hool of Environmental Sciences.
r primary bibliographic entry see Field 4A.
91-02845

EAD LOSSES IN STORM SEWER MAN-OLES: SUBMERGED JET THEORY.
chnical Univ. of Denmark, Lyngby. Inst. of drodynamics and Hydraulic Engineering.
B. Pedersen, and O. Mark.
rnal of Hydraulic Engineering (ASCE) ENDS, Vol. 116, No. 11, p 1317-1328, November 1990. 9 fig, 6 ref.

scriptors: *Head loss, *Hydraulic engineering, wer systems, *Storm sewers, *Submerged jets, , Manholes, Mathematical analysis, Pipes, Pres-e head.

e design of storm sewers especially suffers from k of knowledge of the head losses in manholes. ubmerged jet theory for the flow in manholes h straight throughflow has been developed. e entrance head loss is related to the kinetic rgy transformation associated with the entrain-t/detrainment in the jet. The exit head loss is culated as a Carnot-loss in connection with the a contracta in the exit pipe. The jet theory and eriments show that the only governing parame-for a specific manhole shape is the ratio of hole diameter to pipe diameter. The theory has n compared to laboratory experiments. The d loss in storm sewer manholes was shown to considerably smaller than the values calculated raditional formulas. (Author's abstract)
1-02916

EXPLICIT CALCULATION OF PIPE-NETWORK PARAMETERS.
Kentucky Univ., Lexington. Dept. of Civil Engineering.
P. F. Boulos, and D. J. Wood.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 11, p 1329-1344, November 1990. 2 fig, 8 tab, 10 ref, 3 append. National Science Foundation grant ECE-861205.

Descriptors: *Hydraulic engineering, *Network design, *Pipe flow, *Pipes, *Steady flow, Algorithms, Calibrations, Mathematical equations, Numerical analysis, Water pressure.

An iterative solution of the full set of continuity and energy equations provides a powerful technique for the determination of steady-state pressure and flow conditions in pipe networks. An explicit algorithm is presented for directly determining a variety of design, operating, and calibration parameters for pipe networks. The problem solution is based on the reformulation of the steady-state network equilibrium equations in terms of specified pipe-system parameters. Since these equations are nonlinear, the incremental Newton-Raphson method is used as the basic solution procedure. A continuous variable space is assumed for the various parameters, which are selected to exactly satisfy stated pressure and flow requirements at critical nodes and pipes throughout the pipeline systems for a range of operating conditions. This approach offers a basis for determining the optimum values for the various design, operating, and calibration parameters in the sense that the parameters can be calculated to exactly meet the specified pressure and flow constraints. All types of pipe distribution systems can be considered. The solution space is secured through a well-arranged interaction between network topology, boundary constraints, and network parameters. The feasibility and flexibility of the proposed approach were demonstrated successfully using an example network. (Author's abstract)
W91-02917

MODELING CHANNEL BED TRANSIENTS USING EXPLICIT F-D SCHEMES.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-02918

RESISTANCE TO FLOW IN STEEP ROUGH STREAMS.
Universidad de Los Andes, Merida (Venezuela). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-02920

FIRST STEP AWAY FROM LACEY'S REGIME EQUATIONS.
M. A. Stevens, and C. F. Nordin.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 11, p 1422-1425, November 1990. 1 fig, 1 tab, 9 ref.

Descriptors: *Alluvial channels, *Canal design, *Channel morphology, *Hydraulic engineering, *Mathematical equations, *Sediment transport, Channel flow, Regime channels, River mechanics, Stable channels.

The problem of designing stable canals is in determining what nature would choose for the width, depth, and bed slope of the channel to convey both water and sediment from one point to another if the water and sediment are to flow in a self-formed alluvial channel, when the design discharge and an accompanying sediment concentration of known size are given. Lacey's regime equations explicitly address all issues except rate of sediment transport. The substitution of the sediment concentration in place of Lacey's silt factor is a simple improvement to Lacey's equations because it is a first step toward reformulating the design equations more rigorously on the basis of conservation laws and Newton's laws of motion. As with Lacey's equations, the new set has very limited application. They are for 0.1-0.3-sand; concentrations are less than 100 mg/L; the velocity should be within 0.5-2.5 ft/sec (0.14-0.75 m/s); and the bank material must have enough strength to resist erosion by these velocities. For conditions outside these limitations, another set of regime equations must be developed. (Fish-PTT)
W91-02924

8C. Hydraulic Machinery

DEVELOPMENT OF TURKEY'S ELECTRIC ENERGY.
State Hydraulic Works, Ankara (Turkey).
F. Anik.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 9, p 9-10, September 1990. 1 fig, 6 tab.

Descriptors: *Electric power production, *Hydroelectric plants, *Hydroelectric power, *Turkey, *Water resources development, Administrative agencies, Electric power demand, Future planning, Privatization.

Turkey has 4200 megaWatts (MW) of hydroelectric power presently under construction, and a further 6799 MW planned for projects to be implemented after 1991. The State Hydraulic Works (DSI-Devlet Su Isleri) and the Turkish Electricity Authority (TEK-Turkiye Elektrik Kurumu) are the principal organizations which distribute electric energy in Turkey. The DSI was established in 1953 as a public organization for the development of surface water and groundwater resources in Turkey. After construction of a hydroelectric power plant has been completed, operation becomes the responsibility of TEK. Since the government terminated the monopoly in electric power of TEK in 1984, the private sector has been licensed to construct and operate 20 hydro plants with a total installed capacity of 2062 MW. Turkey covers an area of 779,500 sq km and has an estimated average annual runoff of 186 sq km from its 26 river basins. At present 477 hydropower projects, with a total installed capacity of 34,892 MW, have been studied in Turkey either at masterplan level or to the feasibility stage. Of the current total average annual production of 24,293 gigaWatts (GW), 73% is produced at the five largest stations. According to the latest forecast, electric energy generation is likely to increase by 8.5% per year on average until the year 2010. (MacKeen-PTT)
W91-02110

ATATURK NEARS COMPLETION.
9 Eylul Univ., Izmir (Turkey).
For primary bibliographic entry see Field 8A.
W91-02111

SIR DAM AND POWERPLANT.
9 Eylul Univ., Izmir (Turkey).
For primary bibliographic entry see Field 8A.
W91-02112

MONITORING SYSTEM FOR DETECTING MOVEMENTS OF PENSTOCK SUPPORTS.
Waagner-Biro A.G., Graz (Austria). Research and Development Centre.
For primary bibliographic entry see Field 8G.
W91-02113

ADVANTAGES OF TURNKEY CONTRACTS IN HYDRO DEVELOPMENT.
For primary bibliographic entry see Field 8A.
W91-02114

SOVIET DESIGN OF LARGE TURBINES FOR WIDE HEAD RANGES.
V/O Hydroproject, Moscow (USSR).
M. F. Krasilnikov, and V. A. Linyuchev.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 8, p 34-35, 38-39, August 1990. 4 fig, 2 tab.

Descriptors: *Dams, *Hydraulic machinery, *Hydroelectric plants, *Turbines, *USSR, Design cri-

teria, Economic aspects, Hydraulic equipment, Hydraulic structures, Hydraulic turbines, Hydroelectric power.

The staged construction of large scale projects in the USSR can make a substantial contribution to the return on capital investment because of the large amount of extra electricity which can be produced during the initial low-head stage. This poses new challenges for the design of electromechanical equipment to operate over a wide head range. Three types of equipment are used in such cases, selected on the basis of a technical and economical feasibility study for the specific conditions of the project site. A turbine with a wide range of allowable operating heads may be selected (such as a Kaplan, Francis, or Deriaz turbine), temporary runners with an increased specific speed may be installed for the period of operation at low heads, or two-speed generators may be installed. All three of these options have been used successfully for large scale projects in the USSR. Diagonal flow turbines for operation under a wide range of heads have been installed at the Zeya and Kolyma hydropower plants. Temporary runners in Francis turbines have been installed at Nurek and Sayano-Shushensk, and two-speed generators were installed at the Rogun dam project. Although all of these schemes involve some unrecoverable costs, the power generated during the low-head phase will normally justify the additional expense. (Tappert-PTT)
W91-02155

NEW APPROACH TO TURBINE SPEED.
Monenco Consultants Ltd., Montreal (Quebec).
J. L. Gordon.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 8, p 39, 41-43, 46, August 1990. 2 fig, 4 tab, 4 ref.

Descriptors: *Hydraulic machinery, *Hydraulic turbines, *Hydroelectric plants, *Turbines, Estimating equations, Hydraulic equipment, Hydraulic structures, Hydroelectric power.

Current practice in the turbine industry for determination of turbine speed is to develop empirical formulae for each type of turbine, relating specific speed to the net head. Turbine runner speed thus becomes a function of head, diameter, and runner throat velocity. Both the number of runner blades and the runner speed have an influence on the turbine speed. By including the number of runner blades and the type of draft tube, it is possible to develop a more accurate equation for speed, with one equation covering all types of reaction (pit, bulb, Kaplan, propeller, and Francis) turbines. The new equation is based on an analysis of 155 turbine units. By including the number of runner blades or buckets, and a factor for the type of draft tube, accuracy of the equation is within plus or minus 15 per cent for 88 per cent of the units. The database includes turbine heads ranging from 3 m to 500 m, throat diameters from 1 m to 9 m, throat velocities from 6 m/s to 14 m/s, blade numbers from 3 to 19, and runner speeds from 50 to 750 rev/min. With a larger database, including more high head, high speed Francis units, the equation could be refined further to increase accuracy. The new speed equation is not proportional to the square root of flow. (Tappert-PTT)
W91-02156

BEHAVIOUR OF FRANCIS UNITS UNDER PARTIAL LOADS.
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ingenieria.
J. L. Sanchez Bribiesca, R. B. Carmona Paredes, and L. Carmona Paredes.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 8, p 46-47, 49-52, August 1990. 9 fig, 2 tab, 8 ref.

Descriptors: *Hydraulic machinery, *Hydraulic turbines, *Hydroelectric plants, *Mexico, *Turbines, Electrical equipment, Hydraulic equipment, Hydraulic structures, Hydroelectric power, Performance evaluation, Pressure-measuring instruments.

A study of four Mexican powerplants with Francis turbines examined turbine behavior working under partial loads. The study included a literature review, laboratory experiments, and field prototype measurements. Previous studies suggest that because of the forced vortex core precession movement, hydroelectric power systems are subject to the action of pulsating pressures with frequencies from 25 to 50 per cent of the turbine rotational speed. Pressure transducer data collected at four hydroelectric plants identified pressure fluctuations with frequencies of about 25 per cent of the turbine rotational speed when the discharge through the turbines was close to half of the design discharge. When the discharge was in the range of 25 to 35 per cent of the design discharge, and the total head was close to or larger than the design head, higher pressure fluctuations were produced in three of the four plants with frequencies beyond the predicted range. Laboratory data collected from two vortex generators suggested that to attain large head pressure fluctuations it is not sufficient for one of the exciter frequencies to fit with the system main frequency, but it is necessary to get a certain combination of head and discharge acting simultaneously. A simple procedure has been developed, based upon the transfer matrix method, to predict the behavior of hydroelectric machinery under diverse operating conditions. The numerical results are in good agreement with field prototype measurements. (Tappert-PTT)
W91-02157

UPGRADING PROCUREMENT SPECIFICATIONS FOR HYDROELECTRIC MACHINES.
Harza Engineering Co., Chicago, IL.
R. W. Fazalare.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 8, p 54-56, August 1990. 2 fig, 4 ref.

Descriptors: *Hydraulic equipment, *Hydraulic machinery, *Hydroelectric plants, *Mechanical engineering, *Testing procedures, *Turbines, Computer models, Design criteria, Electrical equipment, Finite element method, Hydraulic structures, Hydraulic turbines, Hydroelectric power.

Specifications for large custom-designed hydraulic machines are in urgent need of upgrading. These typically specify the structural integrity around a nominal design stress of the material, and the hydraulic design around laboratory model tests based on similar units. However, advanced tools available today, such as computer-based finite element analysis, fracture mechanics analysis, and computer modeling of flow and dynamic behavior, are considered mandatory in the modern design of custom hydro machines. In view of the lack of formally adopted guidelines these new design techniques should be required in the specifications, with the detailed design criteria to be agreed between the manufacturer and the engineer. The integrated design analysis should include cyclic loading for a 50 year machine life, a finite element analysis of all major components to determine stress level and material requirements, a fracture mechanics analysis of all materials to determine critical size defect and crack growth propagation rate as well as fatigue stress levels, a dynamic vibration analysis determining amplitude and frequency of each major component, a dynamic analysis of the unit's rotating system covering running clearances, bearing spring constants, etc., and a series of computer model simulation flow analyses to optimize the hydraulic design of the turbine runner and the distribution and cascading of flow through the guidevanes, spiral case and draft tube. (Tappert-PTT)
W91-02158

COMPUTER-CONTROLLED WELL FIELD AND DISTRIBUTION SYSTEM.
Browne (Floyd) Associates Ltd., Marion, OH.
For primary bibliographic entry see Field 5F.
W91-02427

NEW MADRID PUMPING STATION GRAVITY FLOW CONDUIT AND CONFLUENCE, NEW MADRID FLOODWAY, MISSOURI: HYDRAULIC MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W91-02605

YAZOO BACKWATER PUMPING STATION SUMP, WEST-CENTRAL MISSISSIPPI: HYDRAULIC MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Div.
For primary bibliographic entry see Field 8B.
W91-02606

TURBINE-INTAKE FISH-DIVERSION SYSTEM.
Iowa Inst. of Hydraulic Research, Iowa City.
For primary bibliographic entry see Field 8I.
W91-02915

8D. Soil Mechanics

FOUNDATION PROBLEMS IN CHAMPLAIN CLAYS DURING DROUGHTS. I: RAINFALL DEFICITS IN MONTREAL (1930-1988).
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
V. Silvestri, M. Soulie, J. Lafleur, G. Sarkis, and N. Bekkouche.
Canadian Geotechnical Journal CGJOAH, Vol. 27, No. 3, p 285-293, June 1990. 6 fig, 3 tab, 36 ref.

Descriptors: *Clays, *Drought effects, *Evapotranspiration potential, *Expansive clays, *Montreal, *Precipitation, *Rainfall, *Soil mechanics, *Soil water, Drought, Evapotranspiration, Foundation failure, Roots, Vegetation effects, Water deficit.

Historically, damage to lightweight buildings in eastern Canada has often resulted from soil volume changes beneath shallow foundations, due to seasonal moisture variation and clay shrinkage caused by tree roots. During the exceptionally dry summer of 1983, extensive settlement problems developed in lightweight buildings founded in the clay deposits of the Montreal area. A modified budget that keeps a running balance of precipitation and potential evapotranspiration (PET) is applied to the region of study to obtain the soil moisture depletion or rainfall deficit throughout the period 1930-1988. Potential evapotranspiration was estimated using the methods of Thornthwaite, Penman, Blaney and Criddle, and Turc. The Blaney and Criddle method provides the highest estimate for PET. Detailed monthly rainfall deficits were calculated using the method of Thornthwaite. Based upon that method, a rainfall deficit of 170 mm/month is proposed as a threshold value. Above this value, foundation problems are likely to occur in the shrinkable eastern Canadian clays. Different limiting values of the rainfall deficit would be calculated by the other three methods. By calculating the rainfall deficit it is possible to predict whether a particular summer will be relatively wet or relatively dry, and take corrective measures if necessary. Because the climatic and soil conditions in Montreal are similar to those in the St. Lawrence Lowlands, it is believed that these findings apply equally well to those regions. (Tappert-PTT)
W91-02147

PORE PRESSURE FIELD BUILT UP IN A RAPIDLY ERODED SOIL MASS.
Basilicata Univ., Potenza (Italy). Ist. di Geologia e Geotecnica.
G. B. Fenelli, and L. Picarelli.
Canadian Geotechnical Journal CGJOAH, Vol. 27, No. 3, p 387-392, June 1990. 11 fig, 10 ref.

Descriptors: *Clays, *Erosion, *Interstitial water, *Landslides, *Model studies, *Pore pressure, *Slope stability, *Soil mechanics, Expansive clays, Italy, Mathematical models, Piezometers, Soils.

Recent investigations indicate a growing interest in the relationship of pore pressure fields and slope stability in clay formations, particularly with respect to delayed failure. A simple one-dimensional

nodel developed to examine the pore pressure esponse of a saturated soil mass of finite thickness, ubject to a constant rate of erosion, suggests that he valley bottom of some American and Canadian ivers could still be subject to vertical swelling eformations from geological erosion. A clay for- nation near the town of Bisaccia in the Italian ppenines provides a test of this model; the valleys re subject to progressive widening due to sliding henomena. Both in situ and laboratory tests were onducted to investigate the subsoil structure, soil roperties, and groundwater regime. Good quality ndisturbed samples have been collected and tested or plasticity, shrinkage limit, compressibility, and welling index. Pore pressure fields were deter- ined by installing a number of Casagrande piezo- eters and vibrating wire piezometric cells. The ata indicate that the superficial debris cover may e considered as a water reservoir characterized y an almost constant piezometric head very close the ground surface. In the underlying clay mate- als, the piezometric head is almost constant with me, and gradually decreases with depth. Exclud- g the presence of a deep draining layer, this nfirms the hypothesis that the present pore pres- re field is a consequence of the still active ero- on phenomena. Application of the one-dimen- onal model to the data obtained in the clay results a model swelling coefficient of 0.03 sq m/yr, nsistent with the laboratory results. (Tappert-TT)
91-02149

BSERVATIONS ON THE DEVELOPMENT F PORE-WATER STRESSES DURING PIE- OCONE PENETRATION IN CLAYS.
ornell Univ., Ithaca, NY. School of Civil and nvironmental Engineering.
or primary bibliographic entry see Field 7B.
91-02938

MULATION OF DOWNHOLE AND CROS- IOLE SEISMIC TESTS ON SAND USING HE HYDRAULIC GRADIENT SIMILITUDE ETHOD.
itish Columbia Univ., Vancouver. Dept. of Civil gineering.
r primary bibliographic entry see Field 7B.
91-02939

OMPRESSIVE STRENGTH BEHAVIOR OF NE-GRAINED FROZEN SOILS.
lgary Univ. (Alberta). Dept. of Civil Engineer-
Wijeweera, and R. C. Joshi.
nadian Geotechnical Journal CGJOAH, Vol. No. 4, p 472-483, August 1990. 14 fig, 4 tab, 18

scriptors: *Compressive strength, *Frozen soils, athematical models, *Soil physical properties, oil strength, *Soil temperature, *Soil texture, oil water, Frozen ground, Particle size, Stress.

nstant strain-rate (0.01/s) uniaxial compression- ngth tests were conducted on more than 200 urated samples of six fine-grained frozen soils at peratures between -5 and -17 C. Saturated soil ples containing total water contents between % and 105% were prepared using a consolida- apparatus specially designed for this purpose. e effect of dry unit weight, total water content, perature, and soil type on the behavior of peak mpressive strength was studied. Test results indi- e the peak compressive strength of fine-grained s was sensitive to changes in the dry unit ght and the total water content. The tempera- e dependence of the peak compressive strength epresented by a simple power law. An empirical nula was developed to predict the peak com- ssive strength of fine-grained frozen soils at a ticular temperature using index properties, spe- c surface area, particle-size distribution, and dry weight. A linear relationship existed between peak compressive stress and the yield stress. wever, more experimental studies are necessary nderstand clearly the compressive-strength be- ior of fine-grained frozen soils with very high unit weights. (Author's abstract)
1-02940

HYDRAULIC FRACTURE IN EARTH AND ROCK-FILL DAMS.
University of Western Ontario, London. Faculty of Engineering Science.
For primary bibliographic entry see Field 8A.
W91-02942

8E. Rock Mechanics and Geology

GEOPHYSICAL INVESTIGATION--SOUTH-WESTERN GREAT ARTESIAN BASIN.
C. D. Cockshell.
Mines and Energy Review South Australia, No. 157, p 62-67, 1990. 7 fig, 5 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Australia, *Geophysical surveys, Aquifers, Bedrock, Confined aquifers, Geohydrology, Geologic formations, Geologic fractures, Great Artesian Basin, Lake Eyre South, Resistivity, Seismic exploration.

Three geophysical surveys near Lake Eyre South, have indicated complex structural controls affecting the Cretaceous-Jurassic aquifer sequence along the southwestern margin of the Great Artesian Basin. Seismic surveys in 1985 and 1987 indicated that northwesterly trending Adelaidean bedrock highs, bounded by a system of northwest-southeast trending faults, extend into the basin. Bedrock shale, siltstone and quartzite are generally impervious except where fractured by faulting and weathering. Over these highs the aquifer sequence can be moderately well developed, but heavily faulted such as between Roxby Management Services Borefield A and its associated 'northeastern sub-basin'. Alternatively, it can be thinly developed, lenticular or absent altogether, such as northeast of the Borefield 'sub-basin' and southwest of Lake Eyre South. These restrictions on aquifer development subsequently control aquifer recharge to the basin margins as shown by the southeasterly recharge direction into Borefield A. Electromagnetic and electrical resistivity data provided information on thickness and resistivities of the near-surface layers and on the resistivity of Bulldog Shale, which overlies the aquifer sequence. However, very low resistivities of units above the aquifer severely affect the penetration of these methods and hence limit the confidence of interpreting aquifer and bedrock parameters. (Author's abstract)
W91-02529

8F. Concrete

RELATIONSHIP OF RESERVOIR BIOGEOCHEMICAL PROCESSES TO THE STRUCTURAL INTEGRITY OF THE WORLD'S FIRST TOTALLY ROLLER COMPACTED CONCRETE DAM.
Army Engineer District, Portland, OR. Reservoir Regulation and Water Quality Section.
D. W. Larson.
Ergebnisse der Limnologie ERLIA6, Vol. 33, No. 3, p 949-964, 1990. 9 fig, 5 tab, 12 ref.

Descriptors: *Concrete dams, *Concrete technology, *Corrosion, *Dam failure, *Geochemistry, *Limnology, *Phytoplankton, *Reservoirs, *Seepage, *Sulfur bacteria, Aeration, Grouting, Hydrogen sulfide, Lime, Oregon, Oxygen, Sulfuric acid, Willow Creek Dam.

Willow Creek Dam is a U.S. Army Corps of Engineers flood-control project located on a tributary of the Columbia River in Oregon. This project, completed in 1983, is the world's first dam to be built entirely with roller compacted concrete. The dam is 550 m long and 50 m high (streambed to dam crest). Willow Creek Reservoir is extremely eutrophic and is well stratified thermally during the summer. By August, the reservoir's hypolimnion is anoxic and contains high concentrations of hydrogen sulfide and other chemically reduced substances. Heavy phytoplankton blooms, principally of Aphanizomenon flos-aquae, aggravate water quality problems in the impoundment. Apparent defects in the dam's concrete matrix have provided avenues for substantial leakage of hypolimnetic waters. Seepage entering the dam's tunnels and gallery is highly enriched with hydrogen sulfide and dissolved lime. There is concern that oxidation of hydrogen sulfide by chemosynthetic bacteria, producing sulfuric acid, is corroding the dam's concrete. Extensive deposition of calcium carbonate on the gallery walls and floor suggests that deterioration of the concrete is occurring. Studies are underway on the geochemistry, microbiology, and hydrodynamics of seepage waters to determine whether the structural integrity of the dam is in fact at risk. Methods under study to solve this problem include hypolimnetic aeration to maintain deepwater oxygen during summer, thus preventing the buildup of hydrogen sulfide, and further injection of cement grout into the concrete matrix to hopefully arrest the seepage. (Author's abstract)
W91-02399

SURFACE TREATMENTS TO MINIMIZE CONCRETE DETERIORATION. REPORT 2: LABORATORY EVALUATION OF SURFACE TREATMENT MATERIALS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
T. B. Husbands, and F. E. Causey.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report REMR-CS-17, September 1990. Report 2 of a Series. 102 p, 25 fig, 26 tab, 18 ref.

Descriptors: *Concrete testing, *Concretes, *Maintenance, *Materials testing, Concrete structures, Freeze-thaw tests, Polymers, Polypropylene, Shotcrete, Weathering.

In 1984, the US Army Corp of Engineers initiated a research program designated Repair, Evaluation, Maintenance, and Rehabilitation (REMR). One of the REMR work units was the evaluation of surface treatments to minimize concrete deterioration. Many of the Corp's hydraulic structures have experienced concrete surface deterioration due to: (1) freezing and thawing, (2) aggressive chemical exposure, and (3) erosion. Surveys by Corp personnel have shown that freezing and thawing was the major contributing factor to concrete surface deterioration followed by erosion. Many different types of surface treatments were evaluated under this work unit including concrete sealers, coatings, polymer systems, thin overlays, and shotcrete. Emphasis was placed on materials that could be applied to the surface to reduce or prevent damage to concrete by freezing and thawing. Polymer systems for sealing cracks by topical application and elastomeric coatings for coating cracked concrete were evaluated. Other coatings for protecting concrete from erosion, chemical attachment, and graffiti were also evaluated. The siloxanes showed promise as a generic type of sealer for concrete and clay bricks on all tests, except for resistance to freezing and thawing. Some of the elastomeric acrylic coatings can be used for coating cracked concrete if the cracks are narrow (hairline), based on good weatherability, elastomeric properties, and breathability of these coatings. The addition of latex admixtures to shotcrete improves the freeze-thaw durability of the material. Polypropylene fibers appear to reduce drying/cracking of latex-modified shotcrete. (See W90-3759 and W87-03318) (Lantz-PTT)
W91-02611

8G. Materials

MONITORING SYSTEM FOR DETECTING MOVEMENTS OF PENSTOCK SUPPORTS.
Waagner-Biro A.G., Graz (Austria). Research and Development Centre.
G. Rop, and M. Bobik.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 9, p 23-25,28, September 1990. 8 fig.

Descriptors: *Dam construction, *Dams, *Measuring instruments, *Monitoring, *Penstocks, *Seismic properties, Data acquisition, Hydroelectric plants, Kokluce Hydropower Station, Movement

detection, Penstock supports, Strain gages, Turkey.

A monitoring system for the detection of movement of penstock supports was developed for the Kokluce hydropower station, located in a seismic area in eastern Turkey. Wire strain gauges are attached to the penstocks in the areas of maximum tensile strength and compressive stresses and are compensated for temperature by the half-bridge circuit method. The monitoring system comprises three data acquisition and control units, in which the analog data from the strain gauge amplifiers are converted to digital values, a data logger, a printer and an alarm. The normal working order of the powerplant with a capacity of 60 MW was used as the reference load condition. As the monitoring system covers a length of almost 2 km, overvoltage and lightning protection are important parts of the system. Since beginning operation at the end of 1988, no hardware or software problems have occurred. Advantages of the system include reliability, low cost, and suitability for retrofitting at completed and operating stations. (MacKeen-PTT)
W91-02113

EFFECTS OF FLOW DISTURBANCES ON THE ACCURACY OF TURBINE-TYPE WATER METERS.
For primary bibliographic entry see Field 7B.
W91-02143

IMPACT OF HANDPUMP CORROSION ON WATER QUALITY.
International Bank for Reconstruction and Development, Abidjan (Ivory Coast). Regional Water and Sanitation Group.
For primary bibliographic entry see Field 5F.
W91-02338

SURFACE TREATMENTS TO MINIMIZE CONCRETE DETERIORATION. REPORT 2: LABORATORY EVALUATION OF SURFACE TREATMENT MATERIALS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
For primary bibliographic entry see Field 8F.
W91-02611

8I. Fisheries Engineering

OCCURRENCE, RELATIVE ABUNDANCE, AND SIZE OF LANDLOCKED SEA LAMPREY (PETROMYZON MARINUS) AMMOCOETES IN RELATION TO STREAM CHARACTERISTICS IN THE GREAT LAKES.
Department of Fisheries and Oceans, Sault Ste. Marie (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
For primary bibliographic entry see Field 2H.
W91-02068

LAKE ACIDIFICATION AND FISHERIES PROJECT: BROOK TROUT (SALVELINUS FONTINALIS) EARLY LIFE STAGES.
Wyoming Univ., Laramie. Fish Physiology and Toxicology Lab.
For primary bibliographic entry see Field 5C.
W91-02102

FACTORS INFLUENCING COMMUNITY STRUCTURE AND DISTRIBUTION OF DIFFERENT LIFE-CYCLE CATEGORIES OF FISHES IN SHALLOW WATERS OF A LARGE AUSTRALIAN ESTUARY.
Murdoch Univ. (Western Australia). School of Biological and Environmental Sciences.
For primary bibliographic entry see Field 2L.
W91-02123

TIDAL AND TURBIDITY EFFECTS ON THE SHALLOW-WATER FISH ASSEMBLAGE OF KUWAIT BAY.
Kuwait Univ., Safat. Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W91-02126

SALMON AND THE SNAKE: MEETING FISH FLOW OBJECTIVES IN A SEMI-ARID RIVER BASIN.
Watershed Resources, Inc., Santa Fe, NM.
For primary bibliographic entry see Field 6D.
W91-02279

INFLUENCE OF CAGE REARING PISCICULTURE ON WATER QUALITY AND BOTTOM SEDIMENTS IN ARTIFICIAL LAKES.
KNIPIBKS Vodokanalproject, Sofia (Bulgaria). Dept. of Scientific and Technological Research.
For primary bibliographic entry see Field 5C.
W91-02393

EXPERIMENTAL COMPARISON OF THE EFFECTS OF BENTHIVOROUS FISH AND PLANKTIVOROUS FISH ON PLANKTON COMMUNITY STRUCTURE.
Oklahoma Univ., Norman. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-02452

FOODWEB RESPONSE TO THE EXPERIMENTAL MANIPULATION OF A BENTHIVORE (CYPRINUS CARPIO), ZOOPLANKTIVORE (MENIDIA BERYLLINA) AND BENTHIC INSECTS.
Oklahoma Univ., Kingston. Biological Station.
For primary bibliographic entry see Field 2H.
W91-02453

FIELD STUDY OF THE EFFECTS OF WATER TEMPERATURE, DISCHARGE AND TROUT ODOUR ON THE DRIFT OF STREAM INVERTEBRATES.
Toronto Univ. (Ontario). Div. of Life Sciences.
For primary bibliographic entry see Field 2H.
W91-02454

TURBINE-INTAKE FISH-DIVERSION SYSTEM.
Iowa Inst. of Hydraulic Research, Iowa City.
A. J. Odgaard, R. A. Elder, and D. Weitkamp.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 11, p 1301-1317, November 1990. 7 fig, 1 tab, 5 ref. Public Utility District of Grant County, Washington contract No. 430-209; Ebasco Services, Inc., Bellevue, Washington contract No. ES-7264.

Descriptors: *Fish guiding, *Fish management, *Fish passages, *Hydraulic engineering, *Turbines, Field tests, Fish migration, Hydroelectric plants, Intake gates, Salmon, Washington.

A promising method for protecting downstream-migrating juvenile fish form death or injury due to passage through hydroelectric turbines is diversion by screening in the turbine intakes. A fish-diversion system was developed to be used in the turbine intakes of the Wanapum and Priest Rapids developments on the Columbia River, in the state of Washington. The system uses a passive-bar screen, installed through the emergency gate well, to produce a flow pattern that deflects downstream-migrating juvenile salmonids into the gate well for subsequent removal and bypass to below the dam. The system is based on laboratory model studies and field tests. The model studies provide data on the hydraulic performance of the system and result in an understanding of the hydraulic features of the technique, which can be a guide for future designs. The studies also serve as a guide to development of the structural design of the system. The design, field tested in 1986, 1987, and 1988, attains a fish-guidance efficiency of about 68% with a minimal of descaling (removal of fish scales by abrasion). (Author's abstract)
W91-02915

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

WILLIE TAKES A FIELD TRIP COLORING BOOK.
Geological Survey, Indianapolis, IN. Water Resources Div.
D. V. Arvin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-125, August 1990. 37p, 37 fig.

Descriptors: *Children's educational material, *Data acquisition, *Hydrologic data, *Indiana, *Publications, Field tests, Field trip.

This coloring book is an educational tool designed to instruct children on some of the field activities commonly associated with the collection of water resource data. Through the use of line drawings and brief descriptive text, young readers will follow little Willie and his Uncle Bill as they spend a pleasant day in the field measuring streamflow, collecting sediment samples, making groundwater measurements at observation wells, and measuring flow in a pipe. Although this 37-page coloring book is geared to children 5 to 10 years old, people of all ages may find it enjoyable. (USGS)
W91-02251

9C. Research Facilities

WATER RESOURCES ACTIVITIES IN FLORIDA, 1989-90.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02258

9D. Grants, Contracts, and Research Act Allotments

WATER RESEARCH IN AUSTRALIA: CURRENT PROJECTS 1989.
Department of Primary Industries and Energy, Canberra (Australia).
Australian Government Publishing Service, Canberra, Australia. 1990. 163 p.

Descriptors: *Australia, *Bibliographies, *Foreign research, *Water resources research, Annual reports, Data collections, Research facilities.

This Annual Publication incorporates about 1000 summaries of water-related research projects currently being undertaken in Australia by individuals and research organizations. Research projects are grouped according to broad subject categories, and within these are listed in alphabetical order by project title. Two indexes allow retrieval by the names of members of the research team and the organizations carrying out or sponsoring the research, and by subject, using terms from the Aqualine thesaurus and additional Australian terms. Information included in this publication is taken from the Australian computerized data base, Streamline. (Author's abstract)
W91-02612

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN KANSAS--FISCAL YEARS 1987 AND 1988.
Geological Survey, Lawrence, KS. Water Resources Div.

or primary bibliographic entry see Field 7C.
/91-02236

IBLIOGRAPHY OF U.S. GEOLOGICAL URVEY REPORTS ON THE WATER RE-OURCES OF FLORIDA, 1886-1989.
eological Survey, Tallahassee, FL. Water Re-urces Div.
L. Embry, and N. D. Hoy.
vailable from Books and Open File Report Sec-on, USGS, Box 25425, Denver, CO 80225. USGS pen-File Report 90-143, 1990. 196p, 1 fig. Project o. FL-002.

escriptors: *Bibliographies, *Florida, *Ground-ater, *Surface water, *Water quality, *Water re-urces data.

ne U.S. Geological Survey has released a listing its reports on water resources in Florida for the riod 1886-1989. Most of the reports contained in e listing were prepared by the U.S. Geological rvey in cooperation with numerous public agen-es in Florida. The compilation has a full biblio-aphic list of reports arranged alphabetically by nor author. In addition, the reports are indexed geographic areas and by subject. (USGS)
91-02237

CTIVITIES OF THE ALASKA DISTRICT, ATER RESOURCES DIVISION, U. S. GEO-OGICAL SURVEY, 1990.
eological Survey, Anchorage, AK. Water Re-urces Div.
r primary bibliographic entry see Field 7C.
91-02259

EH'S CONTRIBUTION TO THE DEVELOP-ENT OF HYDROLOGY IN ARID AND SEMI-

ARID AREAS IN AFRICA (CONTRIBUTION DU CIEH AU DEVELOPPEMENT DE L'HYDROLOGIE DANS LES ZONES ARIDES ET SEMI-ARIDES D'AFRIQUE).
Comite Interafricain d'Etudes Hydrauliques, Ouagadougou (Burkina Faso). Dept. of Hydrology.
For primary bibliographic entry see Field 2A.
W91-02292

WETLAND AREAS: NATURAL WATER TREATMENT SYSTEM (JAN 78 - AUG 89). CITATIONS FROM THE POLLUTION ABSTRACTS DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5D.
W91-02642

SEWAGE SLUDGE: APPLICATION TO SOILS (JAN 85 - JUL 89). CITATIONS FROM THE BIOBUSINESS DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5E.
W91-02643

WASTEWATER TREATMENT: CHEMICAL INDUSTRY (JAN 70 - SEP 89). CITATIONS FROM THE POLLUTION ABSTRACTS DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5D.
W91-02644

PULPING EFFLUENTS: BIOLOGICAL TREATMENT (JAN 76 - SEP 89). CITATIONS FROM THE PAPER & BOARD, PRINTING & PACKAGING INDUSTRIES RESEARCH ASSOCIATION.
Davis (J.J.) Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5D.
W91-02645

DRINKING WATER QUALITY STANDARDS AND STANDARD TESTS (JAN 72 - MAY 89). CITATIONS FROM THE FOOD SCIENCE AND TECHNOLOGY ABSTRACTS DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5F.
W91-02646

HEAVY METALS IN DRINKING WATER: STANDARDS, SOURCES, AND EFFECTS (JAN 78 - SEP 89). CITATIONS FROM THE LIFE SCIENCES COLLECTION DATABASE.
Davis (J.J.) Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5F.
W91-02647

10F. Preparation Of Reviews

ENVIRONMENTAL CHEMISTRY AND BIOLOGICAL EFFECTS OF CADMIUM COMPOUNDS.
International Association of Environmental Analytical Chemistry, Therwil (Switzerland).
For primary bibliographic entry see Field 5B.
W91-02173

BED CONFIGURATIONS IN STEADY UNIDIRECTIONAL WATER FLOWS: PART II. SYNTHESIS OF FLUME DATA.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
For primary bibliographic entry see Field 2E.
W91-02926

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W91-02410 5B

Hydrogeochemical and Isotopical Investigations of Ground and Surfacewaters at the Southwest Edge of the Harzmountains during an Artificial Induced High Water (Hydrogeochemische und Isotopenchemische Untersuchungen an Grund und Oberflachenwassern am Sudwestrand des Harzes Wahrend eines Kunstlich Induzierten Hochwassers).
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W91-02365 3F

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W91-02368 7A

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W91-02290 2E

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W91-02323 2F

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W91-02388 2H

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W91-02471 4C

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W91-02472 4A

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W91-02397 4C

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W91-02374 2H

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W91-02291 2A

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W91-02295 2A

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W91-02306 8A

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W91-02351 7C

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W91-02735 5C

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W91-02755 2K

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W91-02759 5B

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W91-02559 5B

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W91-02197 5B

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W91-02085 4A

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W91-02748 2K

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W91-02044 5A

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W91-02089 5E

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W91-02173 5B

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W91-02336 2F

Impact of Handpump Corrosion on Water Quality.
W91-02338 5F

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Non-Indian Water Users' Goals: More Is Better, All Is Best.
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Survival of Striped Bass Larvae and Yearlings in Relation to Contaminants and Water Quality in the Upper Chesapeake Bay.
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Growth and Development of Bald-Cypress/Water-Tupelo Stands under Continuous Versus Seasonal Flooding.
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Effects of Chlorinated Benzenes on Diatom Fatty Acid Composition and Quantitative Morphology: II. 1,3,5-Trichlorobenzene.
W91-02437 5C

Effects of Chlorinated Benzenes on Diatom Fatty Acid Composition and Quantitative Morphology: III. 1,2,3-Trichlorobenzene.
W91-02438 5C

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W91-02821 2J

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Application of Groundwater Modelling in Water Resources Management in Denmark.
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Monitoring Program Assesses Water Quality Progress.
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Oil Slick Sizes and Length of Coastline Affected: A Literature Survey and Statistical Analysis--Final Report.
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D11	530	T11	1,220
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 24, NUMBER 4
APRIL 1991

-02959 -- W91-03920
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 24, NUMBER 4
APRIL 1991

W91-02959 -- W91-03920

The Secretary of the Interior has deterimined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 1991.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

HYDROLOGIC DATA BASE MODEL.
South Florida Water Management District, West Palm Beach.
For primary bibliographic entry see Field 7C.
W91-03047

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES. VOLUME III.
For primary bibliographic entry see Field 2F.
W91-03178

MAIN INDUCED CHANGES IN RAINFALL-RUNOFF RELATIONSHIP FOR A MOUNTAINOUS WATERSHED.
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
A. Ben-Zvi, and M. Langerman.
Pirineos: Revista de Ecologia de Montana PRNOAJ, Vol. 134, p 9-21, 1989. 3 fig, 6 tab, 7 ref.

Descriptors: *Cloud seeding, *Hydrologic models, *Israel, *Mountain streams, *Rainfall-runoff relationships, *Small watersheds, Flow discharge, Regression analysis, Runoff volume, Watershed management.

Historical comparison of records for a small mountainous watershed in Israel indicates a substantial reduction of the flow volume with regard to the rainfall depth. A rainfall-runoff model of the linear regression type was used to study the data. Cloud seeding has been shown to cause an increase in the runoff volume with regard to the rainfall. The only other known factor which can be so effective is the extensive watershed management operation carried out in this area in the 1950s. With regard to the rainfall depth, the mean annual volume of the flow has decreased by 45% of its historic value. (Author's abstract)
W91-03432

GLOBAL RIVER RUNOFF CALCULATED FROM A GLOBAL ATMOSPHERIC GENERAL CIRCULATION MODEL.
National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies.
G. L. Russell, and J. R. Miller.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 241-254, September 1990. 5 fig, 3 tab, 20 ref.

Descriptors: *Atmospheric circulation, *Climatology, *Hydrologic models, *Model studies, *Rivers, *Runoff, *Runoff forecasting, Evapotranspiration, Groundwater storage, Parameterization, Precipitation, Rainfall-runoff relationships.

An atmospheric general circulation model was used to calculate runoff for the major rivers of the world. The model has a horizontal resolution of 4 x 5 degrees, but the runoff from each grid box within a particular river's drainage basin was summed on a resolution of 2 x 2.5 degrees to obtain the runoff at the river mouth. The mean annual runoff was calculated and compared with observations for 33 of the world's largest rivers. For about half of the rivers with annual runoff in excess of 200 cu km, the model runoff is within about 20% of the observed value. The model overpredicts the runoff for rivers with less than 200 cu km/yr. Some of the inaccuracy in the runoff predictions occurs because of poor model precipitation fields, but the model's parameterizations of groundwater storage and evapotranspiration are also suspect. New parameterizations, including the effects of both soil type and vegetation, should be investigated. In addition to being a good diagnostic for atmospheric modelers, the runoff that may occur during future climate changes can also be studied with these models. (MacKeen-PTT)
W91-03551

ASSESSING HYDROLOGIC MODEL NONLINEARITY USING RESPONSE SURFACE PLOTS.
Newcastle Univ. (Australia). Dept. of Civil Engineering.
G. Kuczera.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 143-161, October 1990. 16 fig, 3 tab, 18 ref.

Descriptors: *Hydrologic models, *Model studies, *Multivariate analysis, *Parametric hydrology, *Uncertainty, Case studies, Numerical analysis, Probability distribution.

When a conceptual hydrologic model is calibrated to observed data, a posterior distribution summarizing uncertainty about model parameters can be derived. For models with more than two parameters, this distribution can be very awkward to work with. However, when a model is approximately linear over the region of parameter space with appreciable posterior density, the posterior distribution can be approximated by a multivariate normal distribution which provides a powerful tool for studying parameter uncertainty, testing hypotheses, and determining the reliability of model predictions. Model nonlinearity can be assessed using numerical measures. Complementing these measures are response surface plots. When interpreting response surface plots for models with more than two parameters, it is argued that linearized conditional probability regions should be displayed on response surface plots to highlight the region of likely parameter values. Where significant parameter interaction exists, it is possible that only a small fraction of the response surface will display probable model parameter values. In such cases, generating the response surface in principal component planes is computationally more efficient. Two case studies using four-parameter conceptual hydrologic models illustrate these points. (Author's abstract)
W91-03745

INITIAL CONTRIBUTING AREA OF A SMALL WATERSHED.
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 2E.
W91-03760

CLIMATE FACTOR FOR SMALL-BASIN FLOOD FREQUENCY.
Geological Survey, Denver, CO. Water Resources Div.
R. W. Lichty, and M. R. Karlinger.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 577-586, August 1990. 4 fig, 10 tab, 17 ref.

Descriptors: *Climatology, *Flood basins, *Flood forecasting, *Flood frequency, *Hydrologic models, *Rainfall-runoff relationships, Climatic data, Data interpretation, Flood data, Kriging, Mathematical analysis, Mathematical models, Regression analysis, Watersheds.

A climate factor, CT, (T = 2-year, 25-year and 100-year recurrence intervals) that delineates regional trends in small-basin flood frequency was derived using data from 71 long-term rainfall record sites. Values of CT at these sites were developed by a regression analysis that related rainfall-runoff model estimates of T-year floods to a sample set of 50 model calibrations. CT was regionalized via kriging to develop maps depicting its geographic variation for a large part of the United States east of the 105th meridian. Kriged estimates of CT and basin-runoff characteristics were used to compute regionalized T-year floods for 200 small drainage basins. Observed T-year flood estimates also were developed for these sites. Regionalized floods are shown to account for a large percentage of the variability in observed flood estimates with coefficients of determination ranging from 0.89 for 2-year floods to 0.82 for 100-year floods. The relative importance of the factors comprising regionalized flood estimates is evaluated in terms of scale (size of drainage area), basin-runoff characteristics (rainfall-runoff model parameters), and climate (CT). (Author's abstract)
W91-03853

RUNOFF VOLUME ESTIMATION USING GIS TECHNIQUES.
National Park Service, Denver, CO. Denver Service Center.
M. M. Stuebe, and D. M. Johnston.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 611-620, August 1990. 4 fig, 2 tab, 21 ref.

Descriptors: *Flood routing, *Geographic information systems, *Hydrologic models, *Rainfall-runoff relationships, Data interpretation, Mathematical analysis, Mathematical models, Simulation analysis, Surface runoff, Watersheds.

Rainfall-runoff of six watersheds was modeled via the Soil Conservation Service runoff curve number model in two ways: conventionally (manually) and via a geographic information system (GIS). Input data (elevation, soils and landcover) were digital for the latter method. In contrast to previous studies, the GIS was used for all phases of the modeling process, including watershed delineation and routing of runoff. A comparison between the two methods was consistent with results reported by others and indicates that the use of GIS is an acceptable alternative to the conventional method for watersheds lacking relatively flat terrain. Given this limitation, the GIS method may prove advantageous over manual methods when study areas are large or numerous, runoff is modeled repetitively, alternative landcover scenarios are explored, or a digital database already exists for the study area. (Author's abstract)
W91-03856

LINEAR PROGRAMS FOR NONLINEAR HYDROLOGIC ESTIMATION.
California Univ., Santa Barbara. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-03859

VEGETATION AND CLIMATE OF THE LATE CAINOZOIC IN THE MURRAY BASIN AND THEIR BEARING ON THE SALINITY PROBLEM.
New South Wales Univ., Kensington (Australia). School of Biological Sciences.
H. A. Martin.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 291-299, 1990. 7 fig, 1 tab, 30 ref, append. Australian Research Grants Scheme.

Descriptors: *Australia, *Geochemistry, *Geologic history, *Murray-Darling River Basin, *Paleohydrology, *Saline groundwater, *Saline water intrusion, *Salinity, Forest hydrology, Forests, Geohydrology, Marine environment, Paleoclimatology, River systems, Salt marshes, Vegetation establishment.

The Murray Basin, in southeastern Australia, was forested throughout the Tertiary, becoming open woodlands and grasslands in Plio-Pleistocene time. Precipitation was very high through the early Tertiary, with step-like decreases beginning in the late Oligocene-early Miocene. In the mid-late Miocene, widespread rainforests disappeared and were replaced with eucalypt wet sclerophyll forests which were burnt on a regular basis. For a brief interval in the late Miocene-early Pliocene, there is a resurgence of Nothofagus which forms a well defined stratigraphic horizon. The Nothofagus phase is well marked in the major river systems of the western slopes of the Eastern Highlands, but it has also been found in the western Murray Basin. The climate was wetter at this time, which is thought to correlate with the late Miocene-early Pliocene maximum marine transgression. An assemblage with a high chenopod type and Asteraceae pollen content is deceptively like modern assemblages of arid regions, but close examination reveals a salt-marsh environment associated with the early mid-Miocene marine transgression. Throughout the Tertiary and into the early Pleistocene, the only indications of salinity are associated with marine/marginal marine environments. There is no evidence of dryland salinity, as seen today. (Author's abstract)

W91-03903

2B. Precipitation

SOIL CONSERVATION SERVICE CLIMATIC DATA ACCESS FACILITY.
Soil Conservation Service, Washington, DC. Resources Inventory Div.
For primary bibliographic entry see Field 7C.
W91-02998

ACID DEPOSITION IN MARYLAND: SUMMARY OF RESULTS THROUGH 1988.
Maryland Dept. of Natural Resources, Annapolis. Chesapeake Bay Research and Monitoring Div.
For primary bibliographic entry see Field 5B.
W91-03025

RUNOFF EFFECTS ON THE EFFICIENCY OF RAINDROP KINETIC ENERGY IN SHEET EROSION.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
For primary bibliographic entry see Field 2J.
W91-03148

UNIVERSAL INDEX FOR CALCULATING RAINFALL EROSIVITY.
Institute of Soil Science and Yield Prediction, Sofia (Bulgaria).
For primary bibliographic entry see Field 2J.
W91-03150

EXPERIMENTAL MODEL OF EVALUATING SOIL EROSION ON A SINGLE-RAINSTORM BASIS.
Istituto Sperimentale per lo Studio e la Difesa del Suolo, Florence (Italy).
For primary bibliographic entry see Field 2J.
W91-03163

STRUCTURE OF TROPICAL CYCLONES AND SURROUNDING REGIONS AS DETERMINED FROM OLS AND SSM/I IMAGERY ANALYSIS.
Air Force Geophysics Lab., Hanscom AFB, MA.
M. Glass, and G. W. Felde.
Available from the National Technical Information Service, Springfield, Virginia 22161, as AD-A210 320. Price codes: A02 in paper copy, A01 in microfiche. Report no. GL-TR-89-0167, 7 July 1989. 4 p, 7 fig, 8 ref.

Descriptors: *Infrared imagery, *Meteorological data collection, *Meteorology, *Remote sensing, *Satellite technology, *Storms, *Tropical cyclones, Algorithms, Clouds, Convective precipitation, Microwaves.

A group of tropical cyclones of varying peak intensities occurring in the western North Pacific during 1988 were selected for study. Infrared and visible imagery data from the Operational Linescan System (OLS) sensor and passive microwave imagery data from the 7-channel Special Sensor Microwave/Imager (SSM/I) sensor were used. Both instruments are on board the same polar-orbiting Defense Meteorological Satellite System satellite. Imagery analysis of each storm and surrounding environment was performed during different stages of its life. It was concluded that coincident SSM/I (microwave) and OLS (visible and infrared) imagery data show promise as a new tool for delineating the cloud band structure, locating the intense convective cells within the cloud bands, and locating the storm center of tropical cyclones. Wind speed and rain rate fields derived from SSM/I algorithms agreed qualitatively with known features of tropical cyclones. These derived paramcters will become more useful as algorithms arc refined. (Fish-PTT)
W91-03226

USER'S GUIDE FOR THE UPDATED SMITH-FEDDES MODEL.
Arvin/Calspan Advanced Technology Center, Buffalo, NY.
C. W. Rogers.
Available from the National Technical Information Service, Springfield, Virginia 22161, as AD-A210 254. Price codes: A04 in paper copy, A01 in microfiche. Report no. 7330-2, June 1985. 52 p, 5 fig, 2 tab, 6 ref, 4 append. Contract no. N00228-84-C-3157.

Descriptors: *Clouds, *Computer models, *Handbooks, *Meteorological data, *Model studies, Computer programs, Precipitation.

A User's Manual for Smith-Feddes (S-F) model for cloud moisture content has been developed to provide information necessary to use the system effectively. This S-F program uses height of cloud base and top, cloud type, cloud cover percentage, presence of precipitation and vertical profiles of temperature and pressure to provide vertical profiles of cloud condensed moisture content (CMC) and the distribution of cloud particle number concentration by particle size. When precipitation is present, the same information is provided for the precipitation, both in-cloud and below cloud base to the ground. The computer used is the CDC machine, code-named HAL, at the Naval Surface Weapons Center's Fleet Numerical Oceanography Center (FNOC). The S-F input is card image, free format for latitude and longitude, and 9 track, 1600 BPI magnetic tape for the RTNEPH (Real Time NEPHanalysis) cloud data and Terrain tapes. Output is printed. Input to PNTDAT temperature and pressure data is card image in directive format. Output from PNTDAT is card images on a temporary disk file called TAPE7, which is then read by the S-F program. Standard FNOC procedures for running a computer program on machine HAL are to be used. (Fish-PTT)
W91-03228

EFFECTS OF MISSING DATA ON THE CALCULATION OF PRECIPITATION-WEIGHTED-MEAN CONCENTRATIONS IN WET DEPOSITION.
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W91-03293

SEQUENTIAL PRECIPITATION SAMPLERS: A LITERATURE REVIEW.
Nebraska Univ. at Omaha. Dept. of Chemistry.
F. C. Laquer.
Atmospheric Environment Part A: General Topics AEATEN, Vol. 24, No. 9, p 2289-2297, September 1990. 1 tab, 114 ref.

Descriptors: *Instrumentation, *Literature review, *Meteorological data collection, *Precipitation, *Rain gages, *Sample preservation, *Sampling, Chemistry of precipitation, Design criteria, Monitoring, Precipitation scavenging, Trace analysis.

The literature of sequential or within-event precipitation sampler construction and applications is reviewed. Collection devices are classified as manually segmenting samplers, linked collection vessels, automatically segmenting samplers and continuous monitors. The rainfall collectors have in common a large surface area to collect the precipitation and funnels commonly constructed from polyethylene or stainless steel. Early applications of sequential samplers were to determine radioactive fallout removal processes, and to monitor cloud seeding studies, below cloud scavenging and urban and precipitation scavenging studies. The collector design is highly dependent on the type of sample to be taken, i.e., major ions, trace metals, or organics. The collector should be covered to exclude dry deposition that would bias the sample. Deposition monitoring may use either sampling at unit times or at unit precipitation volumes. Precipitation scavenging research may sample by either method. Continuous monitoring or real time analysis of precipitation using a flow through collection system is dynamically attractive. It requires rapidly responding sensors, and a data collection system. The choice of chemical species to be measured determines how frequently the samples are transported to the laboratory. An alternative to immediate analysis is to trap the analyte, immediately converting it into a stable product. The number of samples and the volume to be taken depends on the chemical analysis to be performed. The collection surface for rainfall to be analyzed for the major inorganic ions may be plastic or stainless steel. When trace metals are to be determined in rainwater, the collection surface and sample bottle should be acid washed polyethylene or Teflon. Rainwater used for the determination of organic compounds should be collected on inert surfaces such as glass or stainless steel. Metal funnels can be more easily heated to melt snow than plastic funnels and may hold up better against the elements. The distance between the funnel and the sample container should be short to minimize particle losses to the tubing or other alterations of the sample. (Geiger-PTT)
W91-03294

INTERCOMPARISON OF CONTINUOUS FLOW, AND AUTOMATICALLY SEGMENTING RAINWATER COLLECTION METHODS FOR DETERMINING PRECIPITATION CONDUCTIVITY AND PH.
Nebraska Univ. at Omaha. Dept. of Chemistry.
F. C. Laquer.
Atmospheric Environment Part A: General Topics AEATEN, Vol. 24, No. 9, p 2299-2306, September 1990. 3 fig, 2 tab, 37 ref.

Descriptors: *Acid rain, *Conductivity, *Hydrogen ion concentration, *Instrumentation, *Precipitation, *Rain gages, *Sampling, Automation, Comparison studies, Electrodes, Performance evaluation, Precipitation intensity.

Two precipitation intensity or volume weighted rainwater collection methods, a continuous flow measuring device and a fraction collection system were compared during measurements of pH and conductivity of rainwater. The automatic fraction collector accumulated samples for later laboratory analysis at 0.2 mm intervals. The flow system measured rainwater conductivity and pH every 0.1 mm of rainfall. The flow system used a 60 cm diameter polypropylene funnel while the fraction system used a 40 cm diameter stainless steel funnel to collect the rainwater. Conductivity of the samples was measured in collected sequence using a dip cell. The pH of the fractions was measured using a pH electrode containing an annular ceramic junction recommended for rainwater measurements. Conductivity data from summer thunderstorms in Omaha, Nebraska, collected by the two systems were comparable to each other with integrated collection by a wet-only event collector. The conductivity of the rainwater in both the flow and the fraction systems rapidly decreased at the beginning of the rainfall and then increased at the end of the event. The flow system pH measurement exhibited bias with respect to the fraction collection system due to insufficient electrode equilibration time, especially when the precipitation conductivity was low (<10 microS/cm). (Geiger-PTT)
W91-03295

INTERACTION BETWEEN EQUILIBRATION PROCESSES AND WET OR DRY DEPOSITION.
California Inst. of Tech., Pasadena. Dept. of Chemical Engineering.
S. N. Pandis, and J. H. Seinfeld.
Atmospheric Environment Part A: General Topics AEATEN, Vol. 24, No. 9, p 2313-2327, September 1990. 9 fig, 20 ref. State of California Air Resources Board Agreement A932-054.

Descriptors: *Acid rain, *Aerosols, *Dry deposition, *Mathematical models, *Nitrogen compounds, *Path of pollutants, Deposition, Fog, Hydrogen peroxide, Nitric acid, Numerical analysis.

Three cases were examined to study the relationship between equilibration processes and deposition. The first case concerns a gas phase species A(g) that can be reversibly transferred to the aerosol phase as B(s). In the second case the gas-phase

species (e.g. HCHO, H2O2, O3) in the presence of droplets of liquid water content C is transferred reversibly to the aqueous-phase as B(aq). In the third case two gases A(g) and B(g) react to give a volatile aerosol AB(s), and in general all three species have different deposition velocities. This case is typified by the system of NH3(g), HNO3(g), and NH4NO3(s). Results of numerical analysis show that atmospheric equilibration processes between two phases with different deposition velocities have the potential to affect significantly the amount of total material deposited on the ground. The magnitude of the effects of the equilibration processes depends primarily on the ratio of the deposition velocities of the two phases, on the production/emission rate of the gas phase species, and on the initial distribution of species between the two phases. The deposition of a condensable species equilibrating between gas and aerosol phases can increase by as much as 20 times over that when equilibration processes are not present under gas-phase production rate) or to decrease by as much as 15 times (very small aerosol particles, most of the material initially in the gas phase and high gas-phase production rate). In fog episodes, the deposition of a gaseous species with a Henry's Law constant between 1,000 and 1,000,000 M/atm (e.g. SO2 for pH between 4.5 and 7, H2O2, HCHO etc.) can be enhanced by as much as a factor of 3 because of its transfer to the aqueous phase. For the NH3-HNO3-NH4NO3 system the total deposition can be reduced by as much as a factor of 3 for typical conditions in a polluted atmosphere and small initial concentration of aerosol NH4NO3 with NH3 initially dominating HNO3 in the gas phase. If an operator splitting scheme is used in a mathematical model both equilibration and removal processes should be included in the same operator or very small operator time steps (typically less than 1 min) will be necessary. (Geiger-PTT)
W91-03297

NUMERICAL SIMULATION OF WET SCAVENGING OF AIR POLLUTANTS: I. MODELING OF SEQUENTIAL PRECIPITATION RATES AT THE GROUND.
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W91-03298

NUMERICAL SIMULATION OF WET SCAVENGING OF AIR POLLUTANTS: II. MODELING OF RAIN COMPOSITION AT THE GROUND.
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W91-03299

PRINCIPAL COMPONENT ANALYSIS OF THE LAMB CATALOGUE OF DAILY WEATHER TYPES: PART 2, SEASONAL FREQUENCIES AND UPDATE TO 1987.
University of East Anglia, Norwich (England). Climatic Research Unit.
T. R. Briffa, P. D. Jones, and P. M. Kelly.
International Journal of Climatology IJCLEU, Vol. 10, No. 6, p 549-563, September/October 1990. 9 fig, 4 tab, 7 ref. DOE Grant DE-FG02-86ER69017.

Descriptors: *Climatology, *Meteorology, *Principal component analysis, *Seasonal variation, *Weather patterns, Air temperature, Great Britain, Precipitation, Temporal distribution.

Principal component analysis is applied to seasonal weather-type frequencies from the Lamb Catalogue of Daily Weather Types for the British Isles. Four combinations of the major weather types are identified, which represent around 70% of the variance of the data set. The four generic combinations are indices of the balance between: the westerly and cyclonic types; the westerly and anticyclonic types; the cyclonic or anticyclonic and directional types; and the northerly and other directional types. The significant relationships between the seasonal components and temperature and rainfall are physically reasonable, reflecting changes in the character of the meridional flow and the frequency of cyclonicity and anticyclonicity. A pronounced change in the character of the synoptic circulation over the British Isles has occurred in recent decades. A decline in the frequency of westerly weather types has been compensated for by an increase in the frequency of pure cyclonic and anticyclonic types and, dependent on season, directional types. This development suggests greater variability in the atmospheric circulation and related climatic parameters. The westerly decline has not been as marked in autumn. In autumn, though, there has been a notable shift towards greater southerliness at the expense of northerly weather types. (Geiger-PTT)
W91-03393

CLIMATOLOGICAL CONTINGENCY PROBABILITIES OF CLOUDS.
Liverpool Univ. (England). Dept. of Geography.
A. H. Goodman, A. Henderson-Sellers, and K. McGuffie.
International Journal of Climatology IJCLEU, Vol. 10, No. 6, p 565-589, September/October 1990. 17 fig, 1 tab, 16 ref. Air Force Office of Scientific Research Grants AFOSR-87-0195 and AFOSR-87-0299.

Descriptors: *Climatology, *Clouds, *Probability distribution, *Regional analysis, Satellite technology, Weather data collections, Weather patterns.

The ideas surrounding contingency co-occurrence probabilities of cloud types are discussed with respect to two types of probability: first, that given a lower level cloud (L) there is also an upper level cloud (U), P(L-> U), and secondly the probability that given an upper cloud layer there is a lower cloud layer, P(U->L). Particular emphasis is placed on the fact that analyses to date have considered the frequency of observation of co-occurrence, not the potentially more useful, co-existence probability. From four separate months of global surface observations the P(L->U) was calculated as a function of lower level cloud amount on a global, regional, and individual station basis for (1) stratiform and altiform, and (2) stratiform and cirriform cloud type combinations. Global patterns of P(L->U) behavior are somewhat similar to regional patterns produced by previous work and are, on occasions, reproducible on a regional scale and, in some instances, by individual stations. Values of P(L->U) involving lower level overcasts are required in the calculation of the P(U->L) term, thus rendering climatological estimates of P(L->U) susceptible to biasing if an inappropriate value of P(L->U) for L = overcast is chosen. To demonstrate this effect, monthly global climatologies of P(U->L) were generated for several combinations of upper and lower cloud types using (1) an assumed mean value for the overcast case, and (2) a modification to the previously assumed overcast P(L->U) values, as suggested here. Comparison of these climatologies revealed differences, widely spread across the globe, of mostly within + or -10% according to cloud type, but with a few larger changes in excess of 30%. (Author's abstract)
W91-03394

CLIMATIC CLASSIFICATION FOR QUEENSLAND USING MULTIVARIATE STATISTICAL TECHNIQUES.
Jaffna Univ. (Sri Lanka). Dept. of Geography.
M. Puvaneswaran.
International Journal of Climatology IJCLEU, Vol. 10, No. 6, p 591-608, September/October 1990. 8 fig, 4 tab, 14 ref.

Descriptors: *Australia, *Climatology, *Multivariate analysis, *Rainfall, *Regional analysis, *Spatial distribution, Air temperature, Cluster analysis, Relative humidity, Statistical methods, Weather data collections.

An array of 28 climatic variables for 113 stations in Queensland, Australia, was subjected to factor analysis and cluster analysis to obtain an objective climatic classification for this region. The factor analytical approach elucidated three major factors from the matrix: a humidity factor, a temperature factor, and a rainfall factor. Spatial variation of factor scores was described and linear equations were compiled using the factor loadings that were significant. By grouping these factors scores with the aid of a distance-grouping technique, Queensland was classified into three major homogeneous climatic regions. A further 12 subclimatic regions were also identified. These regions were considerably different than Koppen's classification scheme and were determined solely by climatic factors and not external factors such as soil type and vegetation. (Author's abstract)
W91-03395

DROUGHT OVER ZIMBABWE IN A REGIONAL AND GLOBAL CONTEXT.
Department of Meteorological Services, Harare (Zimbabwe).
C. H. Matarira.
International Journal of Climatology IJCLEU, Vol. 10, No. 6, p 609-625, September/October 1990. 8 fig, 2 tab, 53 ref.

Descriptors: *Climatology, *Drought, *El Nino/Southern Oscillation, *Meteorology, *Rainfall, *Regional analysis, *Zimbabwe, Cyclones, Meteorological data, Seasonal variation.

Meteorological conditions that lead to dry and wet episodes over Zimbabwe were examined by correlation analyses between the Southern Oscillation Index and rainfall over south-eastern central Africa. The results showed significant correlation between the Southern Oscillation (SO) and seasonal rainfall over the region. The results also indicated that the SO signal was stronger over the southeast of Zimbabwe and along the coastal areas of Mozambique. El Nino events seemed to be associated with below normal rainfall over Zimbabwe, while cold events, which were the opposite extreme of the SO, were accompanied by above average rainfall. Three-month seasonal (December-February) deviations of 1000-millibar temperature, surface pressure, and the 500-millibar geopotential height from the long-term mean were analyzed during wet periods and towards the ocean area during dry episodes. A similar pattern was observed at the 500-millibar level. A comparison of wet and dry seasons in relation to the temperature anomaly field pointed to an association between warmer 1000-millibar surface temperatures around the African subcontinent and above normal seasonal rainfall. Correlation analysis showed that a high incidence of tropical cyclones in the Mozambique Channel was associated with below normal rainfall over Zimbabwe. (Author's abstract)
W91-03396

REGIONALITY AND PERIODICITY OBSERVED IN RAINFALL VARIATIONS OF THE BAIU SEASON OVER JAPAN.
Tsukuba Univ. (Japan). Inst. of Geoscience.
A. Murata.
International Journal of Climatology IJCLEU, Vol. 10, No. 6, p 627-646, September/October 1990. 15 fig, 3 tab, 37 ref.

Descriptors: *Climatology, *Japan, *Meteorology, *Rainfall, *Regional analysis, *Seasonal variation, Principal component analysis, Temporal distribution.

The regionality of rainfall variations of the Baiu, a rainy season over Japan, was investigated with special reference to periodicity. Using the Varimax rotated principal component analysis (PCA), Japan was divided into eight regions based on natural-logarithm-transformed rainfall data of June. In order to find significant rainfall variations from a sequence of rainfall data in each region, non-rotated PCA was applied to the rainfall data for each region. Its first component score was defined as the rainfall variation index (RVI). Four regions showed statistically significant periodicities of 10, 8, 4, or 2.2 yr in rainfall variations. In addition, the rainfall variations revealed a similarity in the general shapes of spectral density for each region. The temporal variations of each periodicity showed non-stationary changes. This feature was especially distinct for periodicities at 4 and 2.2 yr. From the

results of squared coherence, it was shown that these periodicities are closely related to variations of the North Pacific High and the Okhotsk High air masses. The validity of the regional division proposed in the present study was confirmed in comparison with other studies. Analysis of correlation coefficients between rainfall amounts and rainfall variation indices during the Baiu rainy season indicated that rainfall variations in June and July displayed satisfactory seasonal representativity. (Author's abstract)
W91-03397

THEORETICALLY DERIVED DISTRIBUTION FOR ANNUAL RAINFALL TOTALS.
K. J. A. Revfeim.
International Journal of Climatology IJCLEU, Vol. 10, No. 6, p 647-650, September/October 1990. 2 tab, 8 ref.

Descriptors: *Meteorology, *Model studies, *Rainfall, *Statistical analysis, Synoptic analysis, Theoretical analysis.

Rainfall occurs as synoptic events, and in many climates annual totals are made up of a moderate to large number of events of varying amounts. Assumption of an underlying Poisson process of event occurrence leads to a simple statistical density, in terms of physically meaningful parameters for the fourth root of annual totals. Analysis of data for four locations (Milan, Italy, Stensele and Kristianstad, Sweden, and Kelburn, New Zealand) gave estimates of event-recurrence rates in agreement with the number of rain-days in the local climates. The density factor for the fourth root of annual rainfall totals may be useful for discriminating between rainfall totals in regimes such as El Nino/La Nina when the distributions are less well represented by overlapping Guassian forms. This analysis complements the compound Poisson distribution which is a realistic model for monthly or other short-term totals. (Author's abstract)
W91-03398

COMPUTED NORMAL RANGE OF IOWA STATEWIDE JULY PRECIPITATION.
Iowa State Univ., Ames. Dept. of Agronomy.
H. C. Vaughan, D. S. Sheets, and G. R. White.
Journal of the Iowa Academy of Science JIASEB, Vol. 97, No. 3, p 91-97, September 1990. 10 fig, 1 tab, 5 ref.

Descriptors: *Climatology, *Iowa, *Meteorological data, *Meteorology, *Precipitation, *Rainfall distribution, Distribution patterns, Moisture deficiency, Rainfall area, Seasonal variation, Standard deviation, Statistical analysis.

Iowa summer rainfall distributions were examined to identify small-scale anomalies. Examination of extremely wet and dry summer months showed that large rain amounts fall mainly in small, cellular areas for both extremely wet and dry months. These configurations result from individual rainfall events. Analysis of the distribution of mean July rainfall across the state revealed significant anomalous wet and dry regions that contrast with the background, east-west rainfall gradient. Because of the skewed nature of summer rainfall distributions, the median value was used to represent a more realistic expected rainfall amount for any given year. Some parts of the state had a more variable distribution and were more sensitive to the expected annual swing of one standard deviation. On the basis of statistical probabilities, these areas can expect summers of more severe moisture deficiencies to occur more often than in the rest of the state. (Author's abstract)
W91-03428

IMPACT OF GLOBAL WARMING AND COOLING ON MIDWESTERN AGRICULTURE.
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 5C.
W91-03429

ATMOSPHERIC RESPONSE TO 1988 DROUGHT CONDITIONS AND FUTURE CLIMATE IMPLICATIONS.
Iowa State Univ., Ames. Dept. of Agronomy.
M. D. McCorcle.
Journal of the Iowa Academy of Science JIASEB, Vol. 97, No. 3, p 84-87, September 1990. 6 fig, 10 ref. Iowa Agriculture and Home Economics Experiment Station Project 2804.

Descriptors: *Agricultural hydrology, *Climatic changes, *Climatology, *Drought effects, *Global warming, *Iowa, *Meteorology, *Precipitation, *Weather forecasting, Air temperature, Atmospheric circulation, Drought, Greenhouse effect, Model studies, Rainfall distribution, Soil moisture.

Plentiful precipitation in the central United States is one of the basic components of the successful agricultural industry in the Corn Belt. A combination of moisture, wind, and topographic factors creates an ideal condition for rainfall over most of the region during the late spring and early summer. In 1988, many ingredients necessary for wet weather were absent. The region experienced a drought unequalled since the 1930s. The drought of 1988 demonstrated that the symptom of drought, namely, dry soils, can exacerbate and even perpetuate drought conditions by decreasing available moisture, altering circulation patterns vital to storm development, and increasing air temperatures. Models that predict future climate change, forecast that dry conditions, such as those in 1988, will become more prevalent in the future 'greenhouse' atmosphere of the central United States. Many of the smaller-scale effects, which were important in perpetuating the drought of 1988, could not be anticipated from these poor-resolution climate models. Therefore, great care should be taken in interpreting these forecast results. (Author's abstract)
W91-03430

CLIMATE CHANGE AND THE POTENTIAL IMPACT ON THE SOIL RESOURCE.
Agricultural Research Service, Ames, IA.
J. L. Hatfield.
Journal of the Iowa Academy of Science JIASEB, Vol. 97, No. 3, p 82-83, September 1990. 15 ref.

Descriptors: *Agriculture, *Climatic changes, *Global warming, *Hydrologic cycle, *Soil management, *Soil water, Air temperature, Atmosphere, Atmospheric chemistry, Greenhouse effect, Nutrients, Precipitation, Resources management, Water use efficiency.

Climatic change will lead to changes in atmospheric carbon dioxide concentrations, temperature, and precipitation. There have been many predictions of the effect of climatic change on plant growth, but none on soil parameters or water use. To fully understand the implications of climatic change on soil management, the expected changes in soil temperature, water use, and water and nutrient use efficiency need quantification. The agricultural community is concerned today about sustainable agriculture. One of the key variables in sustainable agriculture systems is the soil. A changing climatic regime dictates that we understand how the parameters affecting the soil interface with a sustainable agriculture system. (Fish-PTT)
W91-03431

FACTORS ASSOCIATED WITH DISTRIBUTION OF RAINFALL IN THE GALILEE, ISRAEL.
Haifa Univ. (Israel). Dept. of Geography.
H. Kutiel.
Pirineos: Revista de Ecologia de Montana PRNOAJ, Vol. 134, p 41-58, 1989. 8 fig, 5 tab, 15 ref.

Descriptors: *Hydrologic models, *Israel, *Orography, *Rainfall distribution, *Regression analysis, Altitude, Latitudinal studies, Orographic precipitation, Spatial distribution.

Monthly totals from 30 stations in the Galilee, Israel, for 20 rainfall seasons (1960/61-1979/80) were regressed against the longitude, the latitude, and the altitude of the stations. The distribution of the order of entrance into the multiple regression model of the different independent variables resembles previous results for averaged data over the entire period. The results highlight a coherent period in terms of similar factors affecting the spatial rainfall distribution during February and March. Despite the fact that the orography is the main factor affecting the spatial rainfall distribution in the Galilee, during extremely wet periods (months or seasons) the spatial distribution is related more to the distance from the sea than to the altitude. (Author's abstract)
W91-03434

PRECIPITATION CHEMISTRY: ATMOSPHERIC LOADINGS TO THE SURFACE WATERS OF THE INDIAN RIVER LAGOON BASIN BY RAINFALL.
Bionetics Corp., Cocoa Beach, FL.
For primary bibliographic entry see Field 2K.
W91-03440

EFFECT OF AIR POLLUTION CHEMICAL COMPONENTS ON THE ACIDITY OF RAIN WATER IN JAPAN.
Kobe Women's Coll. of Pharmacy (Japan).
For primary bibliographic entry see Field 5B.
W91-03464

USE OF COOPERATIVE WEATHER STATION DATA IN CONTEMPORARY CLIMATE RESEARCH.
Illinois State Water Survey Div., Champaign. Climate and Meteorology Section.
P. J. Lamb, and M. B. Richman.
Transactions of the Illinois Academy of Science TISAAH, Vol. 83, No. 1/2, p 70-81, 1990. 5 fig, 17 ref. NSF Grants ATM 83-12653 and 85-20877.

Descriptors: *Climatic data, *Climatology, *Meteorological data collection, *Precipitation mapping, *Weather data collections, Canada, Climatic changes, Correlation analysis, Networks, Prediction, Regional analysis, Spatial distribution.

Daily precipitation observations made at thousands of cooperative weather stations in the central U.S. and southern Canada during the May-August periods of 1949-1980 were distilled into a set for a grid-like network of 557 locations which were used to delineate areas of spatial precipitation coherence for a range of time scales and periods. This delineation was achieved by applying a variety of eigenvectorial techniques and correlation analysis to network station totals for 3, 7, 15, 30, 41, and 61 day periods. All analyses were performed for May-August as a whole; those for 3 day periods were also conducted on a half-monthly basis. The resulting regionalizations of the vast study domain into smaller areas of precipitation coherence were compared. The regionalizations seem particularly relevant to the predictive crop yield modeling that is now routinely performed for the growing season of the central U.S.; modelers are uncertain about the number, morphology, and spatial representativeness of the regions for which individual models should be utilized. Because the regionalizations also hold for the 3 day time scale, they may also have utility for the 48-96 hour prediction of precipitation. A related potential application is in studies of climatic change over the last 100-150 years. The spatial variation in the extent to which the 3-7 day regionalization changes as the precipitation totalling period is extended to 15, 30, 41, and 61 days provides a framework for investigating how short-period weather variations integrate to climate fluctuations. This study illustrates the great value of the voluntary observers who operated the cooperative weather stations. (Author's abstract)
W91-03503

IMPACT OF SEA SURFACE TEMPERATURE ANOMALIES ON THE RAINFALL OVER NORTHEAST BRAZIL.
California Univ., Los Angeles. Dept. of Atmospheric Sciences.
C. R. Mechoso, S. W. Lyons, and J. A. Spahr.
Journal of Climate JLCLEL, Vol. 3, No. 8, p 812-826, August 1990. 16 fig, 18 ref.

Descriptors: *Climatology, *Meteorology, *Temperature effects, *Water temperature, *Weather patterns, Atlantic Ocean, Marine climates, Northern Hemisphere, Pacific Ocean, Precipitation, Sea breezes, Weather, Wind.

The response of the tropical atmosphere to the sea surface temperature anomalies in the Northern Hemisphere spring of 1984 was investigated. The methodology for investigation consisted of comparing simulations with and without the global distribution of sea surface temperature anomalies in the boundary conditions of the UCLA General Circulation Model. At low levels, the response included weaker southeast trade winds over the Atlantic, increased precipitation off the northeast coast of Brazil, and reduced precipitation west of this region. The increased precipitation was due to enhanced convergence of moisture advected by the southeast trade winds, although the trades themselves were weaker. The results of the western equatorial Atlantic were in apparent agreement with the observed anomalous southern migration of the ITCZ in years with warm sea surface anomalies in the southern tropical Atlantic. There were strong anomalous trade winds over the Pacific extending east of the date line and weak wind anomalies over the maritime continent, in broad agreement with the observed. The sensitivity of the simulated atmospheric response over an ocean basin to using the sea surface temperature anomalies confined to the basin or in the global ocean was analyzed. It was found that there could be notable local differences in the results obtained using those procedures. In particular, the simulation with the sea surface temperature anomalies confined to the Pacific showed weak anomalous trade winds over the western part of this ocean basin and strong westerly anomalies over the maritime continent unlike that with the anomalies in the global ocean. (Author's abstract)
W91-03522

SEA LEVEL AND RAINFALL CORRELATIONS IN AUSTRALIA: TROPICAL LINKS.
Flinders Inst. for Atmospheric and Marine Sciences, Bedford Park (Australia).
R. J. Allan, K. Beck, and W. M. Mitchell.
Journal of Climate JLCLEL, Vol. 3, No. 8, p 838-846, August 1990. 5 fig, 60 ref.

Descriptors: *Australia, *Climatology, *El Nino/Southern Oscillation, *Meteorology, *Rainfall distribution, *Sea level, Seasonal variation, Temperature effects, Water temperature, Weather patterns, Wind.

A preliminary study was made of simultaneous and lagged seasonal cross correlations between northern Australian sea level and district rainfall anomalies. Zero-lagged patterns showed strong links with the El Nino/Southern Oscillation phenomenon over northern and eastern Australia during austral winter-spring seasons. These findings were similar to, but more robust than, those reported for simultaneous cross correlations between Australian district rainfall and either the southern oscillation index. Darwin mean sea level pressure, or northern Australian seas surface temperatures. This appeared to be a consequence of the strong integrating response of northern Australian sea levels, particularly to inverse barometric and wind forcings on seasonal time scales. Such relationships were explored further in lagged cross correlations. As observed in other studies of seasonal persistence associated with El Nino/Southern Oscillation and anti-El Nino/Southern Oscillation phases, rainfall precursors extend in time from one to two seasons. However, significant seasonal cross correlations were found at longer intervals, reflecting the marked sea level response to the often observed anti-El Nino/Southern Oscillation to El Nino/Southern Oscillation sequence of the phenomenon. In particular, austral spring sea levels in northern Australia were negatively correlated with the following austral winter rainfall over parts of northern and south-southeastern Australia. At present an operational evaluation of precursors must await the installation of new telemetering tide gauges in northern Australian ports. (Author's abstract)
W91-03523

EIGHT-MONTH SAMPLE OF MARINE STRATOCUMULUS CLOUD FRACTION, ALBEDO, AND INTEGRATED LIQUID WATER.
Pennsylvania State Univ., University Park. Dept. of Meteorology.
C. W. Fairall, J. E. Hare, and J. B. Snider.
Journal of Climate JLCLEL, Vol. 3, No. 8, p 847-864, August 1990. 16 fig, 1 tab, 28 ref. NASA grant NAG 1-652.

Descriptors: *Albedo, *Cloud cover, *Cloud liquid water, *Meteorological data collection, *Meteorology, Clouds, Data collections, Irradiation, Weather.

As part of the First International Satellite Cloud Climatology Regional Experiment, a surface meteorology and shortwave/longwave irradiance station was operated in a marine stratocumulus regime on the northwest tip of San Nicolas Island off the coast of Southern California. Measurements were taken from March through October 1987, including a First International Satellite Cloud Climatology Regional Experiment Intensive Field Operation held in July. Algorithms were developed to use the longwave irradiance data to estimate fractional cloudiness and to use the shortwave irradiance to estimate cloud albedo and integrated cloud liquid water content. Cloud base height is estimated from computations of the lifting condensation level. The algorithms are tested against direct measurements made during the Intensive Field Operation; a 30% adjustment was made to the liquid water parameterization. The algorithms were then applied to the entire database. The stratocumulus clouds over the island were found to have a cloud base height of about 400 m, an integrated liquid water content of 75 g/sq m, a fractional cloudiness of 0.95, and an albedo of 0.55. Integrated liquid water content rarely exceeds 350 g/sq m and albedo rarely exceeds 0.90 for stratocumulus clouds. Over the summer months, the average cloud fraction shows a maximum at sunrise of 0.74 and a minimum at sunset of 0.41. Over the same period, the average cloud albedo shows a maximum of 0.61 at sunrise and a minimum of 0.31 a few hours after local noon (although the estimate is more uncertain because of the extreme solar zenith angle). The use of joint frequency distributions of fractional cloudiness with solar transmittance or cloud base height to classify cloud types appears to be useful. (Author's abstract)
W91-03524

PREDICTION OF NORTHEAST BRAZIL RAINFALL ANOMALIES.
Wisconsin Univ.-Madison. Dept. of Meteorology.
S. Hastenrath.
Journal of Climate JLCLEL, Vol. 3, No. 8, p 893-904, August 1990. 6 fig, 5 tab, 21 ref. NSF grant ATM-8722410.

Descriptors: *Climatology, *Meteorology, *Rainfall index, *Weather forecasting, Brazil, Data collections, Meteorological data collection, Precipitation, Rainfall, Seasonal variation, Temperature effects, Water temperature.

Expanding on earlier research, empirically based methods were developed for predicting March-September rainfall in northern Northeast Brazil. From a network of 27 raingage stations in Brazil's Nordeste, new rainfall index series were constructed for March-September and October-January. Data input to stepwise multiple regression models further included January values of the Tahiti minus Darwin pressure index, an index of sea surface temperature in the equatorial Pacific, and indices of the fields of meridional and zonal wind components and of sea surface temperature in the tropical Atlantic between 30 deg N and 30 deg S. Empirical orthogonal function analysis of the meridional and zonal wind components and sea surface temperature fields was used in construction the latter three indices. Throughout the study, a sharp distinction was kept between a dependent dataset (1921-42 and 1948-57) used as a training period and an independent portion of the record (1958-87) reserved for prediction experiments. Preseason rainfall was by far the most powerful predictor, allowing 52% of the interannual March-September variance in an independent dataset to be forecast. From experiments with unrestricted data input, a model with the predictors October-January, indices of the field of meridional wind components, and the index of sea surface temperature in the equatorial Pacific showed the best performance, capturing 71% of the March-September variance in the independent dataset. Experiments on the optimal length of the training period suggest that one of 20-30 years was adequate. Updating offers no advantage over a fixed training period. For the purposes of operational application, the maintenance and timely processing of raingage measurements was of paramount importance. The next important task, demanding considerably greater resources, would be the real-time monitoring of the surface wind field over the tropical Atlantic. (Author's abstract)
W91-03525

COMPUTATION OF THE INSTANTANEOUS UNIT HYDROGRAPH AND IDENTIFIABLE COMPONENT FLOWS WITH APPLICATION TO TWO SMALL UPLAND CATCHMENTS.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
For primary bibliographic entry see Field 2E.
W91-03553

GREAT STORM OF 15/16 OCTOBER 1987: PASSIVE MICROWAVE EVALUATIONS OF ASSOCIATED RAINFALL AND MARINE WIND SPEEDS.
Bristol Univ. (England). Dept. of Geography.
E. C. Barrett, C. Kidd, J. O. Bailey, and C. G. Collier.
Meteorological Magazine MTMGA5, Vol. 119, No. 1418, p 177-187, September 1990. 7 fig, 2 tab, 22 ref.

Descriptors: *Data acquisition, *Meteorology, *Microwaves, *Rainfall, *Satellite technology, *Storms, *Wind velocity, England, Meteorological data, Microwave imagery, Rainfall distribution, Rainfall rate, Weather patterns.

Analyses of the Special Sensor Microwave Imager (SSM/I) data for the British Isles and surrounding waters from 15-16 October 1987 were performed. SSM/I carried by current US military meteorological satellites has proven capabilities for the evaluation of several weather-related parameters, including instantaneous rain areas and rain rates, and marine wind speeds. The highest wind speeds appeared in the Bay of Biscay, reaching over 61 kn in places, for the storm of 15-16 October 1987. High speeds were evident in some windward coastal regions, including the west coast of France, the Strait of Dover, and even parts of the west coast of Norway. Application of an SSM/I rainfall algorithm indicated that instantaneous rain rates were as high as 64-128 mm/h southwest of Cornwall, and even higher over Spain. The SSM/I algorithm was successful in depicting the rain in areas beyond the limits of radar coverage. The percentage correspondence between FRONTIERS radar and microwave rain/no rain pixels was 80% for the period from 13 to 19 October, 1987. It is concluded that the SSM/I instrument has clear potential for the monitoring of both rainfall and wind speeds over the British Isles region, especially over water. (MacKeen-PTT)
W91-03559

HEAVY MESOSCALE SNOWFALL EVENT IN NORTHERN GERMANY.
For primary bibliographic entry see Field 2C.
W91-03560

USE OF OPERATIONAL 0-6 AND 3-9 H QUANTITATIVE PRECIPITATION FORECASTS FOR PREDICTING HEAVY RAIN EVENTS.
National Weather Service, Silver Spring, MD. Techniques Development Lab.
J. P. Charba, and J. T. Moeller.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-103946/AS. Price codes: AO3 in paper copy, AO1 in

microfiche. June 1989. 36p, 20 fig, 7 tab, 11 ref.

Descriptors: *Meteorology, *Precipitation, *Weather forecasting, Isohyets, Rainfall forecasting, Statistical analysis.

New 0-6 and 3-9 h objective quantitative precipitation forecasts (OBJ) for the coterminous United States have been recently implemented in the National Weather Service. The forecasts are issued in the form of isohyets of both the maximum point precipitation amount and the probability of equalling or exceeding specific amounts in 40 x 40 n mi boxes. After taking into account differences in the event forecast, the performance of the isohyetical maximum amounts were compared with manual and model-generated quantitative precipitation forecasts (QPF's) issued 2-12 h earlier from the National Meteorological Center (NMC). Results show the accuracy of the OBJ forecasts was substantially better than the longer range NMC QPF's, particularly for the heavier amounts. The utility of the OBJ probability forecasts was also considered. The probabilities exhibit good statistical reliability, particularly where sample sizes are adequate. Also, several examples of very heavy rainstorms indicate the probabilities can be used to express confidence in the predicted isohyets and to assess the overall magnitude of the precipitation event. It is concluded that the isohyetical OBJ forecasts are a useful update of other centralized QPF's and that the probabilities add a useful measure of confidence to the predicted isohyets. (Author's abstract)
W91-03576

CASE STUDY EVALUATION OF SATELLITE-DERIVED RAINFALL ESTIMATES AND THEIR APPLICATION TO NUMERICAL MODEL PRECIPITATION FORECAST VERIFICATION.
National Weather Service Forecast Office, Milwaukee, WI.
G. A. Field.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-194591/AS. Price codes: A05 in paper copy, A01 in microfiche. May 1989. 77p, 32 fig, 4 tab, 50 ref.

Descriptors: *Climatology, *Meteorology, *Precipitation mapping, *Satellite technology, *Weather forecasting, Model studies, Performance evaluation, Verification studies.

Satellite-derived precipitation estimates are computed and then evaluated using a dense network of cooperative observer rain gage reports as the verification. The satellite rainfall estimates are produced every half hour for the 24-hour period starting 1200 GMT, July 20, 1981. They are computed using the operational Scofield-Oliver Convective Rainfall Estimation Technique on the University of Wisconsin's Man-Computer Interactive Data Access System (McIDAS). The McIDAS analysis procedure provides estimate values assigned to grid points spaced 22 km apart. The rainfall observations, however, are at irregularly located positions. In order to be able to objectively evaluate the estimates, the observations are interpolated to the same grid points as the estimates using a minimum of smoothing. Difference fields then are evaluated. The numerical model evaluated is an Australian mesoscale model referred to as the Subsynoptic Scale Model (SSM). The results show that the satellite estimates compare very favorably with the observations, especially with regard to location of rainfall maxima. It is shown that the orientation of the maxima and minima axes in the contoured estimate field is in good agreement with the observations and radar reports. As would be expected, this agreement improves with higher amounts of smoothing. Some displacement errors are observed and it is shown how small location errors can lead to large errors in a gridded difference field. By using satellite estimates as part of the SSM model verification, this study suggests a new application for the use of the Scofield-Oliver technique. Unfortunately, the SSM model fails to accurately predict convective precipitation in this case study. It's forecast precipitation area is too far to the north and the amounts are much too small. Nevertheless, the feasibility of using satellite estimates to verify the model is demonstrated. It is shown that the potential exists for operational numerical (mesoscale) modeling to benefit by having such satellite verification information for precipitation which can be produced in near real-time. (Author's abstract)
W91-03600

DETERMINATION OF AN UPPER LIMIT DESIGN RAINSTORM FOR THE COLORADO RIVER BASIN ABOVE HOOVER DAM.
Morrison-Knudsen Engineers, Inc., Denver, CO.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB91-104562. Price codes: A07 in paper copy, A07 in microfiche. September 1990. 129p, 82 fig, 30 tab, 44 ref, 2 append. Bureau of Reclamation Contract 5-CA-30-02880.

Descriptors: *Colorado River Basin, *Data interpretation, *Design storms, *Model studies, *Rainfall forecasting, *Rainfall rate, *Rainfall-runoff relationships, Computer programs, Glen Canyon Dam, Hoover Dam, Meteorology, Net rainfall, Orographic precipitation, Rainfall area, Simulated rainfall, Spatial distribution, Temporal distribution, Topography.

Storms over the Southern Intermountain Region were reviewed to determine the cause of large rainfall amounts for the May through October season. Rainfall amounts from the largest storms were analyzed using a Bureau of Reclamation mini-storm computer program to determine DAD (depth-area-duration) values. These DAD data formed the basis for the development of the magnitude of the ULDRS (Upper Limit Design Rain Storm) for the Colorado River Basin above Hoover Dam. For this basin, rainfall magnitude is influenced by topography, and an ULDRS magnitude is required for each storm centering. Review of the data from storms indicated that one storm centering on the San Juan Mountains was characteristic for the basin above Glen Canyon Dam. A storm centering on the Pine and Cedar Mountains was characteristic of the basin between Hoover and Glen Canyon Dams. The ULDRS magnitude was determined for these two locations with individual storm spatial and temporal distributions provided. The magnitude and time interval required for storms to recur at these locations was needed. Review of large storms over the basin indicated an interstorm interval increasing from 7 days in midsummer and fall to more than 10 days in the spring would permit the ULDRS to recur. Lesser events could occur with lesser time intervals. (Author's abstract)
W91-03664

TEMPORAL CHANGES IN HEAVY RAINFALL FREQUENCIES IN THE GREAT LAKES BASIN.
Illinois State Water Survey Div., Champaign.
F. Huff, and J. Angel.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 129-135, 4 fig, 3 tab, 6 ref.

Descriptors: *Great Lakes, *Illinois, *Lake management, *Rainfall distribution, *Water level fluctuations, *Water resources management, Climatic changes, Frequency analysis, Frequency distribution, Indiana, Lake Michigan, Michigan, Rainfall intensity, Spatial analysis, Wisconsin.

Analyses of heavy rainstorm data from 61 stations in Illinois during 1901-80 have indicated an increasing trend in the frequency distribution of heavy storms over most of the state since 1940. The increase has been most pronounced in northeast Illinois which borders on Lake Michigan. Evidence of a climatic fluctuation, exhibiting trends upward in the north and downward in the southern part of Illinois, was most evident in the comparison of frequency distributions derived from two 40-year samples and supported considerably by the 20-year trend analyses. Preliminary findings for other lake-bordering states indicate the Illinois high extends across the lake into southwest Michigan, eastward into northwest Indiana, and northward into southern and southeast Wisconsin. Thus, there is continuity in spatial patterns indicated, and a substantial increase in the frequency and intensity of heavy rainstorms is indicated in some portions of the lake-bordering states. These increases appear to be greater than expected from natural climatic variability, and sufficiently large to have implications in water structure designs. (See also W91-03672) (Author's abstract)
W91-03686

STOCHASTIC MODEL OF THE INTERNAL STRUCTURE OF CONVECTIVE PRECIPITATION IN TIME AT A RAINGAUGE SITE.
Universidad Politecnica de Valencia (Spain). Dept. of Hydraulic and Environmental Engineering.
R. Garcia-Bartual, and J. Marco.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 129-142, October 1990. 9 fig, 2 tab, 14 ref.

Descriptors: *Convective precipitation, *Hydrologic models, *Model studies, *Precipitation, *Rainfall intensity, *Statistics, *Stochastic models, *Storms, *Time series analysis, Algorithms, Probable maximum precipitation, Rain gages, Spain, Synthetic hydrology.

Analyses of stochastic structures of precipitation usually center on two distinct problems, the internal and external structures. Internal structure concerns the within-the-storm intensity, while external structure analyzes sequences of precipitation storms. Hyetographs of extreme convective precipitation were modeled in terms of a marked finite point process of convective cell arrivals, each point or occurrence in time representing the birth of a cell. Rain intensity resulting from the activity of each of these cells is assumed to have a gamma-type function shape with peak intensity and volume being random variables. The model has been tested with data from maximum storms during the period 1940-1985 at two sites on the Mediterranean coast of Spain: Valencia and Alicante. The proposed temporal structure showed good agreement with the observed series at the smaller scales (increments of 10 min), and the most characteristic temporal patterns in internal structure of precipitation were adequately described. Simple generation algorithms according to this formulation allow generation of synthetic series. (Author's abstract)
W91-03744

SAMPLING ERRORS FOR RAINGAUGE-DERIVED MEAN AREAL DAILY AND MONTHLY RAINFALL.
Hydrological Research Inst., Pretoria (South Africa).
A. W. Seed, and G. L. Austin.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 163-173, October 1990. 7 fig, 1 tab, 15 ref.

Descriptors: *Areal precipitation, *Convective precipitation, *Data interpretation, *Error analysis, *Meteorology, *Network design, *Rain gages, Meteorologic data, Parametric hydrology, Precision, Rainfall area, Variability.

The accuracy of rain gage derived mean areal rainfall needs to be understood before gage data can be used as ground truth for satellite and radar rainfall measuring systems. Radar data from two geographic locations were used to simulate the mean standard error in using a sparse rain gage network to estimate daily and monthly mean areal convective rainfall over areas ranging from 45,000 to 180,000 sq km. It was found that a network with a regular configuration gave somewhat less-variable errors than the random rain gage network, although the mean errors were very similar. The difference became more pronounced for the very sparse networks. The mean standard error for a particular network and rainfield was found to be a function of the number of gages in the network, the raining fraction of the area and the ratio of the standard deviation over the mean of the non-zero portion of the rainfield. A simple three-parameter relationship was proposed to relate the mean standard error, expressed as percentage of the mean areal rainfall, to these variables. It was found that a

single relationship was able to explain 63% of the variability in the estimated mean standard estimation error, combining data from both regions. Finally, the domain over which the relationship is able to make reasonable predictions is determined by the principle constraint of limiting the raining fraction of the area to 0.5 for networks with >200 rain gages. (Author's abstract) (Fish-PTT)
W91-03746

PARAMETER TRANSFERABILITY FOR A DAILY RAINFALL DISAGGREGATION MODEL.
National Weather Service, Johnson City, NY.
T. W. Econopouly, D. R. Davis, and D. A. Woolhiser.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 209-228, October 1990. 6 fig, 11 tab, 13 ref.

Descriptors: *Climatology, *Hydrologic models, *Local precipitation, *Model studies, *Parametric hydrology, *Rainfall, *Statistical analysis, Data interpretation, Rain gages, Simulation analysis, Stochastic models.

Methods that use readily-available daily rainfall data to stochastically simulate short-time period rainfall have been developed. At least two methods of disaggregating daily rainfall into shorter time periods exist in the literature: the discrete-discrete (D-D) and the discrete-continuous (D-C). The D-C method disaggregates the discrete daily rainfall process into a continuous process of wet periods (showers) and dry periods within a day, and appears to require fewer parameters than the D-D process. The D-C model was modified and applied to data from two midwestern stations in the U.S. Statistical tests indicate that the number of showers, the start times, shower depths, and shower durations of simulated sequences compare favorably with observed sequences, and that the disaggregation model parameters identified at one gage provide a satisfactory fit for three test stations up to 470 km away, provided the test stations are in the same climatological region. (Author's abstract)
W91-03749

INTERCEPTION, THROUGHFALL AND STEMFLOW IN A FOREST IN HIGHLAND SCOTLAND AND THE COMPARISON WITH OTHER UPLAND FORESTS IN THE U.K.
Institute of Hydrology, Balquhidder, Lochearnhead FK19 8PQ, Scotland.
For primary bibliographic entry see Field 2I.
W91-03753

INFLUENCE OF MOUNTAINS ON LARGE-SCALE PRECIPITATION: A DETERMINISTIC APPROACH TOWARDS OROGRAPHIC PMP.
Vienna Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
T. Haiden, P. Kahlig, M. Kerschbaum, and F. Nobilis.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 5, p 501-510, October 1990. 5 fig, 1 tab, 18 ref.

Descriptors: *Areal precipitation, *Meteorology, *Mountains, *Orographic precipitation, *Probable maximum precipitation, *Rainfall forecasting, Austria, Cloud physics, Mathematical analysis, Mathematical models, Precipitation rate.

Probable maximum precipitation (PMP) is the greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of the year. This definition points to the importance of taking into account the synoptic and orographic boundary conditions for investigations of PMP. A physical approach was chosen to estimate orographic precipitation. Based on a balance equation for cloud water and on a kinematic model of air flow over mountains, the distribution of cloud water and precipitation rate is calculated for specified (but arbitrary) inflow conditions and orography. In contrast to comparable models in which the whole condensed water falls out, cloud physical parameters control the efficiency of precipitation formation. These results which concern the problems of precipitation enhancement by terrain-induced vertical motion are a first step toward new considerations regarding Probable Maximum Floods. For an alpine country like Austria, the development of a hierarchy of concepts, using deterministic model physics and a digital terrain representation, appear appropriate. A comparison of model results with observations using inflow data from measurements during actual precipitation episodes in Austria revealed basic similarities between observed patterns and the main structure of the simulated distribution. The basic features of the model are consistent extensions of WMO recommendations. (Hoskin-PTT)
W91-03841

COMPARISON OF OBJECTIVE AND SUBJECTIVE PRECIPITATION PROBABILITY FORECASTS: THE SUFFICIENCY RELATION.
Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
A. H. Murphy, and Q. Ye.
Monthly Weather Review MWREAB, Vol. 118, No. 9, p 1783-1792, September 1990. 8 fig, 2 tab, 20 ref. NSF Grant ATM-8714108.

Descriptors: *Data interpretation, *Forecasting, *Meteorology, *Precipitation, *Precipitation forecasting, *Rainfall forecasting, *Weather forecasting, Comparison studies, Mathematical analysis, Probabilistic process.

The sufficiency relation is used to compare objective and subjective probability of precipitation (PoP) forecasts. The theoretical significance of the sufficiency relation in comparative evaluation arises from the fact that if it can be shown that forecasting system A is sufficient for forecasting system B, then A's forecasts are necessarily of higher quality and greater value to all users than B's forecasts. However, since the sufficiency relation is an incomplete order, the practical significance of this relation warrants further investigation. An operational method of comparing forecasting systems using the sufficiency relation has recently been described in the forecasting literature. This method involves the construction of a so-called forecast sufficiency characteristic (FSC) for each forecasting system, based on a representative set of forecasts and observations. In terms of this characterization, system A is sufficient for system B if A's FSC is superior to B's FSC. Objective and subjective PoP forecasts for six National Weather Service offices are compared in terms of their respective FSCs. Sufficiency was found in only two of the 24 cases defined by various combinations of forecast office, season, and lead time. In these two cases, both involving 12-24 hour forecasts, the subjective forecasts were sufficient for the objective forecasts. Several other cases exhibited a condition described as 'almost sufficient', but caution must be exercised in drawing conclusions regarding the relative quality and/or relative value of forecasts in such cases. Comparison of the FSCs of PoP forecasts and the FSCs of categorical forecasts derived from the PoP forecasts reveals that, as expected, the former are always superior to the latter. (Author's abstract)
W91-03850

SINGLE-DOPPLER OBSERVATIONS OF A WEST AFRICAN SQUALL LINE ON 27-28 MAY 1981 DURING COPT 81: KINEMATICS, THERMODYNAMICS AND WATER BUDGET.
Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
For primary bibliographic entry see Field 7B.
W91-03851

EFFECTS OF CLIMATIC CHANGE ON THE THORNTHWAITE MOISTURE INDEX.
Geological Survey, Trenton, NJ.
G. J. McCabe, D. M. Wolock, L. E. Hay, and M. A. Ayers.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 633-643, August 1990. 11 fig, 1 tab, 18 ref.

Descriptors: *Air pollution effects, *Climatic changes, *Climatology, *Global warming, *Moisture index, *Precipitation, *Thornthwaite Moisture Index, *United States, Atmospheric chemistry, Atmospheric circulation, Carbon dioxide, Evapotranspiration, Meteorology, Model studies, Temperature effects.

The Thornthwaite moisture index is a useful indicator of the supply of water (precipitation) in an area relative to the demand for water under prevailing climatic conditions (potential evapotranspiration). The study examines the effects of changes in climate (temperature and precipitation) on the Thornthwaite moisture index in the conterminous United States. Estimates of changes in mean annual temperature and precipitation for double-atmospheric CO2 conditions derived from three general circulation models (GCMs) are used to study the response of the moisture index under steady-state doubled-CO2 conditions. Results indicate that temperature and precipitation changes under doubled-CO2 conditions generally will cause the Thornthwaite moisture index to decrease, implying a drier climate for most of the United States. The pattern of expected decrease is consistent among the three GCMs, although the amount of decrease depends on which GCM climatic-change scenario is used. Results also suggest that changes in the moisture index are related mainly to changes in the mean annual potential evapotranspiration as a result of changes in the mean annual temperature, rather than to changes in the mean annual precipitation. (Author's abstract)
W91-03858

VEGETATION AND CLIMATE OF THE LATE CAINOZOIC IN THE MURRAY BASIN AND THEIR BEARING ON THE SALINITY PROBLEM.
New South Wales Univ., Kensington (Australia). School of Biological Sciences.
For primary bibliographic entry see Field 2A.
W91-03903

2C. Snow, Ice, and Frost

LABORATORY STUDY ON THE SCAVENGING OF SO2 BY SNOW CRYSTALS.
Mainz Univ. (Germany, F.R.). Meteorological Inst.
For primary bibliographic entry see Field 5B.
W91-03296

COMPUTER SIMULATION OF ICE CONTROL WITH THERMAL-BUBBLE PLUMES: LINE SOURCE CONFIGURATION.
University of Western Ontario, London. Dept. of Civil Engineering.
R. E. Baddour.
Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 4, p 509-513, August 1990. 8 fig, 19 ref.

Descriptors: *Channel maintenance, *Computer models, *Ice breakup, *Ice control, *Simulation analysis, Bubbles, Costs, Navigation channels, Obstructions to navigation, Thermal stratification.

Thermal-bubble plumes in a freshwater environment were studied to determine their ice control capabilities. A computer model was developed to optimize the operation of thermal-bubble installations when designed to control ice. Steady-state ice control simulations would be useful in determining feasible warm water-air combinations required to achieve a specified degree of ice control to maintain navigation channels. The availability and cost of providing warm water and air at the site would ultimately determine the optimal solution. It would generally be more economical to design a system to suppress ice growth and maintain a manageable thickness of ice, than to achieve large, fully open water conditions all the time. Warm water supply may not be required when natural stratification is present or during periods of mild weather. Transient ice control was simulated for the thermal bubbler and a regular bubbler for a 30 day period. The thermal bubbler gave superior ice control in the simulation analysis. Thermal bubble technology may also be applied to thermal and other industrial and municipal discharges into natural water bodies. (Geiger-PTT)

W91-03303

HEAT AND MASS BALANCE OF AN ABLATING ICE JAM.
National Hydrology Research Inst., Saskatoon (Saskatchewan). Northern Hydrology Section.
T. D. Prowse.
Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 4, p 629-635, August 1990. 5 fig, 1 tab, 7 ref.

Descriptors: *Ablation, *Heat budget, *Ice breakup, *Ice jams, *Mathematical studies, Energy, Flood forecasting, Melting, Porosity, Rivers, Theoretical analysis, Water temperature.

The heat and mass balance of an ablating ice jam at the confluence of the Liard and Mackenzie rivers in the spring of 1983 was examined. From May 6 to May 9, sufficient data were collected to determine the magnitude and relative importance of the major heat fluxes that caused thermal decay of the ice jam. The total atmospheric heat input of 125 million MJ and the much larger contribution from hydrothermal sources of 980 million MJ resulted in a total melt of 32.4 million cu m of ice within the jam. These data in combination with previous results regarding jam dimensions permitted calculation of ice jam porosity, a variable frequently used in hydraulic studies of river ice jams although unverified by field data. The largest potential error in the calculations was related to the accuracy of water temperature measurement. Accounting for this resulted in an estimate of porosity of 0.38 + or -10% which lends credence to the commonly assumed value of 0.40. (Author's abstract)
W91-03310

PHOTOHETEROTROPHY AND DARK HETEROTROPHY IN ICE-COVERED LAKE ST. CLAIR.
Windsor Univ. (Ontario). Great Lakes Inst.
For primary bibliographic entry see Field 2H.
W91-03399

HEAVY MESOSCALE SNOWFALL EVENT IN NORTHERN GERMANY.
W. S. Pike.
Meteorological Magazine MTMGA5, Vol. 119, No. 1418, p 187-195, September 1990. 9 fig, 10 ref.

Descriptors: *Germany, *Meteorology, *Precipitation, *Snow, *Snow accumulation, *Storms, Air masses, Cyclones, Eddies, Hamburg, Local precipitation, Vortices, Weather, Weather patterns.

The geographical extent and particular causes of localized heavy snowfalls which occurred near southwest Baltic Sea coasts on the night of 11-12 January 1987 were investigated. A heavy snowfall of between 20 and 70 cm occurred in a 16-hr period along a narrow, sharply defined belt which was, geographically, an extension of the southern Mecklenburg Bight coastline downwind to the west-southwest towards southeastern Hamburg. The orientation of the coastline presented a shallow angle to the onshore wind which was extremely favorable for continuing coastal convergence and uplift between (1) a strong, moist, showery northeasterly airflow over the sea, with air temperatures typically -6 to -10 C, and (2) stagnating, colder overland air near -20 C. A well marked coastal front was formed between the two airflows. The formation of small Baltic Sea warm cyclones intensified the snowfall from time to time, in association with smaller eddy-vortices. The steep cliffs of Rugen Island also provide a natural topographic division of a cold northeasterly airstream, downwind of which the coastal convergence line is likely to form long a marked boundary between fast-flowing and slow-flowing airstreams at low levels. (MacKeen-PTT)
W91-03560

TRACING THE ORIGIN OF NATURAL WATERS IN A GLACIAL TILL SLOPE DURING SNOWMELT.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Land and Water Resources.
B. Espeby.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 107-127, October 1990. 6 fig, 46 ref.

Descriptors: *Flow discharge, *Groundwater movement, *Isotopic tracers, *Oxygen isotopes, *Snowmelt, *Soil water, *Tracers, Chemical properties, Frozen ground, Interstitial water, Iodides, Leaching, Roots, Snow cover, Surface-groundwater relations, Sweden, Vadose zone, Water chemistry.

A study of the origin of water sampled at a set of sampling points in the discharging area of a sloping forested glacial till in Sweden, was performed during the two snowmelts of 1966 and 1987. Analyses of a limited number of chemical components and the oxygen-18 (O-18) content were performed of the sampled water from the snowmelt of 1986. A tracer experiment was performed during the snowmelt of 1987, when potassium iodide was sprayed on top of the snow cover at two surfaces in the discharging area of the slope. The results from both snowmelt studies indicate that macropore channels of old root remains can conduct water rapidly through an unsaturated and frozen matrix without displacing the soil-bound water. Alkalinity and pH values of the macropore water were similar to the snow cores. Even the deeper groundwater from a spring site was affected by the acid surge during the peak snowmelt of 1986, proving that macrostructures present in the till were promoting preferential water movement through the soil matrix. The surge was also detected with the O-18 technique but was not as pronounced as in the values of the chemical components. The tracer experiment gave these results despite the large amount of tracer that was retained in the unsaturated soil matrix. One very important conclusion from this experiment is that iodide should be injected below the humus and the leaching horizons of podsols in order to get good saturated conditions and thereby prevent retention in the matrix. (Author's abstract)
W91-03743

HYDRAULIC PROPERTIES IN AN OPERATIONAL MODEL OF FROZEN SOIL.
Uppsala Univ. (Sweden). Naturgeografiska Inst.
L. C. Lundin.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 289-310, October 1990. 10 fig, 1 tab, 42 ref.

Descriptors: *Frost, *Frozen ground, *Model studies, *Soil physical properties, *Soil water, Clays, Freezing, Hydraulic conductivity, Ice lenses, Impedance, Interstitial water, Loam, Soil moisture retention, Soil structure, Soil temperature.

Many current models of heat and water flow in frozen soils overestimate the freezing-induced redistribution of water. These models also treat the soil physical properties as constant in time although they are strongly influenced by the frost itself. A study was conducted to determine possible methods to overcome these two problems in an operational hydraulic model. Winter measurements of soil temperature and water content were performed on a clay soil and on a layered loam soil. The data were compared with simulations made with a physically-based, one-dimensional model of coupled heat and water flow. Two procedures were tested for the calculation of hydraulic conductivity of partially frozen soil: firstly, an interpolation procedure, taking into account the strong nonlinearity of the hydraulic conductivity function close to the freezing front. Secondly, an impedance parameter was used to describe the effect of ice lenses. A spring time modification of the soil moisture characteristic curve was tested to account for the frost-induced changes of the soil structure. Simulated temperatures and water contents agreed well with measurements, both for the clay and the layered loam soil, after introduction of the impedance parameter. The alternative procedure did not only reduce the hydraulic conductivity of the frozen soil sufficiently to produce a realistic redistribution, but also enabled use of a lower value on the impedance parameter. Changes in water retention properties resulting from frost action during winter caused an overestimation of simulated water content of 15% by volume in the heavy clay soil during spring. This discrepancy was eliminated by increasing the frequency of pore diameters below 0.1 mm in the model during spring. (Author's abstract)
W91-03754

EFFECTS OF CO 2-INDUCED CLIMATIC CHANGES ON SNOWPACK AND STREAMFLOW.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 4C.
W91-03842

COMPARISON OF DIFFERENT STRUCTURES FOR A MONTHLY WATER YIELD MODEL IN SEASONALLY SNOW-COVERED MOUNTAINOUS WATERSHEDS OF IRAN.
Katholieke Univ. Leuven (Belgium). Lab. for Land Management.
For primary bibliographic entry see Field 2E.
W91-03844

DYNAMICS AND ORIGIN OF SALINE SOILS ON THE SLIMS RIVER DELTA, KLUANE NATIONAL PARK, YUKON TERRITORY.
Calgary Univ. (Alberta). Dept. of Geography.
S. A. Harris.
Arctic ATICAB, Vol. 43, No. 2, p 159-175, June 1990. 13 fig, 12 tab, 67 ref, append.

Descriptors: *Deltas, *Frost, *Frozen soils, *Geochemistry, *Permafrost, *Saline soils, *Slims River, *Soil chemistry, *Yukon, Alaska, Leaching, Salinity, Seasonal variation, Snowmelt, Sulfates.

The saline soils of the Slims River Delta have developed on land formed in the last 100 years in an area of otherwise continuous permafrost. Deep seasonal frost on the delta prevents the downward leaching of salts when the snow melts. Instead, the salts accumulate at the surface as the ground dries, while additional salts are added from springs at the base of the surrounding mountains. Late summer rains can leach the soils if they are sufficiently heavy, producing a 3 to 4 fold variation in salinity from year to year. The efflorescences are dominated by the hexahydrate of magnesium sulfate, and the high sulfate content is probably the reason that soils in depressions with the morphology of solonetzic soils remain reasonably friable. The distribution of the characteristic halophytic plant association found on these soils appears to be controlled more by soil moisture content than by actual salinity level. (Author's abstract)
W91-03865

MOVEMENT OF CRUDE OIL IN AN EXPERIMENTAL SPILL ON THE SEEDS SIMULATED PIPELINE RIGHT-OF-WAY, FORT NORMAN, N.W.T.
Alberta Univ., Edmonton. Dept. of Geography.
For primary bibliographic entry see Field 5B.
W91-03866

WINTER SHORT-PULSE RADAR STUDIES ON THE TANANA RIVER, ALASKA.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 7B.
W91-03868

2D. Evaporation and Transpiration

SIMULATION OF DIURNAL TRANSPIRATION FROM WILLOW STANDS.
Gdansk Technical Univ. (Poland). Inst. of Hyrdotechnics.
For primary bibliographic entry see Field 2I.
W91-03200

WILLOW STAND EVAPORATION: SIMULATION OF DIURNAL DISTRIBUTION USING SYNOPTIC WEATHER DATA.

2E. Streamflow and Runoff

Uppsala Univ. (Sweden). Dept. of Hydrology.
For primary bibliographic entry see Field 2I.
W91-03201

MECHANISM OF EVAPORATION FROM SAND COLUMNS WITH RESTRICTED AND UNRESTRICTED WATER TABLES USING DEUTERIUM UNDER TURBULENT AIR-FLOW CONDITIONS.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
E. Shimojima, A. A. Curtis, and J. V. Turner.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 15-54, September 1990. 19 fig, 1 tab, 20 ref.

Descriptors: *Air-earth interfaces, *Deuterium, *Evaporation, *Sand, *Soil columns, *Water table, Air circulation, Evaporation rate, Isotope studies, Microdistillation, Turbulent flow, Water vapor.

Evaporation experiments from sand columns with restricted and unrestricted water tables were carried out to elucidate the mechanism of evaporation from bare land. Turbulent airflow was applied to the exposed surface layer. The transient development of the deuterium composition of liquid water in the sand columns was measured by a microdistillation technique during the experiments. Turbulent airflow affected the evaporative process of water vapor transfer and the deuterium distribution at relatively shallow depths in the columns. The attainment of a steady evaporation rate and deuterium profile was not obtained in either the restricted or unrestricted water table cases until significant time had elapsed. In the unrestricted water table case, the transient processes of evaporation rate, depth of the evaporation front, water table depth and the development of the deuterium concentration profile show a characteristic behavior that may be described by a similarity solution for part of the experimental duration. Significant enrichment of deuterium occurs in the liquid-vapor region and at the upper zone of the liquid region with time. The isotopic enrichment does not affect the physical process of evaporation of liquid water. Information on the transient development of the deuterium concentration profile is very useful for understanding the nature of liquid water and water vapor movement in the columns, and estimation of the depth of the evaporating front is an important index in bare land evaporation. (Author's abstract)
W91-03541

EXAMINING EVAPOTRANSPIRATION IN A SEMI-ARID REGION USING STABLE ISOTOPES OF HYDROGEN AND OXYGEN.
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Water Resources.
C. D. Walker, and J. P. Brunel.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 55-75, October 1990. 10 fig, 39 ref.

Descriptors: *Australia, *Evapotranspiration, *Isotope studies, *Isotopic tracers, *Semiarid lands, *Tracers, *Vegetation effects, Atmospheric water, Deuterium, Diffusion, Eucalyptus trees, Evaporation control, Leaves, Oxygen isotopes, Soil water, Water vapor.

Daily variation of the isotopic composition, both deuterium and oxygen-18, of water in foliage of a mixed eucalyptus 'mallee' community was studied in relation to the isotopic composition of soil water and atmospheric water vapor, transpiration and evapotranspiration, and environmental conditions. The isotopic composition of water in foliage and the soil surface were enriched over adjacent stem and deeper soil water respectively, characteristic of water subject to evaporation. The composition of foliar water varied systematically over the day, being highest in the late afternoon, in response to lower relative humidity. The foliar water composition fitted a steady-state model of leaf water fractionation. It was found that the fraction of leaf water equilibrated with the atmosphere was at a minimum during the middle of the day, fitting earlier observations. The equilibrated fraction was relatively high compared with previous transpiration studies. The soil water isotope-depth profiles had not achieved steady state. Using existing models, we conclude that the foliage and soil compartments are exchanging water vapor, but that some complicated evaporation processes are occurring in the soil, probably as a result of daily temperature cycling. Examining the relationship of the two isotope tracers in the different compartments, the vapor transport fits a transport model in which it is strongly diffusion-limited, both within the soil and leaf. Because of some uncertainty as to the transport mechanisms involved, it is not clear what the relative contributions from soil and foliage are. The vegetation may be having a considerable influence on the total evaporation from the community, since the effects of the root system on the soil structure and soil water transport are not clear. (Author's abstract)
W91-03740

WATER BALANCE OF SNOW TUSSOCK GRASSLAND IN NEW ZEALAND.
Otago Univ., Dunedin (New Zealand). Dept. of Geography.
D. I. Campbell, and D. L. Murray.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 229-245, October 1990. 8 fig, 4 tab, 18 ref.

Descriptors: *Evapotranspiration, *Grasslands, *Hydrologic budget, *New Zealand, *Vegetation effects, *Water yield, Clouds, Drainage, Evaporation, Fog, Forests, Interception loss, Leaves, Lysimeters, Pastures, Precipitation, Rainfall, Storage capacity, Storms, Transpiration, Watersheds.

The water relations of snow tussock grassland have been debated for many years although there are no published catchment comparisons of pasture and tussock vegetation. Measurements of rainfall, drainage, and weight change of a 6-sq-m surface area cylindrical lysimeter containing nine snow tussocks, were combined in a simple water balance equation to calculate evaporation on an hourly basis for 16 months in Otago, New Zealand. For most of the period it was possible to distinguish evaporation from dry foliage (transpiration), and wet canopy evaporation (interception loss), on the basis of leaf wetness. Mean daily transpiration rates ranged from 0.55 mm/day in June to 3.32 mm/day in January; intercepted water evaporated at a median rate of 0.04 mm/h in winter and on summer nights, and 0.08 mm/h during daylight in summer. Interception storage capacity is about 0.5 mm but relative interception losses are high when there are many small rain events. Horizontal interception of water from fog or cloud contributed about 1% of precipitation for the period examined. For the April-March year, total evaporation was 622 mm and transpiration exceeded interception loss in each month. Annual interception loss was 222 mm, or 21.3% of the total precipitation of 1042 mm. Monthly interception loss varied between 10% and 45% of precipitation and was very dependent on storm size and frequency. Snow tussock may be the optimal vegetation for water yield in this environment: transpiration rates are lower than for pasture and interception losses are less than for forests. (Author's abstract)
W91-03750

PALAEOHYDROGEOLOGY OF THE SENEGAL SEDIMENTARY BASIN: A TENTATIVE EXPLANATION OF THE PIEZOMETRIC DEPRESSIONS.
Ecole Inter-Etats d'Ingenieurs de l'Equipement Rural, Ouagadougou (Burkina Faso).
For primary bibliographic entry see Field 2F.
W91-03758

COMPARISON OF MODELS PREDICTING GROUND WATER LEVELS ON HILLSIDE SLOPES.
Stevens Inst. of Tech., Hoboken, NJ. Dept. of Civil, Environmental and Coastal Engineering.
For primary bibliographic entry see Field 2F.
W91-03860

TRAVELTIME AND REAERATION COEFFICIENTS FOR THE NORTH PLATTE RIVER, CASPER TO ORIN, WYOMING.
Geological Survey, Cheyenne, WY. Water Resources Div.
J. G. Rankl, and M. A. Carnevale.
Available from WY Dept. Environmental Quality; Herschler Bldg., Cheyenne, WY 82002. Wyoming Department of Environmental Quality, Cheyenne, State Cooperative Report, 1989. 34p, 11 fig, 6 tab, 24 ref. Project no. WY090.

Descriptors: *Dye dispersion, *Flow velocity, *North Platte River, *Path of pollutants, *Reaeration, *Streamflow data, *Tracers, *Traveltime, *Wyoming, Dye concentrations, Flow duration, Flow rates.

The opportunities for accidental spills of hazardous wastes into the North Platte River between Casper and Orin, Wyoming, are numerous. Highways, railroads, and pipelines cross and parallel the North Platte River. Treated wastewater from cities, industries, and refineries is discharged to the river. The report describes the movement in water of materials that may be spilled or discharged into the North Platte River. Traveltime and dispersion measurements were made on the North Platte River between Casper and Orin at discharges of 800, 890, and 3,100 cu ft/sec. The rate of movement of soluble material spilled or discharged into the North Platte River can be estimated from graphs developed from the four traveltime measurements. The following traveltime characteristics were developed: traveltime of the center of the tracer cloud as a function of stream discharge, velocity of the leading edge and peak concentration of the tracer cloud in relation to stream discharge, tracer-cloud passage time in relation to distance, and unit-peak concentration as a function of traveltime. On the basis of gas-tracer and dye-tracer data for a stream discharge of 800 cu ft/sec, reaeration coefficients were measured for three reaches of the North Platte River. Measured reaeration coefficients ranged from 4.85 to 6.70/day at 20 C, in base-e logarithm units. Reaeration coefficients computed from empirical equations were compared to reaeration coefficient measured in this study. (USGS)
W91-02959

BASIN CHARACTERISTICS, HISTORY OF STREAM GAGING, AND STATISTICAL SUMMARY OF SELECTED STREAMFLOW RECORDS FOR THE RAPID CREEK BASIN, WESTERN SOUTH DAKOTA.
Geological Survey, Rapid City, SD. Water Resources Div.
D. G. Driscoll, and J. S. Zogorski.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-120, 1990. 147p, 29 fig, 75 tab, 22 ref.

Descriptors: *Rapid Creek Basin, *South Dakota, *Stream gaging, *Surface water data, *Surface-groundwater relations, Basin characteristics.

The report presents a summary of basin characteristics affecting streamflow, a history of the U.S. Geological Survey's stream-gaging program, and a compilation of discharge records and statistical summaries for selected sites within the Rapid Creek basin. It is the first in a series which will investigate surface-water/groundwater relations along Rapid Creek. The summary of basin characteristics includes descriptions of the geology and hydrogeology, physiography and climate, land use and vegetation, reservoirs, and water use within the basin. A recounting of the U.S. Geological Survey's stream-gaging program and a tabulation of historic stream-gaging stations within the basin are furnished. A compilation of monthly and annual mean discharge values for nine currently operated, long-term, continuous-record, streamflow-gaging stations on Rapid Creek is presented. The statistical summary for each site includes summary statistics on monthly and annual mean values,

correlation matrix for monthly values, serial correlation for 1 year lag for monthly values, percentile rankings for monthly and annual mean values, low and high value tables, duration curves, and peak-discharge tables. Records of monthend contents for two reservoirs within the basin also are presented. (USGS)
W91-02968

TIME OF TRAVEL OF SOLUTES IN THE TRINITY RIVER FROM DALLAS TO TRINIDAD, TEXAS, MAY AND AUGUST 1987.
Geological Survey, Austin, TX. Water Resources Div.
W. S. Gain.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-614, 1990. 1 sheet, 3 fig, 1 tab, 4 ref.

Descriptors: *Dye releases, *Solute transport, *Texas, *Tracers, *Traveltime, *Trinity River, Dye tracing, Fluorometry, Path of pollutants, Solutes.

A study of the time-of-travel of solutes in a reach of the Trinity River from Dallas to Trinidad, Texas, was conducted in May and August 1987 using 20% Rhodamine WT dye and fluorometry. Two injections of dye were made--one in each of two subreaches--and tracked at several locations downstream. Discharges on the river ranged from 700 to 1,160 cu ft/sec. Traveltime data are presented with a map of the study reach, dye-concentration plots, and traveltime versus distance plots. The mean velocity of the concentration peak for the upper subreach was 1.18 ft/sec. The mean peak velocity for the lower subreach was 1.02 ft/sec. (USGS)
W91-02969

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO.
Geological Survey, Columbus, OH. Water Resources Div.
G. Koltun, and J. W. Roberts.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4126, 1990. 68p, 3 fig, 23 ref.

Descriptors: *Flood peak, *Ohio, *Rainfall-runoff relationships, *Rural areas, Estimating equations, Log-Pearson analysis, Statistical methods.

Multiple-regression equations are presented for estimating flood-peak discharges having recurrence intervals of 2, 5, 10, 25, 50, and 100 years at ungaged sites on rural, unregulated streams in Ohio. The average standard errors of prediction for the equations range from 33.4% to 41.4%. Peak discharge estimates determined by log-Pearson Type III analysis using data collected through the 1987 water year are reported for 275 streamflow-gaging stations. Ordinary least-squares multiple-regression techniques were used to divide the State into three regions and to identify a set of basin characteristics that help explain station-to-station variation in the log-Pearson estimates. Contributing drainage area, main-channel slope, and storage area were identified as suitable explanatory variables. Generalized least-square procedures, which include historical flow data and account for differences in the variance of flows at different gaging stations, spatial correlation among gaging station records, and variable lengths of station record were used to estimate the regression parameters. Weighted peak-discharge estimates computed as a function of the log-Pearson Type III and regression estimates are reported for each station. A method is provided to adjust regression estimates for ungaged sites by use of weighted and regression estimates for a gaged site located on the same stream. Limitations and shortcomings cited in an earlier report on the magnitude and frequency of floods in Ohio are addressed in this study. Geographic bias is no longer evident for the Maumee River basin of northwestern Ohio. No bias is found to be associated with the forested-area characteristic for the range used in the regression analysis (0.0 to 99.0%), nor is this characteristic significant in explaining peak discharges. Surface-mined area likewise is not significant in explaining peak discharges, and the regression equations are not biased when applied to basins having approximately 30% or less surface-mined area. Analyses of residuals indicate that the equations tend to overestimate flood-peak discharges for basins having approximately 30% or more surface-mined area. (USGS)
W91-02972

EVALUATION OF GROUND-WATER RECHARGE ALONG THE GILA RIVER AS A RESULT OF THE FLOOD OF OCTOBER 1983, IN AND NEAR THE GILA RIVER INDIAN RESERVATION, MARICOPA AND PINAL COUNTIES, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02977

FLOOD OF DECEMBER 1987 IN CENTRAL AND EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 4A.
W91-02978

WATER RESOURCES OF THE ELK RIVER BASIN, WEST VIRGINIA.
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
M. V. Mathes, and S. M. Ward.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. West Virginia Dept of Natural Resources, Division of Water Resources, River Basin Bulletin 6, 1990. 37p, 17 fig, 37 ref.

Descriptors: *Hydrogeology, *Water resources data, *West Virginia, Elk River basin, Groundwater, Groundwater quality, Land use, Streamflow, Water quality, Well yield.

The Elk River basin is located in central West Virginia and drains 1,533 sq mi. The water resources of the Elk River basin are used by 12% of the population of West Virginia. In 1984, more than 9 billion gallons of water were withdrawn from the basin. The mean annual outflow of the Elk River is about 2,300 cu ft/sec, which is equivalent to 21 in of runoff. Streamflow in the lower reaches of the Elk River is regulated by Sutton Reservoir, which decreases the magnitude of flood peaks and augments low flow. Surface water in the Elk River and its major tributaries is poorly buffered and susceptible to acidification. Concentrations of dissolved iron, chloride, and manganese exceeded State water quality standards at some sites. Groundwater quality varies with respect to topography and hydrogeologic unit. Wells on hilltops yielded water with greater hardness, lower pH, lower iron concentrations, and higher hardness and sulfate concentrations than did wells in valleys. Water from the Pottsville Group in aquifers in the Lower Pennsylvanian rocks was softer, more acidic, and had a higher concentration of dissolved iron and manganese than water from other hydrogeologic units. Water from the Conemaugh Group in aquifers in the Upper Pennsylvanian rocks was the most mineralized. Reported well yields ranged from 0.08 to 1,000 gallons/min and were greater for wells in valleys than wells on hillsides or hilltops. (USGS)
W91-02982

METHOD FOR COMPUTING SHEETFLOW RUNOFF FOR FLAT SLOPES.
South Florida Water Management District, West Palm Beach. Dept. of Resource Management.
For primary bibliographic entry see Field 7B.
W91-03065

SIMULATION OF WETLAND FLOW DYNAMICS.
South Florida Water Management District, West Palm Beach. Dept. of Resource Management.
For primary bibliographic entry see Field 2H.
W91-03066

PARTIAL AREA CONCEPT AND ITS APPLICATION TO THE PROBLEM OF SEDIMENT SOURCE AREAS.
Alberta Univ., Edmonton. Dept. of Geography.
I. A. Campbell.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 128-138, 70 ref.

Descriptors: *North Carolina, *Partial area runoff, *Rainfall-runoff relationships, *Sediment sources, *Soil erosion, *Tennessee, Catchment basins, Comparison studies, Overland flow, Storm runoff, Water pollution sources.

It is now recognized that the partial area concept is a more broadly applicable way to view runoff generation than the Hortonian overland flow approach. However, the linkage between partial area runoff and sediment source areas has not been described widely in the literature on sediment production and yield nor has it been extensively investigated in the field. Runoff and sediment yield patterns and processes have been treated largely as separate components, if not as independent processes. Application of the partial area concept to overland flow leads to the conclusion that runoff in almost all cases will be generated from an area much smaller than the total basin area. Studies in North Carolina and Tennessee showed that no more than 40% of the basin surface areas typically contributed to even heavy storm runoff and some basins, on average, contributed runoff from only 4.6% of their area. This general principle seems to hold in studies conducted on very large river basins as well, such as the Nile and Yellow River (China). Unfortunately, most published data do not reveal the relationships because the required detailed observations are not available. The implications of the partial area concept are that most methods of working with sediment source and yield data are inadequate and largely unrealistic. If small areas of basins are contributing most or nearly all of the runoff and sediment yield measured at the basin mouth, serious misconceptions will result about processes operating in the watershed if basinwide averaging techniques are used. The extension of these techniques to determine regional or global erosion rates is at best a simplistic speculative exercise. (See also W91-03117) (Rochester-PTT)
W91-03129

ESTIMATING EROSION ON PLOT, FIELD, AND WATERSHED SCALES.
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 2J.
W91-03131

UPLAND EROSION AND DOWNSTREAM SEDIMENT DELIVERY.
Stall (John B.) Ltd., Urbana, IL.
For primary bibliographic entry see Field 2J.
W91-03135

PRELIMINARY ANALYSIS OF RUNOFF AND SOIL LOSS FROM SELECTED LONG-TERM PLOTS IN AUSTRALIA.
Soil Conservation Service of New South Wales, Sydney (Australia).
For primary bibliographic entry see Field 2J.
W91-03155

EXPERIMENTAL DATA ON RUNOFF GENERATION.
Katholieke Univ. Leuven (Belgium). Lab. voor Experimentele Geomorfologie.
J. De Ploey.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 528-539, 4 fig, 28 ref.

Descriptors: *Belgium, *Rainfall-runoff relationships, *Roughness, *Runoff, *Soil erosion, *Soil physical properties, Overland flow, Sheet erosion, Soil surfaces, Soil types, Surface sealing.

In recent years the Laboratory for Experimental Geomorphology in Leuven, Belgium, has focused part of its research on problems dealing with runoff generation. Several runoff threshold conditions on sandy and loamy topsoils, either bare sediments or cropland, and slopes with a steppe vegetation are discussed here. Results from throughout the world are reviewed as they apply to runoff generation and topsoil conditions; roughness elements, stemflow, and runoff generation; and the time to runoff (Tr). Progress in understanding of runoff generation will depend largely on improvement of current techniques and development of advanced techniques to follow changing topsoil conditions during rainfall. Particular attention must be paid to the ambivalent effects of several factors (e.g., roughness elements that control runoff events). Laboratory experiments will be fundamental for elucidating specific mechanisms of runoff generation. The factors in runoff promotion considered here would at first seem to enhance soil erosion, but they can have ambivalent impact on erodibility of topsoils, especially on slopes of low declivity. Roughness elements, if their cover density exceeds a certain critical value, also may protect against erosion. Sealing and crusting, by increasing topsoil smoothness, reduce the resistance to runoff flow. They therefore may reduce topsoil erodibility. This effect is limited to sheetwash, but it helps explain why erosion rates decrease with time on smooth interrill areas under constant flow conditions. (See also W91-03117) (Rochester-PTT)
W91-03160

RIVER MEANDERING.
Water Resources Monograph 12. American Geophysical Union, Washington. 1989. 485p. Edited by Syunsuke Ikeda, and Gary Parker.

Descriptors: *Channel flow, *Channel morphology, *Geomorphology, *Meanders, *River beds, *River flow, *Sediment transport, Mathematical models, Model studies, Shear stress, Theoretical analysis, Topography.

This monograph is an overview of research undertaken by five Japanese and five Americans of various backgrounds (geology, engineering, and geography) on the subject of river meandering. The core group of participants attended three workshops which included tours of rivers and research facilities in the United States and Japan. The fourteen papers compiled in the monograph deal with the following subjects: boundary shear stress and sediment transport in river meanders of sand and gravel; sedimentary controls on channel migration and origin of points bars in sand-bedded meandering rivers; flow in meandering channels with natural topography; sediment transport and sorting at bends; sediment control by submerged vanes; analysis of 2-dimensional bed topography model for rivers; linear theory of river meanders; studies on qualitative and quantitative prediction of meander channel shift, finite amplitude development of alternate bars; alternate bars and meandering (free, forced and mixed interactions); evolution and stability of erodible channel beds; observations on several recent theories of resonance and overdeepening in meandering channels; bar and channel formation in braided streams; and topographic response of a bar to variation in discharge. (See W91-03204 thru W91-03217) (Geiger-PTT)
W91-03203

BOUNDARY SHEAR STRESS AND SEDIMENT TRANSPORT IN RIVER MEANDERS OF SAND AND GRAVEL.
California Univ., Berkeley. Dept. of Geology and Geophysics.
W. E. Dietrich, and P. Whiting.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 1-50, 29 fig, 1 tab, 45 ref. NSF Grants ENG78-16977 and CEE-8307142. American Chemical Society Grant ACS-PRF-18427-AC2.

Descriptors: *Channel morphology, *Geomorphology, *Meanders, *River flow, *Sediment transport, *Shear stress, Bed load, Channel flow, Channel scour, Gravel, Mathematical studies, Particle size, Sand, Topography.

Field measurements in a sand-bedded river and in two gravel-bedded ones were compared to examine controls on boundary shear stress fields, sediment transport processes, and sorting in meanders. Analysis of detailed flow field measurements in the sand-bedded river meander and over a gravel-bedded alternate bar reveals a well-defined spatial structure to the magnitude and sign of forces controlling boundary shear stress that arise from topographically-induced spatial accelerations. The relationship between bedload transport and boundary shear stress fields in river meanders varies with size and heterogeneity of bed material. In bends of moderately to well sorted sand in flows generating boundary shear stresses well above critical (such as in large sandy rivers), downstream varying boundary shear stress is matched by topographically-induced cross-stream transport of sediment. In meanders with high excess shear stress but poorly sorted coarse sand and fine gravel, boundary shear stress variation downstream is partially matched by surface grain size adjustments and by net cross-stream sediment flux. Maxima of bedload transport rate and boundary shear stress do not correspond in some areas. In gravel-bedded meanders with low excess boundary shear stress and low sediment supply, bedload may be much finer than the bed surface, and significant areas of bar surface are covered with grain sizes that constitute a very small portion of the bedload. Substantial bedload transport may only occur over a narrow portion of the bed width where boundary shear stress relative to critical stress of the surface is highest and where the sediment flux from upstream is locally concentrated. In this case, grain size adjustments dominate over topographically-induced cross-stream sediment transport in controlling the relationship between boundary shear stress and bedload transport fields. (See also W91-03203) (Author's abstract)
W91-03204

SEDIMENTARY CONTROLS ON CHANNEL MIGRATION AND ORIGIN OF POINT BARS IN SAND-BEDDED MEANDERING RIVERS.
Tsukuba Univ. (Japan). Environmental Research Center.
H. Ikeda.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 51-68, 18 fig, 44 ref.

Descriptors: *Alluvial plains, *Channel morphology, *Geomorphology, *Meanders, *Sediment transport, Channel flow, Gravel, River beds, Sand.

Field observations in alluvial meandering rivers have revealed that plan form and migration pattern of channels are strongly influenced by the distribution of thick fine-grained cohesive deposits in flood plains. Meandering channels can be classified into four types according to the influence of these cohesive deposits: (1) fixed meanders, (2) restricted meanders, (3) confined free meanders, and (4) truly free meanders. Laboratory experiments and field observations of point bars in low gradient sand-bedded meandering rivers have revealed that, unlike in gravel-bedded rivers, point bars develop in response to the pattern of flow through the beds, that is point bars in these rivers are a result rather than a cause of meandering. Point bar platforms, which are the flat tops of point bars, are gradually covered in these rivers by inner bank accretions deposited out of suspension. Therefore, bends with well developed point bar platforms lacking accretion deposits must be in a state of active channel migration and, consequently widening. (See also W91-03203) (Author's abstract)
W91-03205

FLOW IN MEANDERING CHANNELS WITH NATURAL TOPOGRAPHY.
Washington Univ., Seattle. Geophysics Program.
J. M. Nelson, and J. D. Smith.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 69-102, 13 fig, 24 ref.

Descriptors: *Channel flow, *Channel morphology, *Geomorphology, *Meanders, *Model studies, *Topography, Flow velocity, Sediment transport, Shear stress.

A predictive model for velocity, surface elevation, and boundary shear stress fields in natural meander bends is presented. The approach retains streamwise convective accelerations in the lowest order momentum equations and can be used to investigate flow in channel bends with curvature and topography that vary significantly in the streamwise direction, as is the case in most natural streams and rivers. The total boundary shear stress field obtained from computations includes both skin friction and the form drag associated with pressure forces on bars and bedforms. A simple method for removing the form drag component permits computation of the bottom stress responsible for sediment transport. Results of calculations are compared to measurements obtained in Muddy Creek, a sand-bedded meandering stream in Wyoming possessing the characteristics typical of natural channels. Model predictions of velocity, boundary shear stress, and surface elevation were in excellent agreement with the measurements, primarily due to the careful treatment of convective accelerations in the governing equations. (See also W91-03203) (Author's abstract)
W91-03206

ANALYSIS OF A 2-D BED TOPOGRAPHY MODEL FOR RIVERS.
Waterloopkundig Lab. te Delft (Netherlands).
N. Struiksma, and A. Crosato.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 153-180, 12 fig, 6 tab, 32 ref.

Descriptors: *Channel morphology, *Geomorphology, *Mathematical models, *Meanders, *Model studies, *River beds, *Sediment transport, *Topography, Comparison studies, Flow velocity, Steady flow, Unsteady flow.

Processes of river bed deformation were studied by analysis of a time-dependent 2-dimensional model for river bed topography. The occurrence and behavior of propagating alternate bars are described with a non-steady state analysis. Due to the relatively large propagation velocity of these bars, this type of bed perturbation cannot give an explanation of the much more steady meandering process, which is characterized by the point bar-pool configuration. A steady state analysis turns out to be more appropriate to describe the meandering process. In terms of wave length and longitudinal damping rate, this analysis provides a good description of the phenomena involved. For conditions prevailing in meandering rivers it appears that the result of the interaction between water and sediment motion depends on the ratio of two characteristic adaptation lengths which govern the two independent equations for the flow and for the bed deformation, respectively. In addition, it is shown that the degree of non-linearity of the sediment transport with flow velocity is also an important parameter. The results of the analysis are compared with data from a straight flume experiment with movable bed, in which at the inflow a steady perturbation was imposed, and with data from a curved flume experiment with movable bed and fixed banks. The predicted equilibrium bed topographies in the two experiments agree well with the measured ones. In the straight flume experiment the complete and the simple versions of the linear model give rather similar results (the simple model in this case gives a better prediction). The unsteady linear solution of the complete model gives a rather good prediction of alternate bar wave lengths. The influence of curvature and of secondary flow inertia are shown to play an important role in the phenomenon. In this case the complete model cannot be further simplified. (See also W91-03203) (Geiger-PTT)
W91-03209

LINEAR THEORY OF RIVER MEANDERS.

Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2J.
W91-03210

STUDIES ON QUALITATIVE AND QUANTITATIVE PREDICTION OF MEANDER CHANNEL SHIFT.
Hokkaido Univ., Sapporo (Japan). Dept. of Civil Engineering.
K. Hasegawa.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 215-235, 12 fig, 34 ref.

Descriptors: *Bank erosion, *Channel flow, *Channel morphology, *Geomorphology, *Mathematical models, *Meanders, *Model studies, Literature review, Qualitative analysis, Quantitative analysis.

Studies on alluvial meandering rivers in Japan show that alternative bars appear to be a universal feature of these rivers, two meander patterns are found in the river, and in sinuous meanders, the whole bend migrates downstream at a uniform rate. Meander patterns are classified as simple symmetrical, simple asymmetrical, compound symmetrical, compound asymmetrical, and lobing or double heading. Migration rates of natural river channels have been measured by regression relations between a meander loop and the upstream drainage area, and by dendrochronology. A mechanistic analysis for meander channel changes is based on a theory that assumes the bank erosion rate at any point is in proportion to the near-bank perturbation of depth-averaged flow velocity. Studies of the interrelationships among factors governing channel changes in alluvial rivers show that the influence of channel planform on bank shift is indirect. The planform gives rise to bank erosion or accretion by means of the associated variation in bed topography. However, channel planform does play an important local role in the formation of planimetric flow separation along the inside bank. When this occurs it can yield strong deposition of suspended sediment. This phenomenon can be viewed as a direct effect of channel planform on bank shift. Studies using the universal erosion coefficient in equations governing bank erosion show that the general bank erosion coefficient and the general coefficient for the real erosion rate during a flood maintain values of a similar order of magnitude among a variety of rivers. These parameters thus provide a universal means for characterizing the coefficient necessary to predict bank erosion rates. (See also W91-03203) (Geiger-PTT)
W91-03211

FINITE AMPLITUDE DEVELOPMENT OF ALTERNATE BARS.
Public Works Research Inst., Tsukuba (Japan). River Hydraulics Div.
S. Fukuoka.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 237-265, 21 fig, 23 ref.

Descriptors: *Channel flow, *Channel morphology, *Geomorphology, *Mathematical models, *Meanders, Bank erosion, Reviews, River beds, Sediment discharge.

The planform of the channel associated with the concentration of flow along the river bank is the meander; the corresponding bedform is the alternate bar. To carry out safe and proper flood control measures, it is necessary to determine the equilibrium shapes of alternate bars and meanders, as well as the flow in channels with such morphological features. The flow in a channel with arbitrary periodic planform and alternate bar pattern can be determined with considerable accuracy by using plane two-dimensional analysis. Flow over alternate bars has been studied taking into account the nonlinearity of the flow. The nonlinearity of flow plays an important part in stabilizing the wave height of alternate bars. Since the analysis becomes complicated when the nonlinearity of flow is considered, a straight channel is assumed for the planform to simplify the representation of the shape of alternate bars. The hydraulic indicators for bank erosion to be used in a straight channel with alternate bars and erodible banks were investigated. The transverse slope of the bed, streamline deviation, water level and flow velocity are appropriate hydraulic indicators of a point of flow attack. Temporally varying bars were investigated by photographing and analyzing the movement of bed material with a video camera. The process of development leading to the equilibrium of alternate bars was explained from the relationship between the flow velocity vector and the sediment discharge distribution. The spatial distribution of longitudinal and transverse bed load transport rates and the process of sediment transport and the path difference according to grain size were measured in a bend of a small meandering river with an equilibrium bed profile. An equilibrium bed profile appears when a net outward sediment discharge occurs in a region with maximal bed shear stress. Dimensional analysis is often used to predict equilibrium wave height and length. The equilibrium wave height of alternate bars was studied in the context of changes in sediment discharge. (See also W91-03203) (Geiger-PTT)
W91-03212

ALTERNATE BARS AND MEANDERING: FREE, FORCED AND MIXED INTERACTIONS.
Genoa Univ. (Italy). Inst. of Hydraulics.
G. Seminara, and M. Tubino.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 267-320, 19 fig, 64 ref.

Descriptors: *Channel flow, *Channel morphology, *Geomorphology, *Mathematical models, *Meanders, *Sediment transport, Bank erosion, Boundary conditions, Resonance, Sediment erosion, Steady flow, Unsteady flow.

A systematic treatment is given of the linear and weakly nonlinear aspects of the development of flow and bottom perturbations of lengthscale of the order of channel width in developing meanders. Mathematical models show that an originally straight channel with cohesionless boundary and uniform grain size, unless the channel is too narrow or too wide, undergoes an instability process which, on a relatively fast time scale, leads to the formation of migrating perturbations (alternate bars). As channel widening proceeds, provided the width ratio exceeds a second threshold value above which spatial disturbances may grow, the channel undergoes a second instability process, a planimetric one. The latter process, the details of which still require to be elucidated, is not primarily determined but is definitely affected by the presence of free bars. As the amplitude of meander increases, so does sinuosity, so that free bars tend to decrease their amplitude till they disappear, leaving only forced bars to induce bank erosion. The above model needs further refinements to be able to describe features of the process which have so far been neglected, namely transport in suspension, grain sorting, entrance and wall effects, and unsteadiness. The effect of resonance is the same in all the mathematical models presented. Further experimental and field verification of the whole picture is also needed through carefully designed experiments. (See also W91-03203) (Geiger-PTT)
W91-03213

EVOLUTION AND STABILITY OF ERODIBLE CHANNEL BEDS.
Washington Univ., Seattle. Geophysics Program.
J. M. Nelson, and J. D. Smith.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 321-377, 37 ref.

Descriptors: *Channel erosion, *Channel morphology, *Geomorphology, *Mathematical models, *Meanders, *Model studies, *Sediment erosion, Algorithms, Channel stability, Sediment transport, Shear stress, Topography.

A computational model for flow and boundary shear stress fields in natural channels is combined with a bedload transport algorithm to investigate the genesis and finite amplitude characteristics of riverine bars. Since the time scales associated with bar growth and migration are typically much larger than the time scales of the flow, the flow is treated in a quasi-steady manner, and the modification of the bed topography due to convergences and divergences in the sediment flux field is coupled to the flow model using a simple iterative technique. The topographic evolution algorithm yields accurate predictions of the development of point bars in curved channels and indicates that, while the origin of point bars is primarily due to curvature-induced secondary flow, the ultimate stability of these features is related to topographically-induced streamwise convective accelerations, as well as to gravitational modification of sediment fluxes by bar slopes. The technique presented is also used to investigate the mechanics of alternate bars in straight channels. Comparison of the nonlinear theory with a simple linear stability analysis for these features is used to demonstrate the importance of the nonlinear effects, and to provide a clearer physical understanding of the alternate bar instability. In contrast to point bars, the initial instability of alternate bars is shown to depend on a simple topographic steering response, while the finite amplitude characteristics of these features depend on gravitational effects and the production of secondary flow associated with the curvature of flow streamlines. The evolution model yields good predictions of the finite amplitude morphology of both point and alternate bars, as demonstrated by comparison of model predictions and measured bathymetry for several experimental studies. (See also W91-03203) (Author's abstract)
W91-03214

OBSERVATIONS ON SEVERAL RECENT THEORIES OF RESONANCE AND OVERDEEPENING IN MEANDERING CHANNELS.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
G. Parker, and H. Johannesson.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 379-415, 7 fig, 1 tab, 42 ref, append.
NSF Grants MSM-8311721 and INT-8412678.

Descriptors: *Channel flow, *Channel morphology, *Geomorphology, *Mathematical models, *Meanders, *Model studies, *Resonance, Comparison studies, Sinuous flow, Theoretical analysis.

Three recent linear treatments of alternate bars and flow in meandering channels are compared in terms of a unified framework that is used to clarify the relation between such self-excited topographic effects as alternate bars and curvature-driven phenomena such as point bars. The equation of depth-averaged transverse momentum balance, which may be driven by topography or curvature, is decoupled from the equation governing secondary flow, which is driven essentially by curvature alone. All three theories are found to yield similar results for the phenomena of resonance and overdeepening. For typical natural channels, the equation of transverse momentum balance can be decomposed into a relation governing depth-averaged transverse velocity, and a relation governing helical secondary flow. The two are not directly coupled to each other. Helical secondary flow may be taken to be purely curvature-driven, and unaffected by bed topography at the linear level, whereas the depth-averaged component may be strongly affected by bed topography. Secondary flow may be neglected in a linear treatment of alternate bars. Alternate bar instability can be predicted even in a theory that neglects the linear inertial and frictional terms associated with depth-averaged transverse velocity. The approximate theory provides critical values of ratio of half-width to base flow depth for the inception of alternate bars that are in essential agreement with the more previous theories. The same approximation, i.e. neglect of ratio half-width to base flow depth terms associated with depth-averaged transverse velocity, yields a linear treatment of bend flow that is much simpler from that of (See also W91-03203) (Author's abstract)
W91-03215

BAR AND CHANNEL FORMATION IN BRAIDED STREAMS.
Kyoto Univ. (Japan). Disaster Prevention Research Inst.
Y. Fujita.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 417-462, 30 fig, 3 tab, 75 ref.

Descriptors: *Braided streams, *Channel flow, *Channel morphology, *Geomorphology, *Meanders, *Sediment transport, Hydraulic properties, Theoretical analysis.

Detailed hydraulic experiments were carried out on the behavior of multiple row bars and the formation of braided streams in three flumes, with widths of 0.5, 1.8, and 3.0 m. The characteristic features of change in bed configuration, and also stream bed variation, were described. Higher modes of bars were observed to evolve into lower ones. Braided patterns appeared in cases with small depths; during this transition to lower modes, bar geometry changed suddenly, increasing in wavelength and heights. Bars in high modes proved to have the same hydraulic properties as alternate bars. Several results of previous studies on alternate bars could be applied to predict the behavior of multiple-model bars. It was concluded that the formation of bars of various modes, and stream braiding, as well, can be predicted by a criterion that allows the co-existence of several modes, and corresponds to results of an existing linear stability theory. The times required for the development and the reduction of bar mode are analyzed using the bar heights of individual modes in equilibrium. Mechanisms controlling the formation of the lowest mode and the development of braided streams should be examined more quantitatively from the viewpoint of sediment transport. (See also W91-03203) (Author's abstract)
W91-03216

TOPOGRAPHIC RESPONSE OF A BAR IN THE GREEN RIVER, UTAH TO VARIATION IN DISCHARGE.
For primary bibliographic entry see Field 2J.
W91-03217

SPECIAL FLOOD HAZARD EVALUATION REPORT: CANASERAGA CREEK, TOWN OF GROVE, ALLEGANY COUNTY, NEW YORK.
Army Engineer District, Buffalo, NY.
For primary bibliographic entry see Field 6F.
W91-03225

RESTORATION OF DEGRADED RIVERINE/RIPARIAN HABITAT IN THE GREAT BASIN AND SNAKE RIVER REGIONS.
White Horse Associates, Smithfield, UT.
S. E. Jensen, and W. S. Platts.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 367-404, 14 fig, 94 ref, 2 append.

Descriptors: *Habitat restoration, *Riparian land, *Stream restoration, *Water resources management, *Wetland restoration, *Wetlands, Environmental impact, Planting management, Riparian waters, Soil-water-plant relationships, Water resources development, Watershed management, Wildlife habitats.

Riverine/riparian habitat (RRH) includes interdependent aquatic (riverine) and streamside (riparian) resources that are valuable for fish and wildlife habitat, flood storage and desynchronization, nutrient cycling and water quality, recreation, and heritage values. RRH includes resources both wetter and drier than stipulated for wetlands. Whereas the 'natural or achievable state' of a riparian habitat may be wetland, the 'existing state' may be non-wetland because of natural or anthropogenically-induced changes in the hydrologic character of RRH. There are many different types of RRH, each with distinctive structure, function, and values. Restoration commonly requires: planning to identify preliminary goals and a general approach; baseline assessments and inventories; designs from which the feasibility of accomplishing goals can be assessed; evaluation to assure compliance with designs; and monitoring of variables important to goals and objectives. The goals, approach, and design of restoration projects must be tailored to each type of RRH. Some general elements important to restoration of degraded RRH are: establishment of hydrologic conditions compatible with project goals; efficient handling of soil and substrates in construction; selection and propagation of plants suited to the site and project goals; evaluation of features to enhance habitat for target species; maintenance and control of impacts; and scheduling construction to reflect site constraints and goals. (See also W91-03244) (Author's abstract)
W91-03259

VARIANCES AND COVARIANCES OF THE MAXIMUM ENTROPY ESTIMATORS FOR THE PEARSON TYPE-3 DISTRIBUTION.
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 7C.
W91-03308

KNOWLEDGE-BASED EXPERT SYSTEM FOR FLOOD FREQUENCY ANALYSIS.
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W91-03309

HEAT AND MASS BALANCE OF AN ABLATING ICE JAM.
National Hydrology Research Inst., Saskatoon (Saskatchewan). Northern Hydrology Section.
For primary bibliographic entry see Field 2C.
W91-03310

EFFECT OF DRAINAGE CHANNEL ON EVOLUTION OF WATER TABLE DUE TO RECHARGE FROM TWO PARALLEL CANALS.
Irrigation Design Organization, Roorkee (India).
For primary bibliographic entry see Field 2F.
W91-03358

PHYTOPLANKTONIC BIOMASS AND PRODUCTIVITY IN THE RHONE RIVER PLUME IN SPRING TIME (BIOMASSE ET PRODUCTION PHYTOPLANCTONIQUES DANS LE FRONT DU PANACHE RHODANIEN: SITUATION PRINTANIERE).
Jaffna Univ. (Sri Lanka). Dept. of Geography.
C. Videau, and M. Leveau.
Comptes Rendus de l'Academie des Sciences (Serie 3) Sciences de la Vie CRAMED, Vol. 311, No. 6, p 219-224, September 13, 1990. 3 fig, 1 tab, 10 ref. English summary.

Descriptors: *Chlorophyll, *Estuarine environment, *Phytoplankton, *Plumes, *Primary productivity, *Rhone River, Biomass, Carbon, Estuaries, Stratification.

The distribution of chlorophyll biomass and productivity in the Rhone River plume was studied in three size-fractionated phytoplankton assemblages: microplankton (>10 microns), nanoplankton (10-3 microns) and picoplankton (<3 microns) in relation to hydrological structures. Measurements were made at different stations inside and outside the Rhone plume in May 1988. Seawater samples from 4 light levels were fractionated by passing through a cascade of three different membranes for chlorophyll and carbon fixation measurements (4 hr in situ simulated incubation). Inside the plume, chlorophyll biomass of entire populations showed typical profiles of stratified waters with a chlorophyll maximum in a range from 5 to 8 micrograms/L located at the maximum density gradient. Outside the discharge, surface water layers were more homogenous and chlorophyll values did not exceed 3 micrograms/L. Water layer density influenced the distribution and the biological activity of phytoplankton size fractions. In the upper layer characterized by low salinity, half the chlorophyll biomass was due to nanoplankton. Nanoplankton and picoplankton fixed inorganic carbon to a similar extent (40%). In underlying typical marine waters, 60% of phytoplankton biomass and productivity were achieved by picoplankton. Transitional waters were characterized by an abundant microplankton constituting more than 50% of total chlorophyll biomass whose carbon fixation was higher at the pycnocline and, particularly, near the plume front. (Geiger-PTT)
W91-03392

FLOW DISTRIBUTION IN THE ST. LAWRENCE RIVER SYSTEM AT WOLFE ISLAND, KINGSTON BASIN, LAKE ONTARIO.
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
I. K. Tsanis, and C. R. Murthy.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 352-365, 1990. 8 fig, 5 tab, 11 ref.

Descriptors: *Flow discharge, *Lake Ontario, *Limnology, *St Lawrence River, Flow measurement, Flow rates, Flowmeters, Hydrologic data collections, Satellite technology.

Determination of the mass output through the St. Lawrence River outflow system is an important component in computing a mass balance of chemical loadings in Lake Ontario. Toward this goal, a network of self recording current meter moorings were deployed in the main channels of the St. Lawrence River system in Lake Ontario during 1986 and 1987. On two occasions in 1987, detailed Lagrangian experiments were carried out using a cluster of satellite drifters. The time series data from the current meter network and Lagrangian drifter experiments provided the horizontal and vertical distribution of currents that are adequate to compute the distribution of water transport through the St. Lawrence outflow. The flow distribution in the St. Lawrence River at Wolfe Island is approximately 55% in the south channel and 45% in the north channel. The total flow rate through the St. Lawrence River system from the present study is in good agreement with the direct measurements at the powerplant control facilities at Cornwall. (Author's abstract)
W91-03401

COMPARISON OF MEASURED AND SIMULATED FLOWS DURING THE 15 DECEMBER 1987 DETROIT RIVER FLOW REVERSAL.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
J. A. Derecki, and F. H. Quinn.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 426-435, 1990. 10 fig, 6 ref.

Descriptors: *Detroit River, *Flow models, *Flow profiles, *Great Lakes, *Model studies, *Path of pollutants, *River flow, *Wind-driven currents, Flow measurement, Flow velocity, Mathematical models, Simulation analysis, Water level fluctuations.

Flow reversals in the Detroit River were directly measured by an acoustic Doppler current profiler deployed on the river bottom at Ft. Wayne for about 8 hr on 15 December 1987. The meter provided continuous measurements of the vertical velocity distribution for approximately 1-m depth segments in the overhead water column at quarter-hour intervals. These measurements provided an ideal data set to analyze river dynamics associated with flow reversals and to evaluate the importance of major factors necessary for the occurrence of flow reversals in the river. Analysis of the measurements showed that reasonably accurate simulation of flow reversals with the unsteady flow models require the inclusion of surface wind shear and the use of small time increments that are much shorter than the standard hourly water level data. Model simulation with specially obtained 5 and 15 minute water level and wind data produced generally similar model flows that are reasonably close to the measured values. Because short-period (15 minute or less) wind and water level data are not readily available, river flow reversals simulated using hourly data may be significantly underestimated. (Author's abstract)
W91-03406

HABITAT DIVERSITY AND FISH REPRODUCTIVE FUNCTION OF FLOODPLAIN ECOSYSTEMS.
Lyon-1 Univ., Villeurbanne (France). Lab. d'Ecologie des Eaux Douces.
For primary bibliographic entry see Field 2H.
W91-03482

ALLOCHTHONOUS INPUT AND RETENTION IN A SMALL MOUNTAIN STREAM, SOUTH AFRICA.
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-03488

FACTORS INFLUENCING FISH DISTRIBUTION AND COMMUNITY STRUCTURE IN A SMALL COASTAL RIVER IN SOUTHWESTERN COSTA RICA.
Wisconsin Univ.-Madison. Center for Limnology.
For primary bibliographic entry see Field 2H.
W91-03492

DYNAMIC ASPECT OF COARSE PARTICULATE ORGANIC MATTER (CPOM) ON THE SEDIMENT SURFACE OF A SECOND ORDER STREAM FREE OF DEBRIS DAMS (RITRODAT-LUNZ STUDY AREA).
Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Limnologie.
For primary bibliographic entry see Field 2H.
W91-03493

LITTERFALL, LEAF DECOMPOSITION AND LITTER COLONIZATION OF TESSARIA INTEGRIFOLIA (COMPOSITAE) IN THE PARANA RIVER FLOODPLAIN.
Centro de Ecologia Aplicada del Litoral, Corrientes (Argentina).
For primary bibliographic entry see Field 2H.
W91-03495

EVALUATION OF THE FISHERIES OF THE MACKINAW RIVER BASIN IN CENTRAL ILLINOIS.
Illinois Dept. of Conservation, Aledo.
For primary bibliographic entry see Field 2H.
W91-03504

USE OF PARAMETER TRANSFORMATIONS IN NONLINEAR, DISCRETE FLOOD EVENT MODELS.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
B. C. Bates.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 55-79, September 1990. 8 fig, 5 tab, 29 ref.

Descriptors: *Flood forecasting, *Hydrologic models, *Model studies, *Parameterization, *Rainfall-runoff relationships, Algorithms, Australia, Nonlinear flood event models, Parameter transformations, Statistical analysis.

The use of parameter transformations in calibration and post-calibration studies of conceptual rainfall-runoff models is often justified on the basis of their ability to speed the convergence of automatic parameter estimation algorithms, improve the sampling properties of the parameter estimates, and improve statistical inferences that are based on conventional linear model theory. An examination of the abilities of parameter transformations was undertaken using a nonlinear flood event model, rainfall-runoff data from six Australian catchments, a Gauss-Newton optimization algorithm, three measures of statistical nonlinearity, and three types of joint confidence regions (exact, likelihood, and linear theory) for the model parameters. Results indicated that the 'expected value' transformation of Ross and the power transformation of Tsai can lead to improved sampling properties and statistical inferences on model parameters. However, it is clear that the effect of model reparameterization on the convergence of optimization algorithms may only be slight, and that care must be taken when applying parameter transformations to nonlinear flood event models. (Author's abstract)
W91-03542

SHAPE PARAMETERS OF THE GEOMORPHOLOGIC UNIT HYDROGRAPH.
Electricity Generating Authority of Thailand, Nonthaburi. Meteorology and Hydrology Div.
P. Chutha, and J. C. I. Dooge.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 81-97, September 1990. 3 fig, 1 tab, 20 ref, append.

Descriptors: *Geomorphology, *Hydrograph analysis, *Model studies, *Parameter estimation, *Runoff forecasting, *Unit hydrographs, Geomorphologic unit hydrograph, Hydrography, Multireservoir networks, Numerical analysis, Regression analysis, Shape parameters, Watersheds.

Numerical experiments were carried out to explore: (1) the relationship between the dimensionless third moment and the dimensionless second moment of the classical geomorphologic unit hydrograph (GUH); (2) the sensitivity of this shape indicator to the assumption in the GUH model relating the time delay in a stream segment to some power of the segment length; (3) the relationship between the parameters of the GUH and the geomorphic parameters of the catchment. A closed form analytical solution specifying completely the GUH can be derived using only the formula for the most probable distribution of tributaries of given order among channels of higher order and the classical deterministic analysis based on routing through unequal linear reservoirs. Consequently, the parameters of the GUH can be expressed in terms of geomorphic parameters and a single scaling factor such as the delay time for the reservoir at the outlet from each first order basin or the lag of the catchment response. The dimensionless parameters of the GUH are in most cases highly determined by linear regression in logarithmic space on the geomorphic parameters, and the individual GUH parameters are sensitive to the assumption about the relative sizes of the reservoirs at the outlet of different orders but the product of the peak and the lag of GUH is remarkably stable. The shape of the GUH is closely approximated by the Nash model of a cascade of equal linear reservoirs for all three assumptions about storage variations. (MacKeen-PTT)
W91-03543

POND SEEPAGE IN TWO AND THREE DIMENSIONS.
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
G. Fipps, and R. W. Skaggs.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 133-151, September 1990. 9 figs, 5 tab, 20 ref.

Descriptors: *Hydrologic models, *Infiltration, *Model studies, *Ponds, *Seepage, *Storm runoff, *Storm water management, *Surface-groundwater relations, Hydrology, North Carolina-Barrier islands, Numerical analysis, Pond seepage, Saturated flow, Saturation zone, Seepage rates, Soil properties, Three-dimensional model, Unsaturated flow.

The State of North Carolina requires plans for stormwater, sediment, and erosion management for much of the commercial construction along the coast. Such plans may employ infiltration ponds for stormwater runoff control. Although the concept is fairly straightforward, the factors controlling the operation of these ponds are not well understood. A numerical solution to the Richards equation for three-dimensional (3-D), combined unsaturated and saturated flow was used to analyze pond seepage for geometries characteristic of the North Carolina Barrier Islands. Two-dimensional and three-dimensional seepage rates were obtained for 10 x 10 x 1 m deep ponds, located 16-195 m from the sinks, and spaced 10-190 m apart for two profile depths, 3 and 9 m. For the geometries and soil properties considered, pond seepage was dominated by flow in the saturated zone. The spacing between adjacent ponds affected seepage rates, having a greater effect for large island widths. The numerical solutions were used to develop and test an approximate analytic solution for 3-D steady pond seepage. The approximate solution was obtained by dividing the flow regime into radial and linear flow domains. The predicted rates of the analytic solution agreed with those obtained from the numerical solution. (MacKeen-PTT)
W91-03545

SATELLITE DATA TRANSMISSION AND HYDROLOGICAL FORECASTING IN THE FIGHT AGAINST ONCHOCERCIASIS IN WEST AFRICA.
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Abidjan (Ivory Coast). Centre ORSTOM d'Adiopodoume.
For primary bibliographic entry see Field 7B.
W91-03548

HYDRAULICS OF INTERRILL OVERLAND FLOW ON A SEMI-ARID HILLSLOPE, SOUTHERN ARIZONA.
Keele Univ. (England). Dept. of Geography.
A. J. Parsons, A. D. Abrahams, and S.-H. Luk.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 255-273, September 1990. 12 fig, 2 tab, 21 ref. NATO Grant RG.85/0066.

Descriptors: *Erosion, *Hydraulic properties, *Overland flow, *Rainfall-runoff relationships, *Runoff plot, *Semiarid lands, *Soil erosion, Arizona, Flow resistance, Reynolds number, Simulated rainfall, Slopes.

Simulated rainfall experiments were conducted on an 18 by 35 m runoff plot located in southern Arizona. By using a wide plot that extended from the divide to beyond the rill heads, it was possible to examine the full range of lateral variability and downslope changes in interrill overland flow on a shrub-covered, semi-arid piedmont hillslope. The mean depth (d), mean velocity (v), and Reynolds number (Re) of overland flow were computed for two measured sections situated 12.5 and 21 m from the top of the plot. At-a-section d vs. Re and v vs. Re relations showed that increases in Re are accommodated largely by increases in d. These hydraulic relations are principally the result of resistance to flow increasing with Re as overland flow spreads into new areas. Inasmuch as the maximum (equilibrium) discharge simulated in these experiments has a return period of about 7 yr, increasing resistance to flow as Re increases may be considered typical of most overland flow events on shrub-covered, piedmont hillslopes in southern Arizona. Downslope hydraulic relations differ strikingly from at-a-section relations. Under equilibrium runoff conditions, resistance to flow decreases rapidly as Re increases, permitting increases in Re to be accommodated entirely by increases in v. The decrease in resistance to flow is due to progressive downslope concentration of flow into fewer, deeper threads. Under non-equilibrium conditions, downslope hydraulic relations may be quite different from those obtained at equilibrium, but resistance to flow always decreases downslope. This is a result of low flows following pathways formed by higher flows that concentrate downslope. Analyses of overland flow hydraulics at the scale of interrill areas produce results that are quite different from those obtained from small plots. A knowledge of the hydraulics at this scale is essential if models of interrill overland flow are to become more realistic and, hence better predictors of runoff hydrographs and sediment yield. (Author's abstract)
W91-03552

COMPUTATION OF THE INSTANTANEOUS UNIT HYDROGRAPH AND IDENTIFIABLE COMPONENT FLOWS WITH APPLICATION TO TWO SMALL UPLAND CATCHMENTS.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
A. J. Jakeman, I. G. Littlewood, and P. G. Whitehead.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 275-300, September 1990. 10 fig, 6 tab, 43 ref, append.

Descriptors: *Hydrographs, *Hydrological models, *Instantaneous unit hydrographs, *Model studies, *Rainfall-runoff relationships, *Streamflow, *Streamflow forecasting, *Unit hydrographs, Climatic data, Excess rainfall, Precipitation, Rainfall, Small watersheds, Wales, Watersheds.

A model for relating data on rainfall and other climatic variables to streamflow was presented. The approach is based upon three factors: (1) the representation of total streamflow response as a linear convolution of the instantaneous unit hydrograph with rainfall excess; (2) approximation of this representation in discrete time by a rational transfer function relationship which involves an efficient and flexible parameterization; and (3) use of a simple refined version of the instrumental variable method of parameter estimation as the major tool to determine the number of identifiable flow components in the representation and to estimate their dynamic contributions to the instantaneous unit hydrograph. Stream hydrograph separation is undertaken by convoluting rainfall excess with the identified components of the unit hydrograph. The procedure was applied to two small catchments in Wales. The results demonstrate that at sampling intervals of the order of one hour, successful separation of quick and slow flow components can be achieved with short time series of rainfall and streamflow. (Author's abstract)
W91-03553

COMPARATIVE EVALUATION OF THE ESTIMATORS OF THE LOG PEARSON TYPE (LP) 3 DISTRIBUTION.
Saint Johns River Water Management District, Palatka, FL. Dept. of Surface Water Programs.
For primary bibliographic entry see Field 7C.
W91-03557

SECOND CONFERENCE ON THE MANAGEMENT OF THE ILLINOIS RIVER SYSTEM: THE 1990S AND BEYOND.
For primary bibliographic entry see Field 6A.
W91-03608

COMPARISON OF COMMERCIAL-COMMODITY AND RECREATIONAL USE OF THE ILLINOIS RIVER SYSTEM: THE CASE OF THE ILLINOIS AND MICHIGAN NATIONAL HERITAGE CANAL CORRIDOR.
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 6E.
W91-03628

ILLINOIS RIVER AND THE U.S. CORP OF ENGINEERS.
Army Engineer District, Rock Island, IL.
For primary bibliographic entry see Field 6A.
W91-03632

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY.
Geological Survey, Charleston, WV. Water Resources Div.
D. H. Appel.
Available from Books and Open File Reports Section, USGS Box 25425, Denver, CO 80225. USGS Open File Report 90-150, 1990. 46p.

Descriptors: *Data acquisition, *Geological surveys, *Groundwater, *Surface water, *Water resources, *Water resources data, *Water resources institutes, *West Virginia, Federal jurisdiction, Hydrologic data, Institutions.

The U.S. Geological Survey (USGS) has been active in West Virginia since the early 1900's. During recent years, the District completed several investigations as well as initiated others. An intense effort has been made to publish interpretive reports and data on a near-current basis. As a result of this effort, a significant number of water resources reports were completed and/or published during the 1989 fiscal year. This report contains a complete list of USGS reports addressing West Virginia hydrology as of December 1989. The mission of the Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people in the United States. This is accomplished, in large part, through cooperation with other Federal and non-Federal agencies, by: (1) Collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources; (2) Conducting analytical and interpretive water resource appraisals describing the occurrence, availability, and the physical, chemical, and biological characteristics of surface and groundwater; (3) conducting supportive basic and problem-oriented research in hydraulics, hydrology, and related fields of science to improve the scientific basis for investigations and measurement techniques and to understand hydrologic systems sufficiently well to quantitatively predict their response to stress, either natural or manmade; (4) disseminating the water data and the results of these investigations and research through reports, maps, computerized information services, and other forms of public releases; (5) Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and groundwaters; and (6) Providing scientific and technical assistance in hydrologic fields to other Federal, State and local agencies, to licensees of the Federal Power Commission, and to international agencies on behalf of the Department of State. (Lantz-PTT)
W91-03663

DETERMINATION OF AN UPPER LIMIT DESIGN RAINSTORM FOR THE COLORADO RIVER BASIN ABOVE HOOVER DAM.
Morrison-Knudsen Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 2B.
W91-03664

INITIAL CONTRIBUTING AREA OF A SMALL WATERSHED.
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
W. J. Gburek.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 387-403, October 1990. 10 fig, 37 ref.

Descriptors: *Hydrographs, *Rainfall-runoff relationships, *Simulation analysis, *Surface runoff, *Watersheds, Base flow, Infiltration, Pennsylvania, Rainfall area, Saturation zone, Stream discharge.

The initial contributing area (ICA) of a watershed at the onset of rain is defined as consisting of the stream surface and the area of surface saturation caused by the groundwater table intersecting the land surface above the elevation of the stream. Subsurface flow discharges upward within this area, so the ICA exhibits zero infiltration capacity and potential storage for rainfall. Thus, the ICA is the initial runoff-producing area in variable-source-area generation of storm runoff. The ICA of a 42-ha east-central Pennsylvania watershed was shown to be a function of prestorm base flow; a prediction equation was developed using rainfall-runoff data from small rainstorms. This equation could be incorporated directly into a continuous streamflow model where a base flow value is part of the simulation, or into an event-based hydrograph model where prestorm baseflow is specified as a design parameter. (Author's abstract)
W91-03760

RESPONSES OF PERIPHYTON TO CHANGES IN CURRENT VELOCITY, SUSPENDED SEDIMENT AND PHOSPHORUS CONCENTRATION.
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W91-03820

FIRE AND THE DYNAMICS OF ALLOCHTHONOUS DETRITUS IN A SOUTH AFRICAN MOUNTAIN STREAM.
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-03826

MATHEMATICAL MODELS FOR LONG-TERM PREDICTION OF MOUNTAINOUS RIVER RUNOFF: METHODS, INFORMATION AND RESULTS.
Sredneaziatskii Nauchno-Issledovatel'skii Gidrometeorologicheskii Inst., Tashkent (USSR).
I. D. Shentzis.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 5, p 487-500, October 1990. 8 fig, 2 tab, 6 ref.

Descriptors: *Hydrologic models, *Mathematical models, *Model studies, *Mountains, *River flow, *Runoff forecasting, *Streamflow forecasting, *Surface runoff, Glacial streams, Hydrologic budget, Mathematical analysis, Mountain streams, Soviet Union.

The insufficient accuracy of traditional statistical methods has led to the development of a method for the long-term forecasting of runoff in the Central Asian mountainous rivers for the vegetation period, based on a mathematical model. The model describes the whole cycle of runoff formation in mountainous river basins reflecting processes and factors such as precipitation within the various mountain zones, snow cover formation and levels, glaciation, evaporation, and water storage and transport. Testing of the method for the rivers of the Fergana Valley and western Tien Shan has shown that the new model exhibits greater accuracy than the operational statistical forecast method. This is especially true concerning corrections to the forecast in April-May, when the accuracy of estimates of temporary basin storage becomes most important. In addition, numerical experiments revealed that ignorance of glaciation which makes up 3-5% of the total area of mountainous basins leads to considerable errors of summer runoff forecasts. That is why a component for glacial runoff computation was introduced into the model. Consideration of glacial alimentation has eventually improved the estimation of model computation, and forecasts of mountainous river runoff. (Hoskin-PTT)
W91-03840

COMPARISON OF DIFFERENT STRUCTURES FOR A MONTHLY WATER YIELD MODEL IN SEASONALLY SNOW-COVERED MOUNTAINOUS WATERSHEDS OF IRAN.
Katholieke Univ. Leuven (Belgium). Lab. for Land Management.
M. Moussavi, J. Feyen, and G. Wyseure.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 5, p 535-546, October 1990. 6 fig, 3 tab, 10 ref.

Descriptors: *Iran, *Model studies, *Mountains, *Runoff, *Runoff forecasting, *Snow cover, *Snowmelt, *Streamflow forecasting, *Water yield, Comparison studies, Hydrologic budget, Hydrologic models, Mathematical analysis, Mathematical models, Surface runoff.

In many countries the data available in mountainous watersheds are rare and sometimes the required data are accessible only in monthly time steps or as average daily values over a given month. This study emphasizes the search for an appropriate structure of a monthly water balance model, in conjunction with a nonlinear parameter estimation algorithm, capable of simulating the monthly streamflow in seasonally snow-covered mountainous watersheds, and requiring a minimum number of parameters and amount of input data. Several model structures based on a soil water balance concept were compared for the Rudak catchment of Iran. The main distinction between the different structures was made by the inclusion of either a linear or a nonlinear transformation element for the conversion of overland flow or baseflow into total runoff. A combined water balance model having two main elements, a soil storage element generating excess water, and a transformation element conceptualized by a linear storage-discharge relationship (a linear lumped conceptual model), was found to be the most accurate.

The integration of a nonlinear storage-discharge relationship which leads to a second order nonlinear model did not prove to be more successful than a linear or nonlinear first order element. (Hoskin-PTT)
W91-03844

DAM SAFETY: AN EVALUATION OF SOME PROCEDURES FOR DESIGN FLOOD ESTIMATION.
Salford Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W91-03845

CLIMATE FACTOR FOR SMALL-BASIN FLOOD FREQUENCY.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2A.
W91-03853

DISTRIBUTED DYNAMIC WATERSHED MODEL.
Texas A and M Univ., College Station.
W. P. James, and K. W. Kim.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 587-596, August 1990. 9 fig, 3 tab, 20 ref.

Descriptors: *Hydrologic models, *Mathematical models, *Model studies, *Overland flow, *Rainfall-runoff relationships, *Runoff forecasting, *Simulation analysis, *Watershed models, Data interpretation, Drainage patterns, Mathematical analysis, Mathematical equations, Surface drainage.

A distributed watershed model was developed to mathematically simulate overland and channel flow for a single-event storm. The modeled watersheds in the study were subdivided into rectangular grid elements. All hydrologically significant parameters, such as land slope, rainfall and precipitation excess, were assumed to be uniform within each element. The Green-Ampt method was adopted to generate precipitation excess for each element during the simulation period. A two-dimensional diffusion wave model was used for overland flow routing and an iterative Alternative Direction Implicit scheme was used to solve the simultaneous overland flow equations. Once the overland flow became inflow to the channel, a one-dimensional dynamic wave flood routing technique, based on a four-point, implicit, non-linear finite difference solution of the St. Venant equation of unsteady flow, was applied. A limited number of comparisons were made between simulated and observed hydrographs for areas of about one square mile. Given the appropriate parameters, the model was able to accurately simulate runoff for single-event storms. Comparisons were made between simulated and observed hydrographs for three watersheds. The model was able to accurately simulate the runoff for single-event storms using 61-m by 61-m (200 ft by 200 ft) watershed grid elements. (Author's abstract)
W91-03854

LINEAR PROGRAMS FOR NONLINEAR HYDROLOGIC ESTIMATION.
California Univ., Santa Barbara. Dept. of Geography.
H. A. Loaiciga, and R. L. Church.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 645-656, August 1990. 5 tab, 18 ref. California Water Resources Center Grant W-752.

Descriptors: *Hydrologic models, *Linear programming, *Mathematical equations, *Mathematical models, *Model studies, *Rainfall-runoff relationships, *Runoff forecasting, Hydrology, Mathematical analysis, Regression analysis, Runoff, Surface runoff.

The process of calibrating a hydrologic model is of great importance in applied hydrologic studies. The minimization of the sum of absolute deviations and the minimization of the absolute maximum deviation (minimax) have been transformed into equivalent linear programs for the estimation of parameters in a transient and linear hydrologic system. These two methods yield viable parameter estimates that are globally optimal and reproduce properly the timing and magnitude of hydrologic events and associated variables such as total runoff, flood peak and peak-flood magnitude. The two linear estimation methods compared favorably with the popular least-squares nonlinear estimation method. The generality of the theoretical developments shows that linear program equivalents are adequate competitors of nonlinear methods of hydrologic estimation and parameter calibration. (Hoskin-PTT)
W91-03859

ADDITIONAL ANALYSIS OF PEAK-VOLUME RELATIONS AND STANDARDIZATION PROCEDURES.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
M. E. Molfino, and J. F. Cruise.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 687-692, August 1990. 1 fig, 2 tab, 11 ref.

Descriptors: *Flood hydrographs, *Flood peak, *Hydrologic models, *Mathematical equations, *Model studies, *Peak flow, *Rainfall-runoff relationships, *Runoff forecasting, Hydrology, Mathematical analysis, Mathematical models, Regression analysis, Slopes.

Much has been written about the linear relationship in log space between the runoff volume of a hydrograph and the peak discharge. Three versions of this relation (an original and two standardizations) have been presented and recommended by various authors. The standardized equations were compared to the original relationship and the behavior of the coefficient of determination (r2) in each case is discussed. The r2 of the standardized equations is increased or decreased relative to that of the original relation based upon the magnitude of the original slope. A database of 90 watersheds and over 1200 separate flood hydrographs were used to investigate the comparative utility of these equations. (Author's abstract)
W91-03863

WINTER SHORT-PULSE RADAR STUDIES ON THE TANANA RIVER, ALASKA.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 7B.
W91-03868

COLLAPSE OF RIPARIAN POPLAR FORESTS DOWNSTREAM FROM DAMS IN WESTERN PRAIRIES: PROBABLE CAUSES AND PROSPECTS FOR MITIGATION.
Lethbridge Univ. (Alberta). Dept. of Biological Sciences.
For primary bibliographic entry see Field 6G.
W91-03876

PALYNOSTRATIGRAPHY OF THE CENTRAL WEST MURRAY BASIN.
M. K. Macphail, and E. M. Truswell.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 301-331, 1990. 11 fig, 1 tab, 75 ref, 2 append.

Descriptors: *Australia, *Geohydrology, *Geologic history, *Murray-Darling River Basin, *Paleohydrology, *Palynology, Aquitards, Boreholes, Geologic control, Groundwater, Marine environment, Paleoclimatology, Pollen, Rainfall, River basins, Stratigraphy, Vegetation.

Palynological analyses have been undertaken on four boreholes in the central west Murray Basin, in southeastern Australia, to provide a biostratigraphic framework for geological factors related to groundwater. Three of the boreholes penetrated the marine sequence of the Geera Clay, which acts as an aquitard confining groundwater flow within the aquifers of the Renmark Group. The oldest sediments encountered in this study were early Cretaceous (non-marine); followed by marine transgressions during the middle Eocene-early Oligocene and Oligocene-early/middle Miocene (Geera Clay deposition). Pollen assemblages from the Murray Basin contain a number of taxa, many of them with affinities to modern tropical plant species or groups which are unknown in other southeastern Australian basins. Many of these are of potential stratigraphic value. Broad scale shifts in vegetation, presumably in response to climatic change, are discernible in the Late Oligocene to earliest Miocene over much of the basin. There is a suggestion that the initiation of this shift, which reflects a change from year-round to seasonal rainfall patterns, was diachronous for west to east, but patterns of change in space and time are complex, so the correlative value of changes in pollen frequencies remains limited. (Author's abstract)
W91-03904

2F. Groundwater

GEOLOGY AND GROUND-WATER RESOURCES OF THE SAN CARLOS INDIAN RESERVATION, GILA, GRAHAM, AND PINAL COUNTIES, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
J. G. Brown.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4152, 1989. 39p, 5 fig, 2 plates, 4 tab, 32 ref. Project no. AZ112.

Descriptors: *Alluvial aquifers, *Arizona, *Geohydrology, *Groundwater availability, *San Carlos Indian Reservation, Alluvium deposits, Basin-fill deposits, Specific yield, Transmissivity, Volcanic rocks, Water quality.

The San Carlos Indian Reservation includes about 2,900 sq mi in east-central Arizona. Relatively impermeable pre-Tertiary rocks are exposed in about 23% of the reservation and underlie water-bearing Tertiary and quaternary basin fill and Quaternary stream alluvium in much of the southern part of the reservation. About 9,000 members of the San Carlos Apache Tribe live on the reservation and rely on groundwater to meet public supply, irrigation, and other needs. Basin fill is widespread in the valley of the San Carlos and Gila Rivers and consists of fine sand, silt, limestone, clay, and pyroclastic volcanics that may attain a total maximum thickness of more than 3,200 ft in the reservation. Quaternary stream alluvium overlies the basin fill along many streams and washes. Stream alluvium consists of poorly sorted, unconsolidated, gravelly, muddy, sand; and sandy gravel and reaches a maximum thickness of 100 ft along the San Carlos and Gila Rivers. The volume of recoverable water stored in the basin fill to a depth of 1,200 ft is estimated to be about 20 million acre-ft. The volume of recoverable water stored in the stream alluvium on the reservation is estimated to be more than 100,000 acre-ft. The stream alluvium along the San Carlos River supplies most of the water used for drinking. Water throughout much of the reservation is suitable for most uses except for that in the alluvium along the Gila River, which contains large concentrations of dissolved solids. (USGS)
W91-02961

POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND DURING SEPTEMBER 1988.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02962

HYDROGEOLOGIC AND CHEMICAL DATA FOR THE O-FIELD AREA, ABERDEEN PROVING GROUND, MARYLAND.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-02964

HYDROGEOLOGIC DATA FOR THE CANAL CREEK AREA, ABERDEEN PROVING GROUND, MARYLAND, APRIL 1986-MARCH 1988.
Geological Survey, Towson, MD. Water Resources Div.
J. P. Oliveros, and P. Gernhardt.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-387, 1989. 71p, 29 fig, 3 tab, 4 ref.

Descriptors: *Aberdeen Proving Ground, *Aquifer characteristics, *Aquifer systems, *Coastal aquifers, *Hydrologic data, *Maryland, Groundwater, Unconsolidated aquifers, Water level.

This report is a compilation of hydrologic and geologic data collected for the period April 1986 through March 1988 for the Canal Creek area of Aberdeen Proving Ground, Maryland. Geologic data include lithologic logs for 73 sites and geophysical logs for 71 sites. Hydrologic data consist of hydrographs and synoptic water level measurements. The hydrographs were taken from eight wells that were equipped with continuous water level recorders, and the synoptic water-level measurements were made four times during the study. Well-construction data also are included for 149 observation wells. (USGS)
W91-02965

GEOHYDROLOGY AND NUMERICAL MODEL ANALYSIS OF GROUND-WATER FLOW IN THE PULLMAN-MOSCOW AREA, WASHINGTON AND IDAHO.
Geological Survey, Tacoma, WA. Water Resources Div.
W. E. Lum, J. L. Smoot, and D. R. Ralston.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4103, 1990. 73p, 27 fig, 7 tab, 42 ref.

Descriptors: *Basalts, *Computer models, *Geohydrology, *Groundwater movement, *Loess, *Model studies, Aquifers, Groundwater, Groundwater budget, Groundwater depletion, Groundwater management, Hydraulic conductivity, Recharge, Seepage, Simulation, Storage coefficient, Surface-groundwater relations.

The geohydrology of the Pullman, Washington-Moscow, Idaho area was investigated by mapping geohydrologic units, determining the distribution of hydraulic head in each unit, and determining some of the components of the water budget. This information was used to construct a three-dimensional groundwater-flow model that incorporates three layers--a surficial loess layer, a Wanapum Basalt layer, and a Grande Ronde Basalt layer. The model was used to assess the effects of changes in the rate of withdrawal of groundwater on the water levels in the geohydrologic units and on streamflow in the area. Recharge to the groundwater system was calculated independent of the model. It was determined that current farming practices use soil moisture more effectively than did natural vegetation, and these practices have reduced groundwater recharge by nearly 10%. The three-dimensional model was calibrated using the time-averaged method for the period 1974-85, and was evaluated by simulating historical pumpage rate changes (1890-1985) and comparing calculated with observed water-level changes. Model results indicate that groundwater levels would stop declining if pumpage were stabilized at a constant level. Levels will continue to decline into the foreseeable future, however, as long as groundwater pumpage continues to increase. The source of the additional simulated pumpage is streamflow depletion near pumping locations. (USGS)
W91-02970

HYDROGEOLOGY AND WATER RESOURCES OF THE LOS OSOS VALLEY GROUNDWATER BASIN, SAN LUIS OBISPO COUNTY.
Geological Survey, Sacramento, CA. Water Resources Div.
E. B. Yates, and J. H. Wiese.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4081, May 1990. 76p, 29 fig, 8 tab, 35 ref.

Descriptors: *Geohydrology, *Groundwater, *Groundwater movement, *Los Osos Valley, *Model studies, *Wastewater disposal, *Water pollution control, California, Groundwater management, Hydrogeology, Recharge, Saline water intrusion, San Luis Obispo County, Seawater, Simulation.

The Los Osos Valley groundwater basin on the central California coast extends about 3 miles inland and an unknown distance offshore, where it is hydraulically connected with the Pacific Ocean. Basin fill consists of unconsolidated, complexly layered sediments; individual beds are thin and discontinuous. Groundwater flow was studied using available data, geologic mapping, drilling, and measurements of potentiometric head, water quality, and streamflow. A three-dimensional digital model of the basin was developed and calibrated to match water levels and head-dependent flows during 1970-77 and 1986. Although the model could not simulate perched water tables, other results were adequate and were not sensitive to small errors in input data. Annual recharge comes from rainfall (80%), groundwater inflow (18%), and net recharge from Los Osos Creek (2%). In 1986, principal outflows were net municipal pumpage (34%), net agricultural pumpage (28%), and net outflow across the ocean boundary (28%). Model simulations of water supply and wastewater disposal options indicated that if wastewater is centrally treated and recharged, locally pumped groundwater could meet projected municipal water demand through the year 2010 without causing seawater intrusion, even during brief droughts. If wastewater is exported from the basin, seawater intrusion is likely even if imported water meets approximately half of municipal water demand in the 2010. Wastewater recharge may cause long-term salt buildup in the basin and local waterlogging of soils. (USGS)
W91-02971

MAP OF MEAN ANNUAL RUNOFF FOR THE NORTHEASTERN, SOUTHEASTERN, AND MID-ATLANTIC UNITED STATES, WATER YEARS 1951-80.
Geological Survey, Madison, WI. Water Resources Div.
W. R. Krug, W. A. Gebert, and D. J. Graczyk.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4094, 1990. 11p, 2 fig, 1 pl, 6 tab, 5 ref.

Descriptors: *Data collections, *Hydrologic data, *Maps, *Runoff, *Stream discharge, *Water resources data, Gaging stations.

A map of mean annual runoff for States within the Northeastern, Southeastern, and Mid-Atlantic United States was prepared by the U.S. Geological Survey for the Direct/Delayed Response Project being conducted by the U.S. Environmental Protection Agency. This map shows mean annual runoff during water years 1951-80. Mean annual runoff from the northeastern region during 1951-80 ranged from less than 12 to greater than 40 inches. Runoff from the southeastern region runoff ranged from less than 12 to greater than 55 inches. In the mid-Atlantic region ranged from less than 10 to greater than 40 inches. Error analysis using 93 gaging stations not used for preparing the runoff map showed that the runoff map could be used to predict runoff with an average error of less than 10%. Errors in runoff estimation averaged about 12% if the locations of the gaging stations were used to estimate runoff instead of computing an area-weighted average over the basin. If the locations of the gaging stations were used to estimate runoff, there also was a significant negative bias of the errors that did not occur if the centroid or a weighted average runoff of the drainage basin were used. The runoff map is expected to be more accurate in areas that have a relatively high concentration of gaging stations and little topographic variability, such as part of the Northeast. Based on these criteria, the least reliably mapped areas would be in the Smokey Mountains along the North Carolina-Tennessee border. (USGS)
W91-02973

PLAN OF STUDY FOR THE OHIO-INDIANA CARBONATE-BEDROCK AND GLACIAL-AQUIFER SYSTEM.
Geological Survey, Columbus, OH. Water Resources Div.
E. F. Bugliosi.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-151, 1990. 27p, 10 fig, 23 ref.

Descriptors: *Aquifer characteristics, *Aquifers, *Geohydrology, *Glacial aquifers, *Groundwater, *Indiana, *Ohio, Aquifer systems, Carbonate rocks, Water use.

The major aquifers of 35,000 sq mi area in western Ohio and eastern Indiana consist of Silurian and Devonian carbonate bedrock and Quaternary glacial deposits. These bedrock units and glacial deposits have been designated for study as part of the U.S. Geological Survey's Regional Aquifer System Analysis program, a nationwide program to assess the regional hydrology, geology and water quality of the Nation's most important aquifers. The purpose of the study is to define the hydrology, geochemistry, and geologic framework of the aquifer system within the Silurian and Devonian rocks and glacial deposits, with emphasis on describing the groundwater flow patterns and characterizing the water quality. The study, which began in 1988, is expected to be completed in 1993. In 1980, the aquifers in the study area supplied more than 280 million gallons of water/day to industry, agriculture, and a population of more than 6.3 million people. With a projected future population growth to 7.1 million in 1990, and with intensified agricultural and industrial uses, water withdrawals from these bedrock and glacial aquifers are expected to be increased. The most significant groundwater problems in the study area result from the pronounced areal differences in availability and quality of the groundwater. These differences are related to the lateral discontinuity of many of the glacial deposits and to variations in secondary permeability of the bedrock aquifers associated with patterns of fracturing. Planned activities of the study include compilation of available geohydrologic and water quality data, such as groundwater levels, geohydrologic properties of aquifers, chemical analyses, land use and water use data, and ancillary data such as digital satellite images. Additional geohydrologic and water quality data may be collected from existing wells or wells that may be drilled for this study. A computerized, geographic information system will be used as a data base management tool and for spatial analysis and presentation of the data. A digital computer model will be developed to study the regional groundwater flow system and to investigate the effects of development on the aquifer system. (USGS)
W91-02975

SIMULATION OF GROUND-WATER FLOW IN THE MISSISSIPPI RIVER VALLEY ALLUVIAL AQUIFER IN EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
G. L. Mahon, and A. H. Ludwig.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4145, June 1990. 26p, 10 fig, 25 ref.

Descriptors: *Alluvial aquifers, *Arkansas, *Computer models, *Geohydrology, *Groundwater movement, *Mississippi-Missouri River Valley, *Model studies, *Pumpage, Hydraulic properties, Recharge, Rivers, Storage coefficient, Transmissivity.

The U.S Geological Survey has developed and calibrated a digital model of the flow system in the alluvial aquifer as part of a multiagency Eastern Arkansas Region Comprehensive Study being conducted by the U. S. Army Corps of Engineers. Other cooperating agencies include the U.S. Soil

Conservation Service, the Arkansas Soil and Water Conservation Commission, and the University of Arkansas. The study was prompted by the growing concern about significant water level declines in the Mississippi River Valley alluvial aquifer north of the Arkansas River in eastern Arkansas. The declines are a result of large groundwater withdrawals, mainly for irrigation. After calibration, the flow model was used to simulate the effects of projected groundwater pumpage through the year 2050, based on estimates made by the U.S. Soil Conservation Service for pumpage scenarios with and without water conservation measures. Simulations of projected pumpage indicated that by the year 2050 water level declines would reduce the saturated thickness of the aquifer to less than 20 ft in large areas of eastern Arkansas. More than 26% of the active cells in the scenario without conservation had saturated thicknesses of 20 ft or less and mroe than 16% in the scenario with conservation. The principal areas where the saturated thickness is expected to reach these critical levels are in the Grand Prairie region and in two areas on the east and west sides of Crowleys Ridge. (USGS)
W91-02976

EVALUATION OF GROUND-WATER RECHARGE ALONG THE GILA RIVER AS A RESULT OF THE FLOOD OF OCTOBER 1983, IN AND NEAR THE GILA RIVER INDIAN RESERVATION, MARICOPA AND PINAL COUNTIES, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
A. D. Konieczki, and S. R. Anderson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4148, 1990. 30p, 6 fig, 7 tab, 2 plates, 23 ref. Project No. AZ090.

Descriptors: *Arizona, *Gila River, *Groundwater resources, *Recharge, *Surface-groundwater relations, Gila River Indian Reservation, Maricopa County, Pinal County.

Flow in the Gila River from the flood of October 1983 infiltrated the stream channel and recharged the groundwater system along the Gila River floodplain from Ashurst-Hayden Dam to the confluence with the Salt River. Changes in groundwater levels from January 1983 to March 1984 confirmed the occurrence of recharge to the groundwater system. The average water level change for 74 wells was +24.2 ft. The water-level rise was greatest in the reach from river mile 15 to river mile 22, where the average water level change for 10 wells was +59.4 ft. The average water level increase for 28 miles from river mile 40 to river mile 71 was +14.2 ft. Estimates of recharge from January 1983 to March 1984 ranged from 440,000 to 640,000 acre-ft. A water budget method and a water level change method were used to estimate the recharge to the aquifer. At least 46% to 66% of the recharge was the result of streamflow infiltration from the Gila River during October 1983 to February 1984. The increase in aquifer storage was one to two times greater than the quantity of groundwater pumped from the Gila River Indian Reservation during the 10 years preceding the flood. (USGS)
W91-02977

LARGE SPRINGS IN THE VALLEY AND RIDGE PROVINCE IN TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02979

STRUCTURE AND APPLICATION OF AN INTERFACE PROGRAM BETWEEN A GEOGRAPHIC-INFORMATION SYSTEM AND A GROUNDWATER FLOW MODEL.
Geological Survey, Tucson, AZ. Water Resources Div.
P. C. Van Metre.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-165, 1990. 68p, 2 fig, 4 ref. Project No. AZ104.

Descriptors: *Computer models, *Computer programs, *Geographic information systems, *Groundwater movement, *Model studies, Computers, Geographical information systems.

A computer-program interface between a geographic-information system and a groundwater flow model links two unrelated software systems for use in developing the flow models. The interface program allows the modeler to compile and manage geographic components of a groundwater model within the geographic information system. A significant savings of time and effort is realized in developing, calibrating, and displaying the groundwater flow model. Four major guidelines were followed in developing the interface program: (1) no changes to the groundwater flow model code were to be made; (2) a data structure was to be designed within the geographic information system that follows the same basic data structure as the groundwater flow model; (3) the interface program was to be flexible enough to support all basic data options available within the model; and (4) the interface program was to be as efficient as possible in terms of computer time used and online-storage space needed. Because some programs in the interface are written in control-program language, the interface will run only on a computer with the PRIMOS operating system. (USGS)
W91-02980

CONSIDERATIONS FOR DATA COLLECTION TO SUPPORT SIMULATION ANALYSES IN THE SATURATED ZONE.
For primary bibliographic entry see Field 7A.
W91-02994

NATIONAL WATER INFORMATION SYSTEM USER'S MANUAL. VOLUME 2, CHAPTER 4. GROUND-WATER SITE INVENTORY SYSTEM.
For primary bibliographic entry see Field 7C.
W91-03013

40 CFR 265 INTERIM STATUS INDICATOR-EVALUATION GROUND-WATER MONITORING PLAN FOR THE 216-B-63 TRENCH.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 7A.
W91-03024

GUIDANCE ON REMEDIAL ACTIONS FOR CONTAMINATED GROUND WATER AT SUPERFUND SITES.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-03031

MINIMUM SET OF DATA ELEMENTS FOR GROUND WATER.
Environmental Protection Agency, Washington, DC. Information Management and Services Div.
For primary bibliographic entry see Field 7A.
W91-03044

AQUIFER PROPERTIES DATABASE.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 7C.
W91-03046

INCREASING THE VALUE OF TECHNICAL DATA FOR MAKING GROUNDWATER POLICY DECISIONS.
North Carolina State Univ., Raleigh. Dept. of Economics.
For primary bibliographic entry see Field 7B.
W91-03075

GROUND WATER MODELING ANALYSIS FOR A CONTAMINATED WATER-SUPPLY WELL FIELD IN INDIANA.
Weston (Roy F.), Inc., West Chester, PA.
J. Y. Yang.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 13A-11--13A-18, 7 ref.

Descriptors: *Groundwater pollution, *Groundwater quality, *Indiana, *Model studies, *Monitoring, *Path of pollutants, *Water supply, Solute transport, Trichloroethylene, Volatile organic compounds, Wells.

Trichloroethylene (TCE) contamination was found in a well field in Indiana which provided more than 1,300 million gallons a year for domestic water supply purposes. The initial discovery of TCE contamination occurred in April 1981, during routine testing of finished water by the EPA. All 15 production wells in the well field have shown measurable levels of TCE and other volatile organic compounds (VOCs). Seven of the 15 wells have shown annual average TCE concentrations greater than EPAs safe allowable limit of 5.0 ppb. Some industrial wells, which yield more than 100,000 gpd and are located within 1 mile west of the well field, have been developed in the same unconsolidated sand and gravel deposits. A two-dimensional, numerical groundwater solute transport model was developed and used to evaluate TCE migration in the groundwater system beneath the well field. The preliminary results indicated locations of potential sources of contamination and indicated that additional monitoring wells should be drilled for data collection. (See also W91-03032) (Author's abstract)
W91-03081

DROUGHT MANAGEMENT PLAN: MANAGING AND PROTECTING A RESOURCE.
Camp, Dresser and McKee, Inc., Austin, TX.
For primary bibliographic entry see Field 4B.
W91-03089

BENCH-SCALE STUDY OF THE REMOVAL OF CHROMIUM AND CYANIDE FROM CONTAMINATED GROUNDWATER.
For primary bibliographic entry see Field 5G.
W91-03102

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES. VOLUME III.
Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. 324p. Edited by C. P. Gupta.

Descriptors: *Developing countries, *Geohydrology, *Groundwater management, *Water resources development, *Water resources management, *Workshops, Analytical methods, Groundwater movement, Groundwater potential, Hydrologic models, Management planning, Model studies, Publications, Water demand.

The keynote papers and other significant contributions of an international workshop deliberating on the state-of-the-art techniques in geohydrology and their illustrative applications have been compiled into a series of publications. In the third volume, some of the articles are a critical review/overview of the established techniques, though with a new insight, such as estimation of geohydrological situations. Some others deal with techniques that are known, but not commonly used in geohydrological studies, such as the use of radon in exploration in fractured zones, three-dimensional stochastic modeling for fractured media, and use of cross validation in krigings. The papers have been organized in the same sequence of sessions as in Volumes I and II of this workshop. It is expected that these thought-provoking papers will lead to interactive and purposeful discussions and finally help solidify the operational details, technical guidelines, designs, and practices for hazard-free exploration, exploitation, and management of groundwater resources to meet the ever-increasing demand for water. (See W91-03179 thru W91-03197) (Fish-PTT)

W91-03178

GEOHYDROLOGIC PARAMETER ESTIMATION: PUMPING TESTS AND TRACER TECHNIQUES.
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 1-21, 9 fig, 1 tab, 34 ref.

Descriptors: *Developing countries, *Geohydrology, *Groundwater management, *Hydrologic models, *Model studies, *Parametric hydrology, *Tracers, *Water resources management, Analytical methods, Aquifer characteristics, Aquifer testing, Groundwater movement, Groundwater potential, Management planning, Numerical analysis, Research priorities, Water resources development.

Estimation of the parameters which describe groundwater flow continues to be an important area of research. The recommended approach is to identify the important flow mechanisms before attempting to analyze any pumping tests. In field examples initial studies did not identify the mechanisms that would apply as exploitation of the aquifers developed; for this reason the potential yields of the aquifers were overestimated. It is necessary to carry out controlled tests and select suitable methods of analysis to estimate the magnitude of the aquifer parameters. Numerical analysis is becoming increasingly feasible, since the programs run successfully on microcomputers. The most difficult parameter to estimate is the effective vertical hydraulic conductivity. At present the only reliable method is using carefully-designed pumping tests with analytical or numerical methods of analysis. The development of a more direct method of determining the effective vertical hydraulic conductivity must have a high priority. Tracers are used to learn more about aquifer features, especially the recharge. The techniques which have been developed are reliable and consistent yet there remains the uncertainty as to whether measurements in the unsaturated zone can give reliable information about the quantity of water actually reaching the water table. There are in effect pumping tests and recharge experiments occurring continuously in most aquifers. If records are kept of inflows, well discharges, groundwater hydrographs, and river flows, these can be used with some form of regional or local groundwater model to estimate the important groundwater parameters. (See also W91-03178) (Fish-PTT)
W91-03179

PROGRESS AND PROSPECTS IN ENVIRONMENTAL ISOTOPE HYDROLOGY.
Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
M. A. Geyh.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 23-36, 8 fig, 1 tab, 43 ref.

Descriptors: *Developing countries, *Environmental tracers, *Groundwater movement, *Isotopic tracers, *Tracers, *Water resources development, Analytical methods, Arid-zone hydrology, Groundwater management, Groundwater potential, Hydrologic models, Management planning, Model studies, Radioisotopes, Semiarid lands, Water resources management.

In recent years various techniques based on environmental isotopes have been widely applied in hydrological studies. Most commonly analyzed are the isotope compositions of the environmental radionuclides tritium and radiocarbon as well as those of the stable nuclides of oxygen and hydrogen. The environmental isotope techniques allow determination of the origin of groundwater, its recharge and discharge, quantification of mixtures of different kinds of groundwater, estimation of the age of groundwater, and its movement. New hydrological chronometers such as chlorine-36, argon-39, calcium-41, krypton-81, and krypton-85, as well as the dissolved noble gases, have been introduced during recent years. The dating of groundwater via its dissolved organic carbon compounds seems to be promising. In semiarid and arid zones the estimation of very small evaporation rates from the stable isotope composition of pore water in profiles of the unsaturated zone has become important in groundwater balance studies. There is a trend substituting qualitative for quantitative interpretation of environmental isotope data using mass transport calculations. It has been shown, for instance, that the occurrence of relict resources of fossil groundwater in semiarid zones complicate numerical modeling. Last but not least, long-term monitoring of the isotope composition in groundwater abstracted from production wells may yield recommendations for an optimized groundwater management program. (See also W91-03178) (Author's abstract)
W91-03180

NATURAL RECHARGE OF BASEMENT AQUIFERS IN A SAHEL AND SUDAN CLIMATE: EXPERIMENTAL STUDY IN BURKINA FASO.
Bureau de Recherches Geologiques et Minieres, Orleans (France).
F. Milville, M. Normand, T. Pointet, C. Merlo, and F. Urani.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 47-61, 5 fig, 3 tab, 4 ref.

Descriptors: *Africa, *Burkina Faso, *Developing countries, *Geohydrology, *Groundwater recharge, *Recharge, *Water resources development, Climatic zones, Field tests, Geologic fractures, Groundwater management, Groundwater movement, Groundwater potential, Hydrologic models, Infiltration, Isotope studies, Model studies, Numerical analysis, Water resources management, Water yield.

Two projects have been developed in Burkina Faso, Africa, in order to evaluate by multidisciplinary methods the recharge of basement aquifers in sahelian and sudanese climates, and to perform realistic field tests of exploitation of large yields destined for the irrigation of small areas. The recharge study was carried out on ten pilot stations included within the scope of the first project. Monitoring over a two-year period provided the numerical information required for the constitution and the calibration of combined rain/water level models which allowed the quantitative analysis of the water transit from the surface to the water-saturated underground. Roughly 300 samples were collected for isotope analysis, to attempt dating the water and to study the movement of water masses within the fissured medium. A striking phenomenon of recharge was thus observed and characterized, in both climates concerned. It supposes the infiltration of between 50 and 150 mm of water for the different latitudes in which the tests were conducted. It was also observed that a partitioning effect of the drainage basins into sub-units occurs by water isotopes in particular, which is more and more marked towards the dry zones. This indicates that the aquifers to be exploited in the sahel zones will be even more fragile. (See also W91-03178) (Author's abstract)
W91-03182

HYDROGEOLOGICAL PARAMETER ESTIMATION TECHNIQUES: LOCAL TEST, MODEL FITTING, STOCHASTIC METHODS, AND THE USE OF TRACERS.
Paris-4 Univ. (France).
G. de Marsily, and P. Lachassagne.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 63-75, 49 ref.

Descriptors: *Aquifer testing, *Developing countries, *Geohydrology, *Hydrologic models, *Model studies, *Parametric hydrology, *Water resources development, Analytical methods, Aquifer characteristics, Geostatistics, Groundwater management, Groundwater movement, Groundwater potential, Permeability, Pumping tests, Slug tests, Tracers, Transmissivity, Water resources management.

For most hydrogeological problems the permeability, or transmissivity, of an aquifer is the most important parameter to be determined. To do so, the hydrologist can measure a variety of magnitudes in the field, but he can never directly measure a permeability: he has to rely on a model to interpret the measurements and calculate a permeability or transmissivity. A very large number of models is available, with varying underlying assumptions. It is useful to first define a local parameter value; it is clear then that such local values are frequently highly variable in natural media. One can then try to determine which type of average of these local values is estimated by each method, and what type of average is needed for solving the problem at hand. Geostatistics can be of great help to estimate averages as well as local values at any scale of interest. It is important to apply geostatistics to the correct variable. A slug test or injection test over a small section of a well or piezometer should be considered as the basic method to determine aquifer properties in the field; such tests should then be performed at numerous locations to determine both the type of distribution and the variogram of the local permeability values. In low-permeability media, however, such tests should be continuous, then used to estimate the local transmissivity at the well or the regional transmissivity in the area. Long-term pump tests should be considered as a means to validate the averages which could be obtained from the local measurements. The use of environmental tracers may be helpful as analogs for contaminant transport. (See also W91-03178) (Fish-PTT)
W91-03183

STOCHASTIC SPATIAL PREDICTION OF HYDROGEOLOGIC PARAMETERS: ROLE OF CROSS-VALIDATION IN KRIGINGS.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 7C.
W91-03184

GROUNDWATER FLOW IN UNSATURATED/SATURATED ZONES.
Colorado State Univ., Fort Collins.
H. J. Morel-Seytoux, and C. Miracapillo.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 91-106, 7 fig, 1 tab, 11 ref.

Descriptors: *Aeration zone, *Groundwater movement, *Infiltration, *Model studies, *Surface-groundwater relations, *Water resources development, Analytical methods, Developing countries, Flow models, Groundwater management, Groundwater recharge, Hydrologic models, Parametric hydrology, Recharge basins, Unconfined aquifers, Wadi, Water resources management.

The unsaturated zone plays a crucial role in the hydrologic cycle as the link between surface and groundwater. Though there are many aspects to this interaction, examination of a single aspect, that of aquifer recharge, will illustrate nevertheless most essential elements in the linkage. Typically intermittent streams (wadis) and (artificial) infiltration basins are not in permanent hydraulic connection with the underlying water table aquifer. As water becomes available in the wadi or in the basin, infiltration proceeds. Due to the frequent presence of a clogged layer the water flow below the wadi (or basin) bed is unsaturated. Recharge occurs only after the unsaturated wetting front

reaches the water table. On the other hand, long after infiltration has ceased at the soil surface, recharge continues from the unsaturated storage in excess of field capacity, which has accumulated above the water table during the infiltration phase. The three-dimensional character of the flow is rendered by a technique that consists of matching a flow solution in a vertical cross-section with a flow pattern in a horizontal plane. Practical examples illustrate the influence of the parameters on the water table level below the infiltrating area and on the lateral recharge rate into the part of the aquifer which is not overlain by the river or basin bed. Comparison with field observations shows the technique to be accurate, inexpensive, and easy to apply. (See also W91-03178) (Author's abstract)
W91-03185

ESTIMATING GROUNDWATER RECHARGE USING SURFACE AND SOIL WATER BALANCES.
Institute of Hydrology, Powys (Wales).
J. A. Hudson.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 107-137, 5 fig, 90 ref.

Descriptors: *Groundwater recharge, *Hydrologic models, *Model studies, *Recharge, *Surface-groundwater relations, Analytical methods, Great Britain, Groundwater management, Groundwater potential, Hydrologic data collections, Remote sensing, Water resources development, Water resources management.

Groundwater resources in Britain are divided between those in the chalk, limestone, and permotriassic sandstone aquifers of the south and east and the smaller, less continuous, yet locally important drift and gravel aquifers of the upland north and west. Assessment of the worth and sustainable yields of these sources has depended on the development of techniques for estimating the rate of renewal of groundwater by recharge; these methods rely heavily on the use of surface and soil water balances. The framework, if not necessarily the detail, of these methods is of equal relevance to problems of groundwater exploitation in the developing countries. The relative merits of the available physical, mathematical, and chemical techniques suggests that the main objective should be the provision of comprehensive data collection networks for monitoring precipitation, evaporation, soil moisture content and tension, transpiration, soil moisture drainage and streamflow, in order to construct spatially and temporally relevant models of groundwater recharge. Appropriate data is hard to find in developed countries, which generally have a dense hydrometric infrastructure in place, let alone in developing countries where large scale exploitation of resources is only just beginning. Even where reliable, accurate, precise, long-term records are available, the ability to construct physical models is constrained by the lack of information on the spatial variability of vegetation, soils, and groundwater stores. Remote sensing from airplanes and satellites might eventually solve some of the spatial problems, but the techniques are as yet in their infancy. (See also W91-03178) (Fish-PTT)
W91-03186

INTERACTION BETWEEN THE GROUNDWATER AND UNSATURATED SOIL-WATER FLOW REGIONS.
Rothamsted Experimental Station, Harpenden (England).
E. G. Youngs.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 139-154, 2 fig, 39 ref.

Descriptors: *Groundwater movement, *Infiltration, *Recharge, *Soil water, *Surface-groundwater relations, Aeration zone, Analytical methods, Darcys law, Groundwater management, Hydrologic models, Model studies, Physical models, Soil physical properties, Water resources development, Water resources management, Wetlands.

The application of the physics of water movement through soils provides a rational basis for the management and development of water resources. The physics of water movement in saturated and unsaturated soils is used as the basis of a rational approach to problems involving the interaction between the groundwater and unsaturated soil-water flow regions. Two applications were made using physical theory: (1) the effect of evaporation on water table levels in unconfined aquifers under artesian conditions was analyzed; and (2) the movement of water tables in low-lying wetlands as a response to meteorological input was computed. The classical theory used is based on continuum physics embodied in Darcy's law and Richards' equation for flow through inert homogeneous porous materials. However, the classical theory is inadequate in many real situations when there is soil heterogeneity, when there is soil swelling and shrinking, and when there is soil aggregation. To apply the classical theory of soil-water movement, these complications need to be considered when making measurements of soil properties for predicting water flow in soils; measurements of hydraulic soil properties have to sample volumes larger than the soil's representative elementary volume, which can be found only by repeated measurement on different-sized samples. The collection of good field data could remain a major problem in the understanding of the physics of water movement in both saturated and unsaturated soils. (See also W91-03178) (Fish-PTT)
W91-03187

GEOHYDROLOGICAL DATA ACQUISITION: SOME IMPERATIVES.
National Geophysical Research Inst., Hyderabad (India).
C. P. Gupta.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 155-164, 1 fig, 2 tab, 4 ref.

Descriptors: *Data acquisition, *Groundwater data, *Hydrologic data, *Network design, *Water resources development, Databases, Economic aspects, Geohydrology, Groundwater management, Management planning, Water resources management.

There has been a growing realization of the need for a reliable and credible database for an objective and rational management of groundwater resources. The need is felt all the more strongly in developing countries where the demand on groundwater resources has been incessantly mounting due to a fast growth of population and increased agricultural activities. The objective of a geohydrological data acquisition system (GDAS) is the generation of an appropriate database which could be transformed into a meaningful information system for a hazard-free development of groundwater resources. The design of a GDAS should take into account (1) essential features of the geohydrological regime, (2) specific needs of the users, an (3) the available financial resources for the establishment, operation, and management of the system. Standardization of the methodology and unrestricted accessibility to the database are other prerequisites for communication and meaningful utilization of the geohydrological data. (See also W91-03178) (Author's abstract)
W91-03188

GEOHYDROLOGICAL DATA BASE FOR WATER MANAGEMENT.
Jawaharlal Nehru Technological Univ., Hyderabad (India).
B. H. Briz-Kishore.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 165-174, 4 fig, 2 tab, 6 ref.

Descriptors: *Computer models, *Data storage and retrieval, *Databases, *Groundwater management, *Hydrologic data collections, *Water resources development, *Water resources management, Data processing, Data requirements, Developing countries, Economic aspects, Management planning, Social aspects.

Effective water management acts as a catalyst for extensive socioeconomic development and administrative policy modernization. The extent of modernization depends upon the stimulating impact of the data processing itself, and it is in this sense the geohydrological database development, as part of the water management process, becomes one of the most crucial building blocks of public administration. It is well-known that the data required for different applications in water management is copied from original field records several times. This kind of data-copying results in the redundant storage of data under the same processing environment. Conventional methods involving different physical file structures pose severe limitations such as rigidity for carrying out any extensions and necessity for frequent reorganization. Hence it is essential to formulate an efficient data storage and interaction mechanism removing all the prevailing lacunae and limitations of conventional methods of storage through recently-emerging database systems. A computerized database will provide integrated information on mass balance at any point of time for pragmatic planning, efficient execution, and serious monitoring of several socioeconomic schemes for the benefit of the society. The system can be operated even by nontechnical persons and is capable of responding to several queries simultaneously to stimulate the information through graphic outputs, when well-defined documentation is available. (See also W91-03178) (Author's abstract)
W91-03189

3-D STOCHASTIC DISCRETE FRACTURE NETWORK MODEL FOR SIMULATING FLOW AND TRANSPORT THROUGH FRACTURED MEDIA.
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
M. C. Cacas, E. Ledoux, G. de Marsily, and B. Tillie.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 175-197, 11 fig, 1 tab, 25 ref.

Descriptors: *Flow models, *Fracture permeability, *Geologic fractures, *Groundwater management, *Groundwater movement, *Hydrologic models, *Model studies, *Water resources management, Analytical methods, Channel flow, Flow rates, France, Hazardous waste disposal, Hydraulic conductivity, Hydrologic data, Stochastic models.

A large-scale investigation of fracture flow was recently conducted in a granite uranium mine at Fanay-Augeres, France. Its aim was to develop a methodology for the investigation of possible nuclear waste repository sites in crystalline environments, and thus to determine what measurements to make, and what models to use in order to predict the flow rate in the medium. Four types of data were collected: (1) geometry of the fracture network; (2) local hydraulic properties measured by injection tests in boreholes; (3) global hydraulic behavior from flow rate and piezometric head distribution; and (4) tracer tests. A stochastic fracture network model was developed. The fractures are represented by geometrical discs. The flow through the disc network is simulated by assuming that it occurs through small 'channels.' The model calibration consisted in adjusting the local channel hydraulic conductivities. The model was then used to predict the global hydraulic behavior. This attempt to validate the parameters and the model structure appeared to be positive. A particle trans-

port simulator was coupled to the flow model, based on a particle-following method using the advection-biased random-walk technique. Microscopic dispersion in the fractures and slowing-down effects due to unevenness of the flow paths were taken into account. The transport model was calibrated on tracer tests. The model appears to be able to account for the large-scale channeling phenomenon observed in situ. Moreover, its dispersive properties controlled by the network geometry and the hydraulic conductivities assigned to its flow elements are reasonably comparable to those of the real site. (See also W91-03178) (Author's abstract)
W91-03190

NEW APPROACH TO TRACER TRANSPORT ANALYSIS: FROM FRACTURE SYSTEMS TO STRONGLY HETEROGENEOUS POROUS MEDIA.
California Univ., Berkeley. Earth Sciences Div.
C. F. Tsang.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 199-222, 15 fig, 30 ref. DOE contract number DE-AC03-76SF00098.

Descriptors: *Fracture permeability, *Geologic fractures, *Hydrologic models, *Tracers, Flow models, Groundwater management, Groundwater movement, Groundwater transport, Model studies, Paths of pollutants, Permeability, Water resources development, Water resources management.

In the utilization and management of groundwater resources, a problem that has come into increasing attention in both developed and developing countries is the need for monitoring and maintaining groundwater quality. Many current developments and utilizations of groundwater resources include a study of their flow and transport properties. These properties are needed to evaluate possible changes in groundwater quality and potential transport of hazardous solutes through the groundwater system. Investigation of transport properties of fractured rocks is an active area of research. Most of the current approaches to the study of flow and transport in fractured rocks cannot be easily used for analysis of tracer transport field data. A new approach is proposed based on a detailed study of transport through a fracture of variable aperture, a two-dimensional strongly-heterogeneous permeable system. Tracer breakthrough curves can be analyzed based on an aperture or permeability probability distribution function that characterizes the tracer flow through the fracture. The results may be extended to a multi-fracture system and can be equally applied to a strongly-heterogeneous porous medium. The need for multi-point or line and areal tracer injection and observation tests is a way to avoid the sensitive dependence of point measurements on local permeability variability. (See also W91-03178) (Author's abstract)
W91-03191

NUMERICAL GROUNDWATER QUALITY MODELLING: THEORETICAL BASIS AND PRACTICAL APPLICATIONS.
Gesamthochschule Kassel (Germany, F.R.).
W. K. H. Kinzelbach.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 223-241, 8 fig, 28 ref.

Descriptors: *Flow models, *Groundwater movement, *Hydrologic models, *Model studies, *Path of pollutants, *Solute transport, Analytical methods, Aquifer characteristics, Dimensional analysis, Dispersion, Management planning, Stochastic models, Water resources development, Water resources management.

The types of problems requiring models of the transport of pollutants and their transformation in the saturated zone include: data interpretation; understanding of mechanisms of transport and reactions; estimation of pollutant degradation rates and concentrations; identification of major pollutant sources; and various management planning alternatives. The basis for any model is the mass balance equation in its differential form. Three levels of solving the transport equation can be distinguished: analytical solutions, pathline solutions, and full numerical solutions. Any real world problem is spatially three-dimensional and time-dependent. Yet, approximations in lower spatial dimensionality (i.e. zero-dimensional models, one-dimensional models, horizontally two-dimensional models, and vertically two-dimensional models) are often feasible. The modeling of macrodispersion in the non-asymptotic stage is as yet an unsolved and maybe unsolvable problem. The use of Fickian dispersion models with constant dispersivities is a crude tool only in which the dispersivities are mere fitting parameters. Stochastic techniques are still in the developing phase and more field validations are called for before they can be used on a routine basis in practical aquifer contamination problems. Modeling of chemical processes in aquifer materials remains inherently a complicated task, since the possible number of reaction processes and participating constituents are large. The modeling of flow and transport requires a large amount of data. Usually only a few of these are readily available; some must be estimated by means of a properly-calibrated model. (See also W91-03178) (Fish-PTT)
W91-03192

GROUNDWATER CONTAMINATION: PROCESSES, CHARACTERIZATION, ANALYSIS, AND REMEDIATION.
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5G.
W91-03194

COUPLED MODELLING OF WATER CYCLE AND NITRATE TRANSPORT IN A HYDROLOGICAL SYSTEM.
For primary bibliographic entry see Field 5B.
W91-03195

ARTIFICIAL RECHARGE OF GROUND WATER: STATE OF ART AND LIMITATIONS.
Central Ground Water Board, Ahmedabad (India).
For primary bibliographic entry see Field 4B.
W91-03196

SYSTEMS FOR ARTIFICIAL RECHARGE OF GROUND WATER.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 4B.
W91-03197

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES.
Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. 541p. Edited by C. P. Gupta.

Descriptors: *Developing countries, *Groundwater management, *Groundwater resources, *Water resources development, *Water resources management, Aquifers, Geologic fractures, Groundwater pollution, India, Model studies, Workshops.

Groundwater resources increasingly are being tapped to meet societal needs. However, it is important to recognize that, although groundwater has ubiquitous occurrence and vast magnitude, its potential as a perennial source is subject to wide spatial and temporal variations. It is renewable, but not inexhaustible and, although it is underground, it is not entirely protected from pollution. This second volume of the proceedings of Workshop IGW-89 considers state-of-the-art techniques for geohydrological parameter estimation, data acquisition, analysis of flow in unsaturated zones, studies of contaminant migration, and augmentation of groundwater. Appropriateness of the techniques for use in developing countries is emphasized in many presentations. Specific sessions covered in volume 2 are: management of groundwater resources, particularly in hard rocks (parameterization of groundwater flow regime, modeling of complex aquifers, simulation of flow in fractured rocks, and assessment of dynamic potential of aquifers); pollution of aquifers (groundwater quality modeling, modeling of migration of non-reactive/reactive chemicals, radioactive nuclear waste, and remedial measures); and augmentation of water resources (artificial recharge, rainwater harvesting, and constraints and limitations). (See W91-03312 thru W91-03365) (Rochester-PTT)
W91-03311

OVERVIEW OF FLOW SIMULATION MODELS IN FRACTURED AQUIFERS.
Indian Inst. of Science, Bangalore.
K. Sridharan, M. S. Mohan Kumar, and M. Sekhar.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 485-498, 6 fig, 17 ref.

Descriptors: *Aquifers, *Geologic fractures, *Groundwater movement, *Mathematical models, *Model studies, *Simulation, Groundwater pollution, Indian Institute of Science, Path of pollutants, Reviews, Solute transport.

Mathematical models of groundwater resources have been applied successfully in various situations, but controversy remains concerning the applicability of porous media flow concepts in hard rock aquifers. The obvious differences between hard rock formations and the simple grains-pores picture, as well as the presence of mechanical discontinuity, have raised basic questions. Groundwater flow simulation models for fractured rock aquifers are reviewed here under four categories: (1) fracture-based models; (2) equivalent porous medium models; (3) double porosity models; and (4) leaky aquifer models. The fracture-based models require detailed field data, which can be obtained only on a large scale. Hence these models may be more suited to oil well applications and studies of hazardous contaminant transport, such as nuclear waste. The double porosity models may be more relevant for groundwater applications., particularly well hydraulics. The leaky aquifer model with an aquifer-water table-aquitard system has conceptual similarity with the double porosity model. A general two-domain model that allows lateral and vertical flow in the water table domain, flow transfer between the domains, and considers the effects of anisotropy, well storage, and partial penetration may represent groundwater flow in a fractured rock system. Such a model has the advantage that it can be applied for dug wells or bore wells and, with some simplifications, can be used for regional applications. Numerical solutions have been obtained recently at the Indian Institute of Science for models incorporating some additional simplifications of this general two-layer system. (See also W91-03311) (Rochester-PTT)
W91-03312

NONDEFEATIST DERIVATION OF FINITE DIFFERENCE SCHEMES.
Roorkee Univ. (India). Dept. of Earth Sciences.
P. S. Moharir.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 499-504, 8 ref.

Descriptors: *Finite difference methods, *Groundwater movement, *Mathematical models, *Model studies, Differential equations, Mathematical equations, Performance evaluation.

Groundwater modeling requires solving a partial differential equation subject to initial and boundary conditions. In finite difference modeling, first the derivations are replaced by suitable finite difference approximations, and then the resultant numerical scheme is tested for stability. Although it seems natural to try to improve the approximation in the first stage, it is well established that a more accurate finite difference approximation for the derivatives does not imply automatically a stabler finite difference scheme. The two-stage procedure therefore must be regarded as defeatist, because under it the outcome of the second stage is seen as inevitable and when the result is unfavorable the scheme is abandoned. A nondefeatist approach recommends that the twin objectives of stability of the finite difference scheme and the accurate approximation of the net differential operator be dealt with simultaneously. Both explicit and implicit examples are offered. Besides being a pedagogically preferable method for derivation of finite difference schemes, the method has other advantages. The method explicitly shows compromises that must be made in the condition of unbiasedness, proper diffusivity, and good convergence. Also, the method is very general. (See also W91-03311) (Rochester-PTT)
W91-03313

HYDROGEOLOGY OF THE MIDDLE CHELIFF BASIN (ALGERIA): SIMULATION OF GROUNDWATER FLOWS.
Neuchatel Univ. (Switzerland). Center of Hydrology.
M. Bouzelboudjen, and J. Mania.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 505-521, 8 fig, 2 tab, 11 ref.

Descriptors: *Algeria, *Geohydrology, *Groundwater movement, *Model studies, Aquifers, Cheliff River, Developing countries, Hydrologic models, Mathematical models, Middle Cheliff Basin, Simulation, Surface-groundwater relations, Water demand, Water resources development.

The hydrologic analysis of the alluvial plain of the Middle Cheliff basin (Algeria) permits the successive definition of the boundaries of the alluvial reservoir and the associated sandstone formations, the aquifer geometry, and the hydrologic budget. It appears that the aquifer deposits are thick (100-180 m) on the right bank of the Cheliff River, with the presence of sedimentary deposition gaps (Pliocene-Miocene) in the meridional part of the basin. The utility of the mathematical model based on the finite element method, with steady state conditions, can justify the working hypothesis, with an improvement of the knowledge of hydraulic characteristics of the aquifer and the calculation of complete hydrologic balance. It shows that the effective precipitation and the surface waters of the Cheliff stream represent 40% and 22% of the inputs, respectively. A second simulation based on the finite difference method, with unsteady conditions, leads to the evaluation of the values of specific yield and the determination of the impact of irrigation on the piezometric evolution of the water table. The total requirement of 37 cu hm for the year 2000, with 16.6 cu hm for potable water, 18.4 cu hm for agricultural water, and 2 cu hm for industrial water, cannot be satisfied by pumping only from the aquifer. (See also W91-03311) (Author's abstract)
W91-03314

ROLE OF VERTICAL FLOW IN SEDIMENTARY AQUIFERS.
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton, and M. Thangarajan.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 523-538, 8 fig, 7 ref.

Descriptors: *Aquifers, *Geohydrology, *Groundwater mining, *Groundwater movement, *India, *Pumping, *Vertical flow, Hydrologic models, Model studies, Sedimentary basins, Water demand.

In attempting to understand the responses of sedimentary aquifers to pumping, it is essential to recognize that vertical as well as horizontal flows can occur. Three case studies in India of deep aquifers, from which substantial quantities of water are being abstracted, demonstrate the methods of identifying the presence of both horizontal and vertical flows. Methods of quantifying the vertical flows are introduced. The three aquifers in which vertical flows can be demonstrated are Mehsana, Madras, and Neyveli. Five indicators of vertical flows have been recognized: (1) overflowing wells and springs or high piezometric heads occurring prior to the exploitation of the aquifer; (2) falling piezometric heads and reduction in flow in perennial rivers; (3) increasing pumped drawdowns due to increasing abstraction; (4) continuing long-term fall in the water table elevation; and (5) evidence of vertical flows derived from tracer studies. Vertical flows can be quantified by three different methods: using Darcy's law, examination of a typical cross section, and use of numerical models. In each of the three aquifers considered here, it was originally assumed that groundwater originated from an up-dip recharge area. In the undisturbed state, this was a valid assumption about the conditions within the aquifer. However, heavy exploitation of the aquifers meant that the horizontal flows from the recharge zones no longer were sufficient to meet the demands and vertical flows became important. (See also W91-03311) (Rochester-PTT)
W91-03315

ESTIMATING GEOHYDROLOGIC PARAMETERS FOR GROUNDWATER MANAGEMENT AND LAND SUBSIDENCE CONTROL IN KANTO PLAIN, JAPAN.
National Geophysical Research Inst., Hyderabad (India).
N. Shibasaki.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 539-544, 3 fig, 4 ref.

Descriptors: *Geohydrology, *Groundwater management, *Japan, *Model studies, *Subsidence, Finite element method, Hydrologic budget, Kanto Plain, Mathematical models, Optimization, Pumping tests, Simulation, Statistics.

Kanto Plain, central Japan, is one of the largest plains in Japan; it has been urbanized since the 1950s. Detailed geohydrological investigations were carried out in the Kanto Plain for basin-wide groundwater management and to evolve appropriate strategies for prevention of land subsidence. Geological and hydrogeological studies/analyses were carried out to construct computer simulation models. Geohydrologic parameters were estimated by statistical analyses using pumping tests/routine production tests of water wells and soil test data. The calculated groundwater level and land subsidence obtained with the vertical two-dimensional, multi-aquifer model using the finite element method agreed satisfactorily with the observed values. The water balance and land subsidence studies, which were based on accurate geological and hydrogeological studies/analyses, have helped greatly in evolving optimal exploitation schemes for this area. (See also W91-03311) (Author's abstract)
W91-03316

OPTIMAL PUMPING POLICY AND GROUNDWATER BALANCE FOR THE BLUE LAKE AQUIFER INVOLVING NON-LINEAR GROUNDWATER HYDRAULICS.
Indian Inst. of Tech., Bombay. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W91-03317

DETERMINATION OF ANISOTROPIC PERMEABILITY OF AN UNCONFINED AQUIFER IN EGYPT USING PUMPING TEST DATA OF A PARTIALLY PENETRATING WELL.
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
For primary bibliographic entry see Field 7B.
W91-03318

GROUNDWATER BASIN SIMULATION OF MAHI RIGHT BANK CANAL COMMAND AREA, GUJARAT, INDIA.
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
S. K. Sondhi.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 581-593, 3 fig, 4 tab, 11 ref.

Descriptors: *Groundwater recharge, *India, *Model studies, *Pumping, *Simulation, *Water level fluctuations, *Water table, Groundwater potential, Hydrologic models, Mahi Right Bank Canal Command Area, Mathematical models, Prediction, Statistics, Water resources development.

A groundwater basin simulation model was used to predict the dynamic behavior of the water table in response to groundwater pumpage and net recharge in part of the Mahi Right Bank Canal (MRBC) command area, Gujurat, India. The model is based on a finite difference approach and uses an iterative alternating direction implicit technique as the solution procedure. The model was calibrated and validated by using historical input data. Some statistical parameters such as the mean, standard deviation, coefficient of correlation, and a non-parametric statistical test were used to study the extent of agreement between the observed and the predicted water table depths. No significant difference was found between the distribution of the observed and the predicted water table depths at the 95% confidence level. Net recharge to the groundwater basin was calculated and used for determining additional groundwater potential. The additional groundwater potential available for development in the area is about 265 million cubic meters, which is about 1.6 times the existing level of groundwater development. Sufficient scope exists for a substantial increase in groundwater development. (See also W91-03311) (Author's abstract)
W91-03319

NUMERICAL SIMULATION OF GROUNDWATER FLOW IN FUHRBERG FIELD, HANOVER.
National Geophysical Research Inst., Hyderabad (India).
S. N. Rai, and B. Hoffmann.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 595-606, 6 fig, 1 tab, 6 ref.

Descriptors: *Germany, *Groundwater movement, *Model studies, *Numerical analysis, *Simulation, *Water table fluctuations, Hydrologic budget, Mathematical models, Prediction, Spatial distribution, Temporal distribution, Water level fluctuations.

Groundwater is the main source of water supply to Hanover City (Germany); much of it is obtained from Fuhrberg field. A mathematical model was employed to simulate dynamic behavior of the water table in response to recharge, pumpage, and interaction with a river in Fuhrberg field. An area of 372 sq km, with a maximum extension of 26 km (E-W) by 18 km (N-S) was considered in the

analysis. Water balance analysis was conducted for a period of 14 yr and the model was used to predict the spatio-temporal distribution of the water table in response to proposed pumping and artificial recharge schemes. Based on use of the model, the following conclusions were drawn: (1) good agreement exists between computed and measured water table heights, confirming the validity of the model for simulation in this study area; (2) groundwater flow during the period of investigation (April 1968 through April 1982) exhibited a state of balance; and (3) prediction results indicate an increase in aquifer storage, which leads to a rise in the water table. (See also W91-03311) (Rochester-PTT)
W91-03320

SIMULATION OF REGIONAL HYDRODYNAMICS IN THE NEYVELI AQUIFER.
National Geophysical Research Inst., Hyderabad (India).
C. P. Gupta, M. Thangarajan, V. V. S. Gurunadha Rao, N. K. Balasundar, and S. Muthuram.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 607-618, 10 fig.

Descriptors: *Aquifers, *Groundwater movement, *India, *Mining effects, *Model studies, Geohydrology, Hydrodynamics, Hydrologic models, Leaky aquifers, Lignite, Mathematical models, Neyveli aquifer, Regional analysis, Simulation, Surface-groundwater relations.

The groundwater flow regime in the Neyveli basin (Tamilnadu, India) has been perturbed due to groundwater withdrawals from lignite mines and a large number irrigation wells in the area. The available geohydrological data were analyzed thoroughly for the conceptualization of the complex aquifer system. Both two-dimensional and three-dimensional mathematical models were constructed and aquifer modeling was used to obtain a first-order quantitative understanding of the vertical flows and aquifer-river interactions in the basin. The leakage from the phreatic aquifer into the groundwater regime below the lignite seam contributes significantly toward controlling the hydrodynamics of the region. The model studies also helped in the design of field experiments for better quantification of spatio-temporal variations of geohydrological parameters. (See also W91-03311) (Author's abstract)
W91-03321

COMPARATIVE MODEL STUDY FOR GROUNDWATER RESOURCES EVALUATION IN KELANTAN, MALAYSIA: PART 1. MODEL EVALUATION.
National Univ. of Malaysia, Bangi.
S. Awadalla, I. M. Noor, and I. Ibrahim.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 619-627, 8 fig, 6 ref.

Descriptors: *Groundwater management, *Groundwater resources, *Hydrologic models, *Malaysia, *Model studies, *Water resources development, Aquifers, Developing countries, Observation wells, Piezometric head.

The increasing demand for water supply in Kelantan state, Malaysia, has created an increased need for evaluation, development, and management of groundwater resources. On the basis of recent hydrological investigations and available data on groundwater exploitation in Kelantan, a two-dimensional numerical groundwater model was developed to simulate the present situation and the possible future development of groundwater resources in the area. An optimum set of input data and parameters covering an 11-yr period were used to obtain simulated head values. A good agreement was obtained between these values and observed heads where the differences are quite minor. However, at certain nodes or areas of the aquifer, the computed values had distinct differences from the values measured in the field. Since the grid size for a particular node is quite large (5 km), the representation of the aquifer conditions at the observation wells is restricted. The average parameters and data represented may not be accurate enough to predict the heads at the wells. Nevertheless, the computed values compared quite well with the observed heads and the trends over time are similar. (See also W91-03311) (Rochester-PTT)
W91-03322

MODELLING THE EFFECTS OF PROPOSED PUMPING FROM THE TAMBRAPARNI RIVER BASIN, TAMILNADU, INDIA.
V.O.C. Coll., Tuticorin (India). Dept. of Geology.
A. Balasubramanian, and J. C. V. Sastri.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 629-640, 1 fig, 4 ref, 5 map.

Descriptors: *Groundwater mining, *Groundwater movement, *India, *Model studies, *Water resources development, Computer models, Groundwater resources, Hydrologic models, Mathematical models, Semiarid lands, Surface-groundwater relations, Tambraparni River, Water demand.

The Tambraparni River basin lies in the arid to semiarid climatic zone of India and receives an average annual rainfall of 88 cm. Groundwater occurs mainly under unconfined conditions in the weathered and fractured zones of the crystalline formations. The Tambraparni River is perennial at the present time. A two-dimensional, finite difference computer model was developed to model the groundwater flow of the Tambraparni River basin and was used as a predictive tool. Groundwater potentials were forecast under (1) normal, existing conditions and (2) with a limited stress of 1% increase in the amount of extraction per year up to 1991. The zones of depletion due to the proposed stress and the ultimate effects on groundwater exploitation schemes were inferred. Unwarranted mining of groundwater changes the entire effluent river system into an influent one by 1991. Based on the model results, it is concluded that overexploitation of any groundwater resource should be stopped. (See also W91-03311) (Author's abstract)
W91-03323

EXPLORATION AND DEVELOPMENT OF GROUNDWATER IN THE CRYSTALLINE ROCKS.
Tribhuvan Univ., Kathmandu (Nepal). Central Dept. of Geology.
G. Krishna Rao.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 641-648, 11 ref, 2 plate.

Descriptors: *Geohydrology, *Geologic fractures, *Groundwater potential, *Groundwater resources, *India, Crystalline rocks, Developing countries, Mineralogy.

Crystalline rocks, which constitute a major part of peninsular India, account for nearly 40% of the total aquifer extent in the country. Further irrigation potential of the country depends on understanding these complex aquifers. Field observations in different parts of Andhra Pradesh and Karnataka states revealed that the behavior of different rock types, felsic to mafic, in response to tectonics and weathering differs. Fracture intensity is highest in quartz veins, followed by granites and granitic gneisses and related rocks. Mafic rocks generally are massive with sporadic fracturing. Similarly, the weathered residue from the felsic rocks is relatively more permeable than that from the mafic rocks. The quartz content in crystalline rocks plays a vital role in making them potential aquifers. The weathered residue of quartz-rich felsic rocks would be relatively more permeable than the quartz-poor mafic or basic rocks. Similarly, quartz veins or quartzites and felsic rocks are more brittle than the mafic rocks and hence develop more fracture intensity. In this area, groundwater exploration and development is recommended for the quartz veins and felsic rocks rather than in mafelsic and mafic rocks. (See also W91-03311) (Rochester-PTT)
W91-03324

MANAGEMENT OF GROUND WATER RESOURCES IN COMPLEX AQUIFER SYSTEM OF RAJMAHAL TRAPS OF SAHEBGANJ DISTRICT, BIHAR.
For primary bibliographic entry see Field 4B.
W91-03325

GROUNDWATER ASSESSMENT IN THE SEDIMENTARY BASINS OF EASTERN KENYA.
Nairobi Univ. (Kenya).
G. O. Krhoda.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 661-668, 4 tab, 11 ref.

Descriptors: *Arid lands, *Drought, *Geohydrology, *Groundwater mining, *Groundwater potential, *Groundwater resources, *Kenya, Comparison studies, Data acquisition, Developing countries, Geophysical methods, Lithologic logs, Sand rivers, Stratigraphy, Tana River, Well logs.

Groundwater resources of the sedimentary basins of eastern Kenya were assessed. The sediments were laid down between Paleozoic and Quaternary periods. The area is generally drought-stricken and comprises nearly two-thirds of the total area of the country. The mean rainfall decreases while the rate of potential evapotranspiration increases going northward and eastward. Aridity of the area results from high temperature combined with lack of vegetative cover. The region is drained by sand rivers, except for the Tana River, which runs along the southern boundary. Several geophysical methods were employed with differing success rates. Because of the remoteness of the area, well logging was the most useful method for reconstructing the stratigraphy. Preliminary investigation on the nature of lithologic logs shows that three types of geological terranes within the sedimentary basins of the area have potable water. The first is Pliocene and Quaternary deposits comprising the unconsolidated or poorly consolidated sand and gravel, commonly interbedded with clay. The second terrane consists of semi-consolidated and consolidated agglomerate, sandstone, or shale formations, which are often joined and possess intergranular and fracture porosity and permeability. The third geologic terrane comprises limestone and gypsum beds, which generally contain saline water, largely calcium sulfate. Further research is needed to demarcate these and other geologic terranes in the country. (See also W91-03311) (Author's abstract)
W91-03326

GONDWANA ARTESIAN BASIN IN WEST GODAVARI DISTRICT, ANDHRA PRADESH, INDIA.
B. J. Kumar, K. V. S. Sastry, and K. V. R. J. Krupanidhi.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 669-672, 2 fig.

Descriptors: *Artesian basins, *Geohydrology, *Groundwater mining, *Groundwater potential,

*Groundwater resources, *India, Aquifers, Conjunctive use, Irrigation water, Potentiometric surface, Water resources development, Wells, West Godavari District.

The Central Ground Water Board (CGWB) of India carried out groundwater exploration during the period 1967 to 1972 in the Gondwana basin and identified potential aquifers down to a depth of 300 m. With increased irrigation demand, the CGWB extended its activity to the adjacent areas to explore the possibility of locating deeper Gondwana aquifer systems underlying the younger formations. During the period 1977 to 1984, exploration was carried out down to a depth of 600 m, proving the existence of deeper potential aquifers in Gondwana formations of this district. The Deccan traps form an ideal confining layer for the underlying Gondwana formations, resulting in free-flowing conditions for wells tapping deeper Gondwana aquifers. Granular zones exist from 100 to 260 m down to the explored depth (600 m). The yields from these granular zones range from 3700 to 6000 lpm for varying drawdowns of 19 to 25 m. The average permeability of these granular zones is 10 m/day. The elevation of the potentiometric surface of these aquifers varies from 4 to 25.5 m above ground level, with a gradient of 1 in 200 towards the southeast. These deeper, high-potential aquifers extending from Eluru to Tadepalligudem can be tapped by a battery of heavy-duty tubewells. The free-flowing area between Muppavaram and Kaikaram, near the end of the Eluru canal, can be taken up for conjunctive use of surface and ground waters. Groundwater potential of 83 million cu m is estimated to occur in this area and it can be exploited by constructing 150 tubewells. (See also W91-03311) (Rochester-PTT)
W91-03327

GROUNDWATER DEVELOPMENT FOR DROUGHT RELIEF IN CHANDRAPUR DISTRICT, MAHARASHTRA.
Central Ground Water Board, Nagpur (India).
M. Sankaran, S. Marwah, T. Talukdar, M. R. K. Reddy, and A. K. Madhukar.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 673-676, 1 fig.

Descriptors: *Drought, *Geohydrology, *Groundwater resources, *India, *Water resources development, Chandrapur District, Developing countries, Domestic water, Rural areas, Water supply development, Well logs.

Well logging was conducted in Maharashtra state, India, in response to the drought of 1987-1988. Existing well data were analyzed in relation to rock structure, and sites were selected for wells in the district. In this district, the groundwater resource is the only major source meeting the needs of all water supply schemes in the rural areas. Based on the available data and with proper planning, the program of construction of tubewells in the Gondwana formations has proceeded well. Out of 27 sites selected in the Gondwana formations, 26 tubewells were constructed successfully. Construction of tubewells in Talchir formations, which had not been attempted previously in this district, proved successful in providing domestic water supply. Out of 121 sites selected in Chandrapur district, 51 sites were selected for construction of borewells in the hard rock area. Borewells have been drilled at 24 sites. At Devai, one borehole was abandoned and three borewells were dry at the time of construction. Future groundwater studies should help to meet the needs for village water supplies free from pollution and contamination. (See also W91-03311) (Rochester-PTT)
W91-03328

ADVANCING FRONTIERS OF LATHI-BARMER FRESH WATER MESOZOIC FORMATIONS OF BARMER DISTRICT.
National Environmental Engineering Research Inst., Nagpur (India).
P. G. Adyalkar.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 677-680, 6 ref.

Descriptors: *Aquifers, *Geohydrology, *Groundwater resources, *India, Barmer district, Confined groundwater, Developing countries, Perched groundwater, Remote sensing, Sandstones, Satellite technology, Water table.

In the Mesozoic super group identified in the Barmer district (India), there are two characteristic groups of fresh water bearing formations: Lathi sandstone of Jurassic age and the Cretaceous Barmer sandstone. Recent studies by satellite imagery have defined better the extent of these formations. As a result of intensive work carried out in the period 1952-1964 and subsequently, the Lathi-Barmer formations have been recognized as the most dependable formations in the district. Groundwater occurs in them under perched, phreatic, and confined conditions, the last varying in depth, aggregate thickness, and coarseness of the formation. The phreatic surface ranges from 27 to 75 m below ground level, whereas the piezometric surface ranges from 32 to 92 m. The discharges obtained from boreholes tapping 18-40 m thickness of granular zones range from 6 to 20 L per sec for a drawdown range of 2-15 m. While the specific capacity ranges from 25 to 750 L/min/m of drawdown, the transmissivity ranges from 90 to 1170 sq m/day and hydraulic conductivity from 5 to 32 m/day. (See also W91-03311) (Rochester-PTT)
W91-03329

INDRAVATI-KOLAB BASINS OF KORAPUT AS POTENTIAL GROUND WATER RESERVOIRS OF THE PURANAS IN ORISSA.
National Environmental Engineering Research Inst., Nagpur (India).
P. G. Adyalkar.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 681-684, 6 ref.

Descriptors: *Geohydrology, *Groundwater potential, *Groundwater reservoirs, *Groundwater resources, *India, Developing countries, Drawdown, Geologic fractures, Groundwater basins, Groundwater movement, Hydraulic conductivity, Indravati-Kolab basins, Koraput District, Limestone, Specific yield, Well yield.

The Indravati-Kolab (Sabari) basins of Koraput district in Orissa (India) continue with the identical basins of the same name downgradient in Bastar district of the Chhattisgarh region of Madhya Pradesh. The sandstones, quartzites, and conglomerates of the Purana sequence are poor and problematic aquifers with occasional networks of four or more joints, including a master joint. Such networks of joints extend in depth to 30-60 m. The Kanger calcic limestone is flaggy, but the Jagdalpur magnesian stromatolitic limestone is heterogeneous, resulting in classic development of karst in the Indravati-Kolab basins of Koraput district. With average rainfall in the range of 170-190 cm, wells in the micro-alluvial valleys and karst often are limited to 12 m in depth. Individual tubewells, 90 m deep, are capable of yielding 5-8 L/sec for a drawdown of 6 m, the piezometric zone being 4.5-15 m below ground level. The specific capacity ranges from 50 to 150 L/min/m of drawdown and yield potential is 150-300 cu m/day for a drawdown of 5-10 m, when developed under strict hydrogeologic control. The hydraulic conductivity ranges from 5-10 m/day and the specific yield is 3-8%, with a spacing pattern of 250 m. Laterites, although of limited extent, are of great significance from the point of view of the occurrence of seeps and springs in the highland areas and the richness of the groundwater potential. (See also W91-03311) (Rochester-PTT)
W91-03330

GROUNDWATER MANAGEMENT PLANNING OF ALAPAKKAM AREA, TAMILNADU, INDIA.
Sri Venkateswara Univ., Tirupati (India).
For primary bibliographic entry see Field 4B.
W91-03331

GROUND WATER FLOW IN SOUTHERN PART OF KOSI ALLUVIAL FAN AND ITS EFFECT ON WATERLOGGING, WITH POSSIBLE REMEDIAL MEASURES, DISTRICT SAHARSA, BIHAR, INDIA.
Central Ground Water Board, Patna (India).
P. N. Singh.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 689-697, 3 fig, 1 tab, 2 ref.

Descriptors: *Alluvial aquifers, *Groundwater movement, *India, *Waterlogging, Alluvial fans, Flood control, Kosi River, Kosi District, Water table rise.

Groundwater flow along the ground slope and waterlogging are common in the Kosi district alluvial fan area (India). The shallow depth to water table with phreatic conditions within the sandy aquifer indicate a groundwater surplus. A water table map was prepared based on field studies with the aim of explaining the cause of waterlogging. Water from seepages forms the headwaters of a new stream or accumulates in low-lying areas leading to waterlogging. The continuous groundwater flow is maintained by the influent condition of the Kosi River in its upper reaches. Depth to water table data for 7 yr does not indicate any appreciable rise or difference in water level, even during years of scanty rainfall, and no marked difference in water level has been noticed. The only rise of depth to water table has been recorded in the area along an unlined canal, which is one of the major causes of waterlogging in the area. Among the measures considered for dealing with the waterlogging problem are construction of fish ponds to decant the groundwater from the adjoining land, thus lowering the water table and removal of silt from the river to both lower the water table and improve flood control. (See also W91-03311) (Author's abstract)
W91-03332

SELECTING EFFECTIVE METHODS FOR GROUNDWATER PROSPECTING AND EXPLORATION IN MEKONG DELTA.
General Department of Mine and Geology, S. R. Vietnam.
B. X. Pham.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 701-708.

Descriptors: *Data acquisition, *Geohydrology, *Groundwater mining, *Groundwater potential, *Vietnam, *Water resources development, Aquifers, Developing countries, Field tests, Geophysical surveys, Hau River, Mekong River, Saline groundwater.

In the Mekong delta (Vietnam), groundwater for domestic and industrial uses could be exploited from young sedimentary formations of Cenozoic age. Hydrogeologically these sedimentary formations are very complex and exhibit an irregular distribution of hydrochemical zones. The fresh water-bearing layers are inter-related with saline ones, especially in the region lying between the Tien (Mekong) River and Hau (Bassac) River. Using well drilling and pump test projects for groundwater prospecting as in the past is very expensive and at times has not fully satisfied the

technical requirements. Among new approaches, geophysical methods are being used exclusively for studying fluctuations in level and to determine saline-fresh water boundaries. Since 1980, dozens of regions in the Mekong delta, with average areas of 400-600 sq km, have been explored, with the drilling of hundreds of boreholes with a total length of nearly 100,000 m. Analysis of research needs for this area shows several points: (1) two research stages, prospecting and exploration, are more appropriate than the presently employed three stages (prospecting, preliminary exploration, and detailed exploration); (2) only simple lines of boreholes are employed during the prospecting stage in order to determine the boundaries of the fresh water-bearing formations; (3) increase the application of geophysical methods; (4) thoroughly exploit existing observational data on surface water and groundwater movements as a way of calculating the regime of the various aquifers; (5) apply hydrogeochemical methods more effectively to determine groundwater quality; and (6) employ aerial photography to determine the region's general structure and the smaller structures, with the aim of forecasting groundwater distribution according to area and depth. (See also W91-03311) (Rochester-PTT)
W91-03333

IMPACT OF INTENSIVE IRRIGATION ON GROUNDWATER REGIMEN IN PARTS OF OSMANSAGAR AREA, R. R. DISTRICT, A. P., INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
For primary bibliographic entry see Field 5G.
W91-03334

GROUNDWATER QUALITY OF AN ALLUVIAL AQUIFER.
Centre for Water Resources, Madras (India).
For primary bibliographic entry see Field 5B.
W91-03335

DROUGHTS AS MEANS OF DELINEATION OF AREAS PRONE TO SEA WATER INTRUSION.
National Geophysical Research Inst., Hyderabad (India).
B. S. Sukhija, D. V. Reddy, and I. V. Reddy.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 733-741, 4 fig, 1 tab, 4 ref.

Descriptors: *Drawdown, *Drought, *Groundwater movement, *India, *Saline water intrusion, Groundwater mining, Hydraulic gradient, Pondicherry, Potentiometric surface.

Over-exploitation of groundwater along the coast may result in declining water levels accompanied by the reversal of hydraulic gradient. Work was undertaken in Pondicherry (India) and its surrounding areas with the aim of demonstrating that the comparative study of groundwater levels, groundwater flow, and gradients of normal rainfall, drought, and excessive rainfall could be used to delineate areas prone to sea water encroachment. Drought affects water level in two ways: (1) by reducing recharge and (2) extending the period of agricultural use for irrigation, thus further dropping the mean groundwater level. Using 1979 as the base year, it is shown that groundwater withdrawal increased substantially (to 1.5 times input) during the period 1980-1981 and 1982-1983, resulting in an average decline in groundwater levels of 7 m in the study area. The changes in the shape of the potentiometric surface over this period resulted in reversals of groundwater flow direction from uniformly toward the Bay of Bengal to landward in a few areas, creating areas prone to sea water intrusion. (See also W91-03311) (Rochester-PTT)
W91-03336

GEOCHEMISTRY OF SHALLOW GROUNDWATER AT KIGAMBONI PENINSULA ALONG DAR ES SALAAM COASTAL STRIP TANZANIA.
Dar es Salaam Univ. (Tanzania). Dept. of Geography.
H. H. Nkotagu.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 743-753, 3 fig, 2 tab, 10 ref.

Descriptors: *Geochemistry, *Groundwater chemistry, *Groundwater quality, *Tanzania, *Water quality, Classification, Coastal areas, Dar Es Salaam, Indian Ocean, Potable water, Public health, Sulfates.

Groundwaters near Dar Es Salaam (Tanzania) were sampled and chemically classified. Water types identified were sodium bicarbonate, sodium sulfate, sodium chloride, calcium bicarbonate, and magnesium bicarbonate. Hydrochemical facies change from calcium-sodium facies near the shore of the Indian Ocean to sodium-calcium facies landward and from chloride-sulfate-bicarbonate to bicarbonate-chloride-sulfate. Dissolution of dolomitic limestone, cation exchange, and mixing of fresh recharge water with interstitial marine water, in addition to dissolution of airborne salts, are the major processes responsible for the chemical character of the water. Using the World Health Organization and United States Geological Survey diagrams, water quality was assessed and recommended as suitable for domestic and irrigation uses. In one area, sulfate exceeds the limits of the WHO guidelines. (See also W91-03311) (Rochester-PTT)
W91-03337

DIGITAL MODELLING OF THE HYDROGEOCHEMICAL FACIES OF GROUNDWATERS IN TAMILNADU, INDIA.
V.O.C. Coll., Tuticorin (India). Dept. of Geology.
A. Balasubramanian, R. Thirugnana Sambandam, R. Chellasamy, and J. C. V. Sastri.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 761-767, 1 fig, 13 ref, 1 map.

Descriptors: *Geochemistry, *Geohydrology, *Groundwater chemistry, *India, *Mathematical models, *Model studies, *Water chemistry, Calcium, Carbonates, Cations, Chlorides, Classification, Dissolved solids, Electrical conductivity, Hydrogen ion concentration, Multiple regression analysis, Principal component analysis, Sulfates, Tamilnadu.

Identification, classification, and interpretation of hydrogeochemical facies normally are attempted through graphical representation. Developmental planning of groundwater resources requires a complete picture/model of the major ion characteristics. Factor, principal components, and multiple regression analyses were adopted to develop deterministic and predictive hydrochemical models for the groundwaters of Tamilnadu (India). The deterministic model could show the principal chemical components of aquifers, their pattern of distribution, and the residence time of groundwaters in aquifers. Results of the predictive model could reduce the cost of chemical analysis of sequential water samples normally conducted in a groundwater system. Studies were conducted in two river basins, the Tambraparni and the Vaigai. For the Tambraparni, the dominant factors were: (1) Cl, electrical conductivity (EC), Ca, and total dissolved solids (TDS), with 61.03% of the variance; (2) CO3, pH, SO4, and Na + K, with 75.47% of the variance, and (3) HCO3, Na + K, and TDS, with 85.06% of the variance. For the Vaigai, the principal components were: (1) Cl, Mg, and Na + K, with 52.50% of the variance, (2) SO4, HCO3, and Mg, with 72.75% of the variance, and (3) HCO3 and Na + K, with 87.69% of the variance. Hydrochemical models developed from these results could be used to determine the chemical characteristics of groundwater at any location of interest. Multiple regression analysis could be used as a positive predictive tool for determining the chemistry of the groundwater if the dependent variable EC is measured at any location. (See also W91-03311) (Rochester-PTT)
W91-03339

ANALYSIS OF BREAKTHROUGH CURVES FOR ASSESSING MOVEMENT OF CONTAMINANTS.
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 5B.
W91-03340

DISPERSION OF POLLUTANTS IN POROUS MEDIA FLOW ONE-DIMENSIONAL APPROACH.
College of Engineering, Poona (India).
For primary bibliographic entry see Field 5B.
W91-03341

NUMERICAL MODELLING OF MASS TRANSPORT EQUATION.
Banaras Hindu Univ., Varanasi (India). Dept. of Geophysics.
For primary bibliographic entry see Field 5B.
W91-03342

SINGLE-PHASE/TWO-PHASES NUMERICAL MODEL USING NESTED SQUARE MESHES.
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
E. Ledoux, S. Sauvagnac, and A. Rivera.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 803-814, 9 fig, 13 ref.

Descriptors: *Groundwater movement, *Mathematical models, *Model studies, *Numerical analysis, *Path of pollutants, *Saline water intrusion, *Saline-freshwater interfaces, Coastal aquifers, Nested square meshes, Regional analysis.

A numerical model (NEWVAR) to simulate both the regional groundwater flow and the transient movement of a discrete interface between freshwater and saline-water or any other fluid has been developed. NEWVAR is designed to allow the analysis of a regional two-dimensional groundwater flow in coastal aquifers and permits the prediction of regional freshwater level (one-phase) and two-dimensional freshwater/saline water interface location (two-phases) using nested square meshes. The numerical solution is based on the finite difference method. After an optimal renumbering search, the Gauss-Jordan direct method or the Gauss-Siedel iterative method, through a predictor-corrector scheme, are used for solving steady-state, non-linear equations in the two-phase mode, successively for the freshwater and saline-water terms. In transient state the system of equations is simultaneously solved through semi-implicit method. Different original procedures are used to avoid difficulties generally found in such two-phase models with respect to tracking the transient position of the interface toe. The use of nested square meshes allows both a fine resolution in certain areas along with the possibility of reaching distant hydrogeological boundaries using a minimum of meshes. The numerical solution was tested against analytical ones for the cases of an advancing-retreating interface and a floating freshwater lens over saline water. These tests showed good agreement, thus verifying the finite difference approximation and the original procedures used to overlay the toe tracking dilemma. (See also W91-03311) (Author's abstract)
W91-03343

MEASURES TO OVERCOME THE SALINITY PROBLEMS OF THE COASTAL AREAS IN GUJURAT.

Gujarat Water Resources Dept., Gandhinagar (India).
For primary bibliographic entry see Field 4B.
W91-03345

HYDROCHEMICAL CLASSIFICATION OF THE GROUNDWATER OF THE WADI AL BIH WELLFIELD IN THE NORTHERN PART OF THE UNITED ARAB EMIRATES.
United Arab Emirates Univ., Al Ain. Dept. of Geology
For primary bibliographic entry see Field 2K.
W91-03347

SEMI-ANALYTIC SOLUTION OF ONE-DIMENSIONAL DISPERSION CONVECTION EQUATION.
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
For primary bibliographic entry see Field 5B.
W91-03348

STUDY OF GROUNDWATER POLLUTION AT TIRUMALA, TIRUPATI, INDIA.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 5B.
W91-03350

CASE STUDY OF INTEGRATED EXPLORATION PRACTICE FOR SHALLOW FRESH WATER AQUIFERS IN SOUTHERN PARTS OF RAMNAD DISTRICT (TECHNOLOGY MISSION PROJECT).
AFPRO GIT Unit III, Coimbatore.
J. Srinath, R. Mohommed, and K. M. Namboodiri.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 899-902, 6 fig.

Descriptors: *Aquifers, *Geophysical exploration, *Groundwater mining, *Groundwater resources, *India, Freshwater, Geophysical methods, Paleochannels, Potable water, Ramnad District, Remote sensing, Rural areas, Saline water, Vertical electrical sounding, Water supply development.

The subsurface water in the Mudukulathur block of Ramanathapuram district (Tamil Nadu, India) is mostly saline and at some places it is saltier than sea water. Pits and shallow wells dug out in the tank beds support the need for drinking water in the summer and the quality of water can change daily. A 100-sq km area was selected under the CAPART Technology Mission Project, with the aim of conducting detailed surface water and groundwater studies. Remote sensing, electrical soundings, and pH studies provided information that allowed the area to be classified into four regions for detailed field work. Vertical electrical sounding (VES) profiles were developed and shown to coincide with local geological conditions as determined by remote sensing. Hydradrill equipment was used to drill test holes, and based on the results, production wells were constructed at Kumarakkurichi, Sivalinga puram, Rajakkalpalayam, and Thothamangalamwadi to depths of 10.6, 10.8, 13.8, and 4.9 m, respectively. The four wells were fitted with India Mark II hand pumps and are yielding potable water. This study demonstrated that with remote sensing and water quality data measurements, VES traverses can be used to locate fresh water pockets. The technique was also useful in tracing paleochannels. The fresh water pocket is limited, even in the terri sand area, although it is elevated to 30 m above sea level. In such an environment, pumping schemes may have to be abandoned. (See also W91-03311) (Rochester-PTT)
W91-03351

HYDROGEOCHEMICAL MODELING.
Kerala Univ., Trivandrum (India). Dept. of Geology.
V. Narayanan Nair.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 903-906, 16 ref.

Descriptors: *Geochemistry, *Groundwater chemistry, *Groundwater pollution, *Hydrogeochemical models, *Mathematical models, *Model studies, *Water chemistry, Computer programs, Kinetics, Literature review, Thermodynamics.

Hydrogeochemical modeling is important because of the socioeconomic importance of groundwater and the need to prevent its contamination with pollutants. A hydrogeochemical model is the integration of mathematical, thermodynamic, and kinetic relationships on which the geochemical calculations are based. The required calculations are facilitated by modern electronic computers. The data base required consists of the results of chemical analysis of water samples and should include all the major cationic and anionic elements and the important trace elements. Three types of calculations typically are done: (1) speciation, (2) mass balance, and (3) mass transfer and reaction path. More than 50 computer programs for hydrogeochemical models have been prepared by workers in the field. These computer models have been developed for various purposes and no single code can be used for all applications. The results from computer models can be used to establish baseline geochemical conditions for potential nuclear waste repository sites in India and to simulate the geochemical behavior of transported radionuclides. (See also W91-03311) (Rochester-PTT)
W91-03352

SIWANA-BARMER FRESH WATER BOWLS AS A PANORAMA OF MICRO-ALLUVIAL VALLEYS IN RASASTHAN DESERT.
National Environmental Engineering Research Inst., Nagpur (India).
P. G. Adyalkar, and V. K. Bhagdikar.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 907-910, 8 ref.

Descriptors: *Alluvial aquifers, *Geohydrology, *Groundwater movement, *Groundwater reservoirs, *Hardness, *India, Dissolved solids, Groundwater resources, Well yield.

Micro-alluvial valleys are essentially tiny and individually minimally significant alluvial bodies strewn in the midst of the Malani group of rocks (India). Individually they rarely exceed 500 sq km and they are very limited in depth. In a recent study of Barmer district, two potential fresh water bowls were identified, one in the eastern sector covering the major part of Siwana tahsil and the other west of Barmer in an amphitheater region of Barmer tahsil. The discharge of tubewells in the Siwana bowl varies from 10 to 20 L/sec for a drawdown of 6-20 m, tapping 40-65 m of granular zones in a depth range of about 100m. The specific capacity varies from 35 to 200 L min/m of drawdown with matching high transmissivity and hydraulic conductivity. Dug wells in both the bowls are capable of yielding up to 100 cu m/day with variable phreatic surface. With an areal extent of about 2000 sq km, the static groundwater resources have been estimated at 2000 MCM, most of which remains to be tapped. The water quality in these regions is good, with total dissolved solids of 310-1080 mg/L, total hardness of 70-260 mg/L as CaCO3, chlorides of 50-220 mg/L, and sulfates of 40-120 mg/L. (See also W91-03311) (Rochester-PTT)
W91-03353

DISTRIBUTION OF FLUORIDE IN SHALLOW AQUIFERS IN AND AROUND DISTRICT ROHTAK, HARYANA STATE.
Panjab Univ., Chandigarh (India). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W91-03354

NITRATE POLLUTION IN THE GROUNDWATER OF SANGAREDDY AREA, ANDHRA PRADESH, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
For primary bibliographic entry see Field 5B.
W91-03355

UNDERGROUND STORAGE OF SURPLUS FLOOD WATERS IN GANGETIC PLAIN.
Tata Inst. of Fundamental Research, Bombay (India).
For primary bibliographic entry see Field 4B.
W91-03356

AUGMENTATION OF WATER RESOURCES IN CANAL COMMANDED AREA.
Roorkee Univ. (India). Water Resources Development Training Center.
For primary bibliographic entry see Field 4B.
W91-03357

EFFECT OF DRAINAGE CHANNEL ON EVOLUTION OF WATER TABLE DUE TO RECHARGE FROM TWO PARALLEL CANALS.
Irrigation Design Organization, Roorkee (India).
D. N. Bhargava, G. C. Mishra, and S. Chandra.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 945-957, 4 fig, 2 tab, 2 ref.

Descriptors: *Canal seepage, *Drainage effects, *Groundwater recharge, *Irrigation canals, *Seepage, *Surface-groundwater relations, *Water table rise, Aquifers, Hydraulic engineering, Recharge, Statistical methods.

When irrigation canals are constructed in a basin where a natural drainage system generally exists, part of the recharge due to seepage from the canals will leave the basin through the natural drainage system. If a drainage channel exists near the canals, the water table may rise over time to near the bed level of the drainage channel due to seepage from the canals. A canal-aquifer-drainage channel interaction problem was solved using a discrete kernel approach. The time of activation of a drainage channel running parallel to two continuously running ridge canals and the return flow entering the drainage channel at different times after the activation of the drainage channel were predicted. The time of activation depends on the aquifer parameters, seepage rate from the canals, distance of the drainage channel from the canals, and the elevation of the drainage channel. If a drainage channel is located nearer to the canals, it receives return flow at a higher rate. The water table between two continuously running canals takes the shape of a plateau and it is marginally affected by the presence of the drainage channel. The study led to the following conclusions: (1) a drain activates earlier for canals having larger width, other factors remaining the same; (2) if the spacing between parallel ridge canals is increased, the time for activation of a drain is delayed; (3) a drain activates at an earlier time if its distance from the parallel canals is decreased; and (4) with the presence of a drainage channel, the maximum water table height under the canal (of two parallel canals) that is closest to the drainage channel is marginally affected during a certain initial period. (See also W91-03311) (Rochester-PTT)
W91-03358

WATER CONSERVATION AND ARTIFICIAL RECHARGE TECHNIQUES IN HARD ROCK AREAS.
Central Ground Water Board, Bhopal (India).

For primary bibliographic entry see Field 4B.
W91-03359

ROLE OF DRIP IRRIGATION IN GROUNDWATER MANAGEMENT IN BASALTIC TERRAIN: A CASE STUDY OF SOLAPUR DIST.
D.B.F. Dayanand Coll. of Arts and Science, Sholapur (India).
For primary bibliographic entry see Field 3F.
W91-03360

POSSIBILITIES OF INDUCED RECHARGE AND DEVELOPMENT OF DEEPER AQUIFERS FOR AUGMENTING WATER SUPPLY TO AMBALA URBAN AREA, HARYANA STATE.
For primary bibliographic entry see Field 4B.
W91-03361

INDUCED RECHARGE BY PERCOLATION TANKS IN PARTS OF MAHARASHTRA.
For primary bibliographic entry see Field 4B.
W91-03362

ARTIFICIAL GROUND WATER RECHARGE IN DROUGHT PRONE AREAS.
Central Ground Water Board, Hyderabad (India).
For primary bibliographic entry see Field 4B.
W91-03363

HYDRAULIC FRACTURING TEST FOR GROUNDWATER SIMULATION IN A KARSTIC LIMESTONE AQUIFER, HATTINGEN/BADEN-WEURTTENBURG, WEST GERMANY.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
For primary bibliographic entry see Field 4B.
W91-03364

SIMULATION STUDY CONCERNING STIMULATION OF GROUNDWATER BORE WELLS BY HYDRAULIC FRACTURING.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 4B.
W91-03365

RELATIONSHIP OF RADIUM AND RADON WITH GEOLOGICAL FORMATIONS.
Research Planning Inst., Inc., Columbia, SC.
For primary bibliographic entry see Field 5B.
W91-03372

RIVER RECHARGE.
Caswell, Eichler and Hill, Inc., West Topsham, VT.
For primary bibliographic entry see Field 4B.
W91-03390

PUMP TEST ANALYSIS OF LEAKY AQUIFER.
Roorkee Univ. (India). Dept. of Civil Engineering.
P. K. Swamee, and C. S. P. Ojha.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 5, p 645-655, September/October 1990. 4 fig, 2 tab, 8 ref.

Descriptors: *Aquifer characteristics, *Groundwater potential, *Numerical analysis, *Parametric hydrology, *Pumping tests, Confined aquifers, Graphical analysis, Leakage, Leaky aquifers, Storage coefficient, Transmissivity, Well function.

The quantitative evaluation of an aquifer depends on accurate determination of its parameters. The storage coefficient, transmissivity, and leakage factor are the useful parameters that assess the groundwater potential of a leaky aquifer. These parameters can be determined with the help of pump test data by using graphical as well as numerical methods. Graphical methods are not very reliable as these are subject to personal error of judgment. On the other hand, numerical methods avoid such errors rely on evaluation of the well function either by numerical integration or through approximation valid for small values of the arguments. Due to lack of a full-range equation for the well function, an entire set of pump test data is rarely used in analysis. A high-accuracy expression for the well function for a leaky artesian aquifer valid for an entire range of arguments has been developed, evolving a methodology for determination of cutoff error. By using this approximation well function and minimizing the sum of a criterion function based on the concept of cutoff error, aquifer parameters can be determined. (Author's abstract)
W91-03423

INVESTIGATION OF NONPOINT SOURCE POLLUTION ASSOCIATED WITH KARST AQUIFER SYSTEMS.
Western Kentucky Univ., Bowling Green. Dept. of Health and Safety.
For primary bibliographic entry see Field 5B.
W91-03435

GROUNDWATER SEEPAGE INTO THE INDIAN RIVER LAGOON AT PORT ST. LUCIE.
Florida Inst. of Tech., Melbourne. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W91-03438

COMPLEMENTARY INVESTIGATIVE TECHNIQUES FOR SITE ASSESSMENT WITH LOW-LEVEL CONTAMINANTS.
Science Applications International Corp., Golden, CO. Environmental Remediation Div.
For primary bibliographic entry see Field 5G.
W91-03445

TEMPORAL VARIATIONS OF CHLORINATED SOLVENTS IN ABSTRACTION WELLS.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5B.
W91-03450

HYDROGEOLOGY OF THE BRUNSWICK (PASSAIC) FORMATION AND IMPLICATIONS FOR GROUND WATER MONITORING PRACTICE.
Deutsche Veterinaermedizinische Gesellschaft e.V., Giessen (Germany, F.R.).
A. Michalski.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 4, p 134-143, Fall 1990. 4 fig, 1 tab, 29 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Geohydrology, *Groundwater movement, *Groundwater pollution, *Path of pollutants, *Water quality monitoring, Aquitards, Brunswick Formation, Geohydrologic units, Geologic fractures, Leaky aquifers, Monitoring wells, New Jersey, Shales.

Fractured shales of the Brunswick Formation provide a major aquifer in the most industrialized region of New Jersey. Numerous cases of groundwater contamination have been documented in this formation. However, the effectiveness of monitoring and remediation efforts is often hampered by the use of inappropriate concepts regarding groundwater flow controls in this complex aquifer system. One such concept presumes that near-vertical fractures parallel to the strike of beds provide principal passages for the flow and produce an anisotropic response to pumping stress. Field evidence confirms that the Brunswick Formation hosts a gently dipping, multi-unit, leaky aquifer system that consists of thin water-bearing units and thick intervening aquitards. The water-bearing units are associated with major bedding partings and/or intensely fractured seams. Layered heterogeneity of such a dipping multi-unit aquifer system produces an anisotropic flow pattern with preferential flow along the strike of beds. Within the weathered zone, the permeability of the water-bearing units can be greatly reduced. The commonly used hydrogeologic model of the Brunswick as a one-aquifer system, sometimes with vaguely defined 'shallow' and 'deep' zones, often leads to the development of inadvertent cross-flows within monitoring wells. If undetected, cross-flows may promote contaminant spread into deeper units and impair the quality of hydrogeologic data. Hydrogeologic characterization of the Brunswick shales at any given site should be aimed primarily at identification of the major water-bearing aquitard units. Recommended techniques for this characterization include fluid logging and other in-well tests. (Author's abstract)
W91-03451

DETERMINATION OF TRACE CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUND WATER USING CLOSED-LOOP STRIPPING, EDWARDS AQUIFER, TEXAS.
Geological Survey, Austin, TX.
For primary bibliographic entry see Field 5A.
W91-03465

CAN CONTAMINATED AQUIFERS AT SUPERFUND SITES BE REMEDIATED.
Oak Ridge National Lab., TN. Office of Risk Analysis.
For primary bibliographic entry see Field 5F.
W91-03508

ORIGIN OF SALINE SOILS AT BLACKSPRING RIDGE, ALBERTA, CANADA.
Alberta Research Council, Edmonton. Terrain Sciences Dept.
R. Stein, and F. W. Schwartz.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 99-131, September 1990. 19 fig, 1 tab, 26 ref.

Descriptors: *Alberta, *Canada, *Geochemistry, *Geohydrology, *Saline groundwater, *Saline soils, *Saline water, *Water chemistry, Air-earth interfaces, Bedrock, Blackspring Ridge, Evaporation, Groundwater movement, Sediments, Soil types.

Problems of soil salinity occur at Blackspring Ridge, Alberta in four different settings. The most seriously affected area is at the base of the ridge where salinity appears as severe salt crusting on the surface, salt-tolerant vegetation, and areas of poor or no crop production. Blackspring Ridge is a structural bedrock high that is underlain by Upper Cretaceous sediment of the Horseshoe Canyon Formation. Bedrock is overlain by fluvial, glacial, lacustrine, and aeolian sediment. Piezometric data indicate that groundwater is recharged on and along the upper flanks of Blackspring Ridge and discharges in southern parts of a lacustrine plain that surrounds the ridge. Hydraulic conductivity data, water-level fluctuations, stable isotopes, and hydrochemical data indicate that the fractured near-surface bedrock and overlying thin-drift sediment constitute a zone of active groundwater flow within which salts are generated and transported. Water discharging from this shallow system evaporates and forms saline areas at the base of the ridge. The most seriously affected areas on the lacustrine plain coincide with places where the water table is less than 1.5 m from the ground surface. A high water table occurs locally because of the changing topology of geologic units, and lows in the topographic surface that focus groundwater and surface water flows. Some proportion of the shallow groundwater salinized by evaporation is also transported down the flow system where it mixes with unevaporated water. Surface water, from snowmelt and precipitation events, dissolves salt that was deposited at the surface by evaporating groundwater and redistributes the salt to areas of lower elevation. (Author's abstract)
W91-03544

POND SEEPAGE IN TWO AND THREE DIMENSIONS.
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W91-03545

DEFINITION OF GROUNDWATER FLOW PATTERNS BY ENVIRONMENTAL TRACERS IN THE MULTIPLE AQUIFER SYSTEM OF SOUTHERN ARAVA VALLEY, ISRAEL.
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
E. Rosenthal, E. Adar, A. S. Issar, and O. Batelaan.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 339-368, September 1990. 8 fig, 1 tab, 31 ref.

Descriptors: *Alluvial aquifers, *Environmental tracers, *Flow pattern, *Groundwater movement, *Groundwater recharge, *Model studies, *Recharge, *Tracers, Aquifer characteristics, Arava Valley, Infiltration, Israel, Stable isotopes, Statistical analysis, Storm seepage, Water chemistry.

A model was developed for identification and semi-quantitative evaluation of the different water bodies replenishing groundwater in the southern Arava Rift Valley. The potential sources of recharge into the alluvial aquifer of the valley were assessed by multivariate cluster analysis of environmental tracers such as dissolved ions and stable isotopes. This data was also used to determine the flow pattern to the valley, and within its alluvial aquifer, to the natural outlet of the Red Sea. Spatial variations in the chemical compositions of groundwater and their isotopic ratios are explained as the result of differential rates of replenishment of various water bodies flowing to the Arava. The alluvial aquifer of the southern Arava Valley is recharged by the following water bodies: (1) lateral subsurface flow caused by infiltration of water from flash floods occurring in the neighboring mountain massifs; (2) upward and lateral groundwater flow from sandstone and carbonate aquifers in the Negev and Edom mountains; and (3) leakage from deep-seated brine reservoirs. (Author's abstract)
W91-03556

SURVEY REPORT: STATE ACTIVITIES TO PROTECT GROUND WATER FROM PESTICIDES.
Virginia Univ., Charlottesville. Div. of Urban and Environmental Planning.
For primary bibliographic entry see Field 5G.
W91-03575

TYPES AND EFFECTS OF MICROBIAL CONTAMINATION OF GROUNDWATER.
Environmental Protection Agency, Research Triangle Park, NC. Office of Research and Development.
For primary bibliographic entry see Field 5B.
W91-03577

VULNERABILITY OF KARST AQUIFERS TO CHEMICAL CONTAMINATION.
Environmental Protection Agency, Washington, DC. Office of Health and Environmental Assessment.
For primary bibliographic entry see Field 5B.
W91-03578

CHROMIUM DISTRIBUTION AND TRANSPORT BENEATH A CONTAMINATED SITE.
Sandia National Labs., Albuquerque, NM.
For primary bibliographic entry see Field 5B.
W91-03579

ANALYSIS OF PORE PRESSURE BEHAVIOR OF A ROCKFILL DAM DURING RESERVOIR FILLING.
For primary bibliographic entry see Field 8B.
W91-03591

ROLE OF CROPPING SYSTEMS IN ENVIRONMENTAL QUALITY: GROUNDWATER NITROGEN.
Agricultural Research Service, Lincoln, NE.
For primary bibliographic entry see Field 3F.
W91-03643

BOREHOLE GEOPHYSICS APPLIED TO GROUND-WATER INVESTIGATIONS.
W. S. Keys.
National Water Well Association, Dublin, Ohio. 1989. 313p.

Descriptors: *Borehole geophysics, *Data acquisition, *Geohydrology, *Geophysics, *Groundwater data, *Instrumentation, *Logging (Recording), *Measuring instruments, Groundwater resources, Quantitative analysis, Well logs.

The manual was designed to provide hydrologists, geologists, and others who have the necessary training with the basic information needed to apply the most useful borehole geophysical logging techniques to the solution of problems in groundwater hydrology. Geophysical logs can provide information on the construction of wells and on the character of the rocks and fluids penetrated by those wells and on these factors with time. The response of well logs is caused by: petrophysical factors; the quality, temperature, and pressure of interstitial fluids; and groundwater flow. Qualitative and quantitative analysis of the analog records and computer analysis of digitized logs are used to derive geohydrologic information. This information can then be extrapolated vertically within a well and laterally to other wells using logs. The physical principles by which the mechanical and electronic components of a logging system measure properties of rocks, fluids and wells, and the principles of measurement need to be understood to correctly interpret geophysical logs. Planning the logging operation involves selecting the equipment and the logs most likely to provide the needed information. Information on well construction and geohydrology are needed to guide this selection. Quality control of logs is an important responsibility of both the equipment operator and log analyst and requires both calibration and well-site standardization of equipment. Logging techniques that are widely used in groundwater hydrology or that have significant potential for application to this field include: spontaneous potential, resistance, resistivity, gamma, gamma spectrometry, gamma-gamma, neutron, acoustic velocity, acoustic televiewer, caliper, and fluid temperature, conductivity, and flow. The following topics are discussed for each of these techniques: principles and instrumentation, calibration and standardization, volume of investigation, extraneous effects, and interpretation and applications. (Author's abstract)
W91-03653

INTRODUCTION TO MODELING OF TRANSPORT PHENOMENA IN POROUS MEDIA.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
J. Bear, and Y. Bachmat.
Kluwer Academic Publishers, Boston, Massachusetts. 1990. 553p.

Descriptors: *Groundwater movement, *Model studies, *Path of pollutants, *Porous media, Mass transport, Mathematical models, Porosity, Solute transport.

Practicing engineers and scientists are offered a theoretical background for the modeling of transport phenomena in porous media, applied to specific engineering problems. In principle, mathematical models of problems can be stated and solved at the microscopic level, in terms of values of variables specified at points inside each of the phases, whether fluid or solid, that occupy a porous medium domain. The main objective of the book is to present a methodology for constructing mathematical models of transport problems in a porous medium domain on the basis of the continuum approach. The book is divided into two parts: Part A, consisting of three chapters, presents the general theory of modeling transport phenomena in a porous medium domain. The first chapter presents the continuum approach, defines microscopic and macroscopic levels of description, introduces the concept of spatial averaging and defines some macroscopic characteristics of porous media and their constituents. Chapter 2 continues to develop this approach by presenting a description of transport phenomena at the microscopic level, and by deriving averaging rules for transforming the microscopic level of description of any transport problem to a macroscopic one, in which all state variables and parameters are macroscopic quantities. The various laws that govern the macroscopic fluxes of extensive quantities in a porous medium domain, are also derived. Thermodynamic concepts and quantities are introduced whenever necessary. Finally, by adding macroscopic initial and boundary conditions, a complete mathematical statement, or mathematical model, for any transport problem at the macroscopic level of description is obtained. This is discussed in Chapter 3. In Part B, the general theory presented in Part A is applied to specific problems of transport of mass and volume of a phase, mass of a component and heat in single and multiphase fluid systems in a porous medium domain. The appropriate models are developed at the macroscopic level. (Lantz-PTT)
W91-03654

HYDROLOGY OF LIMESTONE TERRANES: ANNOTATED BIBLIOGRAPHY OF CARBONATE ROCKS, VOLUME THREE.
International Association of Hydrologists.
J. M. Tanner, and R. ShoreDavis.
Contribution to UNESCO IHP Project A.1.13. International Contributions to Hydrogeology, Volume 2, 1986. 341p. Series editor Philip E. LaMoreaux.

Descriptors: *Bibliographies, *Carbonate rocks, *Geohydrology, *Groundwater movement, *Hydrology, *Karst hydrology, *Limestone.

Methods used to investigate the hydrological regime in carbonate terrains includes a broad spectrum of techniques from the fields of geology, geohydrology, hydrology, physics, chemistry, mathematics, and other disciplines. Some of the methods are simple; others are highly sophisticated. This annotated bibliography consists of citations listed alphabetically by principal author and numerically by document number. The annotated citations are followed by secondary author, location, and subject indexes. The Subject Index is preceded by a key to level terms used. The Location Index is by country, and secondarily by individual state. Each index lists the pertinent citations by document number. The bibliography primarily represents citations for the past decade (1975 through 1985) from the following data sources: a computer controlled search of GEOREF and GEOARCHIVE which contain publications of AGI and the Bibliography of North American Geology; Canadiana; American Book Publishing Record; Library of Congress Subject Catalog; Books in Print and Paperbound Books in Print; Bibliographic Guide to Conference Publications; Index to Scientific and Technical Proceedings; and Libros en Venta. (Lantz-PTT)
W91-03656

STATE GROUNDWATER PROTECTION POLICIES: A LEGISLATOR'S GUIDE.
National Conference of State Legislatures, Denver, CO.
For primary bibliographic entry see Field 5G.
W91-03657

ECONOMIC IMPLICATIONS OF GROUNDWATER CONTAMINATION TO COMPANIES AND CITIES.
Freshwater Foundation, Navarre, MN.
For primary bibliographic entry see Field 5C.
W91-03660

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY.
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-03663

MAJOR GEOHYDROLOGIC UNITS IN AND ADJACENT TO THE OZARK PLATEAUS

PROVINCE, MISSOURI, ARKANSAS, KANSAS AND OKLAHOMA--SPRINGFIELD PLATEAU AQUIFER.
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-03665

MAJOR GEOHYDROLOGIC UNITS IN AND ADJACENT TO THE OZARK PLATEAUS PROVINCE, MISSOURI, ARKANSAS, KANSAS, AND OKLAHOMA--WESTERN INTERIOR PLAINS CONFINING SYSTEM.
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-03666

MAJOR GEOHYDROLOGIC UNITS IN AND ADJACENT TO THE OZARK PLATEAUS PROVINCE, MISSOURI, ARKANSAS, KANSAS, AND OKLAHOMA--ST. FRANCOIS AQUIFER.
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-03667

MAJOR GEOHYDROLOGIC UNITS IN AND ADJACENT TO THE OZARK PLATEAUS PROVINCE, MISSOURI, ARKANSAS, KANSAS, AND OKLAHOMA.
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-03668

HYDROGEOLOGY OF THE GALLUP SANDSTONE IN THE SAN JUAN STRUCTURAL BASIN, NEW MEXICO, COLORADO, ARIZONA AND UTAH.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-03669

POTENTIAL FOR AQUIFER COMPACTION, LAND SUBSIDENCE, AND EARTH FISSURES IN AVRA VALLEY, PIMA AND PINAL COUNTIES, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-03670

HYDROLOGIC CHARACTERISTICS OF SOILS IN THE HIGH PLAINS, NORTHERN GREAT PLAINS, AND CENTRAL TEXAS CARBONATES REGIONAL AQUIFER SYSTEMS.
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-03671

GEOHYDROLOGY OF A THIN WATER-TABLE AQUIFER ADJACENT TO LAKE MICHIGAN, NORTHWESTERN INDIANA.
Geological Survey, Indianapolis, IN.
L. R. Watson, and J. M. Fenelon.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 235-245, 2 fig, 1 tab, 11 ref.

Descriptors: *Aquifer characteristics, *Geohydrology, *Great Lakes, *Groundwater movement, Calumet aquifer, Drainage water, Flow discharge, Groundwater quality, Indiana, Lake Michigan, Surface-groundwater relations, Unconfined aquifers, Water level, Water quality control, Water resources management.

The Calumet aquifer underlies a highly industrialized region of northwestern Indiana that contains three steel plants, one large petrochemical refinery, and many smaller manufacturing facilities. This water-table aquifer is composed of fine to medium beach and dune sands less than 65 feet thick. The water table generally is less than 8 feet below land surface. The geohydrologic characteristics of the Calumet aquifer were defined so that a network of groundwater observation wells could be properly installed for a subsequent water quality study. Maps of the water table and aquifer geometry were prepared, aquifer/stream interactions were monitored, and cross-sectional and areal finite difference digital models were constructed. The water table has broad, low-gradient mounds that generally lie between the major surface water drains. Water level records show that aquifer/stream interactions are complex and are somewhat dependent on the stage of Lake Michigan. In a 70-square-mile modeled area, the aquifer discharges about 5 to 10 cu ft/s of water to the Grand Calumet River/Indiana Harbor Canal, which subsequently drains to Lake Michigan. Less than 5 cu ft/s of water discharges directly to Lake Michigan along 20 miles of shoreline. In addition, 20 to 25 cu ft/s of groundwater discharges to leaky sewer systems. (See also W91-03672) (Author's abstract)
W91-03698

WATER QUALITY IN A THIN WATER-TABLE AQUIFER ADJACENT TO LAKE MICHIGAN, WITHIN A HIGHLY INDUSTRIALIZED REGION OF INDIANA.
Geological Survey, Indianapolis, IN.
For primary bibliographic entry see Field 5B.
W91-03699

GROUNDWATER QUALITY: THE ROLE OF AGRICULTURAL POLITICS AND POLICY.
Iowa Univ., Iowa City. Dept. of Geography.
For primary bibliographic entry see Field 6E.
W91-03706

GROUND WATER POLICY OF USDA.
Department of Agriculture, Washington, DC.
For primary bibliographic entry see Field 6E.
W91-03707

RESISTIVITY-RECHARGE RELATIONSHIPS--FIELD STUDY.
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
B. Curtis, and W. E. Kelly.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 39-53, October 1990. 10 fig, 6 tab, 22 ref.

Descriptors: *Field tests, *Geophysical surveys, *Recharge, *Resistivity, *Resistivity surveys, *Soil water, *Vadose zone, Boreholes, Electrical properties, Hydraulic conductivity, Nebraska, Parametric hydrology, Particle size, Permeability, Soil types, Sounding.

From sounding measurements, the variation of electrical resistivity with depth in the soil-vadose zone can be determined. Resistivities were defined for different unsaturated sediment types by interpreting soundings made at locations in Nebraska where borehole control was available. Unsaturated sediments were found to have characteristic resistivities, with resistivity increasing with the coarseness of the soil. The soil resistivity data was combined with estimates of hydraulic conductivity to demonstrate relationships between recharge potential and resistivity. Ideally, such relationships would be based on hydraulic conductivities measured on samples taken from boreholes used for parametric soundings or better still, full-scale tests. In lieu of such measurements, estimates based on locally derived relationships using visual descriptions of grain size data can be used. For the purposes of this study, the ability to designate a range of resistivities as representing highly permeable, moderately permeable, or slowly permeable for recharge is probably appropriate and generally would be satisfactory. (Fish-PTT)
W91-03739

SIMULATION OF SALTWATER INTRUSION IN THE NORTHERN GUAM LENS USING A MICROCOMPUTER.
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
D. N. Contractor, and R. Srivastava.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 87-106, October 1990. 15 fig, 1 tab, 10 ref.

Descriptors: *Coastal aquifers, *Computer models, *Groundwater management, *Microcomputers, *Saline water intrusion, *Saline-freshwater interfaces, *Simulation analysis, Computer programs, Field testing, Finite element method, Groundwater level, Groundwater movement, Hydraulic conductivity, Numerical analysis, Observation wells, Water depth.

For efficient planning and proper management of a coastal aquifer, it is essential to predict the extent of seawater intrusion into the aquifer in response to variations in the components of the freshwater mass balance. Numerical models used to predict the location of the saltwater interface for a given set of hydrologic conditions are broadly classified into two types: diffused interface models and sharp interface models. A two-dimensional (areal) finite element model of saltwater intrusion was modified so that it can run on a microcomputer. The model assumes a sharp interface between freshwater and salt water and simulates the movement of both freshwater and salt water. Linear triangular elements are used to discretize the domain. A preprocessor is used to renumber the nodes of a given network to reduce the bandwidth of the matrix. The model was applied to the Northern Guam aquifer. The hydraulic conductivity in three regions of the aquifer was calibrated using the water level history for a few observation wells. Field measurements of the depth of the interface indicate that the sharp interface assumption is valid for most of the aquifer. Comparison of the depth of the measured 50% isochlor with the computed depth of the interface shows that the two are equal at most locations. In some cases, the computed depth is less than the measured depth which results in a conservative estimate of the interface depth. (Author's abstract)
W91-03742

TRACING THE ORIGIN OF NATURAL WATERS IN A GLACIAL TILL SLOPE DURING SNOWMELT.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Land and Water Resources.
For primary bibliographic entry see Field 2C.
W91-03743

EVOLUTION OF THE CHEMICAL COMPOSITION OF WATER PASSING THROUGH THE UNSATURATED ZONE TO GROUND WATER AT AN EXPERIMENTAL SITE AT THE UNIVERSITY OF SAO PAULO, BRAZIL.
Sao Paulo Univ. (Brazil). Inst. de Geociencias.
M. Szikszay, A. A. Kimmelmann, R. Hypolito, R. M. Figueira, and R. H. Sameshima.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 175-190, October 1990. 7 fig, 4 tab, 14 ref.

Descriptors: *Aeration zone, *Brazil, *Geochemistry, *Groundwater chemistry, *Vadose zone, *Water chemistry, *Weathering, Anions, Chemical properties, Climatic effects, Geology, Hydraulic conductivity, Infiltration, Lithology, Percolation, Soil water, Subtropic zone.

To study the evolution of the chemical composition of water infiltrating through the unsaturated zone to groundwater, water samples were collected weekly over a 14-month period, from porous cups installed at depth intervals of 50 cm through 12 m of the unsaturated zone, at an experimental site at the University of Sao Paulo, Brazil. Previous studies furnished precipitation, hydraulic conductivity, zero-flux plane, lithologic, and geologic data (mean) at the site. The analyses of chemical composition showed that at a depth of 0.5 m, the proportion of cations was exactly the same as that found in the rainwater, i.e., rCa > rMg > rNa > rK, where r = reacting value or meq/L. During percolation of water through the unsaturated zone, the proportion changed to rNa > rK > rMg > rCa, in the groundwater at the site, to rNa > rCa > rK > Mg, and finally at a well further downs-

lope to rCa > rNa > rK > rMg. The proportion of anions in the rainwater was rSO4 > rNO3 > rCl. Immediately after rainfall infiltration, this changed to rSO4 > rCl > rNO3 > rHCO3 in the soil with the appearance of HCO3(-), which became predominant in the groundwater, i.e., rHCO3 > rCl > rSO4 > rNO3. Thus the chemical composition of water in the upper part of the unsaturated zone at the experimental site is influenced by the climate whereas that in the lower part is affected more by local lithology. Three-dimensional computer treatment of each variable showed important variations in the chemistry of water with depth in the unsaturated zone. The variations are less pronounced over time, given the more-or-less uniform conditions of a subtropical climate throughout the year. (Author's abstract)
W91-03747

OVERFLOW THERMAL SPRINGS OF TUSCANY (ITALY).
Consiglio Nazionale delle Ricerche, Pisa (Italy). Ist. Internazionale per le Ricerche Geotermiche.
R. Celati, S. Grassi, and C. Calore.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 191-207, October 1990. 16 fig, 1 tab, 20 ref.

Descriptors: *Aquifers, *Flow models, *Geothermal water, *Groundwater movement, *Italy, *Model studies, *Thermal springs, Confined aquifers, Flow discharge, Flow pattern, Geothermal resources, Infiltration, Mathematical analysis, Outcrops, Permeability, Porous media, Spring water, Water circulation.

There are several low temperature geothermal systems spread over a large part of Tuscany, the Italian region containing high temperature geothermal fields. This region is characterized by a main thermal aquifer that is generally confined, except in some areas where the aquifer formations outcrop; most of the thermal springs of the region are located on the boundaries of these permeable outcrops. Field observations suggest a diffuse flow conceptual model for these springs as opposed to the commonly accepted models that assume water flow along faults or other isolated channels. Mathematical models assuming porous medium flow have been used to investigate some of the main characteristics of water circulation in such systems. The spring discharge can be supplied entirely by water absorbed into the adjacent permeable outcrops or by water belonging to the regional circulation, or by a mixture of the two in different proportions. Infiltration rate, surface morphology, and the resistance to water flow in the aquifer away from the permeable outcrops are factors strongly affecting the flow pattern and spring characteristics. (Author's abstract)
W91-03748

DRAWDOWN AROUND A WELL IN A HETEROGENEOUS, LEAKY AQUIFER SYSTEM.
Kuwait Inst. for Scientific Research, Safat.
F. Szekely.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 247-256, October 1990. 4 tab, 11 ref.

Descriptors: *Aquifer systems, *Aquifer testing, *Groundwater movement, *Leaky aquifers, *Model studies, *Numerical analysis, *Well hydraulics, Aquitards, Boundary conditions, Drawdown, Error analysis, Heterogeneity, Hydraulic properties, Piezometric head.

Real, leaky multiaquifer systems are composed of several aquifers separated by aquitards. All layers have nonuniform hydraulic parameters and irregular lateral extension following natural boundaries. Wells were replaced by point sources, and storativity of aquitards was neglected. A proposed synthesized analytical-numerical (SAN) method is based on the analytical multiaquifer well flow solution, used to treat the singularity of drawdown near the well, assuming laterally homogeneous hydraulic parameters and approximate boundary conditions. The second component of the total drawdown characterizes the effect of heterogeneity of hydraulic parameters and irregular barrier boundaries via distributed sources, and may be estimated by well-conditioned numerical methods. Numerical tests prepared for a well tapping the deepest aquifer of a five-aquifer system, show high numerical accuracy (1-10 mm) far from the well and along the well casing and screen. This numerical error corresponds to the accuracy of measurements of piezometric head and in this way enables one to apply this method for parameter calibration, path line, and travel time analysis in heterogeneous aquifer systems even in the vicinity of the wells. Owing to this feature of the solution, there is no need for extreme refinement of the computational mesh near wells or well fields; in locating nodes, only spatial heterogeneity and boundary conditions should be considered. Because of the linearity of governing equations, the described single well and/or single tapped aquifer solution may be extended easily to the most general case for a well field and/or several tapped aquifers, applying the well-known method of superimposition. (Fish-PTT)
W91-03751

ESTIMATION OF THE HYDRAULIC PARAMETERS OF THE RIO-MAIOR AQUIFER IN PORTUGAL BY USING STOCHASTIC INVERSE MODELING.
California Univ., Berkeley. Dept. of Civil Engineering.
Y. Rubin, J. P. LoboFerreira, J. D. Rodrigues, and G. Dagan.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 257-279, October 1990. 13 fig, 1 tab, 17 ref.

Descriptors: *Aquifer characteristics, *Flow equations, *Groundwater movement, *Model studies, *Portugal, *Stochastic models, Error analysis, Groundwater recharge, Hydraulic properties, Mapping, Mathematical models, Piezometric head, Rio Maior Aquifer, Transmissivity.

A preliminary study of a section of the Rio-Maior aquifer in Portugal was performed to identify the transmissivity and head regional distributions and the natural recharge as a function of time. A small number of transmissivity measurements on one hand and a relative abundance of head measurements (taken over a long period of time) on the other led to the casting of the identification problem in the framework of stochastic inverse modeling. The basic assumptions of the approach, are that the log-transmissivity Y is a normal and stationary random space function, the aquifer is unbounded, and a first-order approximation of the flow equation is adopted. The expected value of the piezometric head H as well as the Y unconditional autocovariance function have analytical expressions which depend on a parameter vector, all of which must be identified based on the model and by use of maximum likelihood procedures and subsequently computing the statistical moments of Y and H conditioned on the same data. This model was applied to the Rio-Maior aquifer, starting with data screening and identification of outliers among measurements, and finally drawing regional maps of the conditional Y and H with their error of estimation. Evaluation of the transmissivity distribution obtained by this method showed an improvement when compared with transmissivity distribution obtained without using the head measurements. (Author's abstract)
W91-03752

TRANSPORT IN HETEROGENEOUS POROUS FORMATIONS: 1. TIME-DEPENDENT CONVECTIVE DISPERSION.
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
For primary bibliographic entry see Field 7C.
W91-03755

TRANSPORT IN HETEROGENEOUS POROUS FORMATIONS: 2. TIME-DEPENDENT DOUBLE DISPERSION.
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
For primary bibliographic entry see Field 7C.
W91-03756

SENSITIVITY ANALYSIS OF '2D-FED,' A MODEL FOR SEAWATER ENCROACHMENT IN LEAKY COASTAL AQUIFERS.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W91-03757

PALAEOHYDROGEOLOGY OF THE SENEGAL SEDIMENTARY BASIN: A TENTATIVE EXPLANATION OF THE PIEZOMETRIC DEPRESSIONS.
Ecole Inter-Etats d'Ingenieurs de l'Equipement Rural, Ouagadougou (Burkina Faso).
B. Dieng, E. Ledoux, and G. de Marsily.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 357-371, October 1990. 6 fig, 11 ref.

Descriptors: *Africa, *Aquifer characteristics, *Arid-zone hydrology, *Depression head, *Evapotranspiration, *Geohydrology, *Paleohydrology, *Piezometric head, *Sedimentary basins, Evaporation, Numerical analysis, Sea level, Simulation analysis, Unconfined aquifers.

The superficial aquifers of the Senegal sedimentary basin, like many other coastal and internal basins in Africa, have piezometric anomalies characterized by a large cone of depression, but without any significant artificial withdrawal in the area. Such depressions are often referred to as 'hollow aquifers,' and may be explained by sea level variations on the Atlantic coast of Africa, following the last glaciation. This possibility was investigated with respect to the cause of the Ferlo piezometric depression of the Senegal sedimentary basin. A multilayered digital model of the entire hydrogeologic system was used to integrate the superficial phreatic aquifer and the underlying aquifers. Simulations were begun from 18,000 BP, thus covering the period from the maximum aridity and lowest sea level to the present. The hydrodynamic behavior of the aquifers was reconstructed, particularly the present piezometry of the entire three-layer system, which is compatible with that observed today, including the depressed shape of the central zone of Ferlo. It was shown that the apparent stable conditions observed today are in fact transient conditions, but with a rate of change too small to be noticeable on a human time scale. Other causes of transient conditions in aquifers can be tectonic uplift or collapse, withdrawal of confining load such as a glacier. However, evaporation losses from deep water table aquifers cannot be ruled out in some circumstances to explain some depressed head zones in truly steady state, as in those in Central Africa. In arid zones, it appears that evapotranspiration can extract water down to several meters in the upper soil and create a discharge from the aquifer by seepage upwards in the unsaturated zone. (Fish-PTT)
W91-03758

CL-36 IN GROUND WATER OF THE MAZOWSZE BASIN (POLAND).
Polish Academy of Sciences, Warsaw. Geological Sciences Inst.
For primary bibliographic entry see Field 2K.
W91-03759

HYDROGEOLOGICAL PROPERTIES OF THE MATRIX OF THE CHALK IN THE LUBLIN COAL BASIN (SOUTHEAST POLAND).
Academy of Mining and Metallurgy, Krakow (Poland). Inst. of Hydrogeology and Engineering Geology.
S. Borczak, J. Motyka, and A. Pulido-Bosch.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 5, p 523-534, October 1990. 11 fig, 18 ref.

Descriptors: *Areal hydrogeology, *Chalk, *Geohydrology, *Poland, *Soil water, Groundwater movement, Interstitial water, Mathematical analysis, Porosity, Soil porosity, Soil properties.

The geohydrological properties of the chalk matrix were determined from laboratory studies of the cores from five boreholes and two mineshafts sunk in a sector 30 km to the east of Lublin. The

interconnected values ranged from 0.15-0.50. More than half of the samples fell between 0.25 and 0.35, the most frequent value being 0.40 in a normal distribution pattern. The interconnected porosity parameter showed a clear tendency to diminish with depth in mineshaft. The average compressed air permeability values fell within the range 0.012-50.6 mDarcy. Conversion to their water equivalent, expressed in m/s (without applying Klinkenberg's correction), yields the following extreme results: 0.898 picometer/s and 0.388 micrometer/s. The values for this parameter adjust to a fairly homogeneous lognormal distribution. There does not seem to be any tendency for this parameter to vary with depth. The specific yield is very low; only 57 samples (slightly more than 37%) were capable of yielding water under the experimental conditions, with values ranging from 0.0001 to 0.0065. The gravitational water content therefore accounts for a very slight fraction of the chalk porosity. The Lublin coal basin matrix is a very porous but only slightly permeable porous medium; its water reserves are hardly susceptible to gravity drainage. The interconnected porosity of the chalk matrix diminishes with depth, probably because of the increase in lithostatic pressure. (Hoskin-PTT)
W91-03843

COMPARISON OF MODELS PREDICTING GROUND WATER LEVELS ON HILLSIDE SLOPES.
Stevens Inst. of Tech., Hoboken, NJ. Dept. of Civil, Environmental and Coastal Engineering.
L. N. Reddi, I. M. Lee, and T. H. Wu.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 657-667, August 1990. 11 fig, 14 ref.

Descriptors: *Groundwater budget, *Groundwater level, *Hydrologic models, *Infiltration, *Mathematical models, *Model studies, *Recharge, *Slopes, *Soil water, Alaska, Comparison studies, Drainage, Evapotranspiration, Finite difference methods, Kriging, Mathematical equations, Piezometry.

A comparative study of ground water level predictions on hillside slopes is conducted. Using a simplified mass balance model that has components for evapotranspiration, recharge and drainage; and a two-dimensional finite difference model that employs kriging to estimate soil parameters and accounts for non-uniform thickness of the soil layer. These models are representative of a wide range of modeling capabilities and are used to illustrate the sensitivity of groundwater level predictions to the sophistication of the modeling techniques. The drainage and recharge components of the two models are evaluated and the importance of unsaturated flow in recharge computations is underscored. Piezometric observations in a small drainage depression on the slope of Kennel Creek Valley in Tongass National Forest, Alaska, were used to evaluate the two models. The results show that, although the predictions differ from the field observations, the simple physically-based mass balance model predicts the groundwater levels as well as the two-dimensional model. It is suggested that caution should be exercised in using complex models to validate simpler models. (Author's abstract)
W91-03860

STRUCTURAL AND STRATIGRAPHIC FRAMEWORK OF GROUNDWATER OCCURRENCE AND SURFACE DISCHARGE IN THE MURRAY BASIN, SOUTHEASTERN AUSTRALIA.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
C. M. Brown.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 127-146, 1990. 13 fig, 96 ref.

Descriptors: *Australia, *Flow discharge, *Geochemistry, *Geohydrology, *Groundwater movement, *Murray-Darling River Basin, *Saline groundwater, *Saline soils, *Stratigraphy, Aquifer systems, Basins, Geologic history, Groundwater barriers, Groundwater basins, Literature review, Paleohydrology, Saline water, Sedimentary basins, Sedimentary structures.

Salinity problems threaten the regional economy and natural environment of the Murray Basin, an important agricultural region in Australia. Groundwater trapped within the basin can only escape by discharge to the Murray River or landscape, where salts accumulate through evapotranspiration. The basin sediments are largely water-saturated, and remaining groundwater storage capacity for increased recharge to aquifer systems is limited. Groundwater levels have therefore risen rapidly after increased infiltration from the clearing of natural vegetation for shallow-rooted plants and irrigation. The extent of characteristic assemblages of Upper Quaternary sediments and landforms shows more widespread salinization under 'natural' conditions at times in the recent geologic past. In the subsurface, a basin-wide stratigraphic framework has been established through documentation of regional distribution, geometry, and depositional environments of Tertiary units. Facies analysis of borehole data and paleogeographic reconstructions indicate at least three major depositional sequences within the Tertiary succession, each having non-marine sediments in the east and north and marine sediments in the western areas. The stratigraphy translates into a number of regional aquifer systems, confining layers, and permeability barriers to groundwater flow, each with distinctive characteristics. The development of natural groundwater discharge sites at the surface of the basin causes flow disruption and upward leakage at subsurface permeability barriers. These barriers occur where aquifer systems of the basin are significantly thinned by concealed basement features and/or by lateral changes in lithology. (Author's abstract)
W91-03889

HYDROGEOLOGY OF THE MURRAY BASIN, SOUTHEASTERN AUSTRALIA.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
W. R. Evans, and J. R. Kellett.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 147-166, 1990. 22 fig, 2 tab, 37 ref.

Descriptors: *Aquifer systems, *Australia, *Geochemistry, *Geohydrology, *Groundwater movement, *Murray-Darling River Basin, *Saline groundwater, *Saline soils, *Soil management, *Water quality, Deterioration, Groundwater barriers, Groundwater level, Groundwater recharge, Infiltration, Saline water, Salinity, Surface-groundwater relations, Water use.

Soil degradation is the most serious environmental issue facing Australia today, and a major problem is the land salinization and degradation of surface water quality in the Murray Basin of southeast Australia. An understanding of regional groundwater processes is necessary to formulate effective management plans to combat the spread of salinity throughout the basin. Groundwater flow in all four of the aquifer groups contained within the three regional groundwater provinces is toward the Murray River, which is the sole conduit for the transport of groundwater and salts out of the basin. The major impediment to flow, the mid-Tertiary low-permeability barrier, extends in a 100-km arc through the center of the basin, and disrupts lateral throughflow in the upper two aquifer groups. This disruption is one of the factors that controls the distribution of groundwater discharge zones, which are ultimately controlled by groundwater pressure in recharge zones. Land clearing in the recharge zones has increased the rainfall infiltration capacity of soils, thereby increasing water pressure, resulting in rising water tables downbasin. The total salt load in the aquifers exceeds 100,000 million tons, and, under the current groundwater-surface water interactive flow regime, <0.004% of this huge salt store is transported out of the basin. Recoverable reserves of groundwater in the unconfined aquifers total around 4.5 million ML/year. The utilization rate is only a few percent of the sustainable yield. Greater use of groundwater in recharge zones would ultimately reduce the rate of rise of the regional down-basin water table, though salt disposal considerations are the limiting factor on any development. (Author's abstract)
W91-03890

IRRIGATION RECHARGE.
Rural Water Commission of Victoria, Armidale (Australia).
For primary bibliographic entry see Field 3F.
W91-03892

EFFECT OF LAND CLEARANCE IN THE MALLEE REGION ON RIVER MURRAY SALINITY AND LAND SALINISATION.
South Australian Dept. of Mines and Energy, Adelaide.
For primary bibliographic entry see Field 4C.
W91-03894

ASPECTS OF STRATIGRAPHY AND STRUCTURE IN RELATION TO THE WOOLPUNDA GROUNDWATER INTERCEPTION SCHEME, MURRAY BASIN, SOUTH AUSTRALIA.
South Australian Dept. of Mines and Energy, Adelaide.
J. M. Lindsay, and S. R. Barnett.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 219-225, 1990. 4 fig, 1 tab, 31 ref.

Descriptors: *Australia, *Flow discharge, *Geohydrology, *Interception, *Saline groundwater, *Stratigraphy, *Water quality control, *Woolpunda Groundwater Interception Sche, Aquifer systems, Geologic control, Groundwater barriers, Groundwater movement, Murray-Darling River Basin, Paleohydrology, Permeability, River basins.

Micropaleontological and biostratigraphic studies have been used to assist understanding the stratigraphic and structural context of groundwater flow systems in the vicinity of the Woolpunda Groundwater Interception Scheme (WGIS)--a major area of saline groundwater discharge to the River Murray in the western Murray Basin, South Australia. Structure was defined by tracing several stratigraphic markers in the Late Oligocene to Middle Miocene succession, including the Lepidocyclina foraminiferal zone and three clay or marl units of low permeability. A cross-section through the upper part of the Cenozoic sequence illustrates east-west arching, gentle Middle to Late Miocene folding, and intermittent mild Cenozoic uplift. Arching and doming across the WGIS area is confirmed by a structure contour plot on the top Renmark Group, and by limited drilling in the deeper Eocene and Cretaceous sediments. The arched structure apparently relates to draping of the Tertiary succession over a high of pre-Tertiary rocks related to the Hamley Fault. This high acts as a permeability barrier to the Renmark Group confined aquifer which thins significantly over it, promoting upward leakage into the water table aquifer, with resultant high saline discharge to the River Murray. (Author's abstract)
W91-03896

GROUNDWATER-RIVERWATER DENSITY CONTRAST: ITS EFFECT ON THE PATTERN OF GROUNDWATER DISCHARGE TO THE RIVER MURRAY.
South Australian Dept. of Engineering and Water Supply, Adelaide.
A. Telfer.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 227-232, 1990. 10 fig, 5 ref.

Descriptors: *Australia, *Density currents, *Geochemistry, *Geohydrology, *Interception, *Murray-Darling River Basin, *Saline groundwater, *Saline water barriers, *Surface-groundwater relations, *Woolpunda Groundwater Interception Sche, Aquifers, Computer models, Discharge measurement, Groundwater movement, River flow, Trenches, Water pressure.

The Woolpunda Groundwater Interception Scheme (WGIS) is being constructed along the

River Murray in South Australia, and is designed to intercept saline groundwater which is discharging into the river from the regional water table. A density contrast between river water and groundwater causes the pressure in the aquifer below the River Murray to be less than that in the aquifer adjacent to the river. The magnitude of the pressure difference is proportional to the depth of the river, and groundwater discharge is biased toward the zones of maximum pressure difference. These zones are the deepest sections of the river, herein called trenches. Groundwater entrainment from the trenches causes plumes of salinized (and hence denser) river water to flow along the bottom of the river. These plumes are fully mixed with the river water where the river is shallow. River salinity measurements and computer modeling of the density contrast effect indicate that the groundwater discharge per unit length of river is 40-60% greater at a trench than elsewhere. (Author's abstract)
W91-03897

ENVIRONMENTAL CONSEQUENCES OF SALINE GROUNDWATER INTRUSION INTO THE WIMMERA RIVER, VICTORIA.
Kaiela Fisheries Research Station, Shepparton (Australia). Fisheries Div.
J. R. Anderson, and A. K. Morison.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 233-252, 1990. 15 fig, 32 ref.

Descriptors: *Australia, *Density stratification, *Environmental effects, *Environmental impact, *Murray-Darling River Basin, *Saline groundwater, *Saline water intrusion, Anaerobic conditions, Conductivity, Geohydrology, River basins, River flow, Water quality control, Water table rise, Watershed management.

Saline groundwater intrusions into lowland reaches of the Wimmera River, western Victoria, Australia, accumulated under low-flow conditions to form stable 'saline pools.' An extensive area of river downstream was affected, and almost all water in the channel during flow stoppages appeared to be of groundwater origin. Saline pools which re-established within two months of flow decline had similar depth, temperature and conductivity to those found six months before. Under the prevailing intermittent flow regime, saline pools would be expected during the 7-month low-flow period in most years. Stable stratification and associated severe hypoxia rendered much of the water in the pools uninhabitable by aerobic organisms. The habitable area in many pools was confined to upper layers and shallow pool margins. Severe deoxygenation and rapid short term changes in salinity and temperature occurred with a 'first flush,' and displacement of partially mixed saline water produced secondary stratifications in deep pools downstream. Vertical conductivity gradients were associated with persistent deoxygenation at many sites as a result of this process. The total area affected by saline groundwater intrusion extended downstream far beyond the immediate area of the intrusion. This river provides a model for other rivers in the Murray-Darling Basin where saline groundwater from rising water tables drains into them. Further studies are required to develop management and control measures to prevent large-scale environmental degradation of riverine habitats in the Murray-Darling Basin. (Author's abstract)
W91-03898

TATIARA PROCLAIMED REGION, SOUTH-EASTERN SOUTH AUSTRALIA: HYDROGEOLOGICAL INVESTIGATIONS AND GROUNDWATER MANAGEMENT.
South Australian Dept. of Mines and Energy, Adelaide.
For primary bibliographic entry see Field 4B.
W91-03899

CHLORINE-36 MEASUREMENTS IN THE MURRAY BASIN: PRELIMINARY RESULTS FROM THE VICTORIAN AND SOUTH AUSTRALIAN MALLEE REGION.
Australian Nuclear Science and Technology Organisation, Sutherland.
R. F. Davie, J. R. Kellett, L. K. Fifield, W. R. Evans, and G. E. Calf.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 261-272, 1990. 7 fig, 1 tab, 34 ref. Australian Water Research Advisory Council Grant No. M86/16.

Descriptors: *Aquifer systems, *Australia, *Chlorine radioisotopes, *Environmental tracers, *Geochemistry, *Groundwater chemistry, *Groundwater movement, *Isotopic tracers, *Murray-Darling River Basin, *Saline groundwater, *Tracers, Geohydrology, Groundwater recharge, Mass spectrometry, Rainfall.

Chlorine-36 (36-Cl) is a naturally-occurring radioactive isotope with a half-life of 301,000 +/-2000 years, and is a natural component of recharge waters into underground aquifers. Furthermore, within the aquifer environment the highly soluble chloride ion has simple geochemistry. These attributes make 36-Cl an ideal isotope for studying salt and water movement within an aquifer system. Chlorine-36 analyses of groundwater samples from 18 wells in the Victorian and South Australian Mallee region of the Murray Basin were carried out using the technique of accelerator mass spectrometry. Results of these analyses show evidence for significant recharge from rainfall over much of the study area to the underlying Murray Group limestone aquifer. Furthermore, the 36-Cl results indicate that the major source of salts to the Murray Group groundwater covered in this study, except for the discharge zones, is recent (compared with the half-life of 36-Cl) atmospheric accession. In particular, the results are not consistent with the addition of connate salts or ancient salt evaporites to the groundwater. In addition to the groundwater flow system, 36-Cl/Cl ratios have been measured for several localized discharge zones (bionkas) north of the Big Desert. The 36-Cl/Cl ratios in these samples vary by as much as a factor of 3. This variation indicates that 36-Cl has considerable potential as a tool in the study of these features. (Fish-PTT)
W91-03900

PRACTICAL ACCOUNT OF INSTABILITIES IN IDENTIFICATION PROBLEMS IN GROUNDWATER SYSTEMS.
Australian National Univ., Canberra. Centre for Mathematical Analysis.
For primary bibliographic entry see Field 7C.
W91-03901

ORIGINS OF GROUNDWATER SALINITY NEAR TRESCO, NORTHWEST VICTORIA.
New South Wales Univ., Kensington (Australia). Centre for Groundwater Management and Hydrogeology.
M. J. Knight, and H. A. Martin.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 285-289, 1990. 7 fig, 1 tab, 12 ref.

Descriptors: *Australia, *Geochemistry, *Geohydrology, *Saline groundwater, *Saline water intrusion, Aquifer systems, Brines, Geologic history, Murray-Darling River Basin, Paleohydrology, Palynology, Playas.

The origins of saline waters in Murray Basin (Australia) aquifers and elsewhere continue to be a subject of considerable debate and controversy. Core samples and groundwater from bores at Tresco, northern Victoria, in the southern margin of the Murray Basin, have been analyzed for palynology and chemistry. An aquifer immediately above the Blanchetown Clay was initially filled with fresh water that became reducing, acidic, and rich in dissolved CO2 in the early Pleistocene. Later, between 400,000 and 18,000 years B.P., the aquifer was invaded by a series of concentrated sodium chloride water pulses. These originated from brine pools below salt playa lakes on the ground surface above the aquifer. This saline invasion significantly changed the chemical evolution path of the groundwater. A marine explanation for the observed salinity patterns is not possible. (Author's abstract)
W91-03902

IVANHOE BLOCK--ITS STRUCTURE, HYDROGEOLOGY AND EFFECT ON GROUNDWATERS OF THE RIVERINE PLAIN OF NEW SOUTH WALES.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
J. R. Kellett.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 333-353, 1990. 11 fig, 1 tab, 13 ref.

Descriptors: *Australia, *Geochemistry, *Geohydrology, *Geologic control, *Groundwater movement, *Murray-Darling River Basin, *Paleohydrology, *Saline groundwater, Flow discharge, Geologic fractures, Groundwater barriers, Land clearing, River basins, Salts, Water table rise.

The Ivanhoe Block is a faulted and uplifted concealed basement ridge complex underlying the mallee sand dunes adjacent to the New South Wales part of the Western Riverine Plain in the central Murray Basin in southeastern Australia. The parallel basement ridges of the Ivanhoe Block deflect flow south in the deeper aquifers, and thinner beds on top of the ridges result in convergence of flow in the shallower aquifers. Groundwater salinity is strata-bound in the aquifers of the Ivanhoe Block and Western Riverine Plain. This Plain is the regional groundwater discharge zone for the eastern Murray Basin in New South Wales, and it has been created by the impeding action of the bounding Ivanhoe Block. The Western Riverine Plain is partitioned into the Balranald-Hatfield discharge zone in its western half (defining the zone of salt production and accumulation in the shallower Tertiary aquifers) and the Moulamein-Mossgiel buffer zone in its eastern half (defining the maximum historical extent of up-basin propagation of refluxed salts). In recent years the Ivanhoe Block has been the focus of growing community concern about clearing in the mallee lands and the susceptibility of these areas to land salinization. The Balranald-Hatfield discharge zone and the lower Willandra Lakes are most at risk from land salinization if water tables continue to rise. The Moulamein-Mossgiel buffer zone is in the second-highest risk category, and the eastern Riverine Plain has a low risk of salinization in its non-irrigated lands. (Author's abstract)
W91-03905

GEOLOGICALLY INDUCED SALINITY AT YELARBON, BORDER RIVERS AREA, NEW SOUTH WALES, QUEENSLAND.
New South Wales Univ., Kensington (Australia). Centre for Groundwater Management and Hydrogeology.
M. J. Knight, B. J. Saunders, R. M. Williams, and J. Hillier.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 355-361, 1990. 13 fig, 2 tab, 11 ref.

Descriptors: *Australia, *Geochemistry, *Geohydrology, *Geologic control, *Murray-Darling River Basin, *Saline groundwater, *Saline soils, Darling River Basin, Geologic fractures, Geophysical surveys, Land management, Land use, Landsat images, Surface drainage, Tectonics, Water chemistry.

Dryland salinity has been gaining importance as a major environmental issue in Australia over the last 20 years. Particular focus has been given in recent times to the Murray-Darling River Basin, where loss of land productivity due to salinization is growing at a considerable rate. A dryland salinity scald approximately 48 sq km in size has been described near Yelarbon on the border of Queensland and New South Wales, near the headwaters of the Murray-Darling River Basin. The saline soils, including solodized solonetz, are severely eroded and readily identified on Landsat MSS imagery. A major fault beneath the scald has caused saline groundwater to leak up into the soil zone preferentially at this location. The evidence for this includes regional tectonic setting, detailed site geolo-

gy, a magnetic geophysical anomaly, surface drainage changes and land surface displacement, hydraulic gradient changes, and groundwater hydrochemical anomalies. Erosion of the geologically caused saline scald is being aggravated by overgrazing. An appropriate land management strategy is to fence the area and assign it nature reserve or national park status. (Author's abstract)
W91-03906

APPLICATION OF LANDSAT THEMATIC MAPPING TO GEOLOGY AND SALINITY IN THE MURRAY BASIN.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 7B.
W91-03907

STRATIGRAPHY AND SEDIMENTOLOGY OF MID-TERTIARY PERMEABILITY BARRIERS IN THE SUBSURFACE OF THE MURRAY BASIN, SOUTHEASTERN AUSTRALIA.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
C. M. Brown, and B. M. Radke.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 367-385, 1990. 10 fig, 6 tab, 51 ref.

Descriptors: *Australia, *Geochemistry, *Geologic history, *Geology, *Groundwater barriers, *Murray-Darling River Basin, *Paleohydrology, *Saline groundwater, *Sedimentation, *Stratigraphy, Clays, Confining beds, Geohydrology, Groundwater movement, Marine environment, Permeability, Porosity, River basins, Water resources management.

In the Murray Basin of southeastern Australia, the accelerated emergence of groundwater-related salinity problems in recent decades has led to the realization that future viability of many of its agricultural communities depends on management of its water resources. Part of the management strategy involves understanding the stratigraphy, distribution, and geometry of units deposited in the mid-Tertiary which now form major subsurface permeability barriers. Subsurface facies analysis of borelogs and paleogeographic reconstructions indicate that the Murray Basin has been invaded by the sea on three occasions during the Cenozoic. In the mid-Oligocene, thin calcareous clay of the lower confining layer was deposited over much of the southwest of the basin, and now separates the underlying Renmark Group aquifer system from the overlying Murray Group aquifer system, but does not impede the groundwater flow from the margins of the basin to the center. As relative sea level continued to rise in the late Oligocene, the thin sediments of the lower confining layer were overlain by thicker limestones, grading laterally into thick calcareous clay (Winnambool Formation) and terrigenous clastics (Geera Clay), which combine to form the mid-Tertiary low-permeability barrier that causes major disruption to the groundwater flow towards the basin center. The Geera Clay is an important subsurface barrier, resulting in flow diversion into the overlying aquifer system. The effective porosity of the Geera Clay was found to be 0-7%, whereas the original porosity was estimated at 5-30%. Burrow interparticle porosity predominated. The occlusion of effective interparticle porosity was caused by mineral precipitation at an early stage. (Author's abstract)
W91-03908

DEVICE FOR IN SITU DETERMINATION OF GEOCHEMICAL TRANSPORT PARAMETERS: 2. BIOCHEMICAL REACTIONS.
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 7B.
W91-03909

DETERMINATION OF SPECIFIC STORAGE BY MEASUREMENT OF AQUIFER COMPRESSION NEAR A PUMPING WELL.
Geological Survey, Denver, CO.
S. G. Robson, and E. R. Banta.
Ground Water GRWAAP, Vol. 28, No. 6, p 868-874, November/December 1990. 7 fig, 1 tab, 18 ref.

Descriptors: *Aquifer characteristics, *Aquifer testing, *Confined aquifers, *Groundwater movement, *Pumping tests, *Storage capacity, Compression, Drawdown, Field tests, Groundwater data, Mathematical studies, Observation wells, Pump wells, Storage coefficient, Theis equation.

Aquifer tests of confined aquifers in deep formations can yield inaccurate specific storage and storage coefficient estimates if the distance between the pumped and observation wells is imprecisely known. The distance between the wells can be uncertain because small deviations in the vertical alignment of deep wells can markedly change the distance between the perforated intervals of the wells. Uncertain distance between wells may seriously degrade the accuracy of specific storage or storage coefficient values calculated from aquifer test data obtained from closely-spaced wells. A method has been proposed whereby compression of the aquifer matrix can be measured during an aquifer test and used to calculate specific storage and storage coefficient values without the knowledge of the distance between the pumped and observation wells. In a field trial of the method, specific storage and storage coefficient values calculated form aquifer compression data were 0.000000816 and 0.000304, which is nearly identical to values (0.000000804 and 0.000299) obtained from longer-term monitoring of aquifer barometric efficiency. Additional comparison with results of a Theis analysis of drawdown data indicates that the aquifer compression data may provide a more accurate determination of specific storage and storage coefficient values than would be possible even if the vertical alignment of the pumped and observation wells had been surveyed. (Author's abstract)
W91-03911

SHALLOW WEATHERED FRACTURE LAYER IN THE NEAR-STREAM ZONE.
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
W. J. Gburek, and J. B. Urban.
Ground Water GRWAAP, Vol. 28, No. 6, p 875-883, November/December 1990. 10 fig, 2 tab, 16 ref.

Descriptors: *Geologic control, *Geologic fractures, *Groundwater movement, *Surface-groundwater relationships, *Watersheds, Cores, Cross-sections, Flow pattern, Hydraulic conductivity, Land use, Piezometers, Stream discharge, Water quality.

The bedrock profile of an east-central Pennsylvania watershed contains a shallow weathered fracture layer. To begin quantifying the effects of this fracture layer on groundwater movement, two valley cross sections were chosen for detailed investigation. One section represents the typical upland watershed situation where the regional groundwater is in contact with the stream for only part of the year, while at the other section the regional groundwater is in perennial contact with the stream. Rock cores extracted from the sections reveal a pattern of extensive fracturing to approximately 50 feet directly under the stream thinning to a relatively uniform 30-ft deep fracture layer away from the channel. Limited seismic investigations support these observations. Piezometers within each cross section show that there is great variability in conductivity within the fracture layer itself. Lateral flow generally occurs within the fracture layer to within approximately 50 ft of the stream; here a converging flow pattern indicates groundwater discharge to the stream. Under wet conditions, the stream in each section serves as a point of groundwater discharge, while under dry conditions, the more upland section shows no groundwater discharge to the land surface. Rather, subsurface flow is likely occurring beneath and parallel to the channel controlled by a discharge point at some downstream location. Finally, water quality samples from the piezometers indicate a direct effect of overlying land use on water quality within the shallow fracture layer. (Author's abstract)
W91-03912

PARTICLE-TRACKING ANALYSIS OF FLOW PATHS AND TRAVELTIMES FORM HYPOTHETICAL SPILL SITES WITHIN THE CAPTURE AREA OF A WELLFIELD.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 5B.
W91-03913

EVALUATION OF AQUIFER BEHAVIOR AND CHARACTERISTICS IN THE SINGRAULI COALFIELD, CENTRAL INDIA.
Indian School of Mines, Dhanbad. Dept. of Applied Geology.
V. D. Choubey, and I. Shankaranarayana.
Ground Water GRWAAP, Vol. 28, No. 6, p 893-899, November/December 1990. 9 fig, 4 tab, 11 ref.

Descriptors: *Aquifer characteristics, *Coal mining effects, *Groundwater management, *Groundwater movement, *India, *Water pollution control, Aquifer systems, Confined aquifers, Field tests, Geohydrology, Groundwater recharge, Hydraulic conductivity, Infiltration, Pump wells, Pumping tests, Surface-groundwater relations, Transmissivity, Unconfined aquifers.

Hydrological investigations were conducted to determine the aquifer characteristics, recharge boundary location, and the amount of groundwater which can be withdrawn safely in order to minimize potential groundwater contamination from open pit coal mining. The impact of surface mining of coal on the groundwater system in the Singrauli Coalfield, Central India, was investigated. Field studies measured the infiltration characteristics of surface-mined land, determined surface water runoff, and analyzed the geohydrologic impacts of surface mining. Analysis of data obtained from boreholes in the study area has revealed two aquifers: an unconfined aquifer composed of medium-grained sandstone, and a confined aquifer composed of medium-to-coarse-grained sandstone. A pumping test conducted on the confined aquifer found values of transmissivity, storage coefficient, and hydraulic conductivity to be 84.14 sq m/day, 0.0004076, and 4,200 cu m/day, respectively, and a recharge boundary located at a distance of 163 m. The recharge boundary was, in fact, determined to be a north-south trending stream situated at about 200 m from the pumping well, closely corroborating the field situation with pump test data. From these studies it was concluded that water supply wells should be completed in the confined aquifer. The large-scale surface coal mining disrupts the shallow groundwater levels within 7-10 km of the cut. At deeper surface mines, water levels may be lowered as much as 70 to 100 m in the shallow aquifer. The water table level reestablishes itself when mining activity stops. This study provides the framework for three-dimensional analysis of such problems as the geohydrology, risk of potential contamination, mine flooding, highwall stability, and reclaimed land surface. (Author's abstract)
W91-03914

INFLUENCE OF AQUIFER HETEROGENEITY ON CONTAMINANT TRANSPORT AT THE HANFORD SITE.
Colorado School of Mines, Golden. Dept. of Geology and Geological Engineering.
For primary bibliographic entry see Field 5B.
W91-03915

COLUMN STUDIES ON METHANOTROPHIC DEGRADATION OF TRICHLOROETHENE AND 1,2-DICHLOROETHANE.
Sonnenschein Nath and Rosenthal, Washington, DC.
For primary bibliographic entry see Field 5G.
W91-03916

EFFECT OF SENSOR ERROR ON INTERPRETATION OF LONG-TERM WATER-LEVEL DATA.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 7B.
W91-03918

ANALYSIS TECHNIQUE FOR MULTILEVEL AND PARTIALLY PENETRATING SLUG TEST DATA.
South Carolina Univ., Columbia. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W91-03919

NUMERICAL GENERATION OF FLOW NETS--THE FLOWNS MODEL.
North Carolina State Univ. at Raleigh. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W91-03920

2G. Water In Soils

EVALUATION OF GROUND-WATER RECHARGE ALONG THE GILA RIVER AS A RESULT OF THE FLOOD OF OCTOBER 1983, IN AND NEAR THE GILA RIVER INDIAN RESERVATION, MARICOPA AND PINAL COUNTIES, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02977

STRUCTURE AND APPLICATION OF AN INTERFACE PROGRAM BETWEEN A GEOGRAPHIC-INFORMATION SYSTEM AND A GROUNDWATER FLOW MODEL.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02980

BIODEGRADATION OF PCP CONTAMINATED SOILS USING IN SITU SUBSURFACE BIORECLAMATION.
Keystone Environmental Resources, Inc., Monroeville, PA.
For primary bibliographic entry see Field 5G.
W91-03100

UPDATE ON IN SITU BIOREMEDIATION OF THE FRENCH LIMITED SUPERFUND SITE.
ENSR-Celgene, Inc., Houston, TX.
For primary bibliographic entry see Field 5G.
W91-03101

PILOT-SCALE BIOREMEDIATION OF CHLORINATED SOLVENT AND PNA-CONTAINING SOILS.
Monsanto Chemical Co., St. Louis, MO.
For primary bibliographic entry see Field 5G.
W91-03104

BIOREMEDIATION OF HEAVY PETROLEUM OIL IN SOIL AT RAILROAD MAINTENANCE YARD.
For primary bibliographic entry see Field 5G.
W91-03107

DESERT ENCROACHMENT IN EGYPT'S NILE VALLEY.
Minya Univ. (Egypt). Soil Science Dept.
M. A. Kishk.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 15-23, 3 fig, 3 tab, 15 ref.

Descriptors: *Arid lands, *Desertification, *Egypt, *Nile Valley, *Soil properties, Deserts, Monitoring, Remote sensing, Soil degradation, Soil texture.

The River Nile plays an enormously important role in the life of Egypt. Studies conducted at Minia and Assiut Universities over the past 10 yr are summarized. Two hundred and seventy-six soil samples were collected at 79 sites located along lines perpendicular to the River Nile and covering an area extending from Aswan in the south to Giza in the North. Most soils located near the Nile have generally fine texture, whereas soils in the interference zone (where desert and Nile soils mix) are coarser. Alluvial soils near the river differ in several respects, as follows: darker color than interference zone soils; lower total carbonate content than interference zone soils (2.8% vs 15.2% average values); higher organic matter content (average 1.24% vs 0.23% in the interference zone; higher cation exchange capacity (32.5 meq/100 g vs 9.1 meq/100 g of soil); different mineral composition reflecting the increased amount of intermixed desert soils in the interference zone; and various other indications of desert encroachment. Desert encroachment represents a great danger to Egypt's cultivated soils and the affected areas should be mapped. A rough estimate of the affected area is 720,000 ha, which represents about one-third of Egypt's cultivated land. Three recommendations are made: (1) desert encroachment should be considered one of the most important challenges to agricultural development in Egypt; (2) measures should be implemented to prevent further mixing of desert sediments with cultivated soils; and (3) remote sensing and other techniques should be employed to monitor the changes in the extent of desert encroachment over time. (See also W91-03117) (Rochester-PTT)
W91-03120

EXPLORATION OF FRACTURED ZONES BY RADON DETERMINATION IN THE SOIL.
T. Pointet.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 37-46, 3 fig, 1 tab, 6 ref.

Descriptors: *Borehole geophysics, *Developing countries, *Environmental tracers, *Geologic fractures, *Radon radioisotopes, *Tracers, *Water resources development, Africa, Burkina Faso, Geohydrology, Geophysical methods, Groundwater management, Groundwater mining, Groundwater movement, Groundwater potential, Soil gases, Water demand, Water resources management, Water yield improvement.

The exploration of aquifer environments in basement rocks, like most aspects of hydrogeology of fractured environments, is marked by their discontinuous character. The statistical study of yields obtained from several tens of thousands of boreholes in African crystalline rocks shows that 15% of them produce more than 5 cu m/ hour. The usual geological analysis however does not determine why one borehole has a small or a high yield. By these methods alone, it is impossible to propose siting rules which would significantly increase the possibility of obtaining large yields. The water demand is presently increasing. The predictable development of irrigated farming and potable water supply of small towns from groundwater supposes that one will be able to find high individual yields in the basement zones with high enough success rates to justify research costs. By turning towards less traditional techniques inspired by structural geology and the study of fracture networks, it has been observed that the radon contained in the soil gases act as an efficient natural tracer, by underlining the presence of permeable zones in a fractured massif. Systematic prospecting by radon dosing in the soil gases brings out locally-concentrated anomalies. The boreholes drilled immediately below these anomalies are usually very productive. Applied to prospecting, the method was tested in Burkina-Faso along with electric and electromagnetic geophysical methods, and with siting techniques based on structural analysis. In environments of crystalline and metamorphic rocks, the water yields obtained from boreholes sited on radon anomalies are distinctly higher than those from boreholes sited by other methods. (See also W91-03178) (Author's abstract)
W91-03181

GROUNDWATER FLOW IN UNSATURATED/SATURATED ZONES.
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 2F.
W91-03185

ESTIMATING GROUNDWATER RECHARGE USING SURFACE AND SOIL WATER BALANCES.
Institute of Hydrology, Powys (Wales).
For primary bibliographic entry see Field 2F.
W91-03186

INTERACTION BETWEEN THE GROUNDWATER AND UNSATURATED SOIL-WATER FLOW REGIONS.
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 2F.
W91-03187

INSENSITIVITY OF REMOTE SENSING TO WATER-LOGGING IN LOW-CAPILLARITY SOILS.
Punjab State Council for Science and Technology, Chandigarh (India).
For primary bibliographic entry see Field 7B.
W91-03418

MATHEMATICAL ZERO-INERTIA MODELING OF SURFACE IRRIGATION: ADVANCE IN BORDERS.
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 3F.
W91-03420

CLIMATE CHANGE AND THE POTENTIAL IMPACT ON THE SOIL RESOURCE.
Agricultural Research Service, Ames, IA.
For primary bibliographic entry see Field 2B.
W91-03431

ELECTROCHEMICAL PROCESSING OF SOILS: THEORY OF PH GRADIENT DEVELOPMENT BY DIFFUSION, MIGRATION, AND LINEAR CONVECTION.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-03539

MEASURING THE HYDRAULIC PROPERTIES OF A STABLE AGGREGATED SOIL.
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
K. R. J. Smettem, and C. Kirkby.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 1-13, September 1990. 5 fig, 3 tab, 24 ref.

Descriptors: *Hydraulic conductivity, *Hydraulic properties, *Soil aggregates, *Soil properties, *Soil water, Diffusivity, Flow models, Mathematical analysis, Permeability, Sorptivity.

Reliable modeling of soil-water flow requires accurate and convenient measurement of the appropriate soil hydraulic properties, which can be particularly problematic in structured soils with a distinct macropore-matrix dichotomy in the flow regime. The hydraulic properties of an aggregated soil at water supply potentials near saturation were obtained using the disc permeameter. The sorptivity, the hydraulic conductivity, and the wetting soil-water characteristic were measured directly. The soil-water diffusivity was derived from measurements of hydraulic conductivity and wetting soil-water characteristic and was also shown to be well described by deconvoluting the sorptivity using the Parlange approximation. This description of soil-water diffusivity conveniently supplements es-

timates obtained over a wider range of water contents using the absorption method of Bruce and Klute, with water content profiles obtained by gamma scanning. Finally, the measured hydraulic conductivity function was accurately described by introduction of a method for scaling the wetting soil-water characteristic over the inter-aggregate and intra-aggregate flow regions and matching to the measured hydraulic conductivity at two points. (Author's abstract)
W91-03540

ORIGIN OF SALINE SOILS AT BLACKSPRING RIDGE, ALBERTA, CANADA.
Alberta Research Council, Edmonton. Terrain Sciences Dept.
For primary bibliographic entry see Field 2F.
W91-03544

PARAMETER IDENTIFICATION OF SOLUTE TRANSPORT MODELS FOR UNSATURATED SOILS.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-03549

AIR PERMEABILITY MEASUREMENTS OF THE UNSATURATED BANDELIER TUFF NEAR LOS ALAMOS, NEW MEXICO.
Oak Ridge National Lab., TN.
P. M. Kearl, R. J. Zinkl, J. J. Dexter, and T. Cronk.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 225-240, September 1990. 4 fig, 2 tab, 21 ref.

Descriptors: *Aeration zone, *Bandelier Tuff, *New Mexico, *Path of pollutants, *Permeability, *Radioactive waste disposal, *Soil water, *Tuff, *Unsaturated flow, Air permeability, Analytical methods, Geologic formations, Los Alamos, Measuring instruments, On-site investigations, Porous media.

The Bandelier Tuff near Los Alamos, New Mexico, is located approximately 200 m above the regional water table. Because of the distance to the water table, organic and radioactive wastes were disposed of in unlined trenches and shafts within the tuff. Concerns regarding the movement of the contaminants, particularly in the vapor phase, prompted a site investigation. Part of that investigation included the determination of the permeability of the tuff. Three methods which measure the intrinsic permeability were used: air injection, vacuum testing, and laboratory testing of rock core samples. Dual packers were used to isolate specific zones for the air injection and vacuum tests. Klinkenburg and dynamic methods were used to measure permeabilities in the laboratory. Comparison of the results showed that vacuum tests produce results which are in good agreement with the laboratory permeabilities for unfractured zones. Permeabilities measured with air injection tended to be as much as an order of magnitude higher than those measured by the other methods. For estimates of the intrinsic permeability in the unsaturated zone, however, both air injection and vacuum tests are reliable methods. Because consolidated core samples are required for laboratory testing, it was concluded that field test results are the more reliable indicators of bulk permeabilities. (Author's abstract)
W91-03550

EVALUATION OF THE HYDROGEOLOGIC SYSTEM IN DISPOSAL OF MIXED WASTES.
Argonne National Lab., IL.
For primary bibliographic entry see Field 5E.
W91-03594

ROLE OF CROP RESIDUE MANAGEMENT IN NITROGEN CYCLING USE.
Agricultural Research Service, Lincoln, NE.
For primary bibliographic entry see Field 3F.
W91-03639

HYDROLOGIC CHARACTERISTICS OF SOILS IN THE HIGH PLAINS, NORTHERN GREAT PLAINS, AND CENTRAL TEXAS CARBONATES REGIONAL AQUIFER SYSTEMS.
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-03671

ELECTRICAL-HYDRAULIC PROPERTIES OF UNSATURATED OTTAWA SANDS.
Army Engineer District, Omaha, NE.
T. Gorman, and W. E. Kelly.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 1-18, October 1990. 8 fig, 7 tab, 22 ref. U.S. Geological Survey grant No. 14-08-0001-G1133.

Descriptors: *Artificial recharge, *Electrical properties, *Hydraulic properties, *Sand, *Soil water, *Unsaturated flow, *Vadose zone, Aeration zone, Groundwater recharge, Hydraulic conductivity, Moisture equivalent, Permeability, Resistivity, Saturated soils.

Relations between the electrical properties of unsaturated vadose zone sediments and their saturated hydraulic conductivity provide a basis for using surface electrical measurements to estimate the potential for artificially recharging groundwater at a site. Laboratory measurements of moisture equivalent (specific retention), saturated permeability, hydraulic conductivity, and electrical resistivity were made on a series of uniform, very fine or medium grain size Ottawa sands. For these sediments, the unsaturated form of Archie's law was shown to be adequate. The experimental results were combined and interpreted to demonstrate a relationship between the apparent formation factor and/or resistivity at the moisture equivalent and saturated hydraulic conductivity for the same sediment. These laboratory results provide a limited experimental basis for relationships between the resistivity of vadose zone sediments and their saturated hydraulic conductivity. (Author's abstract)
W91-03737

RESISTIVITY-RECHARGE RELATIONSHIPS--FIELD STUDY.
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-03739

TRACING THE ORIGIN OF NATURAL WATERS IN A GLACIAL TILL SLOPE DURING SNOWMELT.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Land and Water Resources.
For primary bibliographic entry see Field 2C.
W91-03743

EVOLUTION OF THE CHEMICAL COMPOSITION OF WATER PASSING THROUGH THE UNSATURATED ZONE TO GROUND WATER AT AN EXPERIMENTAL SITE AT THE UNIVERSITY OF SAO PAULO, BRAZIL.
Sao Paulo Univ. (Brazil). Inst. de Geociencias.
For primary bibliographic entry see Field 2F.
W91-03747

HYDRAULIC PROPERTIES IN AN OPERATIONAL MODEL OF FROZEN SOIL.
Uppsala Univ. (Sweden). Naturgeografiska Inst.
For primary bibliographic entry see Field 2C.
W91-03754

ECOSYSTEM DEVELOPMENT IN DIFFERENT TYPES OF LITTORAL ENCLOSURES.
Agricultural Univ., Wageningen (Netherlands). Dept. of Nature Conservation.
For primary bibliographic entry see Field 2H.
W91-03793

HYDROGEOLOGICAL PROPERTIES OF THE MATRIX OF THE CHALK IN THE LUBLIN COAL BASIN (SOUTHEAST POLAND).
Academy of Mining and Metallurgy, Krakow (Poland). Inst. of Hydrogeology and Engineering Geology.
For primary bibliographic entry see Field 2F.
W91-03843

DYNAMICS AND ORIGIN OF SALINE SOILS ON THE SLIMS RIVER DELTA, KLUANE NATIONAL PARK, YUKON TERRITORY.
Calgary Univ. (Alberta). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W91-03865

2H. Lakes

HYDROLOGY, AQUATIC MACROPHYTES, AND WATER QUALITY OF BLACK EARTH CREEK AND ITS TRIBUTARIES, DANE COUNTY, WISCONSIN, 1985-86.
Geological Survey, Madison, WI. Water Resources Div.
S. J. Field, and D. J. Graczyk.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4089, 1990. 38p, 22 fig, 13 tab, 49 ref.

Descriptors: *Aquatic plants, *Black Earth Creek, *Trout, *Water quality, *Wisconsin, Biomass, Dissolved oxygen, Nitrogen, Phosphorus, Sediment yield, Stream discharge, Water temperature.

An intensive monitoring program of Black Earth Creek and its tributaries, in southern Wisconsin was conducted from October 1983 through September 1986, to define aquatic macrophytes, water quality, and the hydrologic factors that affect trout populations. Streamflows for water years 1985 and 1986 were 44 and 60% greater than the long-term average (1955-86). The highest average annual discharge since 1954, 53.4 cu ft/sec, was recorded in water year 1986. The data indicate that trout populations may be related to average annual streamflow because of greater water volumes and colder water temperature. Summer storm runoff resulted in decreased dissolved-oxygen content in two streams studied. During one storm, dissolved oxygen in Black Earth Creek decreased 3.0 mg/L and was less than 6.0 mg/L (the minimum State standard for trout) for 30 hours. Aquatic macrophyte biomass in Black Earth Creek was substantially less in 1986 than in 1985 because of substrate scouring from a flood in July 1985. Discharge from point and nonpoint sources affects Black Earth Creek's water quality. Warm water discharged from a gravel pit increased water temperatures from 2 C to 4 C. Detention ponds in the Brewery Creek basin appear to effectively control suspended-sediment and phosphorus runoff during periods of moderate runoff; this basin had the highest concentration of suspended sediment and total phosphorus but did not have the highest yields of the basins studied. Suspended-sediment yields in water year 1985 were 29% greater than the 12-year-average yields (1955-65, 1985). (USGS)
W91-02974

MAPPING RIPARIAN/WETLAND HABITATS OF THE NEZ PERCE NATIONAL FOREST. A COOPERATIVE APPROACH.
Fish and Wildlife Service, Portland, OR.
For primary bibliographic entry see Field 7B.
W91-03050

ANALYSIS OF WETLAND LOSS IN LAKE GEORGE BASIN USING HISTORICAL AERIAL PHOTOGRAPHY.
State Univ. of New York Coll. at Plattsburgh. Center for Earth and Environmental Science.
G. K. Gruendling, D. J. Bogucki, and R. P. Curran.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 6A-25--6A-34, 2 fig, 5 tab, 7 ref.

Descriptors: *Aerial photography, *Lake George, *Land use, *New York, *Urbanization, *Water

management, *Wetlands, Data interpretation, Drainage effects, Habitats, History.

The Warren County shoreline of Lake George, New York, was investigated for wetland loss and resultant land use change using historical aerial photography (1946-1986). Approximately one-half of the wetlands in the study area had received some impact from development since 1948, with a total wetland habitat loss of 58.2 ha (143.6 acre) or 27.2% of the original wetland area. The bulk of the wetland loss was from filling for urban and residential development. Most wetland alterations occurred prior to 1978. The enactment of two major wetland protection measures by the State of New York has apparently eliminated serious wetland loss in spite of increasing developmental pressures in the Lake George region. (See also W91-03032) (Author's abstract)
W91-03051

SIMULATION OF WETLAND FLOW DYNAMICS.
South Florida Water Management District, West Palm Beach. Dept. of Resource Management.
P. D. Scarlatos, and T. S. Tisdale.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 9A-15--9A-23, 4 fig, 7 ref.

Descriptors: *Flow profiles, *Hydrologic models, *Model studies, *Simulation analysis, *Wetlands, Data interpretation, Drought, Flood flow, Florida, Hydrologic profiles, Infiltration.

Wetlands are ecological systems with unique hydrologic characteristics. Flat terrain, high water tables, and dense vegetation comprise a physical system which is prone to frequent inundation. Due to their ecological value, wetlands have attracted the interest of the public, and subsequently that of the scientific community. An in-depth research regarding wetlands requires the integration of different disciplines such as ecology, forestry, soil chemistry, biology, hydrology, hydraulics, economics and resource management. However, the basis for efficient management of a wetland system depends on a good understanding of the water balance and water dynamics of the system. This can be achieved by mathematically modeling the water movement. Special features of the system that effect its hydrodynamics are high bed friction and surface groundwater interactions. A numerical model for simulating wetland flow dynamics was developed, with the governing equations those for a one-dimensional, depth integrated system. The model can simulate the flooding and drying of wetlands, and the effects of groundwater infiltration. It has the capability to incorporate the effects of infiltration, evapotranspiration, precipitation, lateral inflows, and variable topography. The model was calibrated and tested for an experimental marsh area in southern Florida, and simulated results showed satisfactory agreement with field data. (See also W91-03032) (Lantz-PTT)
W91-03066

FISHERY FUNCTIONS AND VALUES OF FORESTED RIPARIAN WETLANDS.
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
J. H. Crance, and L. S. Ischinger.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 14A-9--14A-16, 1 fig, 43 ref.

Descriptors: *Ecosystems, *Fisheries, *Forest watersheds, *Riparian waters, *River fisheries, *Wetlands, Flood plains, Productivity, Species diversity, Water resources development.

Relationships between freshwater forested flood plain wetlands in the southeastern US and the associated riverine fishery resources are reviewed, and management implications and research needs are discussed in this paper. Forested riparian wetlands provide spawning and nursery habitats for more than 90 species of fish, and the annual fishery harvest from some of the most productive wetlands has exceeded 8,000 kg/sq km. These wetlands also import, store, produce, and recycle materials used in food chains in situ, and are a source of residual materials used in downstream food chains. Wetland characteristics that respond to hydrologic regimes include productivity, species diversity and structure, nutrient cycling, and fish habitat quality and quantity. Thus, anthropogenic changes that affect hydrologic regimes and the fishery resources of these wetlands should be considered when stream corridor developments are evaluated. (See also W91-03032) (Author's abstract)
W91-03084

SUWANNEE RIVER ESTUARY: AN OVERVIEW AND RESEARCH AND MANAGEMENT NEEDS.
Suwannee River Water Management District, Live Oak, FL.
R. A. Mattson, and M. E. Rowan.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 14B-17--14B-31, 3 fig, 2 tab, 13 ref.

Descriptors: *Estuaries, *Florida, *Management planning, *Research priorities, *Suwannee River Estuary, Vegetation, Water quality, Water resources development, Water resources management.

The Suwannee River is the second largest river in Florida in terms of discharge and its estuary is one of the least disturbed by man's activities in the State. The estuary is also one of the least studied, yet it is one of the largest estuarine systems on the Gulf Coast of Florida and is the largest single estuary on the Florida Big Bend coast. Surface area at mean high water has been reported to be 14,336 ha; but the actual area of the estuary is difficult to determine, as it is not a semi-enclosed bay. The estuary was characterized based on existing data and studies, with respect to temperature, salinity, conductivity, pH, turbidity, dissolved oxygen, alkalinity, orthophosphate, nitrates, ammonia, chlorophyll a, fish and wildlife resources, and vegetation. Research and management needs for the estuary were identified in order to develop an effective management plan supported by competent data, and emphasize water quality protection, minimum standards, habitat preservation, and basin resource planning issues. (See also W91-03032) (Author's abstract)
W91-03094

SPATIAL SIMULATION TO AID IN EVALUATING AND TREATING EROSION AND WATER QUALITY PROBLEMS AFFECTING LAKE ERIE.
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W91-03164

SCUDDER'S POND RESTORATION PROJECT FOR VILLAGE OF SEA CLIFF AND TOWN OF OYSTER BAY, NASSAU COUNTY, NEW YORK.
Envirodyne Engineers, Inc., New York.
For primary bibliographic entry see Field 5G.
W91-03218

WETLAND CREATION AND RESTORATION: THE STATUS OF THE SCIENCE.
For primary bibliographic entry see Field 2L.
W91-03244

CREATION, RESTORATION, AND ENHANCEMENT OF MARSHES OF THE NORTHCENTRAL GULF COAST.
Louisiana State Univ., Baton Rouge. School of Forestry, Wildlife and Fisheries.
R. H. Chabreck.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 125-142, 2 tab, 44 ref, 2 append.

Descriptors: *Artificial wetlands, *Coastal marshes, *Louisiana, *Water resources management, *Wetland restoration, *Wetlands, Alabama, Diversion, Drainage engineering, Dredging, Environmental engineering, Levees, Marsh management, Mississippi, Planting management, Salt marshes, Sedimentation, Texas, Tidal marshes, Vegetation establishment, Water resources development, Weirs.

Coastal marshes of the northcentral Gulf Coast comprise almost 50% of the coastal marshes of the United States, excluding Alaska. Over 80% of the marshes in this region occur in Louisiana because of the influence of the Mississippi River. Salt, brackish, intermediate, and fresh marshes are well-represented within the region. Marshes have been created from dredged material deposited in shallow waters and by controlled diversion of river flow to direct sedimentation to specific sites. Plantings are seldom made on dredged material in Louisiana because of the large area to be planted and the fact that natural colonization is rapid. In fresher marshes, dredged material is left as levees after canals are dug that connect to salt water sources. Levees reduce salt water contamination and drainage of the marsh. Dredge material is usually planted in Texas, Mississippi, and Alabama to stabilize the material and hasten marsh development. In tidal marshes, construction of weirs is the most widely used enhancement practice. Impoundments provide a mechanism for controlling water depth and salinity and regulating plant growth. But impoundments can only be constructed in marshes that will support a continuous levee system. Freshwater diversion from the Mississippi River has been used on a small scale for marsh restoration and enhancement but could be used to improve vast areas of the rapidly deteriorating marshes of southeastern Louisiana. Precise information is needed on subsidence rates of individual localities for planning marsh creation and restoration projects. Methods for maximizing subdelta development and determining best use of dredged material are needed. (See also W91-03244) (Author's abstract)
W91-03249

CREATION AND RESTORATION OF FORESTED WETLAND VEGETATION IN THE SOUTHEASTERN UNITED STATES.
A. F. Clewell, and R. Lea.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 195-231, 6 fig, 98 ref, 3 append.

Descriptors: *Artificial wetlands, *Forest ecosystems, *Swamps, *Vegetation establishment, *Water resources management, *Wetland restoration, *Wetlands, Hardwood, Oak trees, Plant populations, Planting management, Soil-water-plant relationships, Trees, Vegetation regrowth, Water resources development.

A wide variety of forest establishment techniques have been employed, some with initial success, but most are too new for critical evaluation. Most of these projects pertain to bottomland hardwood and cypress replacement. The two most significant trends in project activity have been the direct seeding of oaks on abandoned croplands and the replacement of all trees and sometimes the undergrowth at reclaimed surface mines. Project success depends largely on judicious planning and careful execution. The most critical factor for all projects is to achieve adequate hydrological conditions. Other important factors may include substrate stability, availability of adequate soil rooting volume and fertility, and the control of herbivores and competitive weeds. Success criteria for evaluating extant projects throughout the southeast need to place emphasis on the presence of preferred species and on the attainment of a threshold density of trees that are at least two meters tall. At that point, release from regulatory liability should be seriously considered. Several critical information gaps have been identified: (1) the sylvicultural literature warrants further investigation of wetland tree establishment; (2) the conditions conducive to effective natural regeneration need to be elucidated; (3) techniques for undergrowth establishment should be developed; (4) baseline ecological and floristic studies need expansion for certain plant communities and regions; (5) research is needed to deter-

mine if successful forest replacement will provide the functional services of the original ecosystem; and (6) the time is ripe for a coordinated southeastern regional monitoring effort. (See also W91-03244) (Author's abstract)
W91-03252

FRESHWATER MARSH CREATION AND RESTORATION IN THE SOUTHEAST.
Erwin (Kevin L.) Consulting Ecologist, Inc., Fort Myers, FL.
K. L. Erwin.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 233-265, 16 fig, 2 tab, 43 ref, append.

Descriptors: *Artificial wetlands, *Habitat restoration, *Marsh management, *Water resources management, *Wetland restoration, *Wetlands, Environmental impact, Monitoring, Planting management, Research priorities, Vegetation establishment, Water quality control, Water resources development.

Freshwater marsh habitat has been created or restored in the southeast to mitigate the environmental impacts associated with development activity and to provide enhancement of water quality. Key elements to successfully constructing a freshwater marsh system include: realistic goals and measurable success criteria; proper pre-construction design evaluation including a hydrological analysis; contour design; construction technique; proper water quality; compatibility of adjacent existing and future land uses; appropriate substrate characteristics; revegetation techniques; reintroduction of fauna; upland buffers and protective structures; supervision by an experienced professional; post-construction long-term management plan; and monitoring and reporting criteria. The monitoring required must be adequate in scope to determine the success or failure to meet project goals. A typical monitoring plan for a created freshwater marsh should include: (1) a post-construction, pre-planting survey of project contours and elevations; (2) ground and surface water elevation data collection; (3) water quality data collection; (4) biological monitoring including, but not limited to, fish and macroinvertebrate data collection; (5) evaluation of vegetation species diversity, percent cover, and frequency; and (6) wildlife utilization. Critical information gaps and research needs fall into the categories of site selection and design, project construction techniques, comparative studies of the biological communities and processes in created and natural systems, and the role of uplands and transitional habitats. (See also W91-03244) (Author's abstract)
W91-03253

RESTORATION AND CREATION OF PALUSTRINE WETLANDS ASSOCIATED WITH RIVERINE SYSTEMS OF THE GLACIATED NORTHEAST.
D. J. Lowry.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 267-280, 1 fig, 1 tab, 32 ref, append.

Descriptors: *Artificial wetlands, *Glaciation, *Habitat restoration, *Water resources management, *Wetland restoration, *Wetlands, Environmental policy, Environmental quality, Monitoring, Research priorities, Water resources development.

Published information on freshwater wetland creation in the glaciated northeastern United States is largely limited. Though there is more experience in constructing wetlands than the literature base would indicate, there has been no compilation of the experience obtained from most of the wetland creation projects in the region and there appears to be a general lack of detailed monitoring which would provide data necessary for assessment of results. Long-term, comprehensive studies evaluating the functions of created freshwater wetlands in the region are not presently being conducted. There is, therefore, a need to document the ability of such areas to provide a range of ecological and hydrological functions, rather than just serving as sites where wetland plants grow and that waterfowl visit. In evaluating future projects involving wetland creation as mitigation for wetland loss in the region, the following critical points should be emphasized: (1) the project proposal should provide an assessment of the wetland functions; (2) goals should be developed based on the most significant functions; (3) the hydrologic setting and water budget of the created area must be understood; (4) present capabilities to create other wetland types (swamps, fens, bogs) is in question; (5) every attempt should be made to replace lost wetland in the same hydrogeologic unit and reach of the riverine system associated with the original wetland; (6) an understanding of the area where the wetland is proposed to be created is needed; (7) detailed consideration of a number of logistical constraints (hydrologic controls, machinery needs, availability of plant stock and soils, sediment and erosion control, wildlife predation, and barriers to human intrusion) is always necessary; and (8) monitoring requirements should depend on the functions determined to be of most significance at the assessment stage. (See also W91-03244) (Fish-PTT)
W91-03254

REGIONAL ANALYSIS OF THE CREATION AND RESTORATION OF KETTLE AND POTHOLE WETLANDS.
G. G. Hollands.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Coveio, California. 1990. p 281-298, 40 ref, append.

Descriptors: *Artificial wetlands, *Environmental engineering, *Glaciation, *Hydrologic budget, *Water resources management, *Wetlands, Continental basins, Permeability, Potholes, Soil properties, Streams, Surface-groundwater relations, Water resources development, Watershed management.

Kettles are topographic basins created by a variety of glacial processes and occur randomly throughout glaciated regions. They are associated with both permeable and impermeable deposits. Kettle wetlands can have complex hydrologic types: those having no inlet or outlet streams, and those associated with surface water streams. Complex relationships of surface water, groundwater, water chemistry, and other hydrologic elements combine to create water balances. This has been documented in the Prairie Potholes region of the United States where site specific hydrologic research has been conducted. Creating kettle wetlands is similar to other types of freshwater wetland creation, except where unique vegetation and hydrology are involved and replication may be a complex, technical effort. Identification of limiting factors is critical to wetland creation. Typical factors important to kettle wetlands are: surface water hydrology, groundwater hydrology, stratigraphy, soils, and water chemistry. Depending upon the goals of the project, other limiting factors may include: nuisance animals, long-term maintenance/monitoring, lack of funds, and disposals of excavated soil. The primary concern in creating kettle wetlands is the establishment of the proper hydrology. This normally requires mid-course corrections in design during construction to establish proper post-construction hydrology. Critical needs include studies on microstratigraphy, geochemical processes, the properties of organic soil, and the details of hydrology. (See also W91-03244) (Author's abstract)
W91-03255

REGIONAL ANALYSIS OF FRINGE WETLANDS IN THE MIDWEST: CREATION AND RESTORATION.
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
D. A. Levine, and D. E. Willard.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 299-325, 4 tab, 85 ref, 2 append.

Descriptors: *Artificial wetlands, *Lake shores, *Reservoirs, *Water resources management, *Wetland restoration, *Wetlands, Monitoring, Plant populations, Planting management, Shoreline cover, Vegetation establishment, Water level fluctuations, Water resources development.

'Fringe' wetlands are those found along lakes and reservoirs, abundant in the midwest United States. Very few documented cases of fringe wetland mitigation are found. Their prevalence in this region suggests that Midwestern administrators of the regulatory program will be confronted with permits which impact fringe wetlands. Specific goals must be clearly outlined in the mitigation permit and include the following: detailed construction plans; a list of target species consistent with project goals; a long-term management plan; and a complete monitoring plan. To further ensure the success of mitigation, the following is recommended: the establishment of a fringe wetland should not be attempted where the fetch is greater than 13 km unless a dike is constructed to reduce wave action; and revegetation should utilize a combination of both natural (i.e., seed bank) and artificial (i.e., transplants) methods. Further research is needed (1) to determine how fringe wetland plant species and plant communities as a whole influence water quality, (2) to determine how water level fluctuations affect species composition and nutrient cycling in these wetlands, (3) to quantify shoreline stabilization needs and functions, and (4) to develop ecotypically-adapted planting stocks. (See also W91-03244) (Author's abstract)
W91-03256

CREATION AND RESTORATION OF RIPARIAN WETLANDS IN THE AGRICULTURAL MIDWEST.
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
D. E. Willard, V. M. Finn, D. A. Levine, and J. E. Klarquist.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 327-350, 1 fig, 1 tab, 35 ref, 2 append.

Descriptors: *Artificial wetlands, *Habitat restoration, *Riparian land, *Water resources management, *Wetland restoration, *Wetlands, Hydrologic budget, Planting management, Riparian vegetation, Riparian waters, Vegetation regrowth, Water resources development.

Effective restoration of riparian wetlands in the agricultural midwest region of the United States demands an early determination of project goals. There are no systematic records of the changes and developments that have occurred in and around several hundred large midwestern reservoirs with extensive wetland systems. Established goals will narrow the choices of potential project sites, which can then be evaluated based on hydrology, substrate, seedbank viability, and water quality. Creation and restoration plans should include a realistic timetable that accounts for construction and hydrology constraints, including specifications for revegetation species. Finally, plans should estimate long-term vegetation management requirements and establish monitoring schedules to assess project success. (See also W91-03244) (Fish-PTT)
W91-03257

CREATION AND RESTORATION OF RIPARIAN HABITAT IN SOUTHWESTERN ARID AND SEMI-ARID REGIONS.
SWCA, Inc., Tucson, AZ.
S. W. Carothers, G. S. Mills, and R. R. Johnson.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 351-366, 1 tab, 26 ref, 2 append.

Descriptors: *Artificial wetlands, *Habitat restoration, *Riparian land, *Water resources management, *Wetland restoration, *Wetlands, Arid lands, Planting management, Research priorities, Riparian vegetation, Riparian waters, Soil-water-plant relationships, Vegetation establishment, Water resources development.

Though the literature on characteristics, values, and functions of riparian habitats in the arid and semiarid southwestern region of the United States is fairly extensive, few papers that pertain to its creation or restoration are available. Because these projects are so recent, evaluations of successes and

failures are based on short-term results; long-term survival and growth rates are as yet unknown. In most cases, creation and restoration projects have involved the planting of vegetation and not the creation of conditions suitable for the natural regeneration of riparian habitats. Important considerations for riparian creation or restoration projects in the Southwest include: depth to water table; soil salinity and texture; amount and frequency of irrigation; effects of rising and dropping water tables on planted trees; protection from vandalism, off-road vehicles, and livestock; monitoring of growth rates as well as survival; and project design flexible enough to allow for major modifications. Because the creation and restoration of riparian habitats in the Southwest is new and mostly experimental, more information is needed for virtually every aspect of revegetation. Two major questions that need to be answered are whether planted trees survive for more than a few years and reach expected sizes, and what ranges of planting parameters are most cost-effective. Specific information needs include the identification of: the most suitable watering regimes; suitable soil conditions for various tree species; long-term survival and growth rates; and effects of variable water levels on planted trees. (See also W91-03244) (Author's abstract)
W91-03258

OVERVIEW AND FUTURE DIRECTIONS.
San Diego State Univ., CA. Pacific Estuarine Research Lab.
J. B. Zedler, and M. W. Weller.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 405-413, 1 fig, 1 ref.

Descriptors: *Artificial wetlands, *Habitat restoration, *Research priorities, *Water resources management, *Wetland restoration, *Wetlands, Decision making, Economic aspects, Environmental policy, Interagency cooperation, Water resources development.

Despite loss of over 50% of the wetlands in the contiguous United States, there is continuing pressure to use wetlands for immediate economic gain. Functional values that are nearly perpetual are rarely considered, and the complexity, integrity, and uniqueness of natural wetlands are undervalued. The greatest information and research strategies needed are: to improve wetland restoration/creation efforts, to determine the degree to which constructed systems can replace lost functions, and to determine the potential for persistence of restored and constructed wetlands. There is a national need to understand wetland functioning at its most basic and detailed levels, to compare natural and constructed wetlands within biogeographic regions, and to test methods of restoring wetlands using manipulative experimentation. Wetland research should be directed toward the proximate goal of preserving wetland values, and ultimately, of understanding the details of how wetlands function. Problems and objectives involve different research levels (e.g., size of areas, time scales, precision, and complexity). Some problems require immediate solutions for crisis situations; with answers based on research that uses a less precise level or a smaller size scale. The research program must build short-term goals into a long-term design, both to gain perspective and to prioritize projects and funding. Interaction between researchers and regulatory personnel will help solve practical problems and crisis decision-making and help develop technology for restoring degraded wetlands or constructing new ones. (See also W91-03244) (Fish-PTT)
W91-03260

WETLANDS RESTORATION/CREATION/ENHANCEMENT TERMINOLOGY: SUGGESTIONS FOR STANDARDIZATION.
Lewis Environmental Service, Inc., Tampa, FL.
R. R. Lewis.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 417-422, 12 ref.

Descriptors: *Artificial wetlands, *Publications, *Standards, *Water resources management, *Wetland restoration, *Wetlands, Environmental policy, Glossaries, Habitat restoration, Literature review, Water resources development.

A glossary has been prepared which attempts to bring some order to the terminology applied to the topic of wetland creation and restoration. Six glossaries applicable to the topic were reviewed and combined, with additional definitions from individual authors of published papers or proceedings, and regulatory or review agency rule promulgation. The five key definitions are: mitigation, restoration, creation, enhancement, and success. These terms are defined so that there is as little ambiguity and overlap as possible. A glossary definition and an explanation of each of the key terms is provided. (See also W91-03244) (Fish-PTT)
W91-03261

INFORMATION NEEDS IN THE PLANNING PROCESS FOR WETLAND CREATION AND RESTORATION.
For primary bibliographic entry see Field 2L.
W91-03262

WETLAND EVALUATION FOR RESTORATION AND CREATION.
Erwin (Kevin L.) Consulting Ecologist, Inc., Fort Myers, FL.
For primary bibliographic entry see Field 2L.
W91-03263

WETLAND DYNAMICS: CONSIDERATIONS FOR RESTORED AND CREATED WETLANDS.
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 2L.
W91-03264

RESTORATION OF THE PULSE CONTROL FUNCTION OF WETLANDS AND ITS RELATIONSHIP TO WATER QUALITY OBJECTIVES.
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
O. L. Loucks.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 467-477, 4 fig, 3 tab, 19 ref.

Descriptors: *Hydrologic budget, *Rainfall-runoff relationships, *Water resources management, *Watershed management, *Wetland restoration, *Wetlands, Bed load, Headwaters, Hydrologic models, Land use, Model studies, Stream discharge, Streams, Water resources development.

Many wetlands and wetland restoration opportunities occur in the poorly drained headwaters of streams, along the stream floodplains, and at discharge points to larger water bodies. All of these are greatly changed by upland development that accelerates flows and increases the runoff pulse from headwater areas. Successful restoration must consider how the hydrologic pulse may have been changed and whether pulse control measures can bring stream flows within a range consistent with historical development of downstream wetlands. Comparison of spring versus summer loadings pulses indicates major differences in the seasonality of transport of excess nutrients into wetlands and downstream water bodies. The annual average loading is misleading, indicating that statements on wetland functions which ignore their role during pulsed events probably understate their significance. Modeling studies of runoff and sediment transport suggest the combination of reduced soil exposures and restoration of wetland cover in temporary detention areas can produce major benefits in stream water quality. With additional parameters, quantitative estimates could be made of the cumulative impact of wetland restoration toward mitigation of flood peaks and the transport of sediment and toxic substances into the adjacent aquatic systems. The general physical relationships between land use and hydrology provide only a guide to the prospective benefits associated with investment in wetland restoration. There is a need for more complete treatment-response modeling and model testing if the predictive capability needed to improve wetland restoration is to become available. (See also W91-03244) (Author's abstract)
W91-03265

VEGETATION DYNAMICS IN RELATION TO WETLAND CREATION.
Connecticut Coll., New London.
For primary bibliographic entry see Field 2I.
W91-03266

LONG-TERM EVALUATION OF WETLAND CREATION PROJECTS.
Hampshire Coll., Amherst, MA. School of Natural Science.
C. D'Avanzo.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 487-496, 42 ref.

Descriptors: *Artificial wetlands, *Long-term planning, *Management planning, *Performance evaluation, *Water resources management, *Wetland restoration, *Wetlands, Environmental engineering, Evaluation, Habitat restoration, Soil properties, Succession, Vegetation establishment, Water resources development.

The long-term evaluation of artificial wetlands is very difficult because wetlands are created for a variety of purposes. Little is known about basic aspects of many wetland systems, 'succession' in wetlands is less straightforward than previously assumed, and it is difficult to generalize from one wetland type to another. There is a striking range of opinions about the success of wetlands that have been created. On the one hand, the U.S. Army Corps of Engineers' dredged material stabilization program exemplifies artificial wetland projects that appear successful over a decade or more. Several types of criteria including vegetation characteristics, soil chemistry, and animal studies suggest that several dredged material wetlands are becoming similar to reference wetlands with time. But some wetlands characteristics (soil carbon) may require many years to reach natural levels. In contrast, a great many other artificial wetland projects are problematic or failures, because of improper hydrology, erosion, herbivory, and invasion by upland plants. Many projects have never been evaluated so their permanence is not known. In evaluating projects with regard to persistence of the created wetlands, the following points are especially important: (1) evaluations over at least 10-20 years are desirable; (2) vegetation characteristics are useful but do not necessarily indicate function; (3) chemical/physical aspects of wetland soils are also useful in evaluating trends; (4) local reference wetlands are critical for comparative purposes; and (5) some wetlands should be created with great caution because they have failed in the past or because very little is known about these wetland types. (See also W91-03244) (Author's abstract)
W91-03267

REGIONAL ASPECTS OF WETLANDS RESTORATION AND ENHANCEMENT IN THE URBAN WATERFRONT ENVIRONMENT.
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 4C.
W91-03268

WATERFOWL MANAGEMENT TECHNIQUES FOR WETLAND ENHANCEMENT, RESTORATION AND CREATION USEFUL IN MITIGATION PROCEDURES.
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
For primary bibliographic entry see Field 2L.
W91-03269

MITIGATION AND THE SECTION 404 PROGRAM: A PERSPECTIVE.
Environmental Protection Agency, Atlanta, GA.

Region IV.
For primary bibliographic entry see Field 6E.
W91-03271

OPTIONS TO BE CONSIDERED IN PREPARATION AND EVALUATION OF MITIGATION PLANS.
Environmental Protection Agency, Atlanta, GA. Region IV.
For primary bibliographic entry see Field 6B.
W91-03272

PHOTOHETEROTROPHY AND DARK HETEROTROPHY IN ICE-COVERED LAKE ST. CLAIR.
Windsor Univ. (Ontario). Great Lakes Inst.
D. G. Wallen.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 339-345, 1990. 3 fig, 1 tab, 46 ref.

Descriptors: *Carbon, *Glucose, *Great Lakes, *Ice cover, *Iced lakes, *Lake St Clair, *Lakes, *Limnology, *Photosynthesis, *Phytoplankton, Aphotic zone, Euphotic zone, Light intensity, Primary productivity.

Both light and dark uptake of glucose carbon by the microplankton in ice-covered Lake St. Clair were measured several times over the winter period, from December to March. Heterotrophic potentials (Vmax) were consistently and significantly higher in the light (ranging from 3.9-10.7 nanomoles glucose/L/hr) than in the dark (2.5-5.2 nM glucose/L/hr). Respiratory release of glucose carbon ranged from 0.27 to 2.28 times higher in the dark than light. Vertical profiles of photosynthesis and heterotrophy on 21 January and 20 February indicated that photoheterotrophic carbon uptake ranged from 8% of photosynthetic assimilation just below the ice to 60% in the lower euphotic zone, ranging from 125.0-158.3 and 90.6-298.1 ng C/L/hr on 21 January and 20 February, respectively. Dark uptake in the aphotic zone ranged from 87.5-133.3 and 99.9-257.3 nanograms C/L/hr on 21 January and 20 February, respectively. Total assimilation of glucose carbon in the water column ranged from 29% to 36% of total carbon assimilated photosynthetically. Under the harsh winter conditions of low irradiation and temperature the mechanisms of photoheterotrophy and dark heterotrophy may be ecologically important in augmenting reduced photosynthetic production. (Author's abstract)
W91-03399

DYNAMICS OF THE BYTHOTREPHES INVASION OF THE ST. LAWRENCE GREAT LAKES.
Erindale Coll., Mississauga (Ontario). Dept. of Zoology.
W. G. Sprules, H. P. Riessen, and E. H. Jin.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 346-351, 1990. 2 fig, 2 tab, 28 ref.

Descriptors: *Great Lakes, *Introduced species, *Limnology, *Waterfleas, *Zooplankton, Lake Michigan, Population dynamics, Spatial distribution.

Bythotrephes cederstroemii, a predatory planktonic cladoceran, has recently invaded the St. Lawrence Great Lakes from its native Eurasia. The species was probably transported in the ballast water of ships returning from a port such as Leningrad to take on cargo in the Great Lakes. Life history analyses of Bythrotrephes suggest that the invasion probably took place during the late 1970s or early 1980s when shipping traffic to the Great Lakes reached an all-time peak. This introduced cladoceran is highly vulnerable to fish predation due to its large size and prominent eye. B. cederstroemii has already reached densities in Lake Michigan typical of its native lakes. The feeding rates of B. cederstroemii are low compared to the reproductive potential of its plankton prey. Density and feeding rate data for Bythotrephes indicate that it is unlikely to have major impacts on prey populations in the Great Lakes. (Geiger-PTT)
W91-03400

FLOW DISTRIBUTION IN THE ST. LAWRENCE RIVER SYSTEM AT WOLFE ISLAND, KINGSTON BASIN, LAKE ONTARIO.
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2E.
W91-03401

EVALUATION OF SEDIMENT TRAPS IN LAKE ST. CLAIR, LAKE ONTARIO, AND HAMILTON HARBOUR.
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
F. M. Boyce, P. F. Hamblin, D. G. Robertson, and F. Chiocchio.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 366-379, 1990. 7 fig, 5 tab, 15 ref.

Descriptors: *Lake Ontario, *Lake St Clair, *Lake sediments, *Limnology, *Sampling, *Sediment sampler, *Suspended sediments, *Trap efficiency.

The five-chamber version of the Kenney sediment sampler and conventional sediment bottle traps with port diameters of 5, 10 and 15 mm were studied for their ability to sample suspended sediments in shallow, wave-dominated waters in Lake St. Clair, Lake Ontario, and Hamilton Harbor. The catch rates of the horizontally-ported chambers of the Kenney sampler correlated strongly and positively with the root mean square horizontal flow velocity over the trapping interval. A similar dependence was suspected for the settling tubes. There was no strong tendency for the traps tested to sort the sediment differentially; the catch rate was mainly controlled by hydrodynamic effects. The catch rates for the Kenney sampler and the bottle traps were strongly velocity dependent at Reynolds numbers (based on overall trap diameter) up to 10,000 and possibly beyond indicating boundary layer and wake effects at the trap itself. Until a more thorough investigation is made of the effects of horizontal velocity (both steady and oscillating) on all types of sediment traps, it is suggested that sediment traps in moving water be used primarily for qualitative analysis. (Geiger-PTT)
W91-03402

SUDDEN, EXTREME LAKE ERIE STORM SURGES AND THE INTERACTION OF WIND STRESS, RESONANCE, AND GEOMETRY.
Ohio State Univ., Columbus. Dept. of Civil Engineering.
C. Libicki, and K. W. Bedford.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 380-395, 1990. 10 fig, 8 tab, 15 ref. NOAA, Ohio Sea Grant Contract NA79AA-D-00120 and NA80AA-D-0100.

Descriptors: *Lake Erie, *Limnology, *Model studies, *Resonance, *Seiches, *Storm surges, *Wind-driven currents, Friction, Simulation analysis, Topography, Water depth.

Wind-generated surges on Lake Erie are modeled in an attempt to explain their behavior and describe the influence of such factors as non-linear resonance dynamics, planform geometry, bottom topography, and friction on surge development, climax, and dissipation. The maximum surge was typically associated with the first characteristic to spend its entire transit beneath the wind stress. In the idealized case (flat, rectangular basin, no friction), surge height increased with stress band propagation speed until reaching a plateau at resonance. The chief effect upon the main surge of including the nonlinear term (at typical and stress values) is to decrease the surge height and time of arrival by approximately the same fraction. The inclusion of variable bottom topography generally exaggerated the surge height in basins that shallow from upwind to downwind and diminished surge height in the reverse case. Friction diminished surge heights and thickened the shock transition region. The large role played by frictional losses in storms progressing from northeast to southwest indicated the importance of properly accounting for these and other losses, such as nonreflective boundaries, in this type of storm. Variable width can serve to focus and thereby exaggerate surge heights by 40 to 50%. This exaggeration was especially pronounced at resonance at the Buffalo end of the lake. The criteria for resonance are fairly strict: a sharp wind front that remains intact for most of the length of the lake, wind and propagation velocities that are aligned with the lake axis, and a propagation speed that closely matches the free gravity wave speed. Since most destructive storms do not meet these criteria so that resonance is not a major contributing factor. (Author's abstract)
W91-03403

HISTORICAL VARIATION OF WATER LEVELS IN LAKES ERIE AND MICHIGAN-HURON.
National Water Research Inst., Burlington (Ontario). Research and Applications Branch.
C. T. Bishop.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 406-425, 1990. 9 fig, 3 tab, 56 ref.

Descriptors: *Great Lakes, *Lake Erie, *Lake Huron, *Lake Michigan, *Limnology, *Paleohydrology, *Paleolimnology, *Water level fluctuations, Archaeology, Climatic changes, Dredging, High water mark, History, Stratigraphy.

The earliest reliable water level measurements for Lakes Erie and Michigan-Huron (these two lakes behave the same limnologically) recorded in 1819 showed record low water levels. These early measurements are compared with the modern data set beginning in 1860. Historical and archeological evidence at European settlements on the Great Lakes from the early 17th century sheds light on the water level history of these lakes prior to 1819. Rates of isostatic rebound are generally believed to be decreasing exponentially with time. Stratigraphic evidence from Lake Michigan-Huron over the past 1,800 yr is interpreted to deduce water levels over this time period. When the effects on the lake levels of isostatic rebound and man-made channel changes (dredging) were examined, it was concluded that, over at least the last 1,800 yr, climate-related variations in maximum mean annual water levels have probably not exceeded those measured on Lakes Erie and Michigan-Huron since A.D. 1819. (Author's abstract)
W91-03405

DETERMINATION OF AVAILABLE SUBSURFACE LIGHT FOR PHOTOCHEMICAL AND PHOTOBIOLOGICAL ACTIVITY.
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
J. H. Jerome, R. P. Bukata, and J. E. Bruton.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 436-443, 1990. 6 fig, 1 tab, 6 ref.

Descriptors: *Irradiation, *Light intensity, *Light penetration, *Limnology, Downwelling, Mathematical equations.

Appropriate determinations of available subsurface light for photochemical and photobiological processes require accurate estimates of the subsurface scalar irradiation. Quite often only values of downwelling irradiation are available. Therefore, two sets of multiplicative factors were derived. The first set converts a daily irradiation just above the surface into a daily scalar irradiation just below the surface. The second set converts an 'effective' (i.e., depth-averaged) daily irradiation for a specific photic zone into an 'effective' daily scalar irradiation for that photic zone. These multiplicative factors are presented as functions of the subsurface volume reflectance of the water for the volume reflectance range 0.0 to 0.14. For a latitude range appropriate to the Great Lakes, these multiplicative factors vary between 1.1 and 2.1. (Author's abstract)
W91-03407

QUANTITATIVE MODEL OF THE DISPERSAL OF DETRITAL INPUTS AND MINOR COMPOSITIONAL COMPONENTS IN LAKE MICHIGAN SEDIMENTS.
Michigan Univ., Ann Arbor. Dept. of Geological Sciences.
A. R. B. Zimmerman, and R. M. Owen.

Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 444-456, 1990. 9 fig, 4 tab, 58 ref. NOAA Sea Grant NA86AA-D-SG043.

Descriptors: *Detritus, *Great Lakes, *Lake Michigan, *Lake sediments, *Limnology, *Mathematical models, *Model studies, *Sediment transport, Carbonates, Manganese, Particle size, Sediment erosion.

Mathematical models were developed to ascertain the sources, distribution, and fate of sedimentary material entering Lake Michigan. Major compositional end-members were identified by a modified Q-mode factor analysis procedure, and estimates of the relative amount of each end-member in each sample were obtained by linear programming. Four factors account for 93.8% of the total variance. These are interpreted as representing the inputs of fine-grained (Factor 1), and coarse-grained (Factor 2) detrital minerals, manganous carbonate (Factor 3) and non-manganous carbonate (Factor 4) to the lake sediment. Significant linear correlations between the relative amount of each compositional end-member and the grain-size distribution for each sample support these interpretations. Contour plots of end-member distributions suggest that the sediment chemistry of Lake Michigan is primarily influenced by regional-scale physical processes. In a revised version of the model, the distribution of minor sediment components (ferromanganese oxyhydroxides and siliceous plankton tests) were examined. Each model accounted for approximately 90% of the measured elemental concentrations in lake sediment. This modeling approach is a viable method for determining the distribution of sedimentary inputs in large lacustrine basins, and may also be useful in monitoring the dispersal pathways of coastal erosion products or chemical pollutants. (Author's abstract)
W91-03408

MONITORING RIVER PLUME TRANSPORT AND MESOSCALE CIRCULATION IN GREEN BAY, LAKE MICHIGAN, THROUGH SATELLITE REMOTE SENSING.
Wisconsin Univ.-Madison. Environmental Remote Sensing Center.
For primary bibliographic entry see Field 5B.
W91-03410

ROOT AERENCHYMA, OXYGEN LEAKAGE PATTERNS AND ALCOHOLIC FERMENTATION ABILITY OF THE ROOTS OF SOME NYMPHAEID AND ISOETID MACROPHYTES IN RELATION TO THE SEDIMENT TYPE OF THEIR HABITAT.
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 2I.
W91-03414

ADAPTATIONS TO FLOODING IN PLANTS FROM RIVER AREAS.
Katholieke Univ. Nijmegen (Netherlands). Dept. of Experimental Botany.
For primary bibliographic entry see Field 2I.
W91-03415

ECOPHYSIOLOGY OF PLANTS IN WATERLOGGED AND FLOODED ENVIRONMENTS.
Vrije Univ., Amsterdam (Netherlands). Dept. of Ecology and Ecotoxicology.
For primary bibliographic entry see Field 2I.
W91-03416

GENETIC VARIATION AND ADAPTATION TO FLOODING IN PLANTS.
University of East Anglia, Norwich (England). School of Biological Sciences.
For primary bibliographic entry see Field 2I.
W91-03417

LARGE SPATIAL AND TEMPORAL BIOLOGICAL VARIABILITY OF INDIAN RIVER LAGOON.
Saint Johns River Water Management District, Palatka, FL.
R. W. Virnstein.
Florida Scientist FLSCAQ, Vol. 53, No. 3, p 249-256, Summer 1990. 2 fig, 26 ref.

Descriptors: *Biological properties, *Ecology, *Ecosystems, *Florida, *Habitats, *Indian River Lagoon, *Lagoons, *Species composition, Biological samples, Population density, Sampling, Seasonal variation, Spatial distribution, Species diversity, Temporal distribution, Variability.

A large biological variability exists in the Indian River lagoon system, both in spatial and temporal dimensions. Biotic communities in the northern end of the lagoon are temperate, whereas those in the southern part of the lagoon are tropical, e.g. Spartina marshes dominate in the north and mangrove forests and seagrass in the south. The fish fauna of the northern part of the lagoon system is strikingly depauperate when compared to that of the south. Over distances of only a few kilometers or even meters, species composition can change substantially, and densities can vary by two or three orders of magnitude. The lagoon of a few centuries ago was quite different from the lagoon of today. Large changes in submerged vegetation have occurred within the last decade. Changes between years often far exceed and, thus, obscure seasonal patterns. In the same habitat, day-to-day variation in samples collected may be large. Temporal and spatial variability can be used to identify the processes that produce the variability. It is concluded that a representative site or time period does not exist; therefore a sampling program for the Indian River lagoon must reflect the diversity of the system. (Author's abstract)
W91-03443

NITROGEN METABOLISM IN THE BRACKISH LAKE NAKANOUMI: IV. SEASONAL VARIATION OF NITRATE NITROGEN.
Shimane Univ., Matsue (Japan). Environmental Science Lab.
Y. Seike, K. Kondo, H. Hashitani, M. Okumura, and K. Fujinaga.
Japanese Journal of Limnology RIZAAU, Vol. 51, No. 3, p 137-147, 1990. 8 fig, 5 tab, 22 ref.

Descriptors: *Brackish water, *Chlorine, *Lake Nakanoumi, *Lakes, *Limnology, *Nitrates, *Nitrogen cycle, *Saline lakes, *Water chemistry, Japan, Nutrients, Rainfall, Seasonal variation, Snowmelt, Surface water.

The seasonal variation of nitrate in the upper layer in the brackish Lake Nakanoumi was investigated by the analysis of data collected monthly during the period of 1976-1986. Upward trends in nitrate concentration were found in the colder season (January to March), and also in the rainy season (July). In contrast to nitrate, chlorine levels decreased at the same time. A significant negative correlation between nitrate concentration and chlorine concentration in the surface water in Lake Nakanoumi was found in January, February, March and July. In addition, from the analysis of the correlation between the increment of nitrate concentration in the surface water and cumulative rainfall, it was concluded that the accumulation of nitrate in the upper layer is mainly caused by discharge from the rivers into the lake through rainfall and melted snow. (See also W89-00769) (Author's abstract)
W91-03452

SIGNIFICANCE OF LOW-OXYGEN ZONE FOR NITROGEN CYCLING IN A FRESHWATER LAKE: PRODUCTION OF N2O BY SIMULTANEOUS DENITRIFICATION AND NITRIFICATION.
Nagoya Univ. (Japan). Water Research Inst.
M. Yoh, A. Yagi, and H. Terai.
Japanese Journal of Limnology RIZAAU, Vol. 51, No. 3, p 163-171, 1990. 4 fig, 27 ref.

Descriptors: *Cycling nutrients, *Denitrification, *Lakes, *Limnology, *Nitrification, *Nitrogen cycle, Ammonium, Japan, Lake Kizake, Nitrogen, Oxygen depletion.

Denitrifying and nitrifying activities were determined to elucidate the mechanism of nitrous oxide accumulation in the oxygen-depleted zone of Lake Kizake. Both activities were detected without any substrate enrichments in a zone of low-oxygen content (0.03-0.14 ml/L), where nitrous oxide and nitrite had accumulated. The measured nitrifying activity roughly coincided with the ammonium utilization estimated from the ammonium budget in this zone during the observation period. On the basis of these activities and the change in nitrous oxide concentration, it was suggested that the observed nitrous oxide accumulation had dual origins of nitrification and denitrification and that these productions were in dynamic equilibrium with further reduction of nitrous oxide to nitrogen. The low-oxygen zone was found to be an active site for nitrogen cycling and was characterized by the presence of dissolved Mn and the absence of dissolved Fe and sulfide. (Author's abstract)
W91-03453

RELATIONSHIPS BETWEEN PHYTOPLANKTON OCCURRENCE AND SALINITY OR WATER TEMPERATURE IN BRACKISH LAKE NAKANOUMI, 1979-1986.
Shimane Univ., Matsue (Japan). Environmental Science Lab.
K. Kondo, Y. Seike, and Y. Date.
Japanese Journal of Limnology RIZAAU, Vol. 51, No. 3, p 173-184, 1990. 7 fig, 4 tab, 16 ref.

Descriptors: *Lake Nakanoumi, *Limnology, *Phytoplankton, *Saline lakes, *Salinity, *Species composition, *Water temperature, Algal blooms, Brackish water, Japan, Lagoons, Lakes.

The relationships between the occurrence of phytoplankton and salinity or water temperature were investigated for 8 years from 1979 to 1986 in brackish Lake Nakanoumi. Fourteen species such as Skeletonema costatum, Prorocentrum minimum, and Cyclotella nana were dominant in this lake. Five among the 14 species bloomed in conditions of water temperature less than optimal for their growth, whereas every species bloomed in optimum salinity conditions. These observations indicated that the occurrence of dominant phytoplankton species in the lake is more strongly controlled by salinity than by water temperature. A correlation between nutrient concentrations and phytoplankton blooms was not observed in Lake Nakanoumi. The result of a comparison of weighted mean value of water temperature and salinity for the two periods of 1974-1978 and 1979-1986 also indicated the greater importance of salinity than water temperature in the occurrence of phytoplankton blooms in Lake Nakanoumi. (Author's abstract)
W91-03455

SESTONIC C:N:P RATIOS IN THE SOUTH BASIN OF LAKE BIWA WITH SPECIAL ATTENTION TO NUTRITIONAL STATE OF PHYTOPLANKTON.
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
M. Nakanishi, O. Mitamura, and T. Matsubara.
Japanese Journal of Limnology RIZAAU, Vol. 51, No. 3, p 185-189, 1990. 3 fig, 1 tab, 17 ref.

Descriptors: *Japan, *Lake Biwa, *Lakes, *Limiting nutrients, *Limnology, *Nutrient concentrations, *Phytoplankton, Carbon, Nitrogen, Nutrient deficiency, Particulate matter, Phosphorous, Seasonal variation.

To estimate seasonal change in the nutritional state of phytoplankton in the south basin of Lake Biwa, surveys for the determination of particulate C:N:P ratios were conducted at five stations from May 1987 to May 1988. Levels of particulate carbon (PC), particulate nitrogen (PN) and particulate phosphorous (PP) varied in the ranges of 20-210, 3-32, and 0.13-1.09 micromol/L, respectively. Seasonal changes in PC:PN ratio were relatively constant at all stations except for October and/or November when the ratio exceeded 10. On the other hand, the PC:PP ratio often showed extraordinarily high values from May to mid-October.

The seasonal pattern of PN:PP ratio was similar to that observed for PC:PP ratio. The particulate C:N:P ratios indicated the possibility that phytoplankton were exposed frequently to moderate or severe phosphorous deficiency from May to October 1987, but little thereafter until May 1988, whereas they were not in the state of severe nitrogen deficiency except for a given time in November of 1987. (MacKeen-PTT)
W91-03456

RELATIONSHIP BETWEEN THE YEARLY CHANGES IN PHYTOPLANKTON OCCURRENCE AND NUTRIENT CONCENTRATION IN BRACKISH LAKE NAKANOUMI, 1974-1986.
Shimane Univ., Matsue (Japan). Environmental Science Lab.
For primary bibliographic entry see Field 5C.
W91-03457

DETERMINATION OF GOLD IN NATURAL WATERS BY NEUTRON ACTIVATION AND GAMMA-SPECTROMETRY AFTER PRECONCENTRATION WITH TRIBUTYL PHOSPHATE AS SOLID EXTRACTANT.
Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
For primary bibliographic entry see Field 2K.
W91-03463

SANITARY AND BACTERIAL ANALYSIS OF WATER AND BOTTOM SEDIMENTS OF A HEAVILY POLLUTED, HYPERTROPHIC LAKE.
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Dept. of Ecology and Freshwater Biology.
For primary bibliographic entry see Field 5B.
W91-03476

MACROFAUNA OF ELODEIDS OF TWO LAKES OF DIFFERENT TROPHY. I. RELATIONSHIPS BETWEEN PLANTS AND STRUCTURE OF FAUNA COLONIZING THEM.
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
R. Kornijow.
Ekologia Polska ELPLBS, Vol. 37, No. 1/2, p 31-48, 1989. 4 fig, 3 tab, 48 ref.

Descriptors: *Aquatic animals, *Eutrophic lakes, *Limnology, *Macrophytes, *Mesotrophic lakes, *Waterweeds, Aquatic biota, Aquatic plants, Biomass, Ecosystems, Lake Glebokie, Lake Piaseczno, Poland, Species composition, Species diversity.

Very little is known about the influence of lake fertility upon the relationships between macrohydrophytes and the species composition and abundance of fauna colonizing them. The composition and abundance of macrofauna living on elodeid species and how those elodeid species differ in habitat and life cycle was determined then evaluated for different environmental conditions at various stages of lake eutrophication. Studies were conducted between January 1983 and December 1984 in the eutrophic Lake Glebokie and mesotrophic Lake Piaseczno, Poland. Macrofauna colonizing six elodeid species were analyzed (Myriophyllum alternifolium DC., M. spicatum L., Ceratophyllum demersum L., Potamogeton praelongus Wulfen, P. Lucens L., and Elodia canadensis Rich). The preference of several fauna taxons for specific groups of elodeids varied with composition and degree of species diversity and by dominance structure. Greater differences in fauna density and biomass were observed in relation to fresh plant weight. Values were inversely proportional to plant biomass and to density and biomass of fauna, as they relate to bottom surface. These relationships were probably connected with the possibility of using food resources of a given habitat by invertebrates. The higher trophy in Lake Glebokie was reflected by poorer and slightly different quantitative composition, by smaller total species diversity and differently formed dominance structure, higher density and biomass of fauna as related to fresh plant weight and bottom surface, than in Lake Piaseczno. (See also W91-03478) (Mertz-PTT)
W91-03477

MACROFAUNA OF ELODEIDS OF TWO LAKES OF DIFFERENT TROPHY. II. DISTRIBUTION OF FAUNA LIVING ON PLANTS IN THE LITTORAL OF LAKES.
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
R. Kornijow.
Ekologia Polska ELPLBS, Vol. 37, No. 1/2, p 49-57, 1989. 3 fig, 1 tab, 20 ref.

Descriptors: *Aquatic fauna, *Eutrophic lakes, *Limnology, *Macrophytes, *Mesotrophic lakes, *Poland, Aquatic biota, Biomass, Ecological effects, Hornwort, Invertebrates, Mesotrophy, Pondweeds, Species composition, Species diversity, Water depth, Water milfoil.

The horizontal distribution of fauna living on aquatic macrophytes is not well known, and very little information exists concerning the relationship between the depth at which plants grow and the qualitative and quantitative composition of invertebrates colonizing them. Studies were conducted on the occurrence of invertebrate fauna colonizing Myriophyllum alternifolium D.C., Ceratophyllum demersum L. and Potamogeton lucens L. in different types of littoral and at different depths. Mesotrophic Lake Piaseczno and eutrophic Lake Gleobkie, Poland were examined. Differences between the fauna colonizing different types of shore in the mesotrophic lake concerned mainly its species composition and dominance structure. In the eutrophic lake, its density and biomass caused the main differences between fauna, especially in relation to the bottom surface. The influence of depth on invertebrates was reflected mainly by their species composition and dominance structure, and was very distinct in the eutrophic lake. Species abundance was found to decrease with increasing depth. (See also W91-03477) (Mertz-PTT)
W91-03478

CORRELATION BETWEEN BIOMASS, CHLOROPHYLL-A, PHOTOSYNTHESIS AND PHYTOPLANKTON STRUCTURE IN A LAKE.
Akademia Rolnicza, Lublin (Poland). Inst. of Natural Foundations of Plant Production.
W. Wojciechowska.
Ekologia Polska ELPLBS, Vol. 37, No. 1/2, p 59-82, 1989. 10 fig, 4 tab, 33 ref.

Descriptors: *Chlorophyll, *Eutrophic lakes, *Lake Bikeze, *Limnology, *Phytoplankton, *Primary productivity, Biomass, Chlorophyll a, Fluctuations, Photosynthesis, Poland, Productivity, Species composition.

The relationship between phytoplankton biomass, chlorophyll concentration and primary production was investigated over one growing season (April-November) in 16 series, with each series lasting 3 consecutive days. Measurements were taken in shallow (3 m) eutrophic Lake Bikcze, Poland. Biomass, chlorophyll-a concentration and primary production were measured every day. No unequivocal correlation between the three parameters was found. The proportion of chlorophyll-a in phytoplankton biomass varied with phytoplankton structure, cell age and light . Daily variations in phytoplankton populations structures were found, with photosynthesis being limited by light, depending on phytoplankton structure. Ecological studies of phytoplankton are necessary to determine the taxonomic composition and dominance structure of the community studied. (Mertz-PTT)
W91-03479

HABITAT DIVERSITY AND FISH REPRODUCTIVE FUNCTION OF FLOODPLAIN ECOSYSTEMS.
Lyon-1 Univ., Villeurbanne (France). Lab. d'Ecologie des Eaux Douces.
G. H. Copp.
Environmental Biology of Fishes EBFID3, Vol. 26, No. 1, p 1-27, September 1989. 7 fig, 6 tab, 106 ref.

Descriptors: *Aquatic habitats, *Ecosystems, *Fish populations, *Flood plains, *Limnology, *Spawning, Biomass, Braided streams, Geomorphology, Hydrological regime, Introduced species, Lentic environment, Lotic environment, Meanders, Multivariate analysis, Sampling, Succession.

Fish reproduction in flood plain ecosystems, based on relative abundance and total biomass of 0+ juveniles, was studied using the synchronic approach to typological analysis in conjunction with Point Abundance Sampling by modified electrofishing. In three different flood plains of the Upper Rhone River, 1015 point samples yielding 4573 juveniles (0+) from 21 species were collected from 48 ecosystems of various geomorphological origin. The results demonstrate the lotic-to-lentic succession of flood plain ecosystems to be a series of nonsequential reproductive zones, with spawning conditions being reflected by the specific composition and guild structure of the young-of-the-year (YOY) fish assemblages. The habitat diversity and the fish reproductive potential of flood plain ecosystems are strongly influenced by geomorphological origin and by past and present hydrological conditions. The YOY assemblages of autogenically driven ecosystems (usually of anastomose or meander origin) tend to differ both in composition and in quantity from those found in allogenically driven ecosystems (generally of braided origin). Ecosystems of intermediate character, and fish reproduction thereof, occur as the result of either ecosystem rejuvenation or senescence: autogenically driven ecosystems by allogenic mechanisms, or allogenically driven ecosystems at similar and at different successional status, the flood plain as an entity is seen as 'stable' with respect to fish reproduction. (Author's abstract)
W91-03482

GULL CONTRIBUTIONS OF PHOSPHORUS AND NITROGEN TO A CAPE COD KETTLE POND.
Cape Cod National Seashore, South Wellfleet, MA.
For primary bibliographic entry see Field 5B.
W91-03484

DOWNSTREAM EFFECTS OF IMPOUNDMENTS ON THE WATER CHEMISTRY OF THE BUFFALO RIVER (EASTERN CAPE), SOUTH AFRICA.
Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.
R. W. Palmer, and J. H. O'Keefe.
Hydrobiologia HYDRB8, Vol. 202, No. 1/2, p 71-83, August 29, 1990. 5 fig, 3 tab, 44 ref.

Descriptors: *Dam effects, *Reservoirs, *South Africa, *Water chemistry, *Water quality, Agricultural runoff, Dams, Hydrological regime, Low flow, Nitrates, River flow, River systems, Water pollution effects.

Dams are physical barriers in river systems, and they and their associated impoundment water can result in changes to the natural flow regime, water temperature, sediment loads, and chemistry of the receiving river. The downstream effects of impoundments on the chemistry of pristine and polluted stretches of the Buffalo River were investigated in the context of the Serial Discontinuity Concept (SDC), which proposes that dams act as disruptions to the natural continuum of hydrological, physico-chemical, and biotic changes down an impounded river. Impoundments which received water from a near-pristine upper catchment caused alterations of the water quality which were consistent with the SDC, and recovery to riverine conditions was within 2.6 to 18.4 km of the dam, depending on flow. Impoundments which received agricultural runoff and urban effluents generally caused an improvement in the water quality of the downstream reaches (with the exception of nitrate concentrations, which were higher in the tailwaters compared to inflowing water). Impoundments with polluted inflows therefore usually 'reset' the river towards its natural condition, rather than acting as perturbations. This represents a reversal of the SDC described for pristine rivers. The downstream effects of impoundments on water chemistry therefore depend on the relative

impact of other catchment perturbations. These disturbances become more severe during low flow, and it is during this time that the impoundments have the greatest effect on the river. (Author's abstract)
W91-03485

EFFECTS OF ANABAENA FLOS-AQUAE INOCULATION, PH ELEVATION, AND N/P MANIPULATION ON THE ALGAL BIOMASS AND SPECIES COMPOSITION OF AN ACID LAKE.
West Virginia Univ., Morgantown. Dept. of Biology.
G. R. Wilcox, and J. DeCosta.
Hydrobiologia HYDRB8, Vol. 202, No. 1/2, p 85-104, August 29, 1990. 10 fig, 15 tab, 27 ref.

Descriptors: *Acid lakes, *Algae, *Algal growth, *Anabaena, *Cyanophyta, *Hydrogen ion concentration, *Limnology, *Nutrient concentrations, *Population dynamics, *West Virginia, Biomass, Limiting nutrients, Nitrates, Phosphorus, Species composition.

The mechanisms by which blue-green algae become dominant in lakes has been a formidable problem generating a vast number of observations and a variety of hypotheses. Three bag experiments were performed in an acidic lake, Cheat Lake, West Virginia, to determine if an inoculation of the blue-green alga, Anabaena flos-aquae, could be maintained in: (1) acid environments in which the nitrate nitrogen:total phosphorus ratio was manipulated above and below 5; (2) environments in which the pH of the acid lake water was increased to pH 7 or 8, and the nitrate nitrogen:total phosphorus ratio was manipulated above and below 5; and (3) environments in which pH was increased to 7, and 10 micrograms/L phosphorus was added alone and in combination with 70 micrograms/L nitrogen. Algal biomass increased as the concentration of total phosphorus increased in the various treatments. Increased pH treatments with phosphorus addition displayed an initial lag in algal growth of 2 to 6 days followed by intense growth. Analysis of the species composition of the various treatments indicated that increasing pH and adding phosphorus or manipulating the nitrate nitrogen:total phosphorus ratio to less than 5 did not favor blue-green algal growth. These data suggest that the Anabaena flos-aquae inoculated was replaced by the indigenous algae in the environments provided. (Fish-PTT)
W91-03486

ALLOCHTHONOUS INPUT AND RETENTION IN A SMALL MOUNTAIN STREAM, SOUTH AFRICA.
Cape Town Univ. (South Africa). Dept. of Zoology.
B. A. Stewart, and B. R. Davies.
Hydrobiologia HYDRB8, Vol. 202, No. 3, p 135-146, August 31, 1990. 4 fig, 5 tab, 37 ref.

Descriptors: *Leaves, *Litter, *Mountain streams, *Nutrient transport, *Organic matter, *South Africa, *Stream ecology, Detritus, Low flow, River sediments, Seasonal variation, Stream order.

Allochthonous material entering small streams represents the primary energy base available to consumers in these systems. Allochthonous input and benthic coarse particulate organic matter (CPOM) standing stocks were investigated in a first-order stream in the Fynbos Biome in South Africa between May 1984 and April 1985. Monthly falls into Window Stream of all litter types (total) ranged from 11 (September) to 79 (March) g/sq-m. Total annual litter fall was 426 g dry weight, which corresponds to 1.2 g/sq-m/d. Flowers, fruits, and seeds contributed 37 g/sq-m, woody debris, 122 g/sq-m, and leaves 267 g/sq-m to this total. Leaf fall from native trees, which accounted for approximately 57% of total litter input (244 g/sq-m/a), was significantly higher in summer than in winter. The summer peak in leaf fall recorded is far smaller and more protracted than the autumnal peak recorded for many Northern Hemisphere streams. Monthly total standing stocks of CPOM ranged from 14 g dry weight/sq-m in January to 69 g/sq-m in August, and a mean total CPOM standing stock of 41 g/sq-m/month was estimated. This comprised 18 g/sq-m/month soft litter, and 23 g/sq-m/month hard litter. CPOM standing stocks showed no seasonal trends, and with the exception of two species, standing stocks of endemic leaf species reflected their contributions to the total litter fall. Contrary to earlier reports for streams in the Fynbos Biome, Window Stream has CPOM standing stocks well within the ranges reported for low-order streams worldwide. (Author's abstract)
W91-03488

ORDINATION ANALYSIS AND BIOINDICES BASED ON ZOOBENTHOS COMMUNITIES USED TO ASSESS POLLUTION OF A LAKE IN SOUTHERN FINLAND.
Ristola (Paavo) Consulting Engineers Ltd., Hollola (Finland).
For primary bibliographic entry see Field 5A.
W91-03490

DEPTH-TIME DISTRIBUTIONS OF DETRITUS DEPOSITIONS IN LAKE NEMI (VOLCANIC LAKE OF CENTRAL ITALY).
Rome Univ. (Italy). Dipt. di Genetica e Biologia Molecolare.
L. Rossi, L. Picciafuoco, and A. Basset.
Hydrobiologia HYDRB8, Vol. 202, No. 3, p 185-195, August 31, 1990. 4 fig, 2 tab, 28 ref.

Descriptors: *Deposition, *Detritus, *Italy, *Lake sediments, *Limnology, *Organic matter, Bottom sediments, Cores, Ecosystems, Littoral zone, Plankton, Sediment analysis, Sedimentation.

Organic detritus is an important component of lake ecosystems. The depth-time distributions of detritus depositions onto lake bottom and the amount of resident organic matter on the upper layer of the bottom have been assessed in a volcanic lake (Lake Nemi in central Italy). Depositions were sampled monthly across the lake at four depths (0.2 m, 2 m, 6 m, and 30 m) during two years (1983-1984). Organic and ash fractions of sediment cores collected along a depth gradient were assessed in the summer of 1984. The results show: (1) the mean amount of organic matter deposition (size > 10 micrometers) is 1.24 g/sq-m/d dry weight (452.6 g/sq-m/year); (2) the metabolism of large particulate organic matter (LPOM) occurs primarily in the littoral zones not farther than 30 m offshore and the dispersibility of the LPOM may be predicted by a negative exponential model; (3) the deposition on the bottom comprised under the perimeter of about 80% of the lake surface, is principally autochthonous (planktonic in origin); and (4) the detritus settled out of the water column is not completely processed and about half of the total material enters the slow cycle of the sediment in the deepest zone of the lake. (Author's abstract)
W91-03491

FACTORS INFLUENCING FISH DISTRIBUTION AND COMMUNITY STRUCTURE IN A SMALL COASTAL RIVER IN SOUTHWESTERN COSTA RICA.
Wisconsin Univ.-Madison. Center for Limnology.
J. Lyons, and D. W. Schneider.
Hydrobiologia HYDRB8, Vol. 203, No. 1/2, p 1-14, September 14, 1990.4 fig, 4 tab, 41 ref.

Descriptors: *Aquatic habitats, *Coastal streams, *Costa Rica, *Fish populations, *Species diversity, *Stream ecology, Adaptation, Population density, Population dynamics, Riffles, River mouth, Saline water intrusion, Species composition, Tidal effects.

An evaluation was made of the relative importance of habitat size and diversity and distance from the ocean in explaining longitudinal patterns of fish distribution and community structure (species richness, evenness, and diversity) in the lower 5 km of the Rio Claro, a small coastal river in Corcovado National Park, southwestern Costa Rica, with a depauperate freshwater fish fauna. Twenty-two species in pools were observed, 19 of which occurred during quantitative sampling. Most of these species probably spent part of their lives in the Pacific Ocean. No species were observed in riffles, although these habitats were common and several taxa were adapted for life in fast turbulent water. Fish abundance, and species richness, evenness, and diversity were highest near the ocean, where high tides influenced river levels and salinity. Eight species were not observed further than 2900 m from the ocean, whereas six species were not encountered in samples nearest the ocean; the remaining eight species were present throughout the study area. Distance from the ocean was a better predictor of fish abundance and community structure than were pool width, pool depth, pool surface area, pool volume, amount of cover present, substrate diversity, or depth diversity. Qualitative comparisons of this data with previously-published data from 1980-1986, the fish assemblage of the Rio Claro is persistent in both species composition and relative abundance. (Author's abstract)
W91-03492

DYNAMIC ASPECT OF COARSE PARTICULATE ORGANIC MATTER (CPOM) ON THE SEDIMENT SURFACE OF A SECOND ORDER STREAM FREE OF DEBRIS DAMS (RITRODAT-LUNZ STUDY AREA).
Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Limnologie.
G. Bretschko.
Hydrobiologia HYDRB8, Vol. 203, No. 1/2, p 15-28, September 14, 1990. 9 fig, 6 tab, 27 ref.

Descriptors: *Austria, *Deposition, *Nutrient transport, *Organic matter, *Retention capacity, *River sediments, *Stream ecology, *Streams, Bottom sediments, Flood plains, Leaves, Riparian vegetation, Seasonal variation, Stream discharge, Stream order.

Allochthonous organic matter is the main energy basis for low order streams; quantity and quality of imported organic matter are important parameters, defining density and composition of the stream biocoenosis. Oberer Seebach, in the eastern alps of Austria, is a second order stream, draining an uninhabited and densely forested catchment. Because of flood control, the channel has been free of debris dams for more than a century. The study site is characterized by riparian vegetation and the distribution of dry and channel overflow areas. Amounts of leaf material deposited on the sediment surface of the channel are significantly larger during defoliation (20 days) and shortly afterwards ('accumulation period,' 6.64 g/sq-m (110 days) and 29.42 g/sq-m dry weight (133 days, mean of five years) for wet and dry areas, respectively) than during the rest of the year ('intermediate period,' 0.98 and 3.94 g/sq-m (mean of five years) for wet and dry areas, respectively). Woody debris is too scarce to increase the retention capacity. Deposition of leaf material depends on the interaction of input (wind-drift and bank runoff, 124 and 85 g/sq-m for the accumulation and intermediate period, respectively), discharge regime and the relationship between dry and wet channel areas. Periodically inundated areas increase the retention capacity of the stream channel and are comparable with the interrelationship between stream and flood plain. (Author's abstract)
W91-03493

PREDOMINANCE OF PICOPLANKTON AND NANOPLANKTON IN EUTROPHIC CALDER LAKE.
Fordham Univ., Armonk, NY. Louis Calder Conservation and Ecology Study Center.
J. D. Wehr.
Hydrobiologia HYDRB8, Vol. 203, No. 1/2, p 35-44, September 14, 1990. 7 fig, 3 tab, 33 ref.

Descriptors: *Algae, *Eutrophic lakes, *Limiting nutrients, *Limnology, *Phytoplankton, Biomass, Cyanophyta, Dinoflagellates, Ecosystems, Microbiological studies, New York, Nitrogen, Nutrient concentrations, Phosphorus, Primary productivity.

A study was conducted to examine factors regulating the biomass of algal picoplankton in Calder Lake, a small eutrophic lake in southern New York state. A particular focus was a current paradigm which suggests that larger cells may dominate i

nutrient-rich waters, while smaller cells may predominate only in oligotrophic waters. Over two years, phytoplankton biomass consisted predominantly (74% on average) of very small organisms; nanoplankton (<20 to 2 micrometers: 39%) and picoplankton (<2 micrometers to 0.2 micrometers: 35%), despite the presence of surface blooms of colonial cyanobacteria (Microcystis aeruginosa, Anabaena limnetica), and dense metalimnetic populations of the dinoflagellate Ceratium hirundinella. This dimictic system is characterized by relatively high levels of total P, inorganic P, and total inorganic N, but larger forms were rarely the most abundant. Unlike some marine systems, greater abundance of algal picoplankton was not associated with deeper strata (low light), or warmer temperatures. Data suggest that midsummer nutrient limitation, especially P-limitation, favors the development of picoplankton and nanoplankton in the limnetic zone of eutrophic lakes. (Author's abstract)
W91-03494

LITTERFALL, LEAF DECOMPOSITION AND LITTER COLONIZATION OF TESSARIA INTEGRIFOLIA (COMPOSITAE) IN THE PARANA RIVER FLOODPLAIN.
Centro de Ecologia Aplicada del Litoral, Corrientes (Argentina).
J. J. Neiff, and A. P. de Poi.
Hydrobiologia HYDRB8, Vol. 203, No. 1/2, p 45-52, September 14, 1990. 2 fig, 2 tab, 31 ref.

Descriptors: *Colonization, *Decomposing organic matter, *Flood plain sediments, *Floodplain forests, *Invertebrates, *Leaves, *Litter, *Parana River, *Stream ecology, Argentina, Forest ecosystems, Nutrient concentrations, Organic matter, River sediments, Seasonal variation.

Litterfall and leaf decomposition rates were measured in Choui Island, 45 km downstream from the confluence of the Parana and Paraguay Rivers, in Argentina. The material was collected biweekly from April 1985 through September 1986. Decomposition was measured in situ by the litter bag technique. Annual litterfall of Tessaria integrifolia gallery forest measured in the period April 1985 to March 1986 was 8.15 t/ha. Leaf litterfall was seasonal, i.e. significantly less leaf litter was shed during the high water phase than during the low water phase. The 'half life' of the T. integrifolia litter over 38 days of decomposition was 20 days. At the beginning of the experiment, 15 and 38 days subsamples of remaining detritus were analyzed in order to determine changes in the nutrient content. After 38 days of incubation, the order of nutrient disappearance was Ca>K>N>Mg>Na>P. The number of invertebrates per g remaining litter of T. integrifolia increased between incubations days 7 and 31. Collector-gatherers were more abundant after 38 days incubation; there were no shredders colonizing the leaf litter bags. (Author's abstract)
W91-03495

ACCURACY OF POPULATION DENSITY ESTIMATES OF A HORIZONTALLY DISTRIBUTED ZOOPLANKTON COMMUNITY IN DUTCH FISH PONDS.
Agricultural Univ., Wageningen (Netherlands). Dept. of Fish Culture and Inland Fisheries.
E. Verreth.
Hydrobiologia HYDRB8, Vol. 203, No. 1/2, p 53-, September 14, 1990. 5 tab, 18 ref.

Descriptors: *Fish ponds, *Limnology, *Sampling, The Netherlands, *Zooplankton, Copepods, Distribution patterns, Fish farming, Microbiological studies, Population density, Precision, Variation efficient, Waterfleas.

To elucidate the effect of the horizontal distribution of different zooplankton populations on the accuracy of population density estimates in a fish pond, 40 samples were taken according to a rectangular grid which divided the pond into 5 longitudinal rows and 10 transversal columns. The zooplankton consisted of 55% copepods, 43% cladocerans, and 2% Rotatoria. The index of patchiness was mostly higher than 1, revealing a strongly clumped distribution. A more passive wind-induced distribution was detected for most taxonomic groups. Based on the calculated coefficients of variation, a table of the accuracies of the density estimates in relation to the number of samples was presented. For more detailed studies on a particular species population, about 25 samples (column samples of 10 L each) are needed to obtain an accuracy varying between 10 and 20%, depending on the taxonomic group. A slightly higher precision can be obtained, however at a strongly increasing effort. For the practice of fish farming, two to five sample stations should suffice to estimate the total zooplankton abundance with a 30 to 10% accuracy respectively. (Author's abstract)
W91-03496

IMPACT OF MILD EXPERIMENTAL ACIDIFICATION ON SHORT TERM INVERTEBRATE DRIFT IN A SENSITIVE BRITISH COLUMBIA STREAM.
British Columbia Univ., Vancouver. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-03497

DEVELOPMENT AND APPLICATION OF A TECHNIQUE FOR ESTIMATING NUTRIENT DEFICIENCY IN SOFT SEDIMENTS.
Montana State Univ., Bozeman. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W91-03499

HYPOLIMNETIC PROTOZOAN PLANKTON OF A EUTROPHIC LAKE.
Lancaster Univ. (England). Dept. of Biological Sciences.
J. Laybourn-Parry, J. Olver, and S. Rees.
Hydrobiologia HYDRB8, Vol. 203, No. 1/2, p 111-119, September 14, 1990. 7 fig, 27 ref. Natural Environment Research Council Grant GR3/6957.

Descriptors: *Eutrophic lakes, *Hypolimnion, *Limnology, *Plankton, *Protozoa, Benthic environment, Benthos, Biomass, Ecosystems, Epilimnion, Lake stratification, Migration, Population density, Seasonal distribution, Seasonal variation, Species composition, Thermocline.

The importance of the microzooplankton in ecological processes such as energy flow and biogeochemical cycling in the marine environment is well established. Freshwater studies have lagged behind, but there is a growing pool of information on the occurrence and importance of protozoan biomass in the plankton lakes from a range of latitudes. The seasonal distribution of benthic species in the water column above and below the thermocline in a small eutrophic lake was studied. During summer stratification populations of Spirostomum spp., Loxodes spp., Plagiopyla and Deltopylum become established in the plankton on or below the oxycline/thermocline. At shallow sites no migration occurred and populations of the migratory species in the benthos were sparse, with the exception of Plagiopyla which occurred in high densities in the sediment. Two distinct planktonic populations are established during stratification: an epilimnetic community of obligate planktonic ciliates and a hypolimnetic community of benthic migrants. (Author's abstract)
W91-03500

EVALUATION OF THE FISHERIES OF THE MACKINAW RIVER BASIN IN CENTRAL ILLINOIS.
Illinois Dept. of Conservation, Aledo.
D. M. Day, R. W. Sauer, and W. A. Bertrand.
Transactions of the Illinois Academy of Science TISAAH, Vol. 83, No. 1/2, p 82-100, 1990. 4 fig, 5 tab, 25 ref. Federal Aid to Sport Fish Restoration Project F67R; Illinois Department of Conservation, Division of Fisheries.

Descriptors: *Black bass, *Ecological effects, *Fish populations, *Illinois, *Stream fisheries, *Water pollution effects, Bass, Carp, Habitats, Recreation demand, Species composition, Species diversity, Stream biota, Water quality trends, Water resources management.

In 1987, on the Mackinaw River Basin in central Illinois, fish data were collected as part of an ongoing effort by the Illinois Department of Conservation (IDOC) Streams Program to assess statewide stream quality. Fifty-nine fish species were collected from 22 sites. On the Mackinaw River, stations downstream of the town of Mackinaw showed generally lower evenness, lower species richness and lower 'biotic integrity' as indicated by the Alternated Index of Biotic Integrity (AIBI), compared to stations upstream. More intensive investigations are warranted to isolate the habitat or water quality parameters responsible for this change and to determine the potential for implementation of habitat enhancement techniques in this downstream section. Several tributaries, including Panther Creek, Walnut Creek, and Henline Creek, were very high quality as seen with the IBI and appear to be smallmouth bass nurseries. Fish body condition as estimated by relative weight, was good for carp (values near 100) and fair for smallmouth bass (values ranging from 80 to 95). With its diverse fish fauna, aesthetic value, multiple recreational uses including fishing, swimming, canoeing, and hiking, the Mackinaw River represents one of the highest quality streams in Illinois and it is within the public interest to protect this stream from deleterious impacts. (Author's abstract)
W91-03504

ENVIRONMENTAL STUDY ON CHEMICAL POLLUTION OF THE LAKE KORONIA IN NORTHERN GREECE.
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
For primary bibliographic entry see Field 5B.
W91-03534

DYNAMICS OF TURBIDITY CURRENTS MEASURED IN KATSURAZAWA RESERVOIR, HOKKAIDO, JAPAN.
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
K. Chikita, and Y. Okumura.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 323-338, September 1990. 9 fig, 2 tab, 23 ref.

Descriptors: *Lake sediments, *Reservoirs, *Sediment discharge, *Sediments, *Turbidity currents, *Turbidity flow, Diurnal variation, Flow velocity, Hokkaido, Japan, Katsurazawa Reservoir, Mathematical analysis, Reservoir sediments, Reynolds number, Temperature gradient, Underflow, Water temperature.

The movement of turbid underflows in a reservoir was examined using three recording current meters. The density underflows, called turbidity currents, are induced by sediment discharge in the inflow system during the spring thaw. Continuous measurement near the reservoir bottom at two longitudinally located stations showed the characteristic diurnal variations of flow velocity and temperature, and decreasing temperature in the downslope direction. The diurnal temperature variations correspond to the diurnal variations of sediment discharge and its temperature in the inflow system, and the decreasing temperature downslope is explained by the entrainment of upper, cold water which turbidity currents induce. Assuming the water temperature to be 0 C, two mixing coefficients and turbidity-current discharge at the stations were numerically obtained. Applying Manning's equation to the critical, low turbidity-current discharge, a value of 1.51 was obtained for the roughness coefficient, n. Hence, assuming n to be constant, Reynolds number, Re, and densimetric Froude number, Fd, for the turbidity currents were evaluated at 71,000-580,000 and 1.5-4.4, respectively. The entrainment coefficient, Ee, from the equation of continuity holds a significant correlation with 'overall Richardson number'. Decreasing entrainment is due to decreasing friction at the interface with the relative increase of kinetic energy. This could be applied to turbidity currents with Re of the order of 100,000. The downslope movement of turbidity currents with the diurnal variations of discharge and temperature is also explained by the longitudinal propagation of long

waves. These could change from kinematic to intermediate waves with increasing discharge. (Author's abstract)
W91-03555

PEORIA LAKE SEDIMENTATION AND PROPOSED ARTIFICIAL ISLANDS.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5G.
W91-03614

SEDIMENT MANAGEMENT PROBLEMS OF BACKWATER LAKES AND ALTERNATIVE SOLUTIONS.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2J.
W91-03615

HABITAT RESTORATION FOR FISH AND WILDLIFE IN BACKWATER LAKES OF THE ILLINOIS RIVER.
Illinois State Water Survey, Peoria. Water Quality Section.
For primary bibliographic entry see Field 5G.
W91-03616

ILLINOIS RIVER BASIN: LIFEBLOOD OF OUR STATE.
Illinois Dept. of Energy and Natural Resources, Springfield.
For primary bibliographic entry see Field 6G.
W91-03619

VALUE OF CITIZEN STREAM QUALITY MONITORING AS AN EDUCATIONAL TOOL.
Wheaton Park District, IL.
For primary bibliographic entry see Field 5G.
W91-03624

USEPA PERSPECTIVE ON NONPOINT POLLUTION CONTROL AND WETLANDS FUNCTION.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5G.
W91-03631

ECOLOGY OF ESTUARIES. VOLUME II: BIOLOGICAL ASPECTS.
Cook Coll., New Brunswick, NJ. Fisheries and Aquaculture Technology Extension Center.
For primary bibliographic entry see Field 2L.
W91-03658

GREAT LAKES: LIVING WITH NORTH AMERICA'S INLAND WATERS.
Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. 296p. Edited by D. H. Hickcox.

Descriptors: *Great Lakes, *Lake management, *Symposium, *Water policy, *Water resources management, Canada, Climatic changes, Groundwater, Lake fisheries, Lake shores, Recreation, Water pollution sources, Water quality control, Water use.

The Great Lakes of North America, the world's largest assemblage of fresh water, have exerted tremendous influence on the settlement and economic development of North America's interior. Today, 40 million people in eight states and two provinces inhabit the Great Lakes basin. Issues facing the Great Lakes include lakeshore development; increased recreation; domestic and industrial water use; sanitation; navigation; electrical power generation by nuclear, coal-fired, and hydroelectric plants; irrigation; fisheries; wetland preservation; endangered species preservation; shoreline protection; and lake levels. Perhaps the most serious problem facing the Great Lakes is water pollution in its many facets: nonpoint pollution, point source pollution, airborne, in-place (lakebed sediments), and pollution from groundwater. The intense urbanization of the Great Lakes basin and extensive agriculture in the basin ensure that large amounts of pollutants enter the lakes. The papers included in the Great Lakes symposium address many of the problems facing the Great Lakes. They are generally organized into sections covering: Great Lakes policy and management, water levels, climate, water quality, groundwater, and fisheries and recreation. Their authors have been educated in several different disciplines and represent many different constituencies. Some papers focus on site-specific topics; others are wide-ranging in scope and not every topic is evenly covered. However, all authors share a mutual concern for the Great Lakes and the pressing need to find common solutions to the diverse problems facing the lakes. (See W91-03673 thru W91-03703) (Fish-PTT)
W91-03672

GREAT LAKES INSTITUTIONS AND THE POLICY PROCESS: ISSUES IN INTERSTATE AND INTERNATIONAL RESOURCE MANAGEMENT.
Great Lakes Commission, Ann Arbor, MI.
For primary bibliographic entry see Field 6B.
W91-03673

GREAT LAKES RESEARCH NEEDS AND HOW TO MEET THEM.
Michigan Dept. of Natural Resources, Lansing. Office of the Great Lakes.
For primary bibliographic entry see Field 6B.
W91-03674

AGENDA FOR THE MANAGEMENT OF THE GREAT LAKES ON A LONG TERM ECOSYSTEM BASIS.
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 6E.
W91-03675

REASSESSING ESTIMATES OF GREAT LAKES CONSUMPTIVE USES AND IMPACTS.
Corps of Engineers, Chicago, IL. North Central Div.
For primary bibliographic entry see Field 6D.
W91-03676

REMEDIAL ACTION PLANS: A GREAT LAKES PROGRAM WHOSE TIME HAS COME.
International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 6B.
W91-03677

MANAGEMENT OF LAKE ONTARIO RESOURCES: A HOLISTIC PERSPECTIVE.
State Univ. of New York at Buffalo.
R. W. Flint.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 53-64, 2 fig, 2 tab, 34 ref.

Descriptors: *Great Lakes, *Lake Ontario, *Lake management, *Limnology, *Path of pollutants, *Water pollution effects, *Water resources management, Aquatic productivity, Ecological effects, Ecosystems, Environmental impact, Fish conservation, Organic pollutants, Regulations, Water pollution sources, Water quality management.

In light of ever-increasing demand and multiple use of Lake Ontario resources, a clear understanding of the complex interactions among and between system components is vital. Data from various disciplines were examined to determine some of the long-term trends in Lake Ontario and to suggest some potential causative factors for changes observed over time. Demographic shifts coupled with environmental regulations have played a major role in improving water quality. Decreases in phosphorus and phytoplankton, although corresponding to decreased system loading, also appear to be affected by increases in fish biomass from stocking. Linkages between toxic contaminants and system production are becoming more evident. Interlake comparisons suggest less productive systems are more heavily burdened with toxic reserves than more productive systems. There is also evidence demonstrating long-term persistence of these chemicals in Lake Ontario: indicator organisms in sediment profiles; trace organic contaminants in herring gull eggs and lake trout; and interlake ecosystem cycling. It is evident that natural resource managers must develop a better appreciation for the interconnectedness of water quality and fisheries resources problems associated with managing ecological processes, which are often viewed otherwise in isolation from one another. (See also W91-03672) (Fish-PTT)
W91-03678

CHICAGO AND ITS LAKEFRONT: LIVING ON THE EDGE.
Chicago Shoreline Protection Commission, IL.
For primary bibliographic entry see Field 6G.
W91-03679

FLUCTUATING GREAT LAKES WATER LEVELS: EXPECTATIONS AND THE IJC.
International Joint Commission-United States and Canada, Ottawa (Ontario).
For primary bibliographic entry see Field 6E.
W91-03680

GREAT LAKES WATER LEVELS, PAST, PRESENT, AND FUTURE.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
F. H. Quinn.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 83-92, 5 fig, 3 tab, 15 ref.

Descriptors: *Gaging, *Great Lakes, *Lake management, *Water level fluctuations, *Water resources management, Climatic changes, Consumptive use, Diversion, Glaciation, Global warming, Lake shores, Regulations, Riparian land, Seasonal variation, Storm surges.

The Great Lakes are one of our nation's greatest water resources containing 95% of the nation's and 20% of the world's fresh surface water. At the present time, all of the Great Lakes except for Lake Ontario, are receding from record high lake levels for this century. The high lake levels have had a severe impact upon the riparian interests around the lakes. Storms superimposed on the high lake levels have resulted in extensive flooding, houses destroyed, extreme erosion and bluff damage, marina problems, and a loss of habitat for various forms of wildlife. Historic fluctuations began with the retreat of the glaciers around 11,000 years ago, essentially stabilizing about 3,000 years ago. Gaging began in 1860, showing fluctuations from 183.40 m maximum (Lake Superior) to 73.86 m minimum (Lake Ontario). Seasonal cycles (30 to 45 cm) are superimposed on the annual cycles. Event-related fluctuations include storm surge, wind setup, and pressure jumps. The recorded lake levels include the effects of diversions, lake regulation, modifications to connecting channels, and consumptive use. Present lake levels show a rapid drop in November 1986 following the peak of the past high levels regime in 1986. Future Great Lakes levels scenarios can be developed on the basis of both normal climatic variability and the implication of global climatic warming. Higher lake level sequences could be expected in the future. It is important that policy analysis consider a wide range in water levels rather than concentrating only on the high lake level conditions of the past two decades or on the recent drought conditions. (See also W91-03672) (Fish-PTT)
W91-03681

GREAT LAKES WATER RESOURCES MANAGEMENT.
Corps of Engineers, Chicago, IL. North Central Div.

For primary bibliographic entry see Field 6E.
W91-03682

GREAT LAKES--NATURE'S PLAYGROUND.
Army Engineer District, Detroit, MI.
D. L. Schweiger, and N. Noorbakhsh.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 103-110, 9 fig, 7 ref.

Descriptors: *Climatic effects, *Great Lakes, *Lake management, *Water level fluctuations, *Water resources management, Climatic changes, Evaporation, Forecasting, Meteorology, Precipitation, Weather forecasting.

The Great Lakes and their connecting channels make up the largest body of fresh water in the world, with a total surface area of almost 95,000 square miles. Because of the vast land area and population that is influenced by the Great Lakes, fluctuations in the water levels are always a concern to the riparians and the users of this system. In the last 25 years, the Great Lakes have experienced a broad spectrum of water levels, from the mid-1960s lows to the mid-1970 and mid-1980 highs. Although there are many factors, artificial and natural, which affect lake levels, precipitation and evaporation are the prime causes of lake level fluctuations. Long-term fluctuation in the water levels are the result of persistent periods of wet or dry weather. While seasonal variations are moderately predictable, extreme climatic events and the duration of wet or dry periods are not predictable. Present predictions are based on analyses of historic data, including trends in water supplies to the lakes, antecedent precipitation and temperatures, and weather forecasts one month into the future. More dependable and longer-range weather forecasts would substantially improve the reliability of the lake level forecasts, and better enable management of this massive system. (See also W91-03672) (Fish-PTT)
W91-03683

LAKE SUPERIOR'S HIGH WATER LEVEL AND DAMAGES: A DELICATE BALANCE.
Minnesota Dept. of Natural Resources, St. Paul.
For primary bibliographic entry see Field 6B.
W91-03684

ONTARIO HYDRO IMPACTS ON THE GREAT LAKES--AND VICE VERSA.
Ontario Hydro, Toronto.
For primary bibliographic entry see Field 6G.
W91-03685

TEMPORAL CHANGES IN HEAVY RAINFALL FREQUENCIES IN THE GREAT LAKES BASIN.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2B.
W91-03686

REVIEW OF PUBLIC PARTICIPATION IN THE GREAT LAKES WATER QUALITY AGREEMENT.
League of Women Voters of Michigan, Brighton.
For primary bibliographic entry see Field 6B.
W91-03687

MANAGEMENT APPROACHES WITHIN THE 1987 US/CANADA GREAT LAKES WATER QUALITY AGREEMENT.
Environmental Protection Agency, Chicago, IL. Great Lakes National Program Office.
For primary bibliographic entry see Field 6B.
W91-03688

SIGNIFICANCE OF GIS AND REMOTE SENSING TECHNOLOGY IN GREAT LAKES MONITORING AND RESOURCE MANAGEMENT.
Wisconsin Univ.-Madison. Environmental Remote Sensing Center.
For primary bibliographic entry see Field 7B.
W91-03689

GEOPHYSICAL DETERMINATION OF LAKEBED SEDIMENT HYDRAULIC PROPERTIES.
Wisconsin Univ.-Milwaukee. Dept. of Geosciences.
For primary bibliographic entry see Field 7B.
W91-03690

UNITED STATES NONPOINT SOURCE PHOSPHORUS REDUCTION EFFORT.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5G.
W91-03691

ASSESSMENT OF AGRICULTURAL NONPOINT SOURCE POLLUTION POTENTIALS IN THE CANADIAN GREAT LAKES BASIN.
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 5B.
W91-03692

COLONIAL WATERBIRD DEFORMITIES--AN EFFECT OF TOXIC CHEMICAL RESIDUES IN THE GREAT LAKES.
Ecological Research Service, Inc., Bay City, MI.
For primary bibliographic entry see Field 5C.
W91-03694

PHOSPHORUS LEVELS IN ONTARIO STREAMS TRIBUTARY TO THE GREAT LAKES A DECADE AFTER PLUARG.
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5B.
W91-03695

LAKE MICHIGAN TOXIC POLLUTION CONTROL/REDUCTION STRATEGY.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5G.
W91-03696

LAND-USE CHANGES: EFFECT ON WATER QUALITY IN THE PINE CREEK WATERSHED.
Lapeer County Drain Commission, MI.
For primary bibliographic entry see Field 4C.
W91-03697

GEOHYDROLOGY OF A THIN WATER-TABLE AQUIFER ADJACENT TO LAKE MICHIGAN, NORTHWESTERN INDIANA.
Geological Survey, Indianapolis, IN.
For primary bibliographic entry see Field 2F.
W91-03698

WATER QUALITY IN A THIN WATER-TABLE AQUIFER ADJACENT TO LAKE MICHIGAN, WITHIN A HIGHLY INDUSTRIALIZED REGION OF INDIANA.
Geological Survey, Indianapolis, IN.
For primary bibliographic entry see Field 5B.
W91-03699

DEVELOPMENT OF THE LAKE ONTARIO SPORTFISHERY: SOCIOECONOMIC IMPACTS IN NEW YORK STATE.
New York Sea Grant Extension Program, Oswego.
C. P. Dawson, and M. P. Voiland.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 259-268, 2 tab, 21 ref.

Descriptors: *Great Lakes, *Lake Ontario, *Lake management, *New York, *Recreation, *Sport fishing, *Water resources management, Boating, Economic impact, Ecosystems, Lake fisheries, Recreation demand, Social aspects, Water resources development.

Successful redevelopment of the Lake Ontario sportfishery by the New York State Department of Environmental Conservation began with the salmonid stocking program in 1968. The socioeconomic impacts of the sportfishery's development have not been as carefully monitored as the biological parameters and impacts. Fishery resource rehabilitation success on Lake Ontario stimulated coastal community facility and services development. Large increases in angler participation has spurred the development of the charter boat fishing industry, boater and angler access sites, fishing debris, the opening of new fishery-related businesses, and additional employment. Significant seasonal economic impacts from angler trip expenditures have occurred in many coastal communities. Less positive social and economic impacts are also reported such as trespassing, highway congestion, user conflicts, boating facility shortages, increased demand for community services, seasonal employment, concern for fish contaminants, and increased land values. Dramatic resource rehabilitation has led to increasing expectations by sportfishery constituencies for continued growth. A better assessment of and development for sportfishery user needs are necessary. Future management directions will require a greater consideration of social and economic, as well as biological, dimensions of fishery management to effectively and wisely utilize and protect Great Lakes fishery resources. (See also W91-03672) (Author's abstract)
W91-03700

RECREATIONAL BEACH ENVIRONMENT: PERCEPTIONAL DIFFERENCE OF USERS, EMPLOYEES, AND THE PUBLIC.
State Univ. of New York Coll. at Cortland. Dept. of Recreation and Leisure Studies.
For primary bibliographic entry see Field 6D.
W91-03701

DISCUSSION OF LAKE MICHIGAN RIP CURRENT HAZARDS TO SWIMMERS.
Indiana Dunes National Lakeshore, Porter, IN.
R. G. Littlefield.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 279-284, 2 fig, 3 ref.

Descriptors: *Great Lakes, *Lake Michigan, *Lake management, *Recreation, *Rip currents, *Water resources management, Drowning, Indiana, Public waters, Sandbars, Swimming, Water currents.

The southern shoreline of Lake Michigan provides an estimated 15 million regional people a unique recreational opportunity in the form of some of the finest swimming and bathing beaches in this country. Unfortunately, from time to time, weather and nearshore conditions combine to form deadly rip currents which may be responsible for more than half of the water-related fatalities which occur on Lake Michigan beaches each summer. A rip current has the potential of transporting the unwary swimmer out into the deeper water beyond the reach of the shore very rapidly, usually before the average person can react in a defensive manner, and can cause the swimmer to panic and even drown. Rip currents are formed along the southern shore of Lake Michigan when northerly winds cause waves to break on the shallow nearshore sandbar in rapid succession, causing a current to form in the trough and flow parallel to the beach and toward the lowest part of the sandbar. As the water flows across this low area, it erodes a channel which allows the excess water behind the bar to spill lakeward as a powerful rip current. Ironically, the very forces that create rip currents can save swimmers and rescuers alike if they understand that: once carried beyond the sandbar, the current's strength greatly diminishes into a large slow vortex. A swimmer caught in this current should not attempt to swim shoreward against the current, but should swim to one side or the other and get out of the current to where the incoming

waves will carry them shoreward again. An understanding of the mechanics which cause rip currents can aid managers in reducing public exposure and the potential of liability. Experience gained from actions taken at Indiana Dunes National Lakeshore is readily transferable to other lakeshore situations. (See also W91-03672) (Fish-PTT)
W91-03702

EXCURSION, CRUISE AND PASSENGER FERRY SERVICES ON THE GREAT LAKES AND ST. LAWRENCE RIVER.
Great Lakes Commission, Ann Arbor, MI.
For primary bibliographic entry see Field 6D.
W91-03703

BIOMANIPULATION: RETROSPECTIVE AND FUTURE DEVELOPMENT.
Kinneret Limnological Lab., Tiberias (Israel).
For primary bibliographic entry see Field 5G.
W91-03761

ARE BLUE-GREEN ALGAE A SUITABLE FOOD FOR ZOOPLANKTON: AN OVERVIEW.
Istituto Italiano di Idrobiologia, Pallanza (Italy).
R. de Bernardi, and G. Giussani.
Hydrobiologia HYDRB8, Vol. 200/201, p 29-41, August 27, 1990. 9 fig, 3 tab, 55 ref.

Descriptors: *Algal control, *Cyanophyta, *Diets, *Eutrophic lakes, *Food chains, *Lake restoration, *Limnology, *Zooplankton, Biomanipulation, Bioremediation, Food habits, Water quality management.

One of the reasons suggested to explain the dominance of blue-green algae in eutrophic lakes is that they are not used as food by zooplankton, and even when ingested are poorly utilized. An increase in herbivores might be expected to result from biomanipulation of the aquatic food chain. A series of in-lake experimental results indicates that, after the food chain has been biomanipulated, there is a decrease in blue-green density in periods when there is an increase in herbivores. A question remaining is whether this is an accidental result or whether the two observations are related. The suitability of blue-greens as food for zooplankton has been investigated by many workers, with contrasting and inconclusive results. Two main factors seem to play important roles in determining the suitability of blue-green algae as food: (1) the biochemical properties of the different species, or different strains of the same species, and (2) the shape and size of the colonies. Biochemical properties can cause toxic effects on zooplankton, whereas size and shape may interfere strongly with filtering, thus reducing the possibility of gathering food. (Author's abstract)
W91-03763

EFFECTIVENESS OF PHYTOPLANKTON CONTROL BY LARGE-BODIED AND SMALL-BODIED ZOOPLANKTON.
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5G.
W91-03764

ANALYSIS OF PHYTOPLANKTON-ZOOPLANKTON RELATIONSHIPS IN AN OLIGOTROPHIC LAKE UNDER NATURAL AND MANIPULATED CONDITIONS.
Granada Univ. (Spain). Dept. de Biologia Animal, Ecologia y Genetica.
P. Carrillo, L. Cruz-Pizarro, and P. Sanchez-Castillo.
Hydrobiologia HYDRB8, Vol. 200/201, p 49-58, August 27, 1990. 4 fig, 2 tab, 38 ref. Junta de Andalucia Project 9/88.

Descriptors: *Biocontrol, *Biomanipulation, *Ecosystems, *Lake restoration, *Limnology, *Plankton, *Spain, Chlorophyll a, Food habits, Lake La Caldera, Limiting nutrients, Limnocorrals, Nutrients, Oligotrophic lakes, Phytoplankton, Predation, Water quality management, Zooplankton.

During August, 1987, a series of limnocorral experiments was performed in lake La Caldera (southern Spain), a small winter-kill lake in which phytoplankton is strikingly nutrient-limited. The effects of biomanipulation on zooplankton-phytoplankton relationships was assessed by monitoring both individual species and whole-assemblage responses. Two sizes of enclosures were used (15 and 350 L) and two treatments were examined: (1) removal of zooplankton by 45-micrometer filter net and (2) doubling the natural grazing pressure by increasing the zooplankton concentration. Results show the two enclosure types to differ strikingly: flagellates disappeared from the small enclosures, resulting in four-fold to six-fold changes in chlorophyll a concentration and three-fold to four-fold changes in the number of individuals. Most species were grazed (a prey selectivity based on criteria other than size was observed) and their net growth rate increased with zooplankton concentration, causing a net increase in phytoplankton growth, a stimulatory effect probably related to nutrient regeneration that overrides the losses due to grazing. (Author's abstract)
W91-03765

BIOMANIPULATION BY INTRODUCTION OF HERBIVOROUS ZOOPLANKTON: A HELPFUL SHOCK FOR EUTROPHIC LAKES.
Institut fuer Entwicklung und Forschung Dr. Vielberth K.G., Regensburg (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W91-03766

ZOOPLANKTON-PHYTOPLANKTON INTERFACE IN LAKES OF CONTRASTING TROPHIC STATUS: AN EXPERIMENTAL COMPARISON.
California Univ., Davis. Div. of Environmental Studies.
J. J. Elser, H. J. Carney, and C. R. Goldman.
Hydrobiologia HYDRB8, Vol. 200/201, p 69-82, August 27, 1990. 6 fig, 2 tab, 69 ref. NSF Grant BSR-8801084.

Descriptors: *Algal control, *Biocontrol, *Biomanipulation, *Lake restoration, *Limnology, *Plankton, *Trophic level, Biomass, Bioremediation, California, Castle Lake, Clear Lake, Daphnia, Eutrophic lakes, Food habits, Lake Tahoe, Oligotrophic lakes, Phytoplankton, Zooplankton.

An experimental study was conducted to compare algal responses to short-term biomanipulations of zooplankton in three California lakes that encompass a broad range of productivity (ultra-oligotrophic Lake Tahoe, mesotrophic Castle Lake, and strongly eutrophic Clear Lake). To assess the potential strength of grazing in each lake, algal responses to a 16-fold range of zooplankton biomass were evaluated. Algal responses to Daphnia over a range of Daphnia densities from 1-16 animals/L were compared. Effects of both ambient grazers and Daphnia were strong in Castle Lake. However, neither ambient zooplankton nor Daphnia had much impact on phytoplankton in Clear Lake. In Lake Tahoe, no grazing impacts could be demonstrated for the ambient zooplankton, but Daphnia grazing had dramatic effects. These results indicate weak coupling between phytoplankton and zooplankton in Clear Lake and Lake Tahoe, which lie near opposite extremes of lake trophic status for most lakes. These observations, along with work reported by other researchers, suggest that linkages between zooplankton and phytoplankton may be weak in lakes with either extremely low or high productivity. Biomanipulation approaches to recover hypereutrophic lakes that aim only to alter zooplankton size structure may be less effective if algal communities are dominated by large, inedible phytoplankton taxa. (Author's abstract)
W91-03767

WHY DO CLADOCERANS FAIL TO CONTROL ALGAL BLOOMS.
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5G.
W91-03768

STRUCTURAL AND GRAZING RESPONSES OF ZOOPLANKTON COMMUNITY TO BIOMANIPULATION OF SOME DUTCH WATER BODIES.
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 5G.
W91-03769

BIOMANIPULATION AND FOOD-WEB DYNAMICS: THE IMPORTANCE OF SEASONAL STABILITY.
Norsk Inst. for Vannforskning, Oslo.
B. A. Faafeng, D. O. Hessen, A. Brabrand, and J. P. Nilssen.
Hydrobiologia HYDRB8, Vol. 200/201, p 119-128, August 27, 1990. 4 fig, 2 tab, 23 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Food chains, *Lake restoration, *Limnology, *Norway, *Nutrients, *Seasonal stability, Biomass, Cyanophyta, Daphnia, Enclosures, Fish, Food habits, Lake management, Lakes, Long-term studies, Monitoring, Nitrogen, Phosphorus, Phytoplankton, Roach, Water quality management.

Responses of phytoplankton biomass were monitored in pelagic enclosures subjected to manipulations with nutrients (+N/P), planktivore roach (Rutilus rutilus), and large grazers (Daphnia) in 18 bags during spring, summer, and autumn in mesotrophic Lake Gjersjoen (Norway). In general, the seasonal effects on phytoplankton biomass were more marked than the effects of biomanipulation. Primary top-down effects of fish on zooplankton were conspicuous in all bags, whereas control of phytoplankton growth by grazing was observed only in the nutrient-limited summer situation. The effect of nutrient additions was pronounced in summer, less in spring and autumn; additions of fish gave the most pronounced effect in spring. The phytoplankton/zooplankton biomass ratio remained high (10-100) in bags with fish, with the highest ratios in combination with fertilization. The ratio decreased in bags without fish to < 2 in most bags, but real grazing control was observed only in bags with addition of Daphnia. No direct grazing effects were observed on the absolute or relative biomass of cyanobacteria (mainly Oscillatoria aghardhii). The share of cyanobacteria in total phytoplankton biomass was lowest in summer (7-26%), higher in spring (39-63%) and more than 90% in the autumn experiment. The development of the cyanobacterial biomass was rather synchronous in all bags in all the three experiments. A high biomass of Daphnia gave no increase in the pool of dissolved nutrients in spring, a slight increase in summer and a pronounced increase in autumn. While a strong decrease in the P/C-cell quota of the phytoplankton was observed from spring to autumn, no effect of grazing or nutrient release could be related to this P/C status. The experiments indicate that such systems, with high and stable densities of inedible cyanobacteria, are rather insensitive to short-term (3-4 wk) biomanipulation efforts. This is supported by observations on the long-term development of the lake. (Author's abstract)
W91-03770

IMPACT OF WHITEFISH ON AN ENCLOSURE ECOSYSTEM IN A SHALLOW EUTROPHIC LAKE: SELECTIVE FEEDING OF FISH AND PREDATION EFFECTS ON ZOOPLANKTON COMMUNITIES.
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
T. Hanazato, T. Iwakuma, and H. Hayashi.
Hydrobiologia HYDRB8, Vol. 200/201, p 129-140, August 27, 1990. 4 fig, 2 tab, 41 ref. Ministry of Education, Science and Culture, Japan, Grants-in-Aid for Special Project Research 60129034 and 61134044.

Descriptors: *Eutrophic lakes, *Lake management, *Limnology, *Predation, Biomanipulation, Bioremediation, Crustaceans, Ecosystems, Enclosures, Food habits, Midges, Performance evaluation, Rotifers, Whitefish, Zooplankton.

Bag-type enclosures (75 cu m) with bottom sheets and tube-type enclosures (105 cu m), open to the bottom sediment, were stocked with exotic white-

fish (Coregonus lavaretus maraena) to study their predation effects on the plankton community. The fish fed mainly on adult chironomids during the period of their emergence (earlier part of the experimental period). Thereafter, the food preference was shifted to larvae of chironomids and crustacean zooplankters. The predation effects on the plankton community were not evident in the bag-type enclosures where zooplankton densities were consistently low. The fish reduced the crustacean populations composed of Bosmina fatalis, B. longirostris, and Cyclops vicinus, in the tube-type enclosures where the prey density was high (above ca. 50 individuals/L). The results suggested that the intensity of predation depended on the prey density. Rotifers increased in the fish enclosure, probably because Coregonus reduced the predation pressure by Cyclops vicinus on rotifers and allowed the latter to increase. In the fish enclosures no marked changes in species composition were observed. Zooplankton predated by the fish seemed to be distributed near the walls of the enclosures. Enclosure experiments for examining the effects of fish predation on pelagic zooplankton communities have various problems, such as changing the feeding habits of fish. (See also W91-03772) (Author's abstract)
W91-03771

IMPACT OF WHITEFISH ON AN ENCLOSURE ECOSYSTEM IN A SHALLOW EUTROPHIC LAKE: CHANGES IN NUTRIENT CONCENTRATIONS, PHYTOPLANKTON AND ZOOBENTHOS.
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
T. Iwakuma, H. Hayashi, I. Yasuda, T. Hanazato, and K. Takada.
Hydrobiologia HYDRB8, Vol. 200/201, p 141-152, August 27, 1990. 6 fig, 1 tab, 45 ref. Ministry of Education, Science and Culture, Japan, Grants-in-Aid for Special Project Research 60129034 and 61134044.

Descriptors: *Eutrophic lakes, *Japan, *Lake Suwa, *Lake management, *Limnology, Benthos, Biomanipulation, Bioremediation, Crustaceans, Ecosystems, Enclosures, Food habits, Midges, Performance evaluation, Rotifers, Whitefish, Zooplankton.

Large bag-type (75 cu m) and tube-type (105 cu m) enclosures were set up in the shallow, eutrophic Lake Suwa (Japan) and were each stocked with exotic planktivorous whitefish (Coregonus lavaretus maraena). The release of whitefish caused an increase in nutrient concentration in the tube-type enclosure whereas no such increase was observed in the bag-type enclosure. Bottom sediment seemed to be an important source of chironomid food for whitefish. The proportion of phytoplankton measuring < 10 micrometer and 20-40 micrometer, which respectively corresponded to Ochromonas species and Cryptomonas species, was lower in the fish enclosures than in the control, which might have been caused by high grazing pressure by rotifers. The predation by whitefish might have affected the species composition of phytoplankton through reducing copepod predation on rotifers, not through reducing the densities of cladocerans which directly feed on phytoplankton as many investigators have reported. The phytoplankton biomass was not affected much by the release of fish. Possible reasons are that the increase in density of rotifers reduced the biomass of available phytoplankton and that inedible Cyanophyceae were in the decreasing phase of their seasonal succession and could not increase successfully in spite of elevated nutrient levels. (See also W91-03771) (Author's abstract)
W91-03772

FADING RECOVERY: THE ROLE OF ROACH (RUTILUS RUTILUS L.) IN MAINTAINING HIGH PHYTOPLANKTON PRODUCTIVITY AND BIOMASS IN LAKE VESIJARVI, SOUTHERN FINLAND.
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
For primary bibliographic entry see Field 5G.
W91-03773

BOTTOM-UP EFFECTS OF BREAM (ABRAMIS BRAMA L.) IN LAKE BALATON.
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
I. Tatrai, G. Toth, J. E. Ponyi, J. Zlinskzky, and V. Istvanovics.
Hydrobiologia HYDRB8, Vol. 200/201, p 167-175, August 27, 1990. 9 fig, 3 tab, 17 ref.

Descriptors: *Algal control, *Food chains, *Hungary, *Lake Balaton, *Lake restoration, *Limnology, Bacteria, Bream, Crustaceans, Eutrophic lakes, Fish, Phytoplankton, Trophic level, Water quality management.

Enclosures (17 cu m) were used in the mesotrophic area of Lake Balaton (Hungary) to determine the impact of benthivorous bream (Abramis brama L.) on the lower trophic levels during the summers of 1984-1986. In enclosures with a fish biomass similar to the biomass in the eutrophic area of the lake, the number of phytoplankton species was highest. In enclosures with a low fish biomass, the phytoplankton was dominated by the greens. A high biomass of bream in the mesotrophic basin caused bacterial production corresponding to that of the eutrophic part of the lake. Crustaceans were dominated by copepods and were unable to control phytoplankton peaks. Bottom-up effects of bream were more obvious than top-down effects and seem to be more important in the possible control of water quality. (Author's abstract)
W91-03774

APPLICABILITY OF PLANKTONIC BIOMANIPULATION FOR MANAGING EUTROPHICATION IN THE SUBTROPICS.
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5G.
W91-03775

CONDITIONS FOR EFFECTIVE BIOMANIPULATION: CONCLUSIONS DERIVED FROM WHOLE-LAKE EXPERIMENTS IN EUROPE.
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 5G.
W91-03776

FISH MANIPULATION AS A LAKE RESTORATION TOOL IN SHALLOW, EUTROPHIC TEMPERATE LAKES: 1. CROSS-ANALYSIS OF THREE DANISH CASE-STUDIES.
National Environmental Research Inst., Silkeborg (Denmark). Div. of Freshwater Ecology.
For primary bibliographic entry see Field 5G.
W91-03777

FISH MANIPULATION AS A LAKE RESTORATION TOOL IN SHALLOW, EUTROPHIC, TEMPERATE LAKES 2: THRESHOLD LEVELS, LONG-TERM STABILITY AND CONCLUSIONS.
National Environmental Research Inst., Silkeborg (Denmark). Div. of Freshwater Ecology.
For primary bibliographic entry see Field 5G.
W91-03778

PHYTOPLANKTON BIOMASS REDUCTION AFTER PLANKTIVOROUS FISH REDUCTION IN A SHALLOW, EUTROPHIC LAKE: A COMBINED EFFECT OF REDUCED INTERNAL P-LOADING AND INCREASED ZOOPLANKTON GRAZING.
National Environmental Research Inst., Silkeborg (Denmark). Div. of Freshwater Ecology.
For primary bibliographic entry see Field 5G.
W91-03779

ECOLOGICAL CONSEQUENCES OF A MANUAL REDUCTION OF ROACH AND BREAM IN A EUTROPHIC, TEMPERATE LAKE.
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
For primary bibliographic entry see Field 5G.
W91-03780

PREDICTABILITY AND POSSIBLE MECHANISMS OF PLANKTON RESPONSE TO REDUCTION OF PLANKTIVOROUS FISH.
Oslo Univ. (Norway). Dept. of Limnology.
For primary bibliographic entry see Field 5G.
W91-03781

OLIGOTROPHICATION AS A RESULT OF PLANKTIVOROUS FISH REMOVAL WITH ROTENONE IN THE SMALL, EUTROPHIC, LAKE MOSVATN, NORWAY.
Rogalandsforskning, Stavanger (Norway). Aquaculture and Water Research Group.
For primary bibliographic entry see Field 5G.
W91-03782

WHOLE-LAKE FOOD-WEB MANIPULATION AS A MEANS TO STUDY COMMUNITY INTERACTIONS IN A SMALL ECOSYSTEM.
Water Board of Utrecht (Netherlands).
E. van Donk, M. P. Grimm, R. D. Gulati, and J. P. G. Klein Breteler.
Hydrobiologia HYDRB8, Vol. 200/201, p 275-289, August 27, 1990. 5 fig, 4 tab, 42 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Food chains, *Lake management, *Lake restoration, *Limnology, *The Netherlands, *Water quality control, Chlorophyll a, Chlorophyta, Cyanophyta, Denitrification, Lake Zwemlust, Macrophytes, Nitrogen, Nutrients, Phosphorus, Phytoplankton, Public health, Recreation, Snails, Submerged plants, Swimming, Trophic level, Zooplankton.

Whole-lake food web manipulation was carried out in the hypertrophic Lake Zwemlust (The Netherlands) to study the effects on the lake's trophic status and to gain an insight into complex interactions among lake communities. Before manipulation this small (1.5 ha) and shallow (1.5 m) lake was characterized by Microcystis blooms in summer and high chlorophyll-a concentrations were common (about 250 microgram/L). In March 1987 the planktivorous and benthivorous fish species in the lake were completely removed, a new simple fish community (pike and rudd) was introduced, and artificial refuges were created. Light, climate, nutrient concentrations, phytoplankton, zooplankton, fish, macrophytes, and macrofauna were monitored during 1987, 1988, and 1989. After the manipulation, despite the still high P and N loads to the lake (about 2.2 g P/sq m/yr and about 5.3 g N/sq m/yr), the phytoplankton density was low (chlorophyll-a < 5 microgram/L), due to control by large zooplankton in spring and N-limitation in summer and autumn. A marked increase in the abundance of macrophytes and filamentous green algae in 1988 and 1989, as well as N loss due to denitrification, contributed to the N limitation of the phytoplankton. Before manipulation no submerged macro-vegetation was present, but in 1988, about 50% of the lake bottom was covered by macrophytes, increasing to 80% in 1989. This led to substantial accumulation of both N and P, namely 76% and 73%, respectively, of the total nutrients in the lake in particulate matter. The increase in macrophytes caused: (1) direct nuisance to swimmers and (2) the large-scale development of snails, especially Lymnaea peregra, which may harbor the parasite causing 'swimmers' itch.' Harvesting only about 3% of the total macrophyte biomass from the swimmers' area, twice a year, reduced this nuisance without adversely affecting the water clarity. (Author's abstract)
W91-03783

FIRST ATTEMPT TO APPLY WHOLE-LAKE FOOD-WEB MANIPULATION ON A LARGE SCALE IN THE NETHERLANDS.
Water Board of Utrecht (Netherlands).
For primary bibliographic entry see Field 5G.
W91-03784

IS REDUCTION OF THE BENTHIVOROUS FISH AN IMPORTANT CAUSE OF HIGH TRANSPARENCY FOLLOWING BIOMANIPULATION IN SHALLOW LAKES.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
M. L. Meijer, M. W. de Haan, A. W. Breukalaar, and H. Buiteveld.
Hydrobiologia HYDRB8, Vol. 200/201, p 303-315, August 27, 1990. 9 fig, 2 tab, 36 ref.

Descriptors: *Algal control, *Biocontrol, *Biomanipulation, *Fish management, *Lake restoration, *Limnology, *Netherlands, *Suspended sediments, *Transparency, Algae, Biomass, Bioremediation, Chlorophyll a, Detritus, Fish, Model studies, Shallow water, Turbidity.

Experimental reduction of the fish stock in two shallow lakes in The Netherlands shows that such a biomanipulation can lead to a substantial increase in transparency, which is caused not only by a decrease in algal biomass, but by a decrease in resuspended sediment and detritus. A model was developed to describe transparency in relation to chlorophyll-a and inorganic, suspended solids (resuspended sediment). The use of this model showed that more than 50% of the turbidity in these shallow lakes before biomanipulation was determined by sediment resuspension, mainly caused by benthivorous fish. Another analysis reveals that the concentration of inorganic suspended solids and the biomass of benthivorous fish are positively correlated, and that even in the absence of algae a benthivorous fish biomass of 600 kg/ha can reduce the Secchi depth to 0.4 m in shallow lakes. In addition, algal biomass also appeared to be reduced indirectly by removal of benthivorous fish. Reduction of benthivorous fish is necessary to get macrophytes and macrophytes seem necessary to keep the algal biomass low in nutrient-rich shallow lakes. It is concluded that the impact of benthivorous fish on the turbidity can be large, especially in shallow lakes. (Author's abstract)
W91-03785

EARLY RESPONSES OF PLANKTON AND TURBIDITY TO BIOMANIPULATION IN A SHALLOW WATER PRAIRIE LAKE.
North Dakota State Univ., Fargo. Dept. of Zoology.
For primary bibliographic entry see Field 5G.
W91-03786

EFFECTS OF PLANKTIVOROUS FISH MASS MORTALITY ON THE PLANKTON COMMUNITY OF LAKE MENDOTA, WISCONSIN: IMPLICATIONS FOR BIOMANIPULATION.
Wisconsin Univ.-Madison. Center for Limnology.
M. J. Vanni, C. Luecke, J. F. Kitchell, and J. J. Magnuson.
Hydrobiologia HYDRB8, Vol. 200/201, p 329-336, August 27, 1990. 2 fig, 1 tab, 17 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Fishkill, *Lake restoration, *Limnology, *Plankton, Daphnia, Lake Mendota, Lake management, Nutrients, Phosphorus, Phytoplankton, Seasonal distribution, Wisconsin, Zooplankton.

Massive mortality of planktivorous fish had a dramatic impact on plankton community dynamics of Lake Mendota, Wisconsin. After fish mortality, the larger Daphnia pulicaria replaced the smaller Daphnia galeata mendotae, resulting in greater grazing pressure on the phytoplankton. This was accomplished by a much longer spring clear-water period and lower summer phytoplankton biomass compared to years before the fish mortality. Analysis of historical data (from the mid-1970s) showed that previous fluctuations in planktivorous abundance had similar effects on Daphnia abundance and species composition and on summer phytoplankton biomass. However, the mid-1970s fish fluctuations had no detectable effect on summer phytoplankton. Concentrations of P were much higher in the 1970s (spring P 80-135 microgram/L) than in the 1980s (spring P 19-36 microgram/L) and it is possible that high P concentrations may reduce trophic cascade effects on summer phytoplankton communities. This suggests that the success of biomanipulation programs may depend on lake nutrient status. (Author's abstract)
W91-03787

EFFECTS OF PLANKTIVORE ABUNDANCE ON CHLOROPHYLL-A AND SECCHI DEPTH.
York Univ., North York (Ontario). Dept. of Biology.
D. J. McQueen, M. R. S. Johannes, N. R. Lafontaine, A. S. Young, and E. Longbotham.
Hydrobiologia HYDRB8, Vol. 200/201, p 337-341, August 27, 1990. 3 fig, 1 tab, 28 ref.

Descriptors: *Biocontrol, *Food chains, *Limnology, *Transparency, Chlorophyll a, Fish, Fish diets, Lake management, Nutrients, Phosphorus, Statistics.

Two analyses were used to test the hypothesis that planktivore abundances contribute to the residual variation of Secchi depth or chlorophyll-a plotted with respect to mean summer epilimnetic total P. The first analysis involved 15 lake years of data from six lakes. The data set comprised mark-recapture assessment of piscivore and planktivore numbers and estimates of mean summer chlorophyll-a, total P, and Secchi depth. Residual chlorophyll-a variation was not significantly ($p > 0.05$) correlated with planktivore densities, but planktivore densities did contribute ($p < 0.02$) to the residual variation of Secchi depth on mean total P. The second analysis included all of the data used in the first analysis plus an additional 13 lake years of data from the literature. These data showed that the percentage of the total fish community comprising planktivores did not contribute significantly ($p > 0.05$) to the residual variation in chlorophyll-a with respect to mean summer total P. Together, these results suggest that planktivore abundance has a significant cascading impact on water clarity, but no longer term statistically significant impact on mean summer chlorophyll-a concentrations. (Author's abstract)
W91-03788

FACTORS RELATED TO VARIANCE OF RESIDUALS IN CHLOROPHYLL-TOTAL PHOSPHORUS REGRESSIONS IN LAKES AND RESERVOIRS IN ARGENTINA.
Instituto Nacional de Investigacion y Desarrollo Pesquero, Mar del Plata (Argentina).
R. Quiros.
Hydrobiologia HYDRB8, Vol. 200/201, p 343-355, August 27, 1990. 4 fig, 5 tab, 55 ref. Consejo Nacional de Investigaciones Cientificas y Tecnicas Grant PID 3-017400/85.

Descriptors: *Argentina, *Chlorophyll, *Limnology, *Phosphorus, *Primary productivity, Biomass, Dissolved oxygen, Fish, Food chains, Lakes, Macrophytes, Plankton, Regression analysis, Reservoirs, Sediment-water interfaces, Statistical analysis, Submerged plants, Zooplankton.

Data from an extensive mid-summer survey of Argentinian lakes and reservoirs were used to study the effects of variability in internal processes on the residual variance in chlorophyll-total phosphorus (CHL-TP) regression models. These effects were compared with those related to the external characteristics of lakes, e.g., climate, morphometry, and nutrient status. Zooplanktivorous fish biomass, mean macrozooplankton size, dissolved oxygen at the sediment-water interface, and submersed macrophyte development, were shown to be significant in explaining residual variance in CHL-TP for Argentinian lakes and reservoirs. The results suggest that those variables have discontinuous or threshold effects on CHL-TP residuals among lakes. Significant differences also were shown between CHL-TP regressions for lakes with and without zooplanktivorous fish and for lakes with small or large macrozooplankton. Lakes with zooplanktivorous fish, small body size macrozooplankton, and very low hypolimnetic oxygen also have higher chlorophyll levels than predicted from CHL-TP regression models. (Author's abstract)
W91-03789

THREE YEARS OF EXPERIENCE IN BIOMANIPULATING A SMALL EUTROPHIC LAKE: LAGO DI CANDIA (NORTHERN ITALY).
Istituto Italiano di Idrobiologia, Pallanza (Italy).
For primary bibliographic entry see Field 5G.
W91-03790

ENGINEERING AND BIOLOGICAL APPROACHES TO THE RESTORATION FROM EUTROPHICATION OF SHALLOW LAKES IN WHICH AQUATIC PLANT COMMUNITIES ARE IMPORTANT COMPONENTS.
Liverpool Univ. (England). Dept. of Environmental and Evolutionary Biology.
For primary bibliographic entry see Field 5G.
W91-03791

POTENTIAL OF ARTIFICIAL REFUGIA FOR MAINTAINING A COMMUNITY OF LARGE-BODIED CLADOCERA AGAINST FISH PREDATION IN A SHALLOW EUTROPHIC LAKE.
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5G.
W91-03792

ECOSYSTEM DEVELOPMENT IN DIFFERENT TYPES OF LITTORAL ENCLOSURES.
Agricultural Univ., Wageningen (Netherlands). Dept. of Nature Conservation.
J. E. Vermaat, M. J. M. Hootsmans, and G. M. van Dijk.
Hydrobiologia HYDRB8, Vol. 200/201, p 391-398, August 27, 1990. 7 fig, 1 tab, 27 ref.

Descriptors: *Aquatic plants, *Biocontrol, *Biomanipulation, *Enclosures, *Lake restoration, *Limnology, *Macrophytes, *Netherlands, Biomass, Bioturbation, Chara, Daphnia, Fish, Lake Veluwe, Potamogeton, Rotifers, Sediments, Seston.

Macrophyte growth was studied in two enclosure types (gauze and polythene) in a homogeneous Potamogeton pectinatus bed in Lake Veluwe (The Netherlands). The gauze was expected to allow for sufficient exchange within the lake to maintain similar seston densities, whereas the polythene was expected to exclude fish activity and most water exchange. Polythene enclosures held higher P. pectinatus biomass (ash-free dry weight, AFDW) than the lake, and gauze enclosures were intermediate. The enclosures had a higher abundance of other macrophyte species (Chara sp., Potamogeton pusillus) than the lake. Seston ash content was not decreased, but seston AFDW and periphyton ash content and AFDW were lower in polythene than in gauze enclosures. The difference in plant biomass between gauze and polythene may be attributed to a difference in periphyton density and in seston AFDW due to zooplankton grazing; rotatoria and Daphnia densities were higher in polythene enclosures. Since seston and periphyton AFDW and ash content were similar in lake and gauze enclosures, the intermediate macrophyte biomass in the gauze enclosures may be explained by reduced wave action and mechanical stress. Alternatively, phytoplankton inhibition by allelopathic excretions from the macrophytes may have caused the high macrophyte biomass in the polythene, and an absence of sediment-disturbing fish the intermediate biomass in the polythene, and an absence of sediment-disturbing fish the intermediate biomass in the gauze enclosures. Creation of sheltered areas may favor macrophyte growth through both mechanisms. It is concluded that this can be an important tool in littoral biomanipulation. (Author's abstract)
W91-03793

CAN MACROPHYTES BE USEFUL IN BIOMANIPULATION OF LAKES: THE LAKE ZWEMLUST EXAMPLE.
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5G.
W91-03794

BIOMANIPULATION OF LAGO DI CANDIA (NORTHERN ITALY): A THREE-YEAR EXPERIENCE OF AQUATIC MACROPHYTE MANAGEMENT.
Istituto Italiano di Idrobiologia, Pallanza (Italy).
For primary bibliographic entry see Field 5G.
W91-03795

IMPACT OF MECHANICAL DEWEEDING ON DAL LAKE ECOSYSTEM.
Kashmir Univ., Srinagar (India). Centre of Research for Development.
For primary bibliographic entry see Field 5G.
W91-03796

PROPOSALS FOR MACROPHYTE RESTORATION IN EUTROPHIC COASTAL LAGOONS.
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 5G.
W91-03797

ZEBRA MUSSELS (DREISSENA POLYMORPHA): A NEW PERSPECTIVE FOR WATER QUALITY MANAGEMENT.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
For primary bibliographic entry see Field 5G.
W91-03798

SHOALS OF DREISSENA POLYMORPHA AS A BIO-PROCESSOR OF SESTON.
Nicholas Copernicus Univ. of Torun (Poland). Inst. of Biology.
For primary bibliographic entry see Field 5G.
W91-03799

EVALUATION OF CHAOBORUS PREDATION ON NATURAL POPULATIONS OF HERBIVOROUS ZOOPLANKTON IN A EUTROPHIC LAKE.
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
K. Christoffersen.
Hydrobiologia HYDRB8, Vol. 200/201, p 459-466, August 27, 1990. 5 fig, 2 tab, 30 ref. National Science Research Council (Denmark) Grant 11-6934.

Descriptors: *Biomanipulation, *Eutrophic lakes, *Food chains, *Lake management, *Lake restoration, *Limnology, *Predation, *Zooplankton, Daphnia, Denmark, Enclosures, Frederiksborg Slotsso, Migration, Seasonal variation.

The effect of Chaoborus predation on natural zooplankton communities was tested in enclosure experiments during June, July, and August in the eutrophic Frederiksborg Slotsso, Denmark. Natural densities of Chaoborus larvae in enclosures reduced the abundance of copepod nauplii and Chydorus sphaericus up to 60% and 80%, respectively, compared with controls. In contrast, Chaoborus was not able to suppress populations of Eudiaptomus graciloides Daphnia cucullata. Predation was strongest during June and decreased thereafter as Chaoborus pupae emerged. Laboratory experiments showed that a considerable part (20-30% of the population/day) of Chaoborus larvae emerged as pupae at 18-20 C in July and August. Chaoborous larvae occurred in the lake as migratory individuals from May to September with mean population densities of about 100 larvae/sq m. Results from the enclosure experiments suggest that the populations of herbivorous zooplankton in Frederiksborg Slotsso during June, July, and August are not controlled by natural populations of Chaoborous. (Author's abstract)
W91-03800

HYDROPHYTE-MACROINVERTEBRATE INTERACTIONS IN ZWEMLUST, A LAKE UNDERGOING BIOMANIPULATION.
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
For primary bibliographic entry see Field 5G.
W91-03801

MULTIPLICITY OF STABLE STATES IN FRESHWATER SYSTEMS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
M. Scheffer.
Hydrobiologia HYDRB8, Vol. 200/201, p 475-486, August 27, 1990. 8 fig, 28 ref.

Descriptors: *Biomanipulation, *Bioremediation, *Ecosystems, *Lake restoration, *Lakes, *Limnology, *Model studies, Eutrophication, Nutrients, Water pollution treatment.

The presence of multiple equilibria in an ecosystem can cause the system to show hysteresis or sudden jumps, rather than responding smoothly to changes in external factors. The properties have important implications for management of such systems. Minimal models were employed to show that several ecological relationships in freshwater systems potentially give rise to the existence of alternative equilibria over a certain range of nutrient values. An important consequence is that signs of eutrophication are apparent only after the occurrence of changes that are very difficult to reverse. Reduction of the nutrient level as a measure to restore such systems gives poor results, but biomanipulation as an additional measure can have significant effects, provided that the nutrient level has been reduced enough to allow the existence of a stable alternative clear water equilibrium. (Author's abstract)
W91-03802

QUANTIFYING THE FOOD WEBS OF LAKE BLEISWIJKSE ZOOM AND LAKE ZWEMLUST.
Waterloopkundig Lab. te Delft (Netherlands).
A. H. Bakema, W. J. Rip, M. W. de Haan, and F. J. Los.
Hydrobiologia HYDRB8, Vol. 200/201, p 487-495, August 27, 1990. 3 fig, 2 tab, 13 ref.

Descriptors: *Biocontrol, *Biomass, *Computer models, *Food chains, *Limnology, *Model studies, *Netherlands, Biomanipulation, Detritus, Diets, Lake Bleiswijkse Zoom, Lake Zwemlust, Trophic level.

Data on biomass levels from two lakes in the Netherlands, Lake Bleiswijkse Zoom and Lake Zwemlust, on which biomanipulation experiments are being carried out, were compared with some physiological properties of the species present at different trophic levels. These properties include the daily ration and metabolic fraction of heterotrophic species, natural mortality rate and autolysis fraction of primary producers, rate of detritus mineralization, and digestibility of all species. Mean biomass levels during the year were calculated directly from measurements. These combined data were used to see if a consistent description of the food web could be produced, by letting a computer model search for a balanced food web that corresponds most closely to the measurements. The computer model relates the present biomass of species at different trophic levels, by constructing balance equations for the amount of biomass present at each trophic level, using the physiological properties of the species. Results include estimates of production levels, diet composition, and detritus production for species at all trophic levels. (Author's abstract)
W91-03803

BIOMANIPULATION ADDITIONAL TO NUTRIENT CONTROL FOR RESTORATION OF SHALLOW LAKES IN THE NETHERLANDS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
For primary bibliographic entry see Field 5G.
W91-03804

BIOMANIPULATION DEVELOPMENT IN NORWAY.
Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway).
For primary bibliographic entry see Field 5G.
W91-03805

REVIEW: LIMNOLOGICAL MANAGEMENT AND BIOMANIPULATION IN THE LONDON RESERVOIRS.
Royal Holloway and Bedford New Coll., Egham (England). Dept. of Biology.
For primary bibliographic entry see Field 5G.
W91-03806

POTENTIAL FOR BIOMANIPULATION USING FRY COMMUNITIES IN A LOWLAND RESERVOIR: CONCORDANCE BETWEEN WATER QUALITY AND OPTIMAL RECRUITMENT.
Lodz Univ. (Poland). Inst. of Environmental Biology.
For primary bibliographic entry see Field 5G.
W91-03807

RESTORATION OF SHALLOW EUTROPHIC LAKES, AND THE ROLE OF NORTHERN PIKE, AQUATIC VEGETATION, AND NUTRIENT CONCENTRATION.
Witteveen and Bos, Deventer (Netherlands).
For primary bibliographic entry see Field 5G.
W91-03808

EFFECTS OF PLANKTIVOROUS FISHES ON THE PLANKTON COMMUNITY IN A EUTROPHIC LAKE.
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
T. Miura.
Hydrobiologia HYDRB8, Vol. 200/201, p 567-579, August 27, 1990. 3 fig, 4 tab, 27 ref. Japanese Ministry of Education, Science, and Culture Grants-in-Aid 58041037, 59043033, 60041038, 61043034, 62041050, and 63043038.

Descriptors: *Biocontrol, *Biomanipulation, *China, *Eutrophic lakes, *Food chains, *Lake restoration, *Limnology, Carp, Chlorophyll a, Chlorophyta, Computer models, Cyanophyta, Donghu Lake, East Lake, Ecosystems, Model studies, Phytoplankton, Zooplankton.

Stocking silver carp, a phytoplankton feeder, and bighead carp, an omnivorous plankton feeder, at high densities in a eutrophic lake (East Lake or Donghu Lake, China) caused a dramatic change in the lake ecosystem. Microcystis, which had been dominant in summer and a main food of the fishes, decreased markedly and green algae smaller than 10 micrometers then became dominant. Chlorophyll-a per unit area decreased slightly, while the rate of production was higher than in previous years. As the total density of the fishes increased (0.09 to 0.11 fish/sq m), the growth of silver carp was retarded, whereas that of bighead carp increased. Microcystis was unable to become dominant due to increased grazing pressure by the fishes, and small green algae became dominant. The lake conditions became more favorable for zooplankters, which selectively consumed small green algae, and accordingly, the production of zooplankton rose. Bighead carp consumed more animal food, which they assimilate at a higher rate than plant food, and grew better in spite of the fact that the fish density increased. The feeding rate of silver carp was greatly reduced because the green algae were too small to ingest, and the fish therefore grew poorly. Results of a computer simulation of a model consisting of five compartments, representing the blue-green algae, green algae, zooplankton, silver carp, and bighead carp, support the food web change observed in the lake. (Author's abstract)
W91-03809

EXPERIMENTAL STUDY OF THE IMPACTS OF PLANKTIVOROUS FISHES ON PLANKTON COMMUNITY AND EUTROPHICATION OF A TROPICAL BRAZILIAN RESERVOIR.
Companhia de Agua e Esgotos de Brasilia (Brazil). Secao de Estudos de Poluicao Hidrica.
For primary bibliographic entry see Field 5G.
W91-03810

SOME POSITIVE AND NEGATIVE EFFECTS OF STOCKING WHITEFISH ON THE ECOSYSTEM REDEVELOPMENT OF HJARBAEK FJORD, DENMARK.
Viborg Amtskommune (Denmark). Environmental Dept.
For primary bibliographic entry see Field 5G.
W91-03811

ZOOPLANKTON IMPACTS ON CHLOROPHYLL AND TRANSPARENCY IN ONONDAGA LAKE, NEW YORK.
Michigan Technological Univ., Houghton. Dept. of Civil and Environmental Engineering.
M. T. Auer, M. L. Storey, S. W. Effler, N. A. Auer, and P. Sze.
Hydrobiologia HYDRB8, Vol. 200/201, p 603-617, August 27, 1990. 8 fig, 47 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Lake restoration, *Limnology, *Onondaga Lake, *Phytoplankton, *Transparency, *Zooplankton, Algae, Chlorophyll, Crustaceans, Fish, Food chains, New York, Phosphorus, Seasonal distribution.

The transparency of polluted, hypereutrophic Onondaga Lake, New York, has improved substantially in the late 1980s as a result of reductions in phytoplankton biomass in the absence of significant reductions in external phosphorus loading. Much of this improvement has been due to the occurrence of clearing events, e.g., sudden and dramatic increases in transparency. Field measurements, laboratory experiments, and modelling analyses were employed to identify processes regulating phytoplankton standing crop during the spring to fall interval of 1987. Changes in the zooplankton community documented over the past decade support the conclusion that increased zooplankton grazing has contributed to improvements in transparency. Herbivores now represent a greater fraction of the zooplankton population and more efficient cladocerans are present in greater numbers. Biomanipulation practices designed to reduce the abundance of planktivorous fish in Onondaga Lake, e.g., reestablishment of piscivorus species, may reduce pressure on the grazing community and thus result in further improvements in transparency. (Author's abstract)
W91-03812

RESPONSES OF PERIPHYTON TO CHANGES IN CURRENT VELOCITY, SUSPENDED SEDIMENT AND PHOSPHORUS CONCENTRATION.
Washington Univ., Seattle. Dept. of Civil Engineering.
R. R. Horner, E. B. Welch, M. R. Seeley, and J. M. Jacoby.
Freshwater Biology FWBLAB, Vol. 42, No. 2, p 215-232, October 1990. 10 fig, 2 tab, 43 ref. NSF Grant CEE-8304731.

Descriptors: *Algae, *Current velocity, *Limiting nutrients, *Limnology, *Nutrients, *Periphyton, *Phosphorus, *Stream ecology, *Suspended sediments, Biomass, Chlorophyta, Community structure, Cyanophyta, Diatoms.

Research was performed in laboratory streams to evaluate periphytic biomass accrual, export, and community composition over a range of limiting nutrient (phosphorus) concentrations with variable velocity, and suspended sediment addition, in comparison to constant velocity and no suspended sediment. In fixed-velocity treatments, a velocity increase to 60 cm/s significantly enhanced biomass accrual, but further increases resulted in substantial biomass reduction. Diatoms were favored at relatively high velocities and low phosphorus concentrations, whereas the blue-green Phormidium tended to dominate at higher soluble reactive phosphorus (SRP) concentrations and the green Mougeotia seemed to prefer lower velocities. Sudden increases in velocity raised instantaneous loss rates by an order of magnitude or more, but these high rates persisted only briefly. As a result, marked biomass reductions were not apparent a day after the velocity change. Dominance changes from filamentous green or blue-green to diatoms immediately after the increase were reversed within two days. Loss rate increases due to solids addition were much smaller than those accompanying velocity increases, but simultaneous velocity elevation and solids addition produced instantaneous loss rates approximately double those with velocity increases alone. Areal uptake rates of P by algae growing in the laboratory streams increased with SRP concentrations up to approximately 15 microg/L in overlying water. They also increased above 35 cm/s. Overall, uptake rate seemed to vary inversely with biomass. The results suggested that although nutrient uptake is primarily a surface phenomenon, diffusion to interior cells can also determine the responses of attached communities. Both diffusion and uptake rate were stimulated by increasing nutrient concentration and velocity up to certain levels, but became limited by biofilm thickness and scouring. (Author's abstract)
W91-03820

TOXICITY OF A SOLUBLE PEPTIDE FROM MICROCYSTIS SP. TO ZOOPLANKTON AND FISH.
Chile Univ., Santiago. Dept. de Biologia.
For primary bibliographic entry see Field 5C.
W91-03821

ZOOPLANKTON DISTRIBUTION IN RELATION TO TURBIDITY AND RELATED ENVIRONMENTAL GRADIENTS IN A LARGE SUBTROPICAL RESERVOIR: PATTERNS AND IMPLICATIONS.
Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.
R. C. Hart.
Freshwater Biology FWBLAB, Vol. 42, No. 2, p 241-263, October 1990. 6 fig, 9 tab, 43 ref.

Descriptors: *Limnology, *Reservoirs, *South Africa, *Suspended sediments, *Turbidity, *Zooplankton, Copepods, Daphnia, Distribution patterns, Phytoplankton, Transparency.

The longitudinal abiotic and plankton gradients in Lake le Roux, a fjord-like reservoir on the Orange River, South Africa, and their probable causes and implications were examined. Secchi depth transparency doubled from approximately 18 cm at the turbid upper end, to 33 cm near the dam wall. On average, phytoplankton abundance, and total crustacean zooplankton biomass were lowest at the top of the lake, but reached maximal values within 15 km 'downstream,' reflecting the rapid development of plankton. The composition of crustacean zooplankton varied along the length of the reservoir. Both seasonal and inter-annual differences were evident. On average, however, cladocerans (Daphnia, Moina) were especially sparse in the more turbid, uppermost reaches, where advective effects of river inflows were most pronounced. The attainment of maximal zooplankton standing stocks some 15 km downstream was attributable to the proliferation particularly of the herbivorous copepod Metadiaptomus, along with minor increases in several cladoceran components. Metadiaptomus continued to increase downstream, in line with declining turbidity, although Daphnia and Moina reached their respective abundance maxima in central and lower reaches of the reservoir, reflecting slight disparities in response to turbidity or related gradients. By contrast, copepod abundance declined progressively downstream, perhaps reflecting longitudinal shifts in competitive balance between copepods and cladocerans. Certain of the taxa-specific distributions observed contrast with trends reported in other systems. However, the longitudinal distribution of total zooplankton abundance, the occurrence of maximal biomass in Lake le Roux in the region of river inflow matches the pattern reported for crustacean and rotiferan zooplankton in other reservoirs. The pattern observed in Lake le Roux suggests that turbid reservoirs may function as sinks rather than sources of organic matter. (White-Reimer-PTT)
W91-03822

SPECIES DISTRIBUTIONS AND SHELL CHARACTERISTICS OF PISIDIUM (MOLLUSCA: BIVALVIA) IN THE COLORADO FRONT RANGE: THE ROLE OF ABIOTIC FACTORS.
Colorado Univ. at Boulder. Center for Limnology.
J. F. Sounders, and G. W. Kling.
Freshwater Biology FWBLAB, Vol. 42, No. 2, p 275-285, October 1990. 2 fig, 6 tab, 55 ref.

Descriptors: *Acid rain effects, *Acidification, *Alkalinity, *Clams, *Colorado, *Distribution patterns, *Limnology, *Mollusks, *Mountain lakes, *Rocky Mountains, Bivalves, Colorado Front Range, Dissolved organic carbon, Hydrogen ion concentration, Water chemistry.

The relationships between water chemistry, species distributions, and shell characteristics of clams in lakes and ponds of the Colorado Front Range, the eastern-most unit of the Rocky Mountain system were investigated. During the summer (July-August) of 1983 and 1984, water samples were collected from forty lakes in the Colorado Front Range. This period coincides with seasonal stratification for the deeper lakes and is well past any pulse of water from snowmelt. The twenty-five lakes that contained clam populations were classified on the basis of water chemistry using discriminant analysis. Each lake belonged to a habitat type defined by the dominant Pisidium species. The analysis was used to identify chemical variables contributing most to this classification. Alkalinity, pH, and dissolved organic carbon contributed most to the classification of lakes according to the dominant Pisidium species. Alkalinity was also strongly correlated with mean clam weight for populations of P. casertanum, the most common of the five species collected. Historical evidence shows a reduction in the number of lakes occupied by clams and a constriction in the distributions of certain species. These changes have occurred mainly in lakes that now have low alkalinity. The reduction in the number of lakes supporting clam populations, and the constriction of distributions for certain species, suggests very strongly that the general suitability of clam habitats in the Front Range has declined recently. The mechanisms by which habitat quality has been reduced cannot be demonstrated conclusively. However, the results are suggestive of a role for acidification, because the loss of habitat and the disappearance of species coincides with a documented decrease in alkalinity. (White-Reimer-PTT)
W91-03823

SUCCESSIONAL CHANGES IN THE SOFT-WATER MACROPHYTE VEGETATION OF (SUB)ATLANTIC, SANDY, LOWLAND, REGIONS DURING THIS CENTURY.
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
G. H. P. Arts, G. Van der Velde, J. G. M. Roelofs, and C. A. M. Van Swaay.
Freshwater Biology FWBLAB, Vol. 42, No. 2, p 287-294, October 1990. 4 fig, 2 tab, 25 ref.

Descriptors: *Acid rain effects, *Acidification, *Aquatic plants, *Eutrophication, *Lake acidification, *Macrophytes, *Succession, *The Netherlands, Buffering, Historical changes, Organic matter, Quillworts, Sediments.

The most important properties which distinguish soft waters on sandy deposits in atlantic and subatlantic lowland parts of Western Europe from soft waters in other geographical regions are their small size, shallowness, original hydrological isolation and the occurrence of a relatively rich and abundant vegetation of soft-water macrophyte species. The Dutch soft waters are a representative group of these waters. In order to trace changes in soft waters in the Netherlands, sites where the isoetids Littorella uniflora, Lobelia dortmanna, Isoetes lacustris and/or I. echinospora were known to have been present in the past or where they are still found were studied. One hundred forty-six bodies of water with good historical records were selected for study. The significance of differences in sediment and water quality between groups of data was determined using the Kruskal-Wallis and Wilcoxon tests. The survey of the 146 water bodies during the period 1983-1986 revealed striking differences in aquatic vegetation. The most important abiotic changes during this century were an increase in the nutrient content of the water column

and an accumulation of organic matter in the sediment. The processes observed during this century are acidification, eutrophication and water hardening. Soft waters which exhibit a higher buffering capacity have changed under the influence of acidification or eutrophication or are still characterized by an often impoverished or eutrophicated soft-water vegetation. Very soft waters supporting isoetids do not exist any more, mainly because of acidification. As these waters are hydrologically isolated and mainly fed by rainwater and superficial groundwater, acidification may be attributed to the impact of atmospheric pollutants. It is thought that a nymphaeid vegetation of Nymphaea alba and Nuphar lutea may be the final stage of succession during acidification as well as eutrophication of soft waters. (White-Reimer-PTT)
W91-03824

QUANTITATIVE RELATIONSHIPS BETWEEN OLIGOCHAETE COMMUNITIES AND PHOSPHORUS CONCENTRATIONS IN LAKES.
Conservation de la Faune, Saint-Sulpice (Switzerland).
C. Lang.
Freshwater Biology FWBLAB, Vol. 42, No. 2, p 327-334, October 1990. 1 fig, 3 tab, 33 ref.

Descriptors: *Annelids, *Bioindicators, *Eutrophication, *Lakes, *Limnology, *Phosphorus, Community structure, Correlation analysis, Depth, Oligotrophic lakes, Trophic level.

The possibility of using tubificid and lumbriculid worm communities as indicators of trophic state and the factors, such as depth of sampling sites that can modify this relationship, was studied using data from eight Western European and three North American lakes. The relative abundance of oligotrophic species was related to phosphorus concentration. Mean annual concentrations of total phosphorus, recorded in the whole lake during the 5 years preceding the sampling of worms, were averaged and this mean was used to indicate the trophic state. The mean relative abundance (%) of oligotrophic species was negatively correlated with mean concentrations of total phosphorus. Relationships between worms and phosphorus were also modified by the depth of the area from which worms were sampled. The relative abundance of oligotrophic species decreased with increasing phosphorus more rapidly in the deepest area than in the whole lake. Thus, oligotrophic species disappeared from the deepest area at a lower phosphorus concentration than they did from the other areas. The predictable relationship existing between the structure of worm communities and phosphorus concentrations in the water of lakes demonstrates that worm communities are reliable indicators of trophic state. However, this relationship is only applicable to large and deep lakes which were oligotrophic some years ago. Furthermore, it can only be used if oligotrophic species persist in the profundal; that is, as long as the whole profundal does not become anoxic. (White-Reimer-PTT)
W91-03825

FIRE AND THE DYNAMICS OF ALLOCHTHONOUS DETRITUS IN A SOUTH AFRICAN MOUNTAIN STREAM.
Cape Town Univ. (South Africa). Dept. of Zoology.
D. L. Britton.
Freshwater Biology FWBLAB, Vol. 42, No. 2, p 347-360, October 1990. 5 fig, 1 tab, 37 ref.

Descriptors: *Detritus, *Forest fires, *Mountain streams, *Organic matter, *South Africa, *Stream ecology, Litter, Particulate matter, Seasonal variation, Sediments.

The effects of a late-summer prescribed burn on the regime of allochthonous input to a second-order mountain stream in the southwestern Cape, South Africa, and the consequent effects on standing stocks of benthic matter were studied. The input of allochthonous material, standing stocks of benthic organic matter (BOM) and suspended particulate organic matter (POM) were measured in the stream from March 1986 to February 1988. The surrounding fynbos-dominated catchment was subjected to a prescribed burn in March 1987. Litter-fall in the pre-burn year exhibited a distinct seasonal pattern, with peak falls during the early summer. Although the riparian canopy was not directly affected by the fire, in that it did not burn, a heavy, seasonal leaf-fall occurred shortly afterwards. The following summer, litter-fall was less than half that of the pre-burn summer. Standing stocks of BOM were significantly higher in autumn than in winter in the pre-burn year and were inversely related to discharge. Despite the heavy post-burn leaf-fall and low litter-fall during the post-burn summer, there was no significant difference between pre-burn and post-burn BOM standing stocks. Proportions and quantities of fine benthic organic matter in the soft BOM fraction were significantly higher in the post-burn spring, and monthly accumulation of ultra-fine benthic organic matter was also significantly higher in the post-burn spring and summer. These results may reflect accelerated decay rates of BOM in response to enhanced post-burn nitrate concentrations in stream water. Export of coarse particulate organic matter was low in comparison to fine particulate organic matter and particularly to ultra-fine particulate organic matter, and the stream appears to by highly retentive of coarse particulate organic matter. The natural resilience of the riparian vegetation minimizes the potentially disturbing effects of fire on the stream environment. As a result, the prescribed burn had a less than expected effect on both standing stocks of BOM and the stream environment in general. (Author's abstract)
W91-03826

TRACE METAL CHEMISTRY OF A DUTCH RESERVOIR, THE TJEUKEMEER.
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, J. Voerman, T. De Boer, J. R. Moed, and J. Schrotenboer.
Freshwater Biology FWBLAB, Vol. 42, No. 2, p 391-400, October 1990. 4 fig, 2 tab, 14 ref.

Descriptors: *Heavy metals, *Reservoirs, *The Netherlands, *Trace metals, *Water pollution sources, Aluminum, Climates, Cobalt, Copper, Iron, Manganese, Path of pollutants, Peat, Wind-driven currents, Zinc.

The concentrations of total and dissolved (<0.2 micron) Fe, Mn, Cu, Co, Zn, and Al in the Dutch reservoir, the Tjeukemeer, were recorded fortnightly between 1984 and 1986. Due to its reservoir function, in winter the Tjeukemeer receives water that is relatively rich in Fe and Mn from its peaty drainage area. In summer, water from Lake IJsselmeer that is relatively rich in Cu and Zn is flushed by a tributary of the River Rhine into the lake. Therefore trace metal loads, as estimated from annual mean concentrations and hydraulic data, are climate-dependent. In wet years the annual Fe, Mn, Cu and Zn loads may be 3.1, 0.2, 0.001, and 0.009 g/sq m, respectively. In dry years, the Fe and Mn loads may be less than one quarter while the Cu and Zn loads may double. Comparable Cu and Zn inputs occur by deposition, particularly in wet years. Despite the dependence of trace metal loads on the climate-dependent water regime, Principal Component Analysis indicated no strong relation between the total Cu, Co, Zn and Al concentrations in lake water and hydrological tracers such as Cl(-) and UV absorbance. Instead, wind speed appeared to be more strongly connected with the dynamics of these metals. Thus in the shallow Tjeukemeer, internal trace metal loading due to wind-induced resuspension starts to dominate the contributions of external loads to the total metal concentrations at wind speeds exceeding 3 m/s. (Author's abstract)
W91-03827

FACTORS AFFECTING SULFUR INCORPORATION INTO LAKE SEDIMENTS: PALEOECOLOGICAL IMPLICATIONS.
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
M. J. Mitchell, J. S. Owen, and S. Schindler.
Journal of Paleolimnology JOUPE8, Vol. 4, No. 1, p 1-22, 1990. 8 fig, 6 tab, 66 ref. Electric Power Research Institute RP-2174-10.

Descriptors: *Acid rain, *Acid rain effects, *Acidification, *Lake sediments, *Limnology, *Paleolimnology, *Sulfur, Carbon, Hydrogen, Lake acidification, Nitrogen, Organic matter, Path of pollutants, Sulfates.

The use of sulfur as a paleolimnological tracer of limnetic sulfate concentration was examined as part of the Paleoecological Investigation of Recent Lake Acidification (PIRLA) program. A positive relationship was found between limnetic sulfate and sediment S concentrations for the Great Lakes, English Lakes, and lakes from the Adirondack and Northern New England regions. There is a positive correlation between carbon and sulfur concentration in sediment across all regions studied. For assessing historical changes in S accumulation in sediments, enrichment factors were calculated for the PIRLA lakes. Pre-1900 net sediment accumulation rates of S were vary similar across all regions. Sulfur enrichment was greatest in Adirondack sediment which had total post-1900 S accumulation of 1.1 to 7.4 times pre-1900 S accumulation. Sediment from Northern New England (NNE) generally had lower S concentration than Adirondack sediments and S enrichment factors ranged from 1.2 to 2.1. Sediment from the Northern Great Lakes States region had similar S concentration and distribution with depth to NNE sediment. In two Northern Florida lakes, sediment showed little variation in S concentration with depth, but in two other lakes from the same region, there was higher S concentration in deeper layers. Lakes which had the greatest enrichment factors also exhibited the most marked changes in C:S ratios. Ratios of C:N showed little variation (10.6 to 26.1) among the PIRLA lakes. A first order model indicated slow decomposition within these organic rich sediments. Elemental concentrations and ratios of sediment from a variety of lakes and reservoirs were compiled. Maximum and minimum elemental ratios for all data were 28 to 8.1 for C:N, 0.81 to 0.11 for C:H, and 675 to 12.5 for C:S. For the C:S ratios in all regions except the Great Lakes, the maximum ratio was less than 231. Both the maximum and minimum amount of N and H concentration of organic matter is related to biotic processes. The minimum concentration of S is regulated not only by nutrient demands but also by non-assimilatory processes. Sulfur incorporation into sediments is a function of a complex of factors, but limnetic sulfate concentration and organic matter content play a major role in regulating the S content of sediment. (Author's abstract)
W91-03828

STABLE ISOTOPIC COMPOSITIONS OF SULFUR IN PIRLA SEDIMENT CORES.
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
B. Fry.
Journal of Paleolimnology JOUPE8, Vol. 4, No. 1, p 23-29, 1990. 5 fig, 27 ref. NSF grant BSR-86-15191 and Electric Power Research Institute RP-2174-10.

Descriptors: *Acid rain, *Acid rain effects, *Acidification, *Cores, *Isotopes, *Lake acidification, *Paleolimnology, *Sulfur, Isotopic composition, Lakes, Lead, Path of pollutants, Sediments, Sulfur deposition.

Patterns of sulfur isotope change in cores taken in the Paleoecological Investigation of Recent Lake Acidification (PIRLA) project were identified, and the isotopic stratigraphy was used to establish histories of sulfur loading. Stable isotopic compositions of total sedimentary sulfur were determined for cores from eight PIRLA study lakes. Preindustrial sulfur deposited prior to 1800 had roughly constant isotopic compositions within a 1-2‰ range in each core. In more recent sediments, large 5-10‰ decreases in 34S content occurred and likely resulted from the addition of anthropogenic sulfur. These isotopic changes began at the same time that lead concentrations increased in sediments, suggesting a close linkage between lead and sulfur deposition in the mid and late 1800s. (Author's abstract)

W91-03829

PALAEOECOLOGICAL TEST OF THE LAND-USE HYPOTHESIS FOR RECENT LAKE ACIDIFICATION IN SOUTH-WEST NORWAY USING HILL-TOP LAKES.
Bergen Univ. (Norway). Botanical Inst.
H. J. B. Birks, F. Berge, J. F. Boyle, and B. F. Cumming.
Journal of Paleolimnology JOUPE8, Vol. 4, No. 1, p 69-85, 1990. 4 fig, 3 tab, 60 ref.

Descriptors: *Acid rain, *Acid rain effects, *Cores, *Lake acidification, *Lakes, *Land use, *Limnology, *Norway, *Paleolimnology, Chrysophytes, Diatoms, Geochemistry, Hill-top lakes, Hydrogen ion concentration, Pollen.

Recent acidification of Scandinavian lakes and associated biotic changes, such as dramatic decreases in fish populations, are now well documented. Three hypotheses have been proposed to explain these changes: (1) recent increases in the acidity of precipitation resulting from emission of S and N compounds; (2) decreasing pastoral activities in upland areas which have resulted in changes in humus accumulation and decomposition, and acidification of drainage water; and (3) natural long-term acidification of soils as a result of retrogressive soil development during the later phases of all interglacial stages. Lakes perched on hill-tops are ideal sites for testing the hypothesis that land-use associated soil changes are a major cause of recent lake acidification because they have very small catchments, and their water chemistry is largely influenced by the chemical composition of precipitation and underlying bedrock geology. Hill-top lakes in SW Norway were used to test the hypothesis that land-use contributes to lake acidification because their chemistry is little affected by land-use or soil changes. Cores were taken from the deepest point in Holetjorn and Ljosvatn lakes in the Noi-Flekkefjord-Kvinesdal area of Vest-Agdar. Paleolimnological analyses of diatoms and chrysophytes show that prior to ca. 1914 the two hill-top lakes investigated were naturally acid with reconstructed lake pH values of at least 4.8-5.1. Since ca. 1914 lake pH values declined to ca. 4.5-4.7. These results contradict the land-use hypothesis. All the available paleolimnological evidence (diatoms, chrysophytes, pollen, sediment geochemistry, carbonaceous particles) is consistent with the acid-deposition hypothesis. (White-Reimer-PTT)
W91-03830

DEVELOPMENT OF AN INTERDISCIPLINARY PLANNING MODEL FOR WATER AND FISHERY MANAGEMENT.
New Mexico State Univ., Las Cruces. Dept. of Fishery and Wildlife Sciences.
For primary bibliographic entry see Field 6A.
W91-03855

FATE OF NITROGEN AND PHOSPHORUS ENTERING A GULF COAST FRESHWATER LAKE: A CASE STUDY.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 5B.
W91-03857

UNDERWATER PHOTIC ENVIRONMENT OF A SMALL ARCTIC LAKE.
Montreal Univ. (Quebec). Dept. of Biological Sciences.
P. H. Heinermann, L. Johnson, and M. A. Ali.
Arctic ATICAB, Vol. 43, No. 2, p 129-136, June 1990. 8 tab, 1 fig, 63 ref.

Descriptors: *Arctic zone, *Lakes, *Light penetration, *Limnology, *Victoria Island, Canada, Diurnal variation, Keyhole Lake, Model studies, Photoperiodism, Radiation, Simulation analysis, Transmissivity.

The underwater light field in a small arctic lake on Victoria Island, Northwest Territories, was examined. Downward radiance was found to be bimodal, with transmission peaks at 480 and 640 nm. Upward radiance was similar near the surface with peaks at 480 and 620 nm, but became unimodal with depth and shifted to 580 nm near the bottom. Diurnal variation in the underwater downward and upward irradiance of PAR (photosynthetically active radiation), was approximately two orders of magnitude. The spectral quality of light transmission also changed over this 24 hour period. Unimodal transmission of red light occurred in the early morning (1:00 and 5:00) and late evening (22:00), while bimodal transmission of blue-green and red light was observed during the day (9:00-17:30). The vertical attenuation coefficient for downward irradiance at the midpoint of the euphotic zone, was relatively insensitive to changes in solar elevation. Diurnal variation in the reflectance of PAR differed from that predicted by previous simulation model while the inverse relationship between reflectance and the absorption coefficient was in agreement with these same models. Gilvin, humic material in dissolved iron complexes, algal fucoxanthin, chlorophyll a and tripton all contribute to the attenuation of light, and are responsible for the unique underwater spectral transmission in Keyhole Lake. (Author's abstract)
W91-03864

EFFECTS OF BEAVER DAMS ON SUBARCTIC WETLAND HYDROLOGY.
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
M. K. Woo, and J. M. Waddington.
Arctic ATICAB, Vol. 43, No. 3, p 223-230, September 1990. 9 fig, 4 tab, 18 ref.

Descriptors: *Beaver ponds, *Environmental effects, *Subarctic zone, *Wetlands, Flood peak, Flooding, Hydrologic properties, Low flow, Runoff, Streamflow.

Beaver dams are ubiquitous in subarctic wetlands, where runoff in a flat terrain is highly prone to changes as the stream courses are modified by beaver activities. Depending on the state of preservation, streamflow can overtop or funnel through gaps in the dams, leak from the bottom of the dams, or seep through the entire structure. Peak and low flows are regulated by these dams to a varying extent. The formation of beaver ponds causes local flooding, while the open water surfaces of the ponds increase water loss from the wetlands. Water spilled from the dams may cause diversion channels to produce complex drainage patterns. Comparing the water balance of basins with and without a beaver dam at its outlet confirms that the dammed basin lost more water to evaporation, suppressed the outflow, and increased the basin water storage. (Author's abstract)
W91-03867

CONSERVATION OF ENDEMIC RAIN FOREST FISHES OF SRI LANKA: RESULTS OF A TRANSLOCATION EXPERIMENT.
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 8I.
W91-03869

BIODIVERSITY LOSS IN THE TEMPERATE ZONE: DECLINE OF THE NATIVE FISH FAUNA OF CALIFORNIA.
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 6G.
W91-03870

2I. Water In Plants

MODELLING OF ENERGY FORESTRY: GROWTH, WATER RELATIONS AND ECONOMICS.
Simulation Monographs 30. Centre for Agricultural Publishing and Documentation (Pudoc), Wageningen, The Netherlands, 1989. 199p. Edited by K. L. Perttu and P. J. Kowalik.

Descriptors: *Computer programs, *Energy sources, *Forestry, *Model studies, *Simulation analysis, *Soil-water-plant relationships, Economic aspects, Evaporation, Plant growth, Sweden, Transpiration, Willow trees.

This comprehensive volume, which is divided into four parts, documents the modeling of production, water relations and the economics of intensively cultivated short rotation energy forests. The first part gives the background to energy forestry in general, and discusses simulation models. The second part examines growth processes in willow stands, biomass growth processes, and assimilate allocation and nitrogen turnover. The model presented in this part describes willow growth simulation with annual results from a three year cutting cycle. In the third part, three different models are presented on water relations in willow, which is one of the main species for Swedish energy forestry. The fourth part comprises an economic calculation for energy forestry on agricultural land in Sweden as well as the prospects for wood biomass as a regenerable, alternative energy resource. The appendix describes the simulation packages, and contains a sample model for understanding the modeling efforts. (See W91-03199 thru W91-03202) (Author's abstract)
W91-03198

INTRODUCTION TO MODELLING OF PLANT WATER CONDITIONS.
Gdansk Technical Univ. (Poland). Inst. of Hyrdotechnics.
P. J. Kowalik, and K. L. Perttu.
IN: Modelling of Energy Forestry: Growth, Water Relations and Economics. Simulation Monographs 30. Centre for Agricultural Publishing and Documentation (Pudoc), Wageningen, The Netherlands. p 89-96, 1 tab, 32 ref.

Descriptors: *Evaporation, *Forestry, *Model studies, *Plant growth, *Soil-water-plant relationships, *Transpiration, Air temperature, Biomass, Canopy, Comparison studies, Energy, Interception, Irrigation effects, Plant water potential, Radiation, Rainfall, Relative humidity, Soil water, Willow trees.

Three models of soil-water-plant relationships can be used complementarily to determine the variables needed to yield good biomass when dealing with plant growth and water balance in energy forests. In the Kowalik and Eckersten transpiration model, the driving variables consist of recorded 10-minute mean values, diurnal totals and diurnal single values for air temperature, relative air humidity, solar radiation, soil water potential and precipitation. The model describes the diurnal course of transpiration, stomatal behavior, leaf water potential and leaf canopy temperature. The results indicate the importance of the evaporation of intercepted water for heat and mass exchange in the energy forest ecosystems; both amount and duration of rainfall seem to be important factors. In the Halldin evaporation model, the Penman approach is used to simulate willow evaporation. The concept central to Halldin's model is to calculate evaporation, divided into transpiration and evaporation of intercepted water, and to create a simple one-layer soil water budget. The soil water is described in terms of a single compartment and thus the vertical distribution of water uptake in the soil is ignored. The soil water balance is defined as the total available soil water at field capacity minus that at the wilting point. This total is then divided into the fraction of easily available water that does not limit transpiration, and the fraction for which transpiration decreases linearly from its potential value to zero. The Persson and Jansson model is a continuation of the development of earlier Swedish attempts to model soil water and predicts water dynamics for a variety of soils and vegetation covers. The rate of water uptake by roots from different depths depends on plant water requirements, availability of water, and ability of the roots to take up water. The model also evaluates the effects of irrigation. (See also W91-03198) (Geiger-PTT)
W91-03199

SIMULATION OF DIURNAL TRANSPIRATION FROM WILLOW STANDS.
Gdansk Technical Univ. (Poland). Inst. of Hyrdotechnics.
P. Kowalik, and H. Eckersten.
IN: Modelling of Energy Forestry: Growth, Water Relations and Economics. Simulation Monographs 30. Centre for Agricultural Publishing and Documentation (Pudoc), Wageningen, The Netherlands. p 97-119, 6 fig, 36 ref.

Descriptors: *Computer programs, *Diurnal variation, *Forestry, *Mathematical models, *Model studies, *Soil-water-plant relationships, *Transpiration, *Willow trees, Air temperature, Evaporation, Fortran, Interception, Radiation, Relative humidity, Soil water potential.

A computer model of the soil-plant-atmosphere system was applied to simulate transpiration and evaporation of intercepted water and leaf temperature within time steps of one minute in stands of willow in energy forests. Data to test the transpiration model were collected over a two year period at Studsvik, Sweden. Good agreement between estimated and measured leaf-air temperature differences and cumulative transpiration was obtained during periods when the assumptions in the model were fulfilled. The assumptions of a constant aerodynamic resistance or soil hydraulic resistance were not satisfactory and the model should be improved on these points. The results show the importance of evaporation of intercepted water for heat and mass exchange in the energy forest. Rainfall amount and duration are both important factors that must be known. The source code of this SPAC model is written in FORTRAN 77 and makes use of the SIMP simulation modelling support programs. (See also W91-03198) (Geiger-PTT)
W91-03200

WILLOW STAND EVAPORATION: SIMULATION OF DIURNAL DISTRIBUTION USING SYNOPTIC WEATHER DATA.
Uppsala Univ. (Sweden). Dept. of Hydrology.
S. Halldin.
IN: Modelling of Energy Forestry: Growth, Water Relations and Economics. Simulation Monographs 30. Centre for Agricultural Publishing and Documentation (Pudoc), Wageningen, The Netherlands. p 121-146, 9 fig, 27 ref.

Descriptors: *Computer models, *Diurnal distribution, *Evaporation, *Forestry, *Hydrologic budget, *Irrigation requirements, *Model studies, *Willow trees, Fortran, Interception, Transpiration, Weather data collections.

Simple models of the water balance of willow stands are useful to assess irrigation needs in energy forests. Such models rely on evaporation data that can fluctuate diurnally. To overcome this conflict, the KAUSHA model was used dividing the 24-hr cycle into a night-time part and a day-time part. The model was evaluated in a mature Scots pine forest at Jaedraas, central Sweden. Porometer measurements of stomatal resistance allowed independent estimation of parameter values in the Lohammar equation, and these values were used together with climatic data for the whole of 1977 to compare results of the various diurnal distributions for situations without precipitation. Three pulses were tested. One pulse was the astronomically determined day length as duration and a second pulse was 75% as long. A comparison was also made with a 24-hr pulse, to see whether a model without any diurnal distribution might be as good as the other two. All the pulses gave reasonably coherent results, but the 24-hr pulse deviated considerably from a one-to-one relation with the sinusoidal distribution. The pulse of day-time duration was close to linearly related to the sinusoidal distribution, but its value was 10% higher. The pulse using an effective day length of 75% could hardly be distinguished from the sinusoidal distribution in terms of resulting evaporation. (See also W91-03198) (Geiger-PTT)
W91-03201

SIMULATED WATER BALANCE OF A WILLOW STAND ON CLAY SOIL.
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Soil Sciences.
G. Persson, and P. E. Jansson.
IN: Modelling of Energy Forestry: Growth, Water Relations and Economics. Simulation Monographs 30. Centre for Agricultural Publishing and Documentation (Pudoc). Wageningen, The Netherlands. p 147-162, 8 fig, 2 tab, 17 ref.

Descriptors: *Clays, *Computer models, *Forestry, *Hydrologic budget, *Model studies, *Soil water, *Soil-water-plant relationships, *Willow trees, Evapotranspiration, Percolation, Soil properties.

Water balance was estimated in a clay soil using a physically based soil water model (SOIL) in willow stands in Ultuna, Sweden. The model is based on a soil moisture study recorded from thirty-two tensiometers installed in four lines at 15, 30, 45 and 60 cm depth. Daily totals of precipitation, irrigation, global radiation and averages of air temperature, vapor pressure and wind speed were used as driving variables for the model. Water retention curves for a 1 m deep soil profile were obtained from a field about 50 m from the study site. The model also incorporated the effects of stand properties such as interception storage and surface resistance. When different combinations of soil and plant properties were used in the model, good agreement was obtained between simulated and measured tensions. The uncertainty of most importance for the simulated evapotranspiration was the occurrence and efficiency of deep roots, especially if the deep roots were combined with a poor drainage efficiency. (See also W91-03198) (Geiger-PTT)
W91-03202

VEGETATION DYNAMICS IN RELATION TO WETLAND CREATION.
Connecticut Coll., New London.
W. A. Niering.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 479-486, 1 fig, 67 ref.

Descriptors: *Artificial wetlands, *Planting management, *Soil-water-plant relationships, *Vegetation establishment, *Water resources management, *Wetland restoration, *Wetlands, Ecosystems, Hydrologic cycle, Hydrological regime, Plant populations, Succession, Water resources development, Wildlife habitats.

An understanding of the ecological processes involved in coastal or freshwater wetland vegetation development is essential to wetland managers concerned with wetland creation. Ascertaining a sound hydrologic system is basic in any attempt to recreate a wetland system since the vegetation and associated fauna are dependent upon a consistent but usually fluctuating hydrologic regime. Any hydrologic manipulations can also greatly modify what species will become established in a given site or those that may decline in abundance. Traditional succession-climax dogma has limited usefulness in interpreting vegetation change. Thus an understanding of the complex of factors involved in the process, including chance and coincidence, makes the task of the manager even more challenging. Since vegetation change is not necessarily predictable and orderly, as is sometimes thought, it is often difficult to predict the ultimate vegetation in a given created site. Some wetland communities once created may be relatively stable; others may undergo directional or cyclic change, thus adding to the complexity of the ultimate vegetation. Therefore, one of the major goals in wetland creation should be the persistence of the wetland as a self-perpetuating oscillating system. This can be achieved by assuring a sound hydrologic regime. (See also W91-03244) (Author's abstract)
W91-03266

ROOT AERENCHYMA, OXYGEN LEAKAGE PATTERNS AND ALCOHOLIC FERMENTATION ABILITY OF THE ROOTS OF SOME NYMPHAEID AND ISOETID MACROPHYTES IN RELATION TO THE SEDIMENT TYPE OF THEIR HABITAT.
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
A. J. M. Smits, P. Laan, R. H. Thier, and G. van der Velde.
Aquatic Botany AQBODS, Vol. 38, No. 1, p 3-17, October 1990. 3 fig, 2 tab, 60 ref.

Descriptors: *Aquatic plants, *Limnology, *Macrophytes, *Plant morphology, *Rooted aquatic plants, *Sediments, *Soil-water-plant relationships, Alcohols, Anoxic conditions, Aquatic habitats, Fermentation, Oxidation-reduction potential, Oxygen requirements, Root development, Roots.

Apart from other numerous environmental factors affecting the growth of aquatic plants, the organic matter content of the sediment greatly influences the distribution of aquatic macrophytes. Morphological and metabolic characteristics of the roots of two groups of aquatic macrophytes are compared. The first group consists of species frequently occurring on organic sediments with a distinct negative redox potential, such as the nymphaeid macrophytes. The second group contains species generally rooting in a mineral sediment with an oxidative character, such as the isoetids. As a measure for the amount of root aerenchyma, root porosity of these macrophytes was determined. The nymphaeids which were grown in the same type of sediments as the isoetids developed a larger amount of root aerenchyma. Moreover, the roots of the nymphaeids differed from the roots of the isoetids by a reduced oxygen permeability of the root wall and a higher ethanol fermentation rate during anoxic conditions. If the gas permeability of the root wall is high, a large part of the oxygen present in the root will diffuse into the sediment and will subsequently be reduced. Morphological characteristics (i.e., well-developed root aerenchyma and reduced oxygen permeability of the roots), as well as an extensive alcoholic fermentation ability of the roots of the nymphaeids, can be considered essential adaptations to the strong reductive sediments of their habitats. In addition, the lack of these characteristics in the isoetid roots can partly explain why the occurrence of these macrophytes is confined to water bodies with a mineral sediment characterized by a small reductive capability. (Fish-PTT)
W91-03414

ADAPTATIONS TO FLOODING IN PLANTS FROM RIVER AREAS.
Katholieke Univ. Nijmegen (Netherlands). Dept. of Experimental Botany.
C. W. P. M. Blom, G. M. Bogemann, P. Laan, A. J. M. van der Sman, and H. M. van de Steeg.
Aquatic Botany AQBODS, Vol. 38, No. 1, p 29-47, October 1990. 5 fig, 7 tab, 47 ref.

Descriptors: *Adaptation, *Aquatic plants, *Flood plains, *Species composition, *The Netherlands, *Waterlogging, Bioindicators, Flood frequency, Flooding, Flowering, Leaves, Netherlands, Oxygen requirements, Rhine River, River systems, Roots, Soil-water-plant relationships, Submergence, Vegetation, Water level fluctuations.

Flood frequencies and intensities determine both species composition and the behavior of individual plants along many rivers in the world. The vegetation zonation associated with the fluctuating water levels of the Rhine River in the eastern part of The Netherlands was studied. Certain species were chosen as being representative of the vegetation types from the river foreland, and were subjected to various flooding regimes in order to study the adaptive responses upon waterlogging of the soil, submergence, and related changing environmental factors. Differential responses towards flooding in plants can be explained, at least partly, by an ability to elongate petioles and stems in order to protrude above the water surface. The hormone ethylene is involved in the regulation of this process. Renewed contact between leaves and the open air after submergence stimulates the formation of a new aerenchymatous root system in the flood-tolerant species. Increased porosity enables the plants to perform longitudinal transport from aerial and photosynthetic oxygen to the rhizosphere. The internal aeration system of flood-intolerant species

is not sufficient to sustain an aerobic state in the root-soil environment. Another mechanism plants use to survive flooding is to change their timing of reproduction: some species delay their flowering and seed production during flooding periods and survive as vegetative plants; others are able to accelerate flowering during short dry periods in order to produce seeds in the short intervals between two successive floods. The model system in which individual plants serve as indicator species appears to be a manageable tool in studies on adaptations to flooding. (Author's abstract)
W91-03415

ECOPHYSIOLOGY OF PLANTS IN WATERLOGGED AND FLOODED ENVIRONMENTS.
Vrije Univ., Amsterdam (Netherlands). Dept. of Ecology and Ecotoxicology.
W. H. O. Ernst.
Aquatic Botany AQBODS, Vol. 38, No. 1, p 73-90, October 1990. 1 fig, 122 ref.

Descriptors: *Adaptation, *Aquatic plants, *Ecosystems, *Flood plains, *Soil-water-plant relationships, *Waterlogging, Anoxic conditions, Carbon, Iron, Manganese, Metabolism, Nitrogen, Oxygen requirements, Photosynthesis, Resistance, Roots, Sulfur, Vegetation.

Waterlogging and/or flooding of ecosystems may be permanent, as in marshes and bogs, or may occur in a regular daily or seasonal pattern, e.g., the daily flooding of the lower salt marsh or seasonally flooded dune slacks and wetlands. The adaptation of higher plants to waterlogged and flooded environments was studied. The primary effect in the sequence of waterlogging-induced processes is a reduction of the oxygen concentration of the soil. The longer the period of waterlogging lasts, the more the speciation of nitrogen, manganese, iron, sulfur, and carbon changes from the oxidized to the reduced state, often counteracted by a well-functioning aerenchyma. The change in the speciation of soil nitrogen has no effect on plants resistant to waterlogging, whereas reduction of sulfur demands specific adaptations. Secondary metabolic changes as reactions to waterlogging will involve glycolysis, but depend on the extent of anoxia in the soil and thus the root. Flooding will enhance the sequence of waterlogging-induced processes. As soon as the green plant parts are flooded and excluded (partially) from the ambient air, a reduction in photosynthesis will take place and severely affect the energy budget. in addition to ecophysiological adaptation, waterlogging-resistant species may play a role in the survival of less resistant species in the same plant community. (Author's abstract)
W91-03416

GENETIC VARIATION AND ADAPTATION TO FLOODING IN PLANTS.
University of East Anglia, Norwich (England). School of Biological Sciences.
A. J. Davy, S. M. Noble, and R. P. Oliver.
Aquatic Botany AQBODS, Vol. 38, No. 1, p 91-108, October 1990. 1 fig, 2 tab, 58 ref.

Descriptors: *Adaptation, *Aquatic plants, *Flood plains, *Flooding, *Genetics, *Limnology, *Riverine limnology, *Soil-water-plant relationships, DNA, Molecular structure, Plant populations, Salt marshes, Species composition, Tolerance, Variation, Waterlogging.

Evidence exists for genetic variation that can be associated with the evolution of adaptations to flooding: variation related to flooding at the level of molecular mechanism; comparisons of the patterns of variation in flooding-tolerant and non-tolerant species; within-species variation associated with genetically-differentiated populations that enable certain higher plants to tolerate or avoid the effects of flooding are understood. Yet little is known of the genetic basis for these features and less of its variation. An analysis was done of Salicornia, which exists as locally differentiated populations in different tidal flooding regimes, from the lowest to the highest parts of salt marshes. Genetic differentiation can be demonstrated by significant selection coefficients against alien types in reciprocal transplant experiments. The genetic variation within and between these populations were investigated using restriction fragment length polymorphism studies of the ribosomal DNA (rDNA). Two rDNA repeat unit types were found, only one of which occurs in any individual plant. Only the 12-kilobase (kb) fragment was found in populations that experience the most flooding, whereas plants on the highest parts of the marsh had only the 10.5-kb fragment. Typical lower and upper marsh populations were mixed in their fragment compositions, but lower marsh areas supported a higher frequency of the 12-kb fragment than upper marsh and depressions supported a higher frequency of the 12-kb fragment than raised interfluve areas. The use of such DNA variation, which is itself unselected, as a marker for selected genetic variation shows considerable promise for the future. (Author's abstract)
W91-03417

INTERACTIVE EFFECTS OF SALINITY AND CALCIUM ON HYDRAULIC CONDUCTIVITY, OSMOTIC ADJUSTMENT, AND GROWTH IN PRIMARY ROOTS OF MAIZE SEEDLINGS.
Technion - Israel Inst. of Tech., Haifa. Faculty of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W91-03520

CROPPING STRATEGIES FOR EFFICIENT USE OF WATER AND NITROGEN.
For primary bibliographic entry see Field 3F.
W91-03633

ROLE OF CROP RESIDUE MANAGEMENT IN NITROGEN CYCLING USE.
Agricultural Research Service, Lincoln, NE.
For primary bibliographic entry see Field 3F.
W91-03639

ROLE OF NONLEGUMINOUS COVER CROPS IN THE EFFICIENT USE OF WATER AND NITROGEN.
North Carolina State Univ., Raleigh.
For primary bibliographic entry see Field 3F.
W91-03640

ROLE OF ANNUAL LEGUME COVER CROPS IN EFFICIENT USE OF WATER AND NITROGEN.
Kentucky Univ., Lexington.
For primary bibliographic entry see Field 3F.
W91-03641

ROLE OF CROPPING SYSTEMS IN ENVIRONMENTAL QUALITY: SALINE SEEP CONTROL.
Agricultural Research Service, Akron, CO.
For primary bibliographic entry see Field 3F.
W91-03644

EXAMINING EVAPOTRANSPIRATION IN A SEMI-ARID REGION USING STABLE ISOTOPES OF HYDROGEN AND OXYGEN.
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2D.
W91-03740

WATER BALANCE OF SNOW TUSSOCK GRASSLAND IN NEW ZEALAND.
Otago Univ., Dunedin (New Zealand). Dept. of Geography.
For primary bibliographic entry see Field 2D.
W91-03750

INTERCEPTION, THROUGHFALL AND STEMFLOW IN A FOREST IN HIGHLAND SCOTLAND AND THE COMPARISON WITH OTHER UPLAND FORESTS IN THE U.K.
Institute of Hydrology, Balquhidder, Lochearnhead FK19 8PQ, Scotland.
R. C. Johnson.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 281-287, October 1990. 4 fig, 2 tab, 9 ref.

Descriptors: *Forest hydrology, *Interception, *Scotland, *Stemflow, *Throughfall, Annual precipitation, Canopy, Coniferous forests, Interception loss, Seasonal variation, Snow storage, Spatial distribution, Spruce trees, Trees.

Interception loss from a 50-year-old Sitka spruce forest at Balquhidder in Highland Scotland has been determined by measuring precipitation, throughfall and stemflow. Annual mean precipitation at the site was 2130 mm and for the period October 1983 to June 1986, the average interception was 28% with throughfall and stemflow comprising 69 and 3%, respectively of the precipitation. This interception loss is similar to results from other upland forests in the U.K. While large variations were found throughout the year, interception was greatest in the summer months, reaching 79% in May 1985, and least in the winter, 0% in January 1985. Snow interception can be large, 37% in January 1984 when storage on the canopy was estimated to have reached 22 mm water equivalent. The spatial variability of throughfall was dependent on distance away from the tree stem and on the density of the canopy cover. Tree age does not appear to determine interception values but comparison of the relative amounts of throughfall and stemflow with those from other sites shows that there is an increase in throughfall with the age of the tree. This has important consequences for water quality in young forests. (Author's abstract)
W91-03753

2J. Erosion and Sedimentation

SEDIMENT-TRANSPORT CHARACTERISTICS AND EFFECTS OF SEDIMENT TRANSPORT ON BENTHIC INVERTEBRATES IN THE FOUNTAIN CREEK DRAINAGE BASIN UPSTREAM FROM WIDEFIELD, SOUTHEASTERN COLORADO, 1985-88.
Geological Survey, Denver, CO. Water Resources Div.
P. von Guerard.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4161, 1989. 133p, 20 fig, 19 tab, 39 ref. Project no. C0196.

Descriptors: *Benthic fauna, *Sediment transport, Bed load, Bed material, Sediment discharge, Suspended sediments.

Sediment and benthic-invertebrate data were collected during water years 1985 through 1988 in the Fountain Creek drainage basin upstream from Widefield, Colorado. Sediment data collected include suspended-sediment concentrations and particle size analysis of suspended sediment, bedload, and bed material. Sediment-transport equations were derived for total suspended-sediment discharge and suspended-sand discharge at seven periodic sampling sites. Annual suspended-sediment loads for water years 1985 through 1988 and mean suspended-sediment yields were computed for the seven periodic sampling sites. Mean annual suspended-sediment yield for 1985 through 1988 increased about 73% downstream in the Fountain Creek drainage basin primarily as a result of sediment discharging from Monument Creek. Bedload discharge was computed at six of the periodic sampling sites and ranged from 2.6 to 3,570 tons/day. Bedload discharge, as a percentage of total sediment discharge, ranged from 6 to 92%, and the smaller values occurred during rainfall runoff. Number of taxa, species density, and similarity indices were determined for benthic invertebrates at five of the periodic sampling sites. Multiple comparison tests were used to test for similarity of benthic invertebrates between the five sites. Multiple-regression analysis was done to determine the effects of sediment transport on benthic-invertebrate densities. Median grain size of bed material collected in conjunction with benthic-invertebrate samples and flooding during the 30 days prior to

sampling consistently accounted for the most variation in mean densities of total organisms and major taxa groups sampled. (USGS)
W91-02963

SAN FRANCISCO CENTRAL BAY SUSPENDED SEDIMENT MOVEMENT, REPORT 1: SUMMER CONDITION DATA COLLECTION PROGRAM AND NUMERICAL MODEL VERIFICATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
L. M. Hauck, A. M. Teeter, W. Pankow, and R. A. Evans.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report No. HL-90-6. September 1990. Report 1 of a Series. 122 p, 23 fig, 8 tab, 21 plates, 68 ref.

Descriptors: *Data acquisition, *Model studies, *San Francisco Bay, *Sediment transport, *Suspended sediments, Currents, Field tests, Mathematical models, Salinity, Water quality.

Field data were collected on currents, salinities, and suspended sediments intensively over a lunar day, and sporadically over a fortnight, in September 1988 for the purpose of identifying transport processes and conditions in central San Francisco Bay, and for numerical model verification. The field data collected during the low freshwater inflow period of September 1988 indicated that Central Bay had near-oceanic salinities, was vertically well mixed, and had moderately low total suspended material (TSM). Net delta outflow of fresh water into the bay system was only about 2,500 cu ft/sec (cfs) during this period. TSM at the Golden Gate survey range averaged about 16 mg/L, increased upstream to 34 mg/L at the entrance to South Bay, and increased to 45 mg/L at the Richmond Bridge near the entrance to San Pablo Bay. Peak TSM values were greater than average values by a factor of about three. Tidal fluxes of TSM were large, commensurate with the tidal prism of this system. Observed tidal fluxes were roughly 30,000 metric tons per lunar day at the Golden Gate range, 19,000 metric tons per lunar day at the entrance to the South Bay, and 44,000 metric tons per lunar day at Richmond. Conditions were typical of a low freshwater inflow summer season in this area. A two-dimensional horizontal finite element was applied and verified to field and physical hydraulic model data. (Lantz-PTT)
W91-03010

LOUISIANA SCOUR ANALYSIS MANAGEMENT SYSTEM (LASAMS).
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-03076

SOIL EROSION AND CONSERVATION.
This volume is based on 'Malama Aina '83,' the International Conference on Soil Erosion and Conservation, held January 16-22, 1983, in Honolulu, Hawaii. Soil Conservation Society of America, Ankeny, Iowa. 1985. 793p. Edited by S. A. El-Swaify, W. C. Moldenhauer, and Andrew Lo.

Descriptors: *Conferences, *Erosion control, *Model studies, *Sediment sources, *Soil conservation, *Soil erosion, Crop yield, Hawaii, Management planning, Mathematical models, Network design, Nonpoint pollution sources, Water pollution control, Water pollution sources.

Highly visible land degradation, widespread famine, and heightened environmental awareness have prompted worldwide interest in soil and water conservation. The International Conference on Soil Erosion and Conservation, held at Honolulu, Hawaii, in 1983, provided a continuing forum for the exchange of research findings and experiences in the search for solutions to soil and water conservation problems. This volume is based on papers presented at the meeting. Four themes were emphasized: (1) delineating sediment sources and estimating the magnitude and extent of soil erosion methodological, analytical, and country reports); (2) quantifying the impacts of soil erosion and sedimentation on land productivity and the environment (changes in soil fertility and physical properties, experimental and modeling efforts to assess crop responses, soil water characteristics as an element of productivity, particularly for arid/semiarid regions, and economic assessment of erosion impact); (3) establishing quantitative values for erosion-causing parameters (parameter assessment, modeling and model adaptation, and manipulation for controlling erosion); and (4) creating global and regional networks for implementing soil and water conservation programs (unifying principles, needs, terminology, methodology, reporting, and interdisciplinary requirements for conservation-effective land use planning). (See W91-03118 thru W91-03177) (Rochester-PTT)
W91-03117

SOIL CONSERVATION IN INDIA.
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
For primary bibliographic entry see Field 4D.
W91-03118

OVERVIEW OF SOIL EROSION AND SEDIMENTATION IN THAILAND.
Kasetsart Univ., Bangkok (Thailand). Dept. of Soils.
S. Jantawat.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 10-14, 1 tab, 10 ref.

Descriptors: *Erosion rates, *Sediment erosion, *Sedimentation, *Soil erosion, *Thailand, Chi River, Deforestation, Huai Pa Tao River, Lame Dome Noi River, Mune-Chi River, Water pollution sources.

Soil erosion occurs extensively on rolling cropland in Thailand. Soil erosion can be measured directly at several sites. It also can be computed using an empirical formula for a given soil type, slope, and management, or it can be estimated from the rate of sediment transport in rivers. For regional analysis, suspended sediment measurements provide a convenient index of mean soil erosion rates. Soil erosion rates were estimated for 79 watersheds in Thailand (8.45 to 104,000 sq km). Sediment production rates ranged from 7.61 to 3873.79 t/sq km/yr. The highest erosion rate was in the Lame Dome Noi River watershed, which is a tributary of the Mune-Chi River. The lowest rate was in Huai Pa Tao River Basin, a tributary of the Chi River. Soil erosion in the five regions of Thailand ranged from 11.86 to 2044.98 t/sq km/yr in the northern region, 7.61 to 3873.79 t/sq km/yr in the northeast, 20.14 to 569.60 t/sq km/yr in the central plains region, 26.77 to 355.79 t/sq km/yr in the eastern region, and 30.23 to 1786.98 t/sq km/yr in the southern region. The highest erosion rates occurred in the northeastern region, where the largest area of deforestation has occurred, suggesting that soils in this region are sensitive to erosion when natural cover is removed. (See also W91-03117) (Rochester-PTT)
W91-03119

CONSEQUENCES OF HEAVY MECHANIZATION AND NEW ROTATION ON RUNOFF AND ON LOESSIAL DEGRADATION IN NORTHERN FRANCE.
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
For primary bibliographic entry see Field 4C.
W91-03121

EFFECTS OF GRAZING AND TRAMPLING ON SOIL DETERIORATION AROUND RECENTLY DRILLED WATER HOLES IN THE SAHELIAN ZONE.
Office de la Recherche Scientifique et Technique Outre-Mer, Abidjan (Ivory Coast).
For primary bibliographic entry see Field 4C.
W91-03122

EFFECTS OF VARIOUS VEGETATION LAYERS IN AN ACACIA AURICULIFORMIS FOREST PLANTATION ON SURFACE EROSION IN JAVA, INDONESIA.
Agricultural Univ., Wageningen (Netherlands). Dept. of Forest Management.
K. F. Wiersum.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 79-89, 1 fig, 3 tab, 16 ref.

Descriptors: *Acacia trees, *Forest watersheds, *Indonesia, *Soil erosion, *Vegetation effects, Ecosystems, Java, Litter, Soil conservation, Ubrug Forest.

Few data have been published on the interactions and relative importance of the different effects of various forest components on erosion. More than 40 yr ago, Coster published such a study for forests in Java, in which the effects of different forest components were studied by removing them and then measuring incident rainfall and sediment loss. In the present study, a more integrated approach was used that accounted for the separate effects of the various vegetation layers. The research site was in the Ubrug forest near Jatiluhur (W Java, Indonesia) on a clayey soil in an area of 2,900 mm average annual rainfall. Canopy effects on amount and erosive force of precipitation, undergrowth and litter effects on erosion, and the combined effect of the various vegetation layers were examined. The findings on the relative importance for erosion protection of the various vegetation layers support Coster's results. Erosion without direct soil cover (litter layer) is an order of magnitude higher. The addition of other vegetative layers does not change the erosion rate significantly. In fact, the presence of trees without litter may actually increase erosion. This study indicates that the protective influence of forest vegetation depends mostly on the vegetation's influence on the interface between the erosive agent and the eroded medium, rather than on its direct influence on these two properties. Trees have a variable, and often negative effect, in protecting the soils from rainfall, whereas the positive effect of humus incorporation on the soil develops over longer periods. It is the proper functioning of the forest ecosystem rather than the presence of trees that is important for erosion control. (See also W91-03117) (Rochester-PTT)
W91-03124

SOIL EROSION STUDIES IN THE NORTHERN MOUNTAIN RANGE, TRINIDAD, UNDER DIFFERENT CROP AND SOIL MANAGEMENT.
University of the West Indies, St. Augustine (Trinidad and Tobago). Faculty of Agriculture.
For primary bibliographic entry see Field 4C.
W91-03125

QUANTIFYING EROSION-CAUSING PARAMETERS IN A NEW ZEALAND WATERSHED.
South Canterbury Catchment Board and Regional Water Board, Limaru, New Zealand.
J. R. I. Cuff.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 99-112, 2 fig, 5 tab, 9 ref.

Descriptors: *Bank erosion, *New Zealand, *Sediment sources, *Slope degradation, *Soil erosion, Channel erosion, Limaru, Rainfall, Slope effects, Water pollution sources.

In New Zealand, excessive erosion in the upper mountain areas and subsequent sediment transport in rivers traversing the lower plains cause concern for those responsible for soil and water conservation. Factors causing erosion were investigated in the Orari catchment, a 550-sq km, steep, grass-covered watershed formed on greywacke/argillite and located in the east central part of South Island. Elevations range from 270-2000 m and mean annual rainfall is 1000 mm. Various sources of sediment were identified and the influence of various factors on sediment yield were examined. Slope, elevation, mean annual rainfall, amount and type of bare ground above, aspect, horizontal slope position, and geology were considered. The distri-

bution of all erosion types, except streambank erosion, is caused by on-site slope processes, which in turn are partly determined by several parameters (slope angle, altitude, mean annual rainfall, horizontal slope position, geology, and type of bare ground above). Of all the parameters influencing erosion distribution, man can influence only certain categories of bare ground. However, some of these bare-ground categories can exert considerable influence on erosion potential. Streambank erosion principally occurs in the channel wall, normally on flatter channel gradients, and is likely to be aggravated if there is detritus supplied from upstream. This erosion is less likely to be affected by on-site slope processes. (See also W91-03117) (Rochester-PTT)
W91-03126

WITHIN-FURROW EROSION AND DEPOSITION OF SEDIMENT AND PHOSPHORUS.
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 3F.
W91-03127

USE OF SOIL SPECTRAL PROPERTIES FOR MONITORING SOIL EROSION.
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 7B.
W91-03128

PARTIAL AREA CONCEPT AND ITS APPLICATION TO THE PROBLEM OF SEDIMENT SOURCE AREAS.
Alberta Univ., Edmonton. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-03129

DESIGN AND CONSTRUCTION CONSIDERATIONS FOR SEDIMENT SAMPLING OF STREAMFLOWS.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
J. A. Replogle, and S. A. El-Swaify.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 139-148, 5 fig, 13 ref.

Descriptors: *Analytical methods, *Bed-load discharge, *Sampling, *Sediment sampler, *Sediment sampling, *Suspended sediments, Comparison studies, Design criteria, Hawaii, Performance evaluation.

Sampling of runoff water sediments for the purpose of estimating sediment discharge often involves high sampling errors. In an effort to overcome the limitations of such samplers as Coshocton wheel samplers and H-flume combinations, a hypothetical, highly accurate sediment sampling system for both bedload and suspended particles is presented. Theoretical considerations in design of the ideal sampler are considered, performance of previous samplers is reviewed, and recommendations are made for building a practical model of the ideal sampler. In six field installations for storm flow rate and sediment sampling done in Hawaii, the sediment portion caused the most problems for a rotary, multistage sampler prototype. Although the system was judged to be capable of providing a fair to good sampling of water, bedload materials, and suspended sediments, many operational problems were encountered. These included soil aggregates that plugged the sampler slots, inundation by major floods and crop debris, and overtopping of the sample container. The following recommendations are made: (1) select a site with up to 1 m of overfall if possible; (2) fit a traversing mechanisms with a slotted sampler having two guard slots on each side, constructed and mounted with 10-deg downstream slope to help clear debris; (3) make the slot at least as wide as the maximum sample particle size to be collected; (4) provide an appropriate motor to ensure uniform speed of the traverser; and (5) use a cycle counter and diverter valve to control sample size. If timed samples are collected, then each sample pulse can be changed in volume by the chain drive speed. This will not change the sample volume collected. If the sampler can be constructed as described and time-delivery of the sample can be recorded, directed sampling from a channel overfall is possible without a flume contraction. (See also W91-03117) (Rochester-PTT)
W91-03130

ESTIMATING EROSION ON PLOT, FIELD, AND WATERSHED SCALES.
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
A. S. Rogowski, R. M. Khanbilvardi, and R. J. DeAngelis.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 149-166, 9 fig, 2 tab, 10 ref. EPA-ARS Interagency Agreement Funds EPA-IAG-D5-E763.

Descriptors: *Appalachian Region, *Sediment discharge, *Soil erosion, *Strip mines, Computer programs, Hydrologic models, Kriging, Mathematical models, Pennsylvania, Rehabilitation, Runoff, Statistics, Universal soil loss equation.

Because of high rainfall, many newly reclaimed stripmined sites in the Appalachian region of the United States will become susceptible to soil erosion before adequate cover can be established. The nature of the erosion problem on plots, fields, and watersheds was examined and a suitable scale to estimate potential and actual erosion was investigated. Three tracts, in Jefferson, Centre, and Northumberland Counties, Pennsylvania, were examined. A geostatistical technique for structural analysis was applied to these three sets of data and appropriate dispersion and estimation statistics were computed. Using kriging programs, the estimated distributions of potential erosion were analyzed for areas of different sizes and the results were compared with actual data from monitored runoff plots. Measured and estimated values were then compared with values computed using the computer erosion-deposition model of Khanbilvardi and associates. This model also was used to delineate contributing zones and principal areas of deposition at the Centre County site (Pine Glen). Having examined the apparent effects of different scales on erosion prediction over an area, it is concluded that estimation of erosion on a 1-ha basis likely will lead to the optimum prediction capability, especially on mined and reclaimed lands in Appalachia. This conclusion is based primarily on the results of structural analysis of soil loss data that suggest a workable continuity range of about 0.1 km ($3a = 3(0.035) = 0.105$), on an exponential variogram model, and on the examination of relative dispersion and extension statistics that are about the same or smaller than for a smaller or a larger area. The present findings, as well as the recent development of the erosion-deposition computer model, raise questions about the validity of extending the universal soil loss equation (USLE) predictions to larger areas, even when USLE is applied in conjunction with the sediment delivery ratio. (See also W91-03117) (Rochester-PTT)
W91-03131

INTERRILL EROSION RATES AND SEDIMENT CHARACTERISTICS.
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
L. D. Meyer.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 167-177, 1 fig, 3 tab, 18 ref.

Descriptors: *Rill erosion, *Sediment erosion, *Sheet erosion, *Soil erosion, *Soil texture, Agricultural runoff, Iowa, Mississippi, Sediments, Storm runoff.

Rill and interrill erosion, often called sheet erosion, occur over so much of the land surface that they are hardly noticeable in comparison with the more spectacular soil losses from gully and stream channel erosion. Rill erosion often can be evaluated visually when it is especially serious, but interrill erosion is usually so inconspicuous that it must be evaluated experimentally. Experiments were conducted to evaluate interrill erosion over a wide range of soil and cropping conditions using a portable, multiple-intensity rainfall simulator. Most of the studies were conducted on typical agricultural fields (Mississippi, 15 soils; Iowa 3, soils) using rain intensities of about 10, 25, 67, and 105 mm/hr Most of the research plots were on row sideslopes in row-cropped fields, typical interrill areas for intensively cropped agricultural land. Because interrill and rill erosion result from different erosive agents (rainfall and runoff, respectively), study of them separately rather than in combination is better for understanding complex soil erosion processes and developing effective erosion control practices. Interrill erosion rates as great as 50 t/ha-hr may result when intense rainstorms occur on poorly protected, highly erodible soil. Interrill erosion rates vary greatly, depending on soil type, rain intensity, and soil surface cover. The rates are affected to a lesser extent by slope steepness, prior land use, and amount of rainfall. The characteristics of sediment eroded from interrill sources vary greatly with soil texture and aggregation. Fine-textured soils often have coarse sediment because much of the sediment erodes as sizeable aggregates. The size distribution of sediment from aggregated soils can be estimated by laboratory procedures using samples of surface soil. The wet aggregates in sediment have densities of about 2 g/cu cm and they usually contain as much or more clay-size material as the original soil. Once eroded by raindrop impact from interrill areas, the aggregates are unlikely to be broken down further during transport through the cropland runoff system. Interrill erosion can be a major source of sediment from agricultural land and other disturbed land. Consequently, efforts to reduce interrill erosion have the potential to significantly reduce soil losses from such land. (See also W91-03117) (Rochester-PTT)
W91-03132

STOCHASTIC SIMULATION OF GULLY NETWORKS ON ERODED LAND.
Tokyo Univ. (Japan). Faculty of Agriculture.
M. Nakano, A. Takagi, and N. Haraguchi.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 178-187, 6 fig, 3 tab, 13 ref.

Descriptors: *Geomorphology, *Gullies, *Gully erosion, *Model studies, *Simulation, *Stochastic models, *Stream classification, Graphical analysis, Japan, Mathematical models, Stochastic process, Topography.

There are no widely accepted mathematical methods of quantitatively describing, simulating, and estimating gully networks. Gully networks were simulated with a model that starts with gully heads and draws the lines of the gullies downward through confluence. This is the opposite of the stream channel growth model used in geography, which starts with an outlet of channel networks and develops stream networks from there by headward growth of channels through branching. Gully networks generated by the model were compared with observed gully networks in Japan. Gully networks developed on a topographically concave slope can be described quantitatively with Strahler's stream channel ordering system. When the number of gullies of each order was plotted against gully orders on the ordinate of a logarithmic scale, the lines were slightly concave downward. When plotting the mean length of gullies of each order in the same fashion, the lines become conical and have a peak. A model in which the locations of gully heads are specified using uniform random numbers and gully lines drawn downward in zigzag fashion at angles selected with Gaussian random numbers can approximate the observed gully networks. Furthermore, the model suggests the following: (1) as gully networks grow, the number of gullies of each order increases in nearly the same ratio; (2) the mean length of gullies of lower order, however, decreases whereas that of gullies of the highest order increases; and (3) if flat surfaces were constructed, gully networks smaller in magnitude might develop such that the number of gullies of each order would decrease and the mean lengths of gullies of the second and third order would increase. (See also W91-03117) (Rochester-PTT)

W91-03133

SEDIMENT YIELD MODELING OF ROADWAYS.
New Mexico State Univ., Las Cruces. Dept. of Civil, Agricultural and Geological Engineering.
T. J. Ward.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 188-199, 3 fig, 2 tab, 36 ref.

Descriptors: *Erosion, *Forest watersheds, *Model studies, *Roads, *Sediment yield, California, Idaho, Long-term studies, Mathematical models, Montana, New Mexico, North Carolina, Storm runoff.

Historically, most erosion monitoring has focused on agricultural lands. In the last 25-30 yr, there has been a growing effort to address the problem of erosion from roadways, specifically those in forest environments. Empirical, long-term sediment yield studies have been conducted. More recently, mathematical modeling of long-term storm event erosion and sediment yield has been attempted. Two general approaches are currently in vogue: empirically derived regression models and physical process models. Research in the field of sediment yield monitoring as it relates to forested areas is reviewed and results of model validation are discussed. Sites in which the modeling validation was conducted are: Coweeta Experimental Watershed, North Carolina; mine haul roads in Montana and Idaho; California forest roads; and New Mexico forest roads. Comparisons among the sites indicated that the response of the Coweeta, California, and New Mexico road surfaces was, on average, quite similar. The mine haul roads responded with a bit more runoff from rainfall and significantly smaller sediment yields. One reason that yields were lower was gravel cover on the mine haul road sites. Modeling of roadways using physical process computer models (ROSED for Coweeta, ROSED and SIRSED for mine roads, and SIRSED for California roads) has proved to be an acceptable and representative means of estimating water and sediment yields, although there are some problems remaining. It is now possible to collect data, derive model parameters, and then make relatively good estimates of sediment yields from other rainfall events. (See also W91-03117) (Rochester-PTT)
W91-03134

UPLAND EROSION AND DOWNSTREAM SEDIMENT DELIVERY.
Stall (John B.) Ltd., Urbana, IL.
J. B. Stall.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 200-205, 3 fig 1 tab, 6 ref.

Descriptors: *Agricultural watersheds, *Channel detention, *Sediment yield, *Soil erosion, *Universal soil loss equation, Agricultural runoff, Geomorphology, Illinois, Incised channels, Mathematical analysis, Nonincised channels, Sediment sampler, Statistics.

The universal soil loss equation (USLE) is widely used for determining upland erosion and United States Agricultural Research Service soil scientists continue to conduct research to define more accurately the relevant factors. However, soil loss measurement as is done with plots using the USLE does not provide an accurate indication of sediment continuing downstream because much eroded sediment is deposited at the downhill end of the slope, beyond the measuring flume. In a study of 20 lake and pond watersheds in Illinois, it was concluded that the density of nonincised channels in a watershed reflected the amount of sediment entrapped in the watershed. (Nonincised channels are defined as those crossable by a farm tractor; incised (non-crossable) channels are routinely indicated on soil maps.) Most of the soil lost from a cultivated slope stops upon reaching the nonincised channel and thus is not relevant when calculating sediment input to streams. An equation was developed: S = -1.0 minus 0.25N, where S is the sediment entrapped in the watershed, varying from 0 to 8.0 t/ha/yr and N is the density of nonincised channels in the watershed, varying from 6.8 to 32.3 m/ha. The equation has a standard error for S of plus or minus 1.6 and a correlation coefficient R of 0.75 with 18 degrees of freedom. Although the equation is a statistical, not a physical relation, it is an indicator of the factors affecting sediment deposition within a watershed. In Illinois, and perhaps in the entire midwest, the density of nonincised channels in a watershed can aid in making a good estimate of sediment delivery to streams. (See also W91-03117) (Rochester-PTT)
W91-03135

ADJUSTING THE UNIVERSAL SOIL LOSS EQUATION FOR USE IN WESTERN EUROPE.
Faculte des Sciences Agronomiques de l'Etat, Gembloux (Belgium).
A. Bollinne.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 206-213, 4 tab, 9 ref.

Descriptors: *Erosion rates, *Europe, *Sediment yield, *Soil erosion, *Universal soil loss equation, Belgium, Comparison studies, Estimating equations, Slopes, Soil properties.

Tables and nomographs are available to calculate the values of the parameters of the universal soil loss equation (USLE) used in the United States. Research was carried out at a station in Sauveniere (Gembloux, Belgium) to verify these values. The soil, on a 6.5% slope, is a loess-derived silt loam in which an Orthic Hapludalf develops. Studies were conducted to verify the following factors: rainfall threshold values for erosion index 30 (EI30), correlation between EI30 and soil loss, soil erodibility factor (K), cover factor (C), and topographic factor (LS). Measurements are in progress to determine the support practice factor (P), but values of the USLE are used provisionally. A field comparison of use of the USLE with unmodified values versus the values determined as part of the present study showed that soil loss estimated with unmodified values used in the United States was too low. The modified USLE give better estimates but still underestimates soil loss on gentle slopes. In the unmodified USLE, the threshold value of 12.7 mm for rainfall definitely is too high., the correlation between EI30 and soil loss is low, and the slope factor seems to underestimate soil loss on gentle slopes (< 4%). Further research is needed to determine an erosion index more suitable than EI30 in western Europe, to quantify the values of other parameters such as C and P, and to verify the amplitude of variations of K-values for the loamy soils found there. The risk of soil loss can be estimated provisionally using the following equation (EI30 for rainfalls >= 1 mm): A = A sub jn x K sub m x LS/0.636 x CP, where A sub jn = soil loss on the bare reference plot (A sub jn = 0.19 EI30 + 0.64, with R = 0.58), K sub m = the adjusted K value (K sub m = 1.16 (K sub w minus 0.48) plus 0.43, where K sub w comes from a nomograph, and 0.636 = the value of LS from the reference plot. (See also W91-03117) (Rochester-PTT)
W91-03136

IMPACT OF EROSION ON LAND PRODUCTIVITY AND WATER QUALITY IN THE UNITED STATES.
Resources for the Future, Inc., Washington, DC.
P. Crosson.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 217-236, 3 tab, 14 ref.

Descriptors: *Agricultural watersheds, *Crop yield, *Soil erosion, *United States, *Water quality, Corn, Management planning, Regression analysis, Soil losses, Soybeans, Wheat.

Erosion from cropland causes two forms of damage: (1) loss of productivity of the cropland and (2) damage to downstream sites where the eroded material is deposited. Three questions are addressed here in a review of information about the United States: what is known about these two forms of erosion damage, what is known about the future magnitudes of these problems, and how serious are the current and future levels of these impacts. A study conducted using a regression approach with data from 616 counties growing corn and 299 counties growing soybeans demonstrated that erosion had a significant negative effective on the growth of corn and soybean yields, although the effect seems to have been concentrated in counties where erosion exceeded 11.2 t/ha. Erosion did not significantly retard the growth of wheat yields (data from 191 counties). The present approach produced results generally in agreement with those obtained using the Yield-Soil Loss Simulator and in a study conducted by Larson and associates. All three methods show yield reductions due to erosion over extended time scales. Little is known about the fate of eroded soil that is deposited near the source. However, there appears to be a consensus that its effects are negative; it clogs drainage ditches and irrigation canals, for example. The soil that enters streams also has deleterious effects, including increased turbidity, shortening of reservoir life spans, impeding navigation, and destruction of fish spawning habitats. The T-values used by the Soil Conservation Service (soil loss tolerances) may be too high. The case for policies to control erosion to reduce off-farm damage is strong, but the information base needed to devise cost-effective policies is weak. (See also W91-03117) (Rochester-PTT)
W91-03137

PHYSICAL COMPONENTS OF THE EPIC MODEL.
Agricultural Research Service, Temple, TX. Grassland, Soil and Water Research Lab.
J. R. Williams.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 272-284, 2 tab, 17 ref.

Descriptors: *Economic aspects, *Erosion-Productivity Impact Calculator, *Hydrologic models, *Model studies, *Plant growth, *Soil erosion, Erosion, Hydrology, Mathematical models, Nutrients, Resources Conservation Act, Soil temperature, Tillage, United States, Weather.

The EPIC (Erosion-Productivity Impact Calculator) model was developed by the Agricultural Research Service (United States Department of Agriculture) beginning in 1981. The model comprises physically based components for simulating erosion, plant growth, and related processes and economic components for assessing the cost of erosion, determining optimal management strategies, and son on. EPIC simulates the physical processes simultaneously and realistically using readily available inputs. The physical components of EPIC can be placed into seven major divisions: hydrology, weather, erosion, nutrients, plant growth, soil temperature, and tillage. EPIC simulations have been performed on 150 test sites in the continental United States and 13 test sites in Hawaii. Generally, the test results appear reasonable. The EPIC model is operational. It has produced reasonable results under a variety of climatic conditions, soil characteristics, and management practices. It also has demonstrated sensitivity to erosion in terms of reduced crop production. Although designed to be used in the Resources Conservation Act analysis of the current status of soil and water resources in the United States, EPIC has additional potential uses, including: (1) national-level conservation policy studies; (2) national-level program planning and evaluation; (3) project-level planning and design; and (4) as a research tool. (See also W91-03117) (Rochester-PTT)
W91-03138

SIMULATION OF INDIVIDUAL-STORM SOIL LOSS FOR MODELING THE IMPACT OF SOIL EROSION ON CROP PRODUCTIVITY.
Agricultural Research Service, Ames, IA.
J. M. Laflen, G. R. Foster, and C. A. Onstad.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 285-295, 5 tab, 20 ref.

Descriptors: *Crop yield, *Erosion-Productivity Impact Calculator, *Hydrologic models, *Model studies, *Soil erosion, Mathematical models, Model testing, Prediction, Storm runoff, Universal soil loss equation.

Determination of erosion's effect on crop productivity in the United States is to be made using an erosion, crop productivity model. An important part of the model--Erosion Productivity Impact Calculator (EPIC)--is soil erosion prediction. The soil erosion prediction component for EPIC is still undergoing development and testing. Current proposed equations for estimating soil erosion in EPIC are described here, including: modification of the rainfall erosivity factor, modification of the universal soil loss equation (USLE) crop and management factor (C, including prior land use subfactor, crop-canopy subfactor, surface-roughness subfactor, and residue-cover subfactor), and testing of storm loss simulation. Only portions of these equations are incorporated in the current EPIC. A simplified method for computing C values is now used. Three different approaches to computing C values are being compared, but eventually one will be chosen based on the results of the comparison. Newer information is now available concerning roughness and residue impacts on soil erosion. (See also W91-03117) (Rochester-PTT)
W91-03139

MODEL FOR QUANTIFYING INCENTIVE PAYMENTS FOR SOIL CONSERVATION IN CROPPING REGIONS SUBJECT TO WATER EROSION.
La Trobe Univ., Bundoora (Australia). School of Agriculture.
For primary bibliographic entry see Field 4D.
W91-03140

CROP YIELD REDUCTION DUE TO REDUCED PLANT AVAILABLE WATER CAUSED BY WATER EROSION.
Technische Univ., Munich (Germany, F.R.). Lehrstuhl fuer Bodenkunde.
For primary bibliographic entry see Field 4C.
W91-03144

ESTABLISHMENT OF PLANT COVER PARAMETERS FOR MODELLING SPLASH DETACHMENT.
National Coll. of Agricultural Engineering, Silsoe (England).
R. P. C. Morgan.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 377-383, 4 tab, 13 ref.

Descriptors: *Model studies, *Rainfall impact, *Soil erosion, *Soil-water-plant relationships, *Splash detachment, *Vegetation effects, England, Kinetic energy, Mathematical models, Parameter estimation.

The rate of splash detachment (DET) without plant cover varies with the kinetic energy (KE) of the rainfall. The relationship can be expressed by the power function DET = k KE to bth power, where k is an experimentally derived measure of the detachability of the soil, and b ranges in value from about 0.8 on sandy soils to 1.4 for clayey soils, with a value of 1.0 being reasonably representative and mathematically convenient. The effects of a plant cover can be accounted for by reducing the predicted detachment rate by a ratio that varies by the height, canopy cover, and ground cover of the plant assemblage. The ratio has a curvilinear relationship with the percentage canopy and ground cover, and this relationship suggests the following modeling equation: DET = k (KE.e to the -a.INCEP power) to the bth power, where INCEP is the percentage of rainfall that contributes to permanent interception and stemflow and therefore does not contribute to splash detachment and k is an index of soil detachability with the prevailing plant-soil complex and ranges from 0.03 to 0.15, with 0.06 being reasonably representative. This equation has been adopted for the splash detachment phase of a model to predict mean annual soil loss. Field measurements of the rate of splash detachment over 100-day periods were made between May 1973 and August 1979 in Bedfordshire, England, over a range of soils and plant covers. The factor b was negative whenever plant cover was present. Laboratory experiments were conducted to assess the effects of plant cover on the rate of splash detachment and on the volume and energy of rain reaching the ground surface. It was found that the modeling equation adequately represents the reductions in kinetic energy of rain as a result of interception by plant cover. More data are required on percentage of rainfall interception by different plants. Values of k can be determined experimentally for a series of storms, but they are relatively high for crops with large leaves on which raindrops coalesce and produce throughfall with large drop sizes. Under these conditions, b becomes negative. (See also W91-03117) (Rochester-PTT)
W91-03145

EFFECTIVENESS OF EI30 AS AN EROSIVITY INDEX IN HAWAII.
Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Sciences.
A. Lo, S. A. El-Swaify, E. W. Dangler, and L. Shinshiro.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 384-392, 3 fig, 9 ref.

Descriptors: *Erodibility, *Hawaii, *Rainfall intensity, *Soil erosion, *Universal soil loss equation, Agricultural runoff, Annual precipitation, Estimating, Mathematical equations, Performance evaluation.

To employ the universal soil loss equation (USLE) in Hawaii, appropriate values for each USLE factor are needed. A study was conducted to test whether the erosivity index, defined as the product of storm kinetic energy and maximum 30-minute intensity (EI30), is applicable in Hawaii. Methods for its approximation were determined. Erosivity was investigated in three steps (1) studies of soil detachment under standard conditions, (2) studies of soil detachment, entrainment, and transport on standard runoff plots, and (3) these parameters were studied on field-scale plots in the absence of crop effects. Sand splash measured with calibrated sand splash cups correlated well with EI30. Linear regression relationships between EI30 and soil loss from standard bare plots and small watersheds also were well correlated. Because of the linear relationships between sand splash, soil loss, and EI30 index, it is concluded that the EI30 index is suitable for quantifying erosivity of Hawaiian rainstorms. A relationship between maximum 30-min and 60-min rainfall intensities was developed. The estimated EI30 index compared well with the true EI30 index. The comparison improved even further when storm EI30 indices were summed over the month and over the year. Against the EI30 index, rainfall totals on a storm, daily, monthly, seasonal, and annual basis, along with readily available Fournier and modified Fournier indices, were tested. Average annual rainfall was chosen as the best estimator of the average annual EI30 index. The estimation procedures were employed to develop a detailed isoerodent map for the island of Oahu. By using the annual rainfall amount estimation to refine and improve this map, it was possible to draw detailed isolines in areas where no data points previously existed. The map is recommended for use in the application of the universal soil loss equation in Hawaii. (See also W91-03117) (Rochester-PTT)
W91-03146

EROSION CONTROL IN URBAN RIVER VALLEYS: TORONTO, ONTARIO.
Surrey District, Vancouver (British Columbia).
For primary bibliographic entry see Field 4D.
W91-03147

RUNOFF EFFECTS ON THE EFFICIENCY OF RAINDROP KINETIC ENERGY IN SHEET EROSION.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
P. I. A. Kinnell.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 399-405, 3 fig, 11 ref.

Descriptors: *Kinetic energy, *Rainfall impact, *Rainfall-runoff relationships, *Sheet erosion, *Soil erosion, Australia, Erodibility, Infiltration, Thunderstorms, Vegetation effects.

Geographic applicability of an erosion model might increase through an approach that maintains a relatively simple structure, such as that of the universal soil loss equation (USLE), while adopting a more process-oriented approach to the selection of parameters. Such an approach was used in developing and applying a model for the effects of raindrop and surface water flows on sheet erosion. A model for total soil loss was developed that considered the effect of surface soil conditions (eg, erodibility and type and amount of vegetation) on the efficiency of the kinetic energy of raindrops and surface water flows. Tests were conducted in the field on bare fallow plots situated in Ginninderra, Australian Capital Territory. The rainfall events (n=43) ranged from long periods of low-intensity rainfall, which are common in winter, to intense summer thunderstorms. Runoff depths ranged from 0.2 to 57 mm. Infiltration rates ranging from 2-6 mm/hr were common during the low-intensity events, whereas infiltration rates of 15-20 mm/hr were common for storms in summer. A reasonable relationship was shown between soil loss and the product of (a) rainfall energy and (b) the positive difference between rainfall intensity and an approximation for the average infiltration rate for the event. (See also W91-03117) (Rochester-PTT)
W91-03148

RATE OF SOIL DETACHMENT BY OVERLAND FLOW, WITH AND WITHOUT RAIN, AND ITS RELATIONSHIP WITH DISCHARGE, SLOPE STEEPNESS, AND SOIL TYPE.
University of Science and Technology, Kumasi (Ghana). Faculty of Agriculture.
C. Quansah.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 406-423, 11 fig, 4 tab, 31 ref.

Descriptors: *Overland flow, *Rainfall impact, *Sediment discharge, *Slopes, *Soil erosion, Mathematical equations, Regression analysis, Rill erosion, Slope effects, Soil properties.

Studies on the four phases of the erosion process have focused mainly on splash detachment and transport. A laboratory study was conducted to measure detachment of particles by overland flow, with and without rain; to examine the effect of varying slope steepness and soil type on the relative contribution to detachment by overland flow and raindrop impact; and to establish power equations for the flow's detachment rate with slope steepness, discharge, and soil type. Detachment by overland flow without rain occurred primarily by rilling. Rainfall increased detachment rate, and there was a relatively even removal of particles from the eroding bed. By determining the amount of material detached by overland flow with and without rain, it was possible to calculate the relative contributions to total detachment by overland flow and by splash. On gentle slopes most detachment on the soils was by splash, whereas overland flow detached little soil. As slope increased, splash detachment increased gradually, but detachment by overland flow increased rapidly. Multiple regression techniques indicated a highly significant (p=0.001) correlation between overland flow and slope steepness and discharge. There is a critical slope steepness at which rainfall impact and overland flow contribute equally to detachment. At lower slopes, raindrop impact dominates, whereas at steeper slopes, flow dominates detachment. The critical slope steepness, knowledge of which is necessary to apply control measures for the appropriate detaching agent, is soil specific. New equations accommodating the effects of rainfall-runoff interactions and grain size effects were established in the course of this study, but they have not been

validated under field conditions to date. (See also W91-03117) (Rochester-PTT)
W91-03149

UNIVERSAL INDEX FOR CALCULATING RAINFALL EROSIVITY.
Institute of Soil Science and Yield Prediction, Sofia (Bulgaria).
N. G. Onchev.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 424-431, 3 tab, 23 ref.

Descriptors: *Rainfall impact, *Rainfall intensity, *Rainfall-runoff relationships, *Soil erosion, *Universal Index, Bulgaria, Erodibility, Erosion rates, Mathematical studies, Runoff.

Studies in various parts of the world have demonstrated the need for a more objective index than EI30 for calculating rainfall erosivity that will not be affected by regional differences in rainfall. A new index was developed based on two critical quantitative characteristics: quantity and intensity of rainfall not inducing runoff, used for separating the active erosive portion in every rainfall. The erosivity of each rainfall is determined by the active runoff-inducing part, which in Bulgaria represents the sum of the periods with an intensity > or = 0.180 mm/min and total quantity > or = 9.5 mm. On the basis of this regularity, the universal index (UI) could be deduced for calculating rainfall erosivity according to the following equation: R' = P/sq root of t, where R' = the universal index, P = quantity of rainfall > or = 9.5 mm, and t = the duration of rainfall with intensity > or = 180 mm/min. The UI is superior in terms of rainfall erosivity representativeness to all indices and characteristics of rainfall tested so far because it does not include those rainfalls that are incapable of producing erosion (i.e., P < 9.5 mm, intensity < 180 mm/min). (See also W91-03117) (Rochester-PTT)
W91-03150

CLASSES OF RELIEF SUSCEPTIBILITY FOR SURFACE EROSION.
International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
E. Bergmsa.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 432-436, 1 fig, 2 tab, 7 ref.

Descriptors: *Land slope values, *Relief classification, *Soil erosion, *Soil physical properties, *Topography, Classification, Graphical analysis, Mapping, Rills, Slope effects.

Relief classes described in the Soil Survey Manual (U.S. Department of Agriculture) were used as the starting point in an attempt to develop a relationship to the length/steepness (LS) values according to the universal soil loss equation (USLE). This could not be done because the LS graphs run across the slope ranges of the relief classes. However, if classes described by combinations of slope length and slope steepness are considered, it appears possible to create classes that have only a limited variation of LS value. Ultimately, six relief steepness classes were related to erosion slope length classes so that hazard surveys could be conducted using mapping units on scales of about 1:10,000 and 1:50,000. Within each relief steepness class, the erosion slope length class (e.g., 12-30 m, 30-60 m, etc.) is associated with a 'step' value indicating the degree of erosion hazard. Tentatively, rill occurrence is estimated to increase soil loss by two to five or six steps. The ratio will depend strongly on the soil texture and steepness and the overland flow volume. It has been shown that rill hazard increases with overland flow volume, heavier texture, and slope steepness. (See also W91-03117) (Rochester-PTT)
W91-03151

SOIL ERODIBILITY FACTOR: A PERSPECTIVE.
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
M. J. M. Romkens.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 445-461, 1 fig, 5 tab, 31 ref.

Descriptors: *Erodibility, *Reviews, *Soil erosion, *Soil properties, *Universal soil loss equation, K values, Ponding, Prediction, Simulated rainfall, Storms.

Since its introduction, the universal soil loss equation (USLE) has been gradually and systematically improved. The soil factor (usually referred to as the soil erodibility factor, K) is reviewed here, including: the soil factor in early soil loss equations (e.g., Zingg's, Smith's, and Smith and Whitt's); the USLE and the soil erodibility factor (definition, long-term values, fallow requirements); K values of natural runoff plots; rainfall simulation-based K values versus soil properties (K-factor determination, soil properties); and improving soil erodibility factor predictions. A universally applicable prediction equation for K values may not exist. Within the limits of the definition, however, accurate K-value estimates are best obtained from direct measurements on natural runoff plots if a sufficiently long observation period is used and unit plot conditions are met. Good estimates may be obtained from rainfall simulator studies provided storm weighting reflects the frequency pattern for the location and unit plot requirements are met. Indirect estimates, based on nomograph or other predictive relationships of soil properties, need to be considered carefully in relation to the type of soils for which these relationships were derived. In the absence of a suitable predictive model, substantial errors in K values may be made. Current evaluation techniques are based on a statistical relationship between the soil erodibility factor and a series of soil properties, antecedent conditions, and weather patterns. If a statistical relationship yields acceptable estimates of K values, an understanding of the underlying erosion processes is, from a utilitarian standpoint, not essential. The complexity of the erosion process precludes any simple calculation of the soil erodibility factor. Yet, some variability in K-value measurements can be reduced by estimating the effect of variation in antecedent soil water and soil surface roughness. The current procedure of excluding storms with less than 1.27 cm of rainfall can be improved by using predictions of ponding time and surface retention. (See also W91-03117) (Rochester-PTT)
W91-03153

PERCENT CROWN COVER RELATED TO WATER AND SOIL LOSSES IN MOUNTAINOUS FOREST IN THAILAND.
Kasetsart Univ., Bangkok (Thailand). Faculty of Forestry.
N. Ruangpanit.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 462-471, 5 fig, 3 tab, 10 ref.

Descriptors: *Forest watersheds, *Soil erosion, *Soil-water-plant relationships, *Thailand, *Vegetation effects, Chingmai, Litter, Mountain streams, Runoff, Soil losses, Watershed management.

Conservationists have long recognized that living plants and litter reduce runoff and erosion. A study was conducted in northern Thailand at the Doi Pui, Kog-Ma Watershed Research Station, Chingmai (elevation 1,350 m) with the aim of determining how different densities of crown cover affect runoff and erosion. There were two objectives: (1) to determine the specific crown cover required for minimizing water and soils losses and (2) to establish the density limits to which crown cover may be altered without losing its effectiveness for watershed protection. Sample plots were 4 x 20 m and were located on a southwest-facing 20-25% slope of the hill evergreen forest. Twelve regression equations were developed to show runoff and erosion as functions of rainfall under various percentages of crown cover. Both runoff and erosion increased with increasing amounts of rainfall and decreased with increasing percent crown cover, particularly as crown cover declined from 70%. The minimum amount of rainfall that caused erosion was 10 mm. The maximum infiltration capacity or soil water absorption to fulfill the demand of depression storage and establish an initial quantity of surface detention was equivalent to about 5 mm of rainfall. Erosion varied directly with runoff in a curvilinear relationship. One cu m/ha of surface runoff would cause about 3 kg/ha of soil loss. Erosion and runoff increased with rainfall intensity, rapidly when intensity exceeded 20 mm per hour and crown cover was reduced below 70%. The ratio of rainfall intensities of 0-10, 10-20, and > 20 mm/hr to cumulative soil loss was 1:4:8 and to runoff was 1:2:3.5. Runoff and erosion rates also increased with rainfall duration. As crown cover was reduced below 70%, they increased markedly, particularly with 60-min and longer rainfall durations. There was a close and direct relationship between crown cover and surface runoff or soil erosion, but crown cover had a minor effect on the total volume of surface runoff and soil erosion. In managing forest land, especially in areas designed for watershed protection purposes, the specific crown cover required to minimize surface runoff and soil erosion should be at least 70% and in combination with minimum bare soil openings. (See also W91-03117) (Rochester-PTT)
W91-03154

PRELIMINARY ANALYSIS OF RUNOFF AND SOIL LOSS FROM SELECTED LONG-TERM PLOTS IN AUSTRALIA.
Soil Conservation Service of New South Wales, Sydney (Australia).
K. Edwards.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 472-479, 2 fig, 4 tab, 14 ref.

Descriptors: *Agricultural practices, *Agricultural runoff, *Australia, *Soil erosion, *Vegetation effects, Long-term studies, Model studies, Pastures, Prediction, Universal soil loss equation, Wheat.

The universal soil loss equation (USLE) may not be valid or useful were large soil losses are infrequent but account for most of the total soil loss over the long term. In some Australian plots where data have been collected for up to 30 yr, preliminary analysis shows a heavily skewed distribution of soil loss. Data now are being collated from studies in New South Wales (Australia) that have been under way since the 1940s. Analysis of the data has three major aims: to provide quantitative measures of soil loss, to evaluate the USLE's applicability to Australian conditions, and to provide the basis for development, if necessary, of a soil loss prediction model for Australia. Plots of 100 sq m were enclosed by wooden planks and fitted with an apron and sill at the lower end. Runoff is led into a silt collection box. Such plots were established at Gunnedah and Wagga in the wheat belt of New South Wales; slopes of the plots were, respectively, 8.5 and 8.0 percent and annual rainfall averages 644 mm and 561 mm. The treatments imposed on the plots included both permanent pasture and a wheat rotation (wheat every second year). Although only a small proportion of the results from these runoff and soil loss trials are considered, a few trends are obvious. Large losses are infrequent but contribute most of the total losses. As a consequence, the concept of average annual losses is not very meaningful and may preclude use of the USLE. The results also demonstrate the protection provided by growing or inert vegetative material. Soil losses from cropped plots far exceed those from the pasture plots. Within the cropping rotation, significant losses are restricted to periods when ground cover is reduced by cultivation. More data from a wider range of centers will be needed to determine whether the USLE is applicable to Australian conditions. (See also W91-03117) (Rochester-PTT)
W91-03155

MODIFYING THE UNIVERSAL SOIL LOSS EQUATION FOR FOREST LAND.
Forest Service, Atlanta, GA.
G. E. Dissmeyer, and G. R. Foster.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 480-495, 15 fig, 3 tab, 14 ref.

Descriptors: *Forest soils, *Forest watersheds, *Soil erosion, *Universal soil loss equation, *Vegetation effects, Fabric dams, Field tests, Organic matter, Rill erosion, Sheet erosion, Soil properties.

The universal soil loss equation (USLE) has evolved as the major tool for estimating sheet and rill erosion. The subfactor approach has evolved as use of the USLE has expanded and has provided needed flexibility. The subfactor allows estimates of erosion to be made systematically where no data are available, based upon an evaluation of site-specific conditions. Starting in the spring of 1977, various United States Department of Agriculture agencies pooled their efforts to produce a new a procedure for assigning cover-management-factor values to forest land. The major subfactors operating in many forests are (1) amount of bare soil, (2) canopy, (3) soil reconsolidation, (4) high organic matter content, (5) fine roots, (6) residual binding effect, (7) onsite storage, (8) steps, and contour tillage. The USLE needs to be adapted before it is adopted for use in new situations. If this is done, erosion estimates will be more accurate. Although the traditional approach of plots and watersheds is always best for validating the USLE, it requires significant financial and technical resources and equipment. An alternative is the use of fabric dams, which can effectively and inexpensively measure and demonstrate erosion from a variety of conditions. Fabric dams are constructed at the toe of plots using erosion-control fabric that allows water through while filtering out soil particles. Before the USLE can be used in new situations, rainfall erosivity (R) and soil erodibility (K) factors need to be developed using procedures given in Agriculture Handbook 537. (See also W91-03117) (Rochester-PTT)
W91-03156

RESEARCH ON THE UNIVERSAL SOIL LOSS EQUATION IN INDIA.
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
G. Singh, R. Babu, and S. Chandra.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 496-508, 3 fig, 6 tab, 23 ref.

Descriptors: *Cultivated lands, *India, *Model studies, *Soil erosion, *Universal soil loss equation, Comparison studies, Performance evaluation, Research facilities, Soil management, Watershed management.

Of India's 328.8 million ha, about 175 million ha are affected by soil erosion and other land degradation problems. About 80 million ha of agricultural land are affected by erosion. Erosion research on runoff plots in India started as early as 1929. Soils on runoff plots in India include alluvial, black, regosal, red, and lateritic and deep lateritic soils. There are eight soil conservation research demonstration and training centers as well as other institutions collecting data concerning universal soil loss equation (USLE) factors (i.e., rainfall erosivity (R), soil erodibility (K), slope-length (L), slope-gradient (S), topographic (LS), cropping management (C), and soil conservation practice (P)). Considerable soil loss data has been collected at the soil conservation research centers in India, but the USLE remains the best model available, with some modifications supported by research. Data collected at the Central Soil and Water Conservation Research and Training Institute, Dehra Dun, and its centers, as well as by other agencies, such as the state governments' research centers and universities, have been used for developing various USLE factors. In some cases, the factors developed are only first approximations. Insufficient research data are available to develop a new prediction equation model specifically for Indian conditions. At present, specific values of some USLE factors are available that can be used to assess the gross soil erosion under different management conditions in India. (See also W91-03117) (Rochester-PTT)
W91-03157

APPLICABILITY OF THE UNIVERSAL SOIL LOSS EQUATION (USLE) AND MODIFIED USLE IN HAWAII.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
K. R. Cooley, and J. R. Williams.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 509-522, 4 fig, 4 tab, 11 ref. Soil Conservation Service Cooperative Agreement 12-14-5001-320.

Descriptors: *Agricultural runoff, *Agricultural watersheds, *Hawaii, *Soil erosion, *Universal soil loss equation, Model studies, Performance evaluation, Pineapple, Sugarcane, Vegetation effects.

Lack of information on actual soil erosion and its relationship to causal factors in Hawaii has restricted the adaptation or modification of methods used elsewhere to estimate erosion. Mainland-derived equations, such as the universal soil loss equation (USLE), generally overestimate soil loss compared to observations. Rainfall, runoff, and erosion data were obtained over 7 yr from 5 small Hawaiian agricultural watersheds (0.615-2.84 ha). The objectives were to estimate values of the crop factor (C) for pineapple and sugarcane from measured data and to determine the applicability of the USLE and the modified USLE (MUSLE) to Hawaii. Generally, the factors most difficult to estimate when initially applying the USLE or MUSLE are C and the soil erodibility factor (K). The other factors are based on measured precipitation or runoff, or they can be estimated from observations or topographic maps. In the present study, C factors were estimated by measuring or using previously determined values of the support practice factor (P), the rainfall erosion index (R), the slope length (L) and steepness (S) factors, K, the storm runoff volume (Q), and the peak runoff rate (q sub p), and then solving for C. Overall, the C values determined for Hawaiian watersheds in this way are lower than those given in the Soil Conservation Service handbook. C values for pineapple tend to be slightly higher than those for sugarcane for the same hydrologic soil group, although the range of values may be the same. A data-based comparison of the USLE and MUSLE methods of estimating soil losses indicates that the USLE predictions will be higher than the MUSLE predictions when equal values of K, LS, P, and C are used. This suggests that C values near the lower end of the range should be selected for the USLE and higher values for the MUSLE. Estimates of total soil loss (annual average by USLE) ranged from 1.96 to 4.23 t/acre/yr for the five watersheds. Average observed losses ranged from 0.36 to 4.35 t/acre/yr for the same five watersheds. (See also W91-03117) (Rochester-PTT)
W91-03158

EXPERIMENTALLY DERIVED MODIFICATION OF THE USLE.
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
C. K. Mutchler, and C. E. Murphree.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 523-527, 8 ref.

Descriptors: *Cultivated lands, *Slope effects, *Soil erosion, *Topography, *Universal soil loss equation, Errors, Kinetic energy, Mathematical equations, Rainfall impact, Tillage, United States.

The universal soil loss equation (USLE) was developed primarily from data collected in the midwestern United States to predict erosion on valuable farmland in that region. Erosion on slopes less than 3% was not recognized as significant. Studies were conducted on erosion on flat lands and it was found that this can be serious; high rainfall rates are especially significant for soil erosion on low slopes. Based on studies of the individual factors under flat land conditions, the USLE is modified to A = R Rc K Kc L S C1 C2 C3, C4, C5, P, where the A is the estimated soil loss and R, K, L, S, and P are rainfall erosion index, soil erodibility, slope length, slope steepness, and erosion control processess. The subscripted values Rc and Kc represent correction factors to account for the effects of low slope on the rainfall erosion index and slope length, respectively. C1, C2, C3, C4, and C5 subfactors of the crop factor covering, respectively, land use residual, incorporated residual, tillage intensity and recency, macroroughness, and cover-canopy effects. Several recommendations are made for applying the USLE on flat lands, including: (1) using a new equation for the kinetic energy portion of the R factor (although the current equation does not cause any significant error in the United States); (2) using proposed values of Rc to correct the USLE for use on low slopes under high rainfall conditions until a better formulation of Rc = f(R, theta) can be developed (theta = slope steepness); (3) using Kc to represent variable soil erodibility when the C subfactors are used; otherwise, using the constant K with variable soil erodibility included in the average annual cropstage C factor; (4) using a new equation to compute the exponent for computing the slope-length factor from slope length on slopes of less than 3%; and (5) continuing development of the C-subfactor system and extend it for all crops and management systems. (See also W91-03117) (Rochester-PTT)
W91-03159

EXPERIMENTAL DATA ON RUNOFF GENERATION.
Katholieke Univ. Leuven (Belgium). Lab. voor Experimentele Geomorfologie.
For primary bibliographic entry see Field 2E.
W91-03160

IMPACT OF CHECK DAMS ON STEEP MOUNTAIN CHANNELS IN NORTHEASTERN TAIWAN.
Taiwan Forestry Research Inst., Taipei.
For primary bibliographic entry see Field 4D.
W91-03161

NEW MATHEMATICAL MODEL OF SOIL EROSION AND DEPOSITION PROCESSES WITH APPLICATIONS TO FIELD DATA.
Griffith Univ., Nathan (Australia).
C. W. Rose, and D. M. Freebairn.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 549-557, 2 fig, 13 ref.

Descriptors: *Australia, *Deposition, *Hydrologic models, *Mathematical models, *Model studies, *Soil erosion, *Universal soil loss equation, Erosion control, Mulches, On-site data collections, Soil properties.

The universal soil loss equation (USLE) is helped in the United States by the extensive data base available for important agricultural regions. Other countries have difficulty in amassing such a data base, and there is some uncertainty in predictive use of the USLE, especially where its hydrologic simplicity may limit its utility, as is the case with vertisols. Research on deterministic, process-oriented models ultimately may complement the USLE and relieve such limitations. A new approach is outlined here that is based on the principles of hydrology and erosion and deposition processes. Based on a theoretical analysis, an equation was developed for total sediment loss per unit plane width from a given area. This equation involves total sediment loss (Qs), the slope of the plane (S), a nondimensional factor for the efficiency of the sediment entrainment process (nu), the fraction of the soil surface unprotected by mulch or stone (Cr), the total runoff per unit area for the specific runoff event (RT), and the length of the plane in meters (L). The simplified theory of this equation was applied to field experiments in which Qs and RT were measured or estimated, S varied from 5-7 percent, and L was approximately 30 m. The experiments were carried out on soils of high clay content at two sites in the Darling Downs, Queensland, Australia. One soil was a vertisol. Soil loss in these experiments could be on the order of 200 tons/ha in a single runoff event with bare soil. The exposure fraction Cr (Ce for mulch experiments) was varied by the use of surface stubble from previous crops. Cr varied from zero (complete cover) to 1.0 (bare soil). The value of nu was calculated for all major runoff events at the two sites over 6 yr of record for a limited range of slope but a wide range of Cr. A strong functional dependence of nu on Cr was noted. Entrainment

efficiency, nu, fell from approximately 0.7 at Cr = 1 to approximately 0.25 at Cr = 0.9. Thus, a cover of only 10% reduced soil loss by almost two-thirds, supporting the well-known conservation effectiveness of stubble mulch. (See also W91-03117) (Rochester-PTT)
W91-03162

EXPERIMENTAL MODEL OF EVALUATING SOIL EROSION ON A SINGLE-RAINSTORM BASIS.
Istituto Sperimentale per lo Studio e la Difesa del Suolo, Florence (Italy).
G. Chisci, M. Sfalanga, and D. Torri.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 558-565, 2 fig, 2 tab, 15 ref.

Descriptors: *Italy, *Model studies, *Soil erosion, *Storm runoff, *Universal soil loss equation, Forecasting, Kinetic energy, Rainfall impact, Simulated rainfall.

Soil erosion is widespread and severe in Italy. The National Research Council sponsored a 5-yr project on soil conservation that ended in June 1982. As part of this project studies were conducted of soil erosion mechanics with a view toward supplying information for use in soil loss models based on erosion mechanics. Laboratory experiments, field experiments with a rainfall simulator, and field experiments with natural rainfall were performed. The model used is based mainly on soil availability (alpha) and force of transport of runoff (F). Availability is a balance between some subfactors, namely raindrop and runoff detachment rates and erosion rate. An estimator of F was proposed and tested with satisfactory results, although further tests are needed. Raindrop detachment rate depended mainly on rain kinetic energy and soil characteristics. Runoff detachment rate was proportional to runoff shear stress. Both detachment rates need to be tested further, especially that for runoff. The model has some weak points: (1) the force of transport and the shear stress are estimated through formulas derived under conditions of uniform flow at a steady state and (2) runoff characteristics strongly affect the model. However, since the model is intended to forecast soil loss during critical events, simplifications in forecasting runoff are to be expected. The experimental results indicate that the main factors and subfactors defining the universal soil loss equation (i.e., kinetic energy of rain, particle size distribution, and organic matter content) are related strongly to erosion as all of them are implicitly or explicitly present in the model. The model is far from operative, but the results so far indicate that it shows promise for forecasting soil loss during critical events, a type of forecasting of great importance for the Italian environment. (See also W91-03117) (Rochester-PTT)
W91-03163

SPATIAL SIMULATION TO AID IN EVALUATING AND TREATING EROSION AND WATER QUALITY PROBLEMS AFFECTING LAKE ERIE.
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W91-03164

GULLY SIDEWALL DEVELOPMENT IN NEW SOUTH WALES, AUSTRALIA.
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
T. J. Blong.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 574-584, 6 fig, 14 ref.

Descriptors: *Australia, *Bank erosion, *Erosion control, *Erosion rates, *Gully erosion, *Soil conservation, *Soil erosion, Headwaters, Management planning, Model studies, Rainfall impact.

Discontinuous gully headcut erosion has been fairly well documented, but comparatively little attention has been paid to the role of gully sidewalls. In three areas in New South Wales (Australia), sidewall erosion may be responsible for more than half the total volume of gully erosion. Recent results of studies in this area are summarized, the relationship between sidewall and erosion rates is demonstrated, the connection between sidewall evolution and headcut retreat is illustrated, and some implications for gully studies and soil conservation are discussed. Relatively simple, rapid field and photographic measurements were used, but they suggest several tentative conclusions and implications for soil conservation. More than half the sediment derived from a gully system may result from sidewall erosion. In some gully systems, the proportion resulting directly from linear incision may be relatively small. Gully sidewall development in some areas of New South Wales, and very likely elsewhere, is dominated by the growth, decay, and stabilization of flutes. Processes of rainsplash and slopewash are believed to dominate the active stage of gully sidewall development, but this cannot be demonstrated yet. Assuming that surface area ratio is an adequate surrogate for sidewall erosion rate, some readily identifiable segments of gully sidewall erode three or more times faster than other identifiable segments. In a simple gully system, the rate of erosion would increase from the headcut to some point downgully, beyond which it declines. However, most gullies have a relatively complex growth form to which this simple model is less applicable. At a given segment of gully sidewall in the Razorback area (80 km SW of Sydney), maximum erosion rates are reached perhaps 20-40 yr after sidewall initiation by headcut retreat. The erosion rate for the segment then declines to a relatively low value when the sidewall reaches a stable angle with a plant cover (perhaps as many as 50 yr after initiation. Two important implications for soil conservation stem from these observations: (1) installation of a successful gully headwall control structure will not halt downgully sediment yield in the short term and (2) because sediment yield is largely derived from portions of the gully sidewall positioned on the rising limb of the bell-shaped gully natural history curve (10-30 yr), there is probably little point in spending conservation money reshaping gully sidewalls that have progressed to the falling limb of the curve (30-50 yr) because erosion rate already is declining naturally. (See also W91-03117) (Rochester-PTT)
W91-03165

SIMPLIFIED SEDIMENT YIELD MODEL FOR SMALL AREA DISTURBANCES ON SURFACE-MINED LANDS.
Simons, Li and Associates, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 4C.
W91-03166

SOIL EROSION AND ITS CONTROL IN DEVELOPING COUNTRIES.
Food and Agriculture Organization of the United Nations, Rome (Italy).
For primary bibliographic entry see Field 4D.
W91-03175

RIVER MEANDERING.
For primary bibliographic entry see Field 2E.
W91-03203

BOUNDARY SHEAR STRESS AND SEDIMENT TRANSPORT IN RIVER MEANDERS OF SAND AND GRAVEL.
California Univ., Berkeley. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2E.
W91-03204

SEDIMENTARY CONTROLS ON CHANNEL MIGRATION AND ORIGIN OF POINT BARS IN SAND-BEDDED MEANDERING RIVERS.
Tsukuba Univ. (Japan). Environmental Research Center.
For primary bibliographic entry see Field 2E.
W91-03205

FLOW IN MEANDERING CHANNELS WITH NATURAL TOPOGRAPHY.
Washington Univ., Seattle. Geophysics Program.
For primary bibliographic entry see Field 2E.
W91-03206

SEDIMENT TRANSPORT AND SORTING AT BENDS.
Saitama Univ., Urawa (Japan). Dept. of Foundation Engineering.
S. Ikeda.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 103-125, 12 fig, 34 ref. Ministry of Education and Culture of Japan Grant 59020003.

Descriptors: *Bed load, *Channel morphology, *Geomorphology, *Mathematical models, *Meanders, *Model studies, *Sediment sorting, *Sediment transport, *Topography, Channel flow, Channel scour, Particle size.

Equilibrium sorting of bed material transported as bedload and bed topography were considered for uniformly-curved channels. A formula for lateral bedload transport was developed, including the effects of secondary flow and gravity due to lateral bed slope and was successfully applied to a natural river. The coarsening of sediment size toward the outside bank was predicted. The major agent for the sorting was associated with the tendency for coarser grains to feel a larger ratio of lateral gravitational force to fluid force than finer grains. The bed topography was calculated so as to allow for coupling with the lateral sorting. The results indicated that sorting suppressed local scour near the outer bank. Application to the lower Wabash River indicated that the maximum depth of scour is reduced by about 36% due to sorting. (See also W91-03203) (Author's abstract)
W91-03207

SEDIMENT CONTROL BY SUBMERGED VANES: DESIGN BASIS.
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
A. J. Odgaard, and A. Spoljaric.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 127-151, 13 fig, 2 tab, 21 ref. NSF Grant MSM-8611147.

Descriptors: *Bank erosion, *Channel erosion, *Channel morphology, *Design criteria, *Erosion control, *Geomorphology, *Sediment erosion, *Vanes, Theoretical analysis.

Studies were conducted to develop vanes to protect against bank erosion. Preliminary investigations showed that vanes are effective in deepening the center portion of a straight channel. Attempts to verify and improve critical design relations of vanes yielded two equations that provide reasonable, gross estimates of horizontal lift and drag on thin, flat, small-aspect ratio riverbed vanes at angles of incidence up to about 20 degrees. Although low Froude number wing theory predicts that cambering of the vane should increase lift, the experimental data showed little improvement. This was explained by boundary-layer separation around the vanes, which is more pronounced around cambered vanes than around thin, flat vanes. Vane thickness increased the size of the separation zone on the rear side of the vane which caused a decrease of lift. The theory predicted a significant increase of lift with decreasing flow depth/vane height ratio within the range 2 to 4 (the range for which vane systems are designed). The increase was due to suppression of the tip vortex by the free surface, which results in an increase of the pressure difference between the vane surfaces. The experimental data confirmed this trend. The difference between theory and experiments was attributed to boundary-layer separation, which was not accounted for in the theory. The velocity data suggested that the lateral spacing of vanes in a layout should not exceed 1.5 to 2 flow depths if the layout is to produce a common circulation. The longitudinal spacing of vanes depends on the rate of decay of induced circulation. Vanes must be aligned in reference to the trailing-vortex line produced by upstream vanes. Applica-

tion of the present findings applies to horizontal rigid beds, and performance of vanes on movable beds is currently being studied. (See also W91-03203) (Geiger-PTT)
W91-03208

ANALYSIS OF A 2-D BED TOPOGRAPHY MODEL FOR RIVERS.
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 2E.
W91-03209

LINEAR THEORY OF RIVER MEANDERS.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
H. Johannesson, and G. Parker.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 181-213, 7 fig, 2 tab, 40 ref, append.
NSF Grants MSM-8311721-02 and INT-8412678.

Descriptors: *Channel morphology, *Geomorphology, *Mathematical models, *Meanders, *Model studies, *River beds, *Topography, Bank erosion, Channel flow, Resonance, Sediment transport, Theoretical analysis.

A mathematical model was developed for the calculation of flow field and bed topography in curved channels with an erodible bed. A small perturbation approach is used to linearize the governing equations, which retain the full coupling between the flow field, the bedload transport, and the bed topography. This coupling is shown to increase significantly the lateral bed slope in the upstream part of a channel bed, even beyond the value for fully developed bed flow which is approached in the downstream part of a channel bend. The coupling is also shown to give rise to resonant behavior for certain combinations of input variables. For a certain combination of input variables, curvature forces a perturbation of alternate bar type to the flow. Overdeepening is explained in terms of the wavelength and damping obtained with a linear analysis of the governing equations for the steady state case, assuming zero curvature. If the present model is used to carry out this analysis, the governing equations are the same as for the alternate bar analysis, except that unsteady terms are dropped. The predicted flow field and bed topography compare very well with laboratory data. Further, assuming the banks to be erodible, the model is used to predict wavelengths of river meanders. The results compare favorably with both laboratory and field data. (See also W91-03203) (Author's abstract)
W91-03210

STUDIES ON QUALITATIVE AND QUANTITATIVE PREDICTION OF MEANDER CHANNEL SHIFT.
Hokkaido Univ., Sapporo (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-03211

FINITE AMPLITUDE DEVELOPMENT OF ALTERNATE BARS.
Public Works Research Inst., Tsukuba (Japan). River Hydraulics Div.
For primary bibliographic entry see Field 2E.
W91-03212

ALTERNATE BARS AND MEANDERING: FREE, FORCED AND MIXED INTERACTIONS.
Genoa Univ. (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 2E.
W91-03213

EVOLUTION AND STABILITY OF ERODIBLE CHANNEL BEDS.
Washington Univ., Seattle. Geophysics Program.
For primary bibliographic entry see Field 2E.
W91-03214

OBSERVATIONS ON SEVERAL RECENT THEORIES OF RESONANCE AND OVERDEEPENING IN MEANDERING CHANNELS.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2E.
W91-03215

BAR AND CHANNEL FORMATION IN BRAIDED STREAMS.
Kyoto Univ. (Japan). Disaster Prevention Research Inst.
For primary bibliographic entry see Field 2E.
W91-03216

TOPOGRAPHIC RESPONSE OF A BAR IN THE GREEN RIVER, UTAH TO VARIATION IN DISCHARGE.
E. D. Andrews, and J. M. Nelson.
IN: River Meandering. Water Resources Monograph 12. American Geophysical Union, Washington. 1989. p 463-485, 9 fig, 12 ref.

Descriptors: *Channel morphology, *Geomorphology, *Mathematical models, *Meanders, *Model studies, *Numerical analysis, *Sediment transport, Channel flow, Flood discharge, Green River, Sediment discharge, Sediment erosion, Utah.

A fully nonlinear numerical model was used to analyze the characteristics of flow and sediment transport in a reach of the Green River near Ouray, Utah. The reach has gentle, but complicated curvature and contains a prominent mid-channel bar composed of medium to fine sand. Bankfull channel width and area vary significantly through the study reach. Model calculations were compared with the observed lateral distribution of unit discharge and mean annual bed-material transport and were found to be in excellent agreement. Adjustment of channel topography over a period of time at a constant discharge was calculated at discharges of 50 cu m/sec (approximately 40% of the mean annual flow), 275 cu m/sec, and 475 cu m/sec (approximately the bankfull discharge). Each simulation began with the same topography, which was surveyed at a discharge of approximately 275 cu m/sec, 5 weeks after a peak discharge of approximately 620 cu m/sec. Gradually decreasing flows following the flood peak and significant bed-material transport rates tended to maintain a channel topography in equilibrium with the discharge. Bar topography was enhanced greatly at a discharge of 475 cu m/sec. Sediment accumulated on the bar surface and was eroded from the side channels except in the downstream part of the secondary channel where some sediment was deposited. At a discharge of 50 cu m/sec, the bar crest stood nearly 1 m above the water surface, and there was no flow through the secondary channel. More than 1 m of material accumulated in the primary channel along most of the length of the bar, over a period of two days. A comparison of aerial photographs taken of the Ouray reach between 1963 and 1987 showed very little change in the bar, in spite of the fact that bar topography tended to adjust relatively quickly to changes in river discharge. Neither established vegetation nor debris had a stabilizing effect upon the bar. Long-term stability of the bar appeared to be due to a constriction in channel width and area located slightly downstream of the bar apex. (See also W91-03203) (Author's abstract)
W91-03217

EVALUATION OF SEDIMENT TRAPS IN LAKE ST. CLAIR, LAKE ONTARIO, AND HAMILTON HARBOUR.
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
For primary bibliographic entry see Field 2H.
W91-03402

QUANTITATIVE MODEL OF THE DISPERSAL OF DETRITAL INPUTS AND MINOR COMPOSITIONAL COMPONENTS IN LAKE MICHIGAN SEDIMENTS.
Michigan Univ., Ann Arbor. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2H.
W91-03408

WHY SEDIMENTS DEPOSIT IN LINED CHANNELS.
Irrigation and Power Research Inst., Amritsar (India).
T. C. Paul, and V. S. Sakhuja.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 5, p 589-602, September/October 1990. 7 fig, 2 tab, 17 ref.

Descriptors: *Canal design, *Canal linings, *Channel accretion, *Drainage engineering, *Irrigation engineering, *Mathematical analysis, *Sedimentation, Cross-sections, Deposition, India, Irrigation canals, Mathematical equations, Roughness coefficient, Sediment discharge, Sediment transport, Waterlogging.

In order to alleviate waterlogging, minimize maintenance costs, and improve conveyance efficiency, numerous unlined channels in India are replaced by parallel-running, cup-shaped (round-bottom), brick-lined (rigid boundary) channels. The operation of these newly-lined channels manifests sediment deposition all along the wetted perimeter. This is quite surprising because: (1) the grade and concentration of sediment entering these lined channels (from their parent unlined branch canals) remain the same as in the case of unlined channels; (2) water surface or bed slopes are unchanged because the channel command is the same; and (3) the roughness coefficient rather appreciably decreases on account of the lining. Sediment distribution in lined channels could probably be attributed to workmanship, quality of materials used, provision of steps at the channel bottom, and shape of cross-section adopted. The most efficient shape of conveyance of sediment transport with no deposition is the rectangular section placed with its longer side horizontal, followed by the conventional trapezoidal section. The cup-shaped section should not be used since it is the least efficient for sediment transport. Criteria for determining the limiting concentration of transported sediment can be calculated by means of a mathematical equation, and infers that the trapezoidal section is superior to a cup-shaped section for sediment transport as bed load. The suggested function for the limiting bed load concentration in rigid boundary channels should be given a fair trial. (Author's abstract)
W91-03419

LANDSLIDES IN THE UPPER JORDAN GORGE.
Haifa Univ. (Israel). Dept. of Geography.
M. Inbar, and M. Even-Nir.
Pirineos: Revista de Ecologia de Montana PRNOAJ, Vol. 134, p 23-40, 1989. 13 fig, 1 tab, 14 ref.

Descriptors: *Climatology, *Debris cone, *Erosion, *Israel, *Jordan, *Jordan River, *Landslides, *Sediment transport, *Watershed management, Canyons, Clear-cutting, Forest hydrology, Rainfall, Talus.

Extensive active landslides affected by climatic events are found in the Jordan River Gorge. The lithological structure of the basaltic lava flows determine the extent and type of slide; the river removes the talus material promoting further falling and sliding. A total amount of 100,000 cu m of material was removed from the canyon during the January 1969 rainfall event; the average annual debris removal is estimated at 500 cu m/yr. Forest clearing and hydrological changes in the watershed are the main anthropogenic factors promoting erosion processes in the region. (Author's abstract)
W91-03433

DEVELOPMENT AND APPLICATION OF A TECHNIQUE FOR ESTIMATING NUTRIENT DEFICIENCY IN SOFT SEDIMENTS.
Montana State Univ., Bozeman. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W91-03499

FACTORS CONTROLLING SEDIMENT DISCHARGE IN THE MAHANADI RIVER BASIN, INDIA.
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
G. J. Chakrapani, and V. Subramanian.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 169-185, September 1990. 10 fig, 4 tab, 25 ref.

Descriptors: *India, *River sediments, *Sediment discharge, *Sediment load, *Sediments, Geology, Mahanadi River, Monsoons, Rainfall, River basins, River flow, Seasonal variation, Silt load, Suspended sediments.

Annual, seasonal, monthly, and daily variation in the water and sediment discharge in the Mahanadi River and its controlling factors were evaluated. The water discharge varies from 9.61 to 1809.71 cu m/s and the total suspended matter varies from 130 to 806 mg/L. The smaller tributaries upstream carry higher sediment concentration. No yearly cyclic pattern in the water flow in the basin was observed. More than 95% of the sediment discharge takes place in the monsoon, of which the discharge during July, August, and September is 90% of the annual total. On certain days of the year, the sediment discharge accounts for 10-15% of the total annual load. Water discharge, rainfall, and geology of the basin and the smaller tributaries upstream seem to control bulk of the sediment discharge. The Mahanadi annually delivers 15.74 million tonnes of sediment to the Bay of Bengal and more than 80% of the sediment load is carried in the coarse silt fraction. (Author's abstract)
W91-03547

HYDRAULICS OF INTERRILL OVERLAND FLOW ON A SEMI-ARID HILLSLOPE, SOUTHERN ARIZONA.
Keele Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-03552

DYNAMICS OF TURBIDITY CURRENTS MEASURED IN KATSURAZAWA RESERVOIR, HOKKAIDO, JAPAN.
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
For primary bibliographic entry see Field 2H.
W91-03555

CONTROLLING SOIL EROSION IN THE ILLINOIS RIVER BASIN.
Illinois Dept. of Agriculture, Springfield. Div. of Natural Resources.
For primary bibliographic entry see Field 4D.
W91-03611

PEORIA LAKE SEDIMENTATION AND PROPOSED ARTIFICIAL ISLANDS.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5G.
W91-03614

SEDIMENT MANAGEMENT PROBLEMS OF BACKWATER LAKES AND ALTERNATIVE SOLUTIONS.
Illinois State Water Survey Div., Champaign.
N. G. Bhowmik.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 58-64, 4 fig, 1 tab, 11 ref.

Descriptors: *Backwater effect, *Dams, *Environmental effects, *Illinois, *Illinois River, *Locks, *Sedimentation, *Water resources management, Dredging, Flood plains, Lake restoration, Peoria Lake.

The construction of locks and dams along the Illinois River, especially in the reach extending from Grafton to the Lake DePue area, has created a large number of backwater areas within the main floodplains of the river. These backwater areas are called backwater lakes and they are subject to natural variations in water depths and sediment deposition. Over the last 100 years or so all the river basins in Illinois have been subjected to intense human activities and alterations. As a result of these natural and human interventions, the Illinois River Valley has experienced a tremendous amount of sediment deposition in recent years. Many of the 53 or so backwater lakes along this river have lost 30 to 100% of their capacity to sediment deposition. Peoria Lake, a bottomland lake, has lost 68% of its 1903 capacity, and Upper Peoria Lake will eventually attain the appearance of an incised river with broad and shallow wetlands on both sides. On the average, about 20.6 million tons of sediment is deposited annually over the entire valley, with a deposition rate of 0.81 to 2.2 inches per year. Recently implemented nonpoint source pollution control measures are showing their impacts on the receiving bodies of water through substantially lower concentrations of trace elements within the recently deposited sediment. Numerous alternative solutions can be considered for managing these backwater lakes, including constructing closing structures, periodic and selective dredging, using dredged materials to create artificial islands, diverting high flows, imposing management practices on the watershed, and converting some of the backwater lakes to marsh and wetland habitats. A concerted effort, in which various physical, biological and environmental factors are considered, is needed for the development of an acceptable management scenario for these backwater lakes. (See also W91-03608) (Author's abstract)
W91-03615

SEDIMENT MANAGEMENT.
Illinois Univ., Urbana. Water Resources Center.
For primary bibliographic entry see Field 4D.
W91-03627

EROSION CONTROL IN THE ILLINOIS RIVER BASIN PAST, PRESENT, AND FUTURE.
Soil Conservation Service, Champaign, IL.
For primary bibliographic entry see Field 4D.
W91-03630

SUBAERIAL EXPOSURE AND CHANGES IN THE STABILITY OF INTERTIDAL ESTUARINE SEDIMENTS.
Bristol Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 2L.
W91-03813

DISTRIBUTION AND TEXTURE OF THE BOTTOM SEDIMENTS IN A SEMI-ENCLOSED COASTAL INLET, THE ISMIT BAY FROM THE EASTERN SEA OF MARMARA (TURKEY).
Middle East Technical Univ., Mersin (Turkey). Inst. of Marine Sciences.
For primary bibliographic entry see Field 2L.
W91-03819

FACTORS AFFECTING SULFUR INCORPORATION INTO LAKE SEDIMENTS: PALEOECOLOGICAL IMPLICATIONS.
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 2H.
W91-03828

STABLE ISOTOPIC COMPOSITIONS OF SULFUR IN PIRLA SEDIMENT CORES.
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2H.
W91-03829

2K. Chemical Processes

GEOCHEMICAL COMPUTER CODES: A REVIEW, FINAL REPORT.
For primary bibliographic entry see Field 7C.
W91-03027

STEAM DISTILLATION WITH RESIN EXTRACTION FOR ISOLATION AND CONCENTRATION OF ORGANIC COMPOUNDS FROM AQUEOUS SAMPLES.
Ames Lab., IA.
K. D. Dix, and J. S. Fritz.
Analytica Chimica Acta ACACAM, Vol. 236, No. 1, p 43-49, September 1990. 3 fig, 6 tab, 31 ref. U.S. Department of Energy Contract W-7405-Eng-82.

Descriptors: *Analytical methods, *Distillation, *Organic compounds, *Separation techniques, *Water analysis, Chemical analysis, Ethyl acetate, Gas chromatography, Pollutant identification, Resins.

Steam distillation was combined with solid-phase resin extraction using a simple apparatus and interface for the isolation and concentration of organic compounds from aqueous samples. Ethyl acetate was efficient for the removal of all analytes tested. Factors affecting the recovery of model compounds were the cleanliness of the glassware and sticking of compounds to the condenser. The recovery of methyl esters and many other compounds was markedly improved by disconnecting the condenser. Recoveries of 80% or better were obtained for a wide variety of organic compounds with boiling points ranging from 136 to 404 C with a run time of less than 25 minutes. A concentration effect of at least 100-fold allowed the analysis of compounds at the microgram/L range using gas chromatography with flame ionization detection. (Geiger-PTT)
W91-03290

SOLID-PHASE EXTRACTION OF HERBICIDES FROM WELL WATER FOR DETERMINATION BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY.
Monsanto Agricultural Products Co., St. Louis, MO.
For primary bibliographic entry see Field 5A.
W91-03292

GEOCHEMISTRY OF SHALLOW GROUNDWATER AT KIGAMBONI PENINSULA ALONG DAR ES SALAAM COASTAL STRIP TANZANIA.
Dar es Salaam Univ. (Tanzania). Dept. of Geography.
For primary bibliographic entry see Field 2F.
W91-03337

DIGITAL MODELLING OF THE HYDROGEOCHEMICAL FACIES OF GROUNDWATERS IN TAMILNADU, INDIA.
V.O.C. Coll., Tuticorin (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-03339

HYDROCHEMICAL CLASSIFICATION OF THE GROUNDWATER OF THE WADI AL BIH WELLFIELD IN THE NORTHERN PART OF THE UNITED ARAB EMIRATES.
United Arab Emirates Univ., Al Ain. Dept. of Geology
F. El Schami, and A. R. Hamdan.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 853-865, 7 fig, 2 tab, 9 ref.

Descriptors: *Geochemistry, *Groundwater quality, *Salinity, *United Arab Emirates, *Water quality, Aquifer characteristics, Classification, Groundwater chemistry, Regional analysis, Saline groundwater, Spatial distribution, Well fields.

The Wadi al Bih well field is considered one of the most important fresh water well fields in the

United Arab Emirates. Examination of the hydrochemistry of the groundwater shows the variability in areal distribution of the major groundwater chemistry types and the change in groundwater quality with time. Nine major groundwater types have been identified and delineated using the numerical approach to classification derived by Haddad. The overall chemistry of the Wadi al Bih groundwater indicates that alkalies exceed alkaline earths and strong acids exceed weak acids. The salinity of the production water wells ranged from 360 to 3670 mg/L in 1987 and from 435 to 4,140 mg/L in 1988. The fresh groundwater is concentrated around the periphery of the well field, whereas most of the salinity is found in the central portion. (See also W91-03311) (Rochester-PTT)
W91-03347

HYDROGEOCHEMICAL MODELING.
Kerala Univ., Trivandrum (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-03352

DISTRIBUTION OF FLUORIDE IN SHALLOW AQUIFERS IN AND AROUND DISTRICT ROHTAK, HARYANA STATE.
Panjab Univ., Chandigarh (India). Dept. of Geology.
S. Kumar, and A. Syed.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 911-915, 1 fig, 1 tab, 9 ref.

Descriptors: *Agricultural chemicals, *Fertilizers, *Fluorides, *Geochemistry, *Groundwater pollution, *India, *Nonpoint pollution sources, *Water pollution sources, Aquifers, Drinking water, Fluorapatite, Groundwater chemistry, Human diseases, Phosphates, Public health.

Fluoride concentration in the range 0.6-1.2 mg/L is essential in potable water for substantial protection against dental caries, but higher concentrations can cause mottling of the teeth and even higher concentrations may lead to fluorosis. Geochemical factors affecting the occurrence and distribution of fluoride were examined with respect to shallower aquifers in and around Rohtak, Haryana, India. The analytical results reveal that high fluoride concentration is a major problem in the area studied. Fluoride concentration exceeding the desirable limit (0.6-1.2 mg/l) is a major health hazard. Fourteen samples had concentrations within the desirable range, but five samples had a value below 0.6 mg/L. Most of the area had fluoride concentrations above 1.2 mg/L, with some areas having values >2 mg/L (highest value = 4.10 mg/L). High values can be attributed to the use of phosphatic fertilizers and the presence of fluor-apatite, which are being leached down to the saturated zone in irrigation return flows. (See also W91-03311) (Author's abstract)
W91-03354

RADON, RADIUM AND URANIUM IN DRINKING WATER.
For primary bibliographic entry see Field 5F.
W91-03366

OCCURRENCE OF RADIONUCLIDES IN DRINKING WATER, A NATIONAL STUDY.
Environmental Protection Agency, Cincinnati, OH. Office of Administration and Resources Management
For primary bibliographic entry see Field 5B.
W91-03373

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC APPROACH FOR MONITORING ETHOFUMESATE IN PLANT, SOIL AND WATER.
Jordan Univ., Amman. Analytical Chemistry Labs.
For primary bibliographic entry see Field 5A.
W91-03412

PRECIPITATION CHEMISTRY: ATMOSPHERIC LOADINGS TO THE SURFACE WATERS OF THE INDIAN RIVER LAGOON BASIN BY RAINFALL.
Bionetics Corp., Cocoa Beach, FL.
T. W. Dreschel, B. C. Madsen, L. A. Maull, C. R. Hinkle, and W. M. Knott.
Florida Scientist FLSCAQ, Vol. 53, No. 3, p 184-188, Summer 1990. 1 fig, 2 tab, 13 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Deposition, *Florida, *Indian River Lagoon, *Nutrients, *Water pollution sources, *Wet deposition, Ammonium, Baseline studies, Limiting nutrients, Nitrates, Seasalt, Sulfates, Surface runoff, Surface water, Wastewater pollution.

Rain volume and chemistry monitoring as part of the Kennedy Space Center Long Term Environmental Monitoring Program included the years 1984-1987 as part of the National Atmospheric Deposition Program. Atmospheric deposition in rainfall consisted primarily of seasalt and hydrogen ion, sulfate, nitrate, and ammonium ions. The deposition of nitrogen (a principal plant nutrient) was on the order of 200-300 metric tons per year to the surface waters. Although the contribution of rainfall to the total nitrogen budget is smaller than that of other sources, it was about one-third of that contributed by sewage effluent in 1985. It can be construed as the current background level of nitrogen input. Phosphorus, which is not a significant constituent of rainfall, is probably the primary limiting nutrient of the lagoon system. This information indicates that control of nutrient loading from surface runoff and domestic effluent is essential to reducing the nutrient enrichment of the Indian River lagoon basin. (MacKeen-PTT)
W91-03440

FIELD METHODS FOR MEASUREMENT OF GROUND WATER REDOX CHEMICAL PARAMETERS.
Geological Survey, Denver, CO. Geologic Div.
For primary bibliographic entry see Field 7B.
W91-03444

NITROGEN METABOLISM IN THE BRACKISH LAKE NAKANOUMI: IV. SEASONAL VARIATION OF NITRATE NITROGEN.
Shimane Univ., Matsue (Japan). Environmental Science Lab.
For primary bibliographic entry see Field 2H.
W91-03452

SIGNIFICANCE OF LOW-OXYGEN ZONE FOR NITROGEN CYCLING IN A FRESHWATER LAKE: PRODUCTION OF N2O BY SIMULTANEOUS DENITRIFICATION AND NITRIFICATION.
Nagoya Univ. (Japan). Water Research Inst.
For primary bibliographic entry see Field 2H.
W91-03453

RELATIONSHIPS BETWEEN PHYTOPLANKTON OCCURRENCE AND SALINITY OR WATER TEMPERATURE IN BRACKISH LAKE NAKANOUMI, 1979-1986.
Shimane Univ., Matsue (Japan). Environmental Science Lab.
For primary bibliographic entry see Field 2H.
W91-03455

DETERMINATION OF TOTAL PHOSPHORUS IN WATERS WITH AMPEROMETRIC DETECTION BY COUPLING OF FLOW-INJECTION ANALYSIS WITH CONTINUOUS MICROWAVE OVEN DIGESTION.
Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Anorganisch-Chemisches Inst.
For primary bibliographic entry see Field 5A.
W91-03458

FIELD METHOD FOR DETERMINATION OF TRACES OF THIOLS IN NATURAL WATERS.
Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Marine and Atmospheric Chemistry.
For primary bibliographic entry see Field 5A
W91-03459

CRITICAL COMPARISON OF TWO STANDARD DIGESTION PROCEDURES FOR THE DETERMINATION OF TOTAL MERCURY IN NATURAL WATER SAMPLES BY COLD VAPOUR ATOMIC ABSORPTION SPECTROMETRY.
Umea Univ. (Sweden). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W91-03460

PRECONCENTRATION OF LEAD, CADMIUM, COPPER AND ZINC IN WATER AT THE G/G LEVEL BY NON-BOILING EVAPORATION.
Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 5A.
W91-03461

DETERMINATION OF VANADIUM IN WATER BY ATOMIC ABSORPTION SPECTROMETRY WITH ELECTROTHERMAL ATOMIZATION AND USING HOT INJECTION AND PRECONCENTRATION ON THE GRAPHITE TUBE.
Santiago Univ. (Spain). Faculty of Chemistry.
For primary bibliographic entry see Field 5A.
W91-03462

DETERMINATION OF GOLD IN NATURAL WATERS BY NEUTRON ACTIVATION AND GAMMA-SPECTROMETRY AFTER PRECONCENTRATION WITH TRIBUTYL PHOSPHATE AS SOLID EXTRACTANT.
Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
T. V. Shishkina, S. N. Dmitriev, and S. V. Shishkin.
Analytica Chimica Acta ACACAM, Vol. 236, No. 2, p 483-486, September 17, 1990. 1 tab, 23 ref.

Descriptors: *Analytical techniques, *Chemical analysis, *Gold, *Laboratory techniques, *Spectrometry, *Water analysis, Analytical methods, Charcoal, Gamma radiation, Neutron activation analysis, Tributyl phosphate.

A method for the preconcentration of gold in natural waters at the sampling site using tributyl phosphate as a solid extractant was developed as a preliminary step prior to the determination of gold by neutron activation and gamma-spectrometry. The tributyl phosphate was saturated with gaseous chlorine for extracting all gold species. In batch experiments gold was quantitatively retained on the tributyl phosphate in 10 minutes. After extraction and washing, the tributyl phosphate was ashed or back-extracted. Gold was quantitatively eluted with hot, neutral 0.025 molar thiourea. The gold content of residues of ashing or eluents after evaporation was determined by neutron activation and gamma-spectrometry. The detection limit for the overall procedure was 0.2 nanogram/L. The efficiency was tested on equilibrated solutions prepared from river water and tracer solutions of gold. Twenty samples of equilibrated gold solution were prepared as indicated and preconcentration with the solid extractant was carried out after 20 days. The results of counting were compared with those for standard concentrated solutions prepared simultaneously with equilibrated gold solutions from aliquots of a gold solution containing 195-Au tracer. In was found that 98% +/-2% of gold was adsorbed on tributyl phosphate. The efficiency of the proposed method was confirmed by the simultaneous use of the activated charcoal preconcentration technique. Comparison of the results indicates that the use of the chlorine-saturated solid extractant containing about 45% trihutyl phosphate for the concentration of gold from natural waters was very efficient. (Mertz-PTT)
W91-03463

NITRATE DEPLETION IN THE RIPARIAN ZONE AND STREAM CHANNEL OF A SMALL HEADWATER CATCHMENT.
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 5B.
W91-03483

DOWNSTREAM EFFECTS OF IMPOUNDMENTS ON THE WATER CHEMISTRY OF THE BUFFALO RIVER (EASTERN CAPE), SOUTH AFRICA.
Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.
For primary bibliographic entry see Field 2H.
W91-03485

EVOLUTION OF THE CHEMICAL COMPOSITION OF WATER PASSING THROUGH THE UNSATURATED ZONE TO GROUND WATER AT AN EXPERIMENTAL SITE AT THE UNIVERSITY OF SAO PAULO, BRAZIL.
Sao Paulo Univ. (Brazil). Inst. de Geociencias.
For primary bibliographic entry see Field 2F.
W91-03747

CL-36 IN GROUND WATER OF THE MAZOWSZE BASIN (POLAND).
Polish Academy of Sciences, Warsaw. Geological Sciences Inst.
J. Dowgiallo, Z. Nowicki, J. Beer, G. Bonani, and M. Suter.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 373-385, October 1990. 4 fig, 1 tab, 23 ref.

Descriptors: *Chlorine radioisotopes, *Environmental tracers, *Geochemistry, *Geohydrology, *Groundwater movement, *Poland, *Radioactive tracers, *Tracers, Confined aquifers, Geologic fractures, Groundwater recharge, Hydraulic properties, Precipitation, Water chemistry.

Groundwater samples from the Oligocene aquifer of the Mazowsze artesian basin in Poland have been analyzed for Cl-36 using the ETH/PSI-AMS facility. The results show that: (1) the measured Cl-36/Cl ratios for samples taken in the recharge areas of the basin are in good agreement with calculations based on assumption of Cl-36 fallout in modern precipitation; (2) some of the samples show a reduced Cl-36/Cl ratio as compared with the assumed input value and the corresponding points on the dilution curve, presumably representative for the whole area, pointing to radioactive decay as the main process responsible for the decrease of Cl-36 content in water; and (3) several samples show an increase in Cl-36 concentration as compared with the input value corrected for dilution. As the neutron flux in Oligocene deposits is supposed to be low, there must be inflow of water from formations underlying the aquifer. Hydraulic connections of the Lower Triassic formation with the Oligocene deposits are possibly a result of tectonic movements which produced fissure systems. This study is preliminary, and further investigations should concentrate on the evaluation of Cl-36 production in the Oligocene and the underlying formations. Since the interpretation of Cl-36 measurements depends strongly on the recharge values, more detailed data regarding the Cl-36 content of water penetrating into the aquifer are needed. The results obtained so far show that the application of Cl-36 as a hydrogeological tracer is useful, although the interpretation of these results can be difficult. (Fish-PTT)
W91-03759

NEAR-SHORE HYPOXIA IN THE CHESAPEAKE BAY: PATTERNS AND RELATIONSHIPS AMONG PHYSICAL FACTORS.
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
For primary bibliographic entry see Field 2L.
W91-03816

TRACE METAL CHEMISTRY OF A DUTCH RESERVOIR, THE TJEUKEMEER.
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 2H.
W91-03827

DISSOLVED FREE AMINO ACID CYCLING IN AN ESTUARINE OUTFLOW PLUME.
University of Southern California, Los Angeles. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2L.
W91-03836

SPECTROPHOTOMETRIC DETERMINATION OF ANIONIC SURFACTANTS IN TAP AND RIVER WATERS WITH I-(10-BROMODECYL)-4-(4-AMINONAPHTHYLAZO)-PYRIMIDINIUM BROMIDE.
Okayama Univ. (Japan). School of Health Sciences.
For primary bibliographic entry see Field 5A.
W91-03839

GAS CHROMATOGRAPHIC DETERMINATION OF SYSTEMIC FUNGICIDE TRICYCLAZOLE IN SOIL AND WATER.
Zhejiang Agricultural Univ., Hangzhou (China). Dept. of Plant Protection.
For primary bibliographic entry see Field 5A.
W91-03846

STRUCTURAL AND STRATIGRAPHIC FRAMEWORK OF GROUNDWATER OCCURRENCE AND SURFACE DISCHARGE IN THE MURRAY BASIN, SOUTHEASTERN AUSTRALIA.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 2F.
W91-03889

HYDROGEOLOGY OF THE MURRAY BASIN, SOUTHEASTERN AUSTRALIA.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 2F.
W91-03890

SALINE SEEPAGE AND LAND DEGRADATION--A NEW SOUTH WALES PERSPECTIVE.
Soil Conservation Service of New South Wales, Sydney (Australia).
For primary bibliographic entry see Field 5B.
W91-03893

EFFECT OF LAND CLEARANCE IN THE MALLEE REGION ON RIVER MURRAY SALINITY AND LAND SALINISATION.
South Australian Dept. of Mines and Energy, Adelaide.
For primary bibliographic entry see Field 4C.
W91-03894

ASPECTS OF STRATIGRAPHY AND STRUCTURE IN RELATION TO THE WOOLPUNDA GROUNDWATER INTERCEPTION SCHEME, MURRAY BASIN, SOUTH AUSTRALIA.
South Australian Dept. of Mines and Energy, Adelaide.
For primary bibliographic entry see Field 2F.
W91-03896

GROUNDWATER-RIVERWATER DENSITY CONTRAST: ITS EFFECT ON THE PATTERN OF GROUNDWATER DISCHARGE TO THE RIVER MURRAY.
South Australian Dept. of Engineering and Water Supply, Adelaide.
For primary bibliographic entry see Field 2F.
W91-03897

ENVIRONMENTAL CONSEQUENCES OF SALINE GROUNDWATER INTRUSION INTO THE WIMMERA RIVER, VICTORIA.
Kaiela Fisheries Research Station, Shepparton (Australia). Fisheries Div.
For primary bibliographic entry see Field 2F.
W91-03898

TATIARA PROCLAIMED REGION, SOUTHEASTERN SOUTH AUSTRALIA: HYDROGEOLOGICAL INVESTIGATIONS AND GROUNDWATER MANAGEMENT.
South Australian Dept. of Mines and Energy, Adelaide.
For primary bibliographic entry see Field 4B.
W91-03899

CHLORINE-36 MEASUREMENTS IN THE MURRAY BASIN: PRELIMINARY RESULTS FROM THE VICTORIAN AND SOUTH AUSTRALIAN MALLEE REGION.
Australian Nuclear Science and Technology Organisation, Sutherland.
For primary bibliographic entry see Field 2F.
W91-03900

ORIGINS OF GROUNDWATER SALINITY NEAR TRESCO, NORTHWEST VICTORIA.
New South Wales Univ., Kensington (Australia). Centre for Groundwater Management and Hydrogeology.
For primary bibliographic entry see Field 2F.
W91-03902

IVANHOE BLOCK--ITS STRUCTURE, HYDROGEOLOGY AND EFFECT ON GROUNDWATERS OF THE RIVERINE PLAIN OF NEW SOUTH WALES.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 2F.
W91-03905

GEOLOGICALLY INDUCED SALINITY AT YELARBON, BORDER RIVERS AREA, NEW SOUTH WALES, QUEENSLAND.
New South Wales Univ., Kensington (Australia). Centre for Groundwater Management and Hydrogeology.
For primary bibliographic entry see Field 2F.
W91-03906

APPLICATION OF LANDSAT THEMATIC MAPPING TO GEOLOGY AND SALINITY IN THE MURRAY BASIN.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 7B.
W91-03907

STRATIGRAPHY AND SEDIMENTOLOGY OF MID-TERTIARY PERMEABILITY BARRIERS IN THE SUBSURFACE OF THE MURRAY BASIN, SOUTHEASTERN AUSTRALIA.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 2F.
W91-03908

FIELD EVIDENCE FOR THE EFFECT OF ACETATE ON LEACHATE ALKALINITY.
Water and Earth Science Associates Ltd., Kitchener (Ontario).
For primary bibliographic entry see Field 5B.
W91-03910

2L. Estuaries

SAN FRANCISCO CENTRAL BAY SUSPENDED SEDIMENT MOVEMENT. REPORT I: SUMMER CONDITION DATA COLLECTION PROGRAM AND NUMERICAL MODEL VERIFICATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2J.
W91-03010

SUWANNEE RIVER ESTUARY: AN OVERVIEW AND RESEARCH AND MANAGEMENT NEEDS.
Suwannee River Water Management District, Live Oak, FL.
For primary bibliographic entry see Field 2H.
W91-03094

DEVELOPMENT OF MANAGEMENT STRATEGIES FOR BARATARIA BASIN, LOUISIANA.
Louisiana Geological Survey, Baton Rouge.
For primary bibliographic entry see Field 5G.
W91-03095

WETLAND CREATION AND RESTORATION: THE STATUS OF THE SCIENCE.
Island Press, Covelo, California. 1990. 594p. Edited by Jon A. Kusler, and Mary E. Kentula.

Descriptors: *Artificial wetlands, *Habitat restoration, *Management planning, *Publications, *Water resources management, *Wetland restoration, *Wetlands, Compensation, Decision making, Environmental control, Environmental engineering, Environmental impact, Environmental protection, Regional planning, Research priorities, United States, Water law, Water resources development.

In the last decade, interest has increased in coastal and freshwater wetland restoration and creation at all levels of government, in the scientific community, and in the private sector. Restoration and creation have been advocated to reduce the impacts of wetlands activities; compensate for additional losses; restore or replace wetlands already degraded or destroyed; and serve various new functions such as wastewater treatment, aquaculture, and waterfowl habitat. U.S. Environmental Protection Agency personnel agreed that there was a pressing need to determine how well created and restored wetlands compensate for losses permitted under Section 404 of the Clean Water Act. An effort was made to capture information not published elsewhere and incorporate it with published literature to produce a unique resource. The status report is the first major publication resulting from research initiated on wetland creation and restoration. Conceived as a mechanism for identifying the adequacy of the available information, this status report will help set priorities for the research program and provide Agency personnel with an analytical framework for making Section 404 permit decisions based on the status of the science of wetland creation and restoration. The report is composed of two volumes. The first volume is a series of regional reviews, summarizing wetland creation and restoration experiences in broadly-defined wetland 'regions.' the second volume is a series of theme papers, covering a wide range of topics of general application to wetland creation and restoration (hydrology, management techniques, planning). (See W91-03245 thru W91-03272) (Fish-PTT)
W91-03244

WETLAND MITIGATION ALONG THE PACIFIC COAST OF THE UNITED STATES.
San Francisco State Univ., Tiburon, CA. Tiburon Center for Environmental Studies.
M. Josselyn, J. Zedler, and T. Griswold.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 3-36, 1 fig, 6 tab, 74 ref, 2 append.

Descriptors: *Artificial wetlands, *Coastal zone management, *Habitat restoration, *Water resources management, *Wetland restoration, *Wetlands, Coastal lagoons, Coastal marshes, Databases, Estuarine environment, Hydrologic properties, Monitoring, Vegetation establishment, Water resources development, Watershed management, Wildlife habitats.

Mitigation to compensate for coastal wetland losses has taken place under federal and state permit policies for over 15 years. As a result, a substantial database has developed in the scientific and governmental literature on which to base recommendations for improvement in mitigation practice. Hydrologic characteristics of a mitigation site are especially important as they structure the possible wetland habitats that can be created. Within the Pacific coastal zone, four general hydrological types occur: wetlands associated with small rivers or lagoons, wetlands associated with major estuaries and coastal embayments, wetlands associated with rivers, and non-tidal wetlands. Within each of these broad categories, watershed management and specific opportunities and constraints must be considered prior to approving mitigation proposals. Elements that need to be included within mitigation proposals are a description of existing conditions, a description of proposed hydrological conditions, means by which mitigation site constraints are to be ameliorated, planting procedures, determination of appropriate buffers, enforceable construction procedures, and monitoring programs. Outside of site-specific review, resource agencies must assess the long-term implications of individual permit approvals. Reappraisal should be based on detailed analysis contained within accessible database files. Such appraisal can provide important information on regional trends and means by which mitigation can be redirected to better serve fish and wildlife needs. (See also W91-03244) (Author's abstract)
W91-03245

CREATION AND RESTORATION OF TIDAL WETLANDS OF THE SOUTHEASTERN UNITED STATES.
North Carolina State Univ., Raleigh. Dept. of Soil Science.
S. W. Broome.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 37-72, 10 fig, 4 tab, 85 ref.

Descriptors: *Artificial wetlands, *Habitat restoration, *Tidal marshes, *Water resources management, *Wetland restoration, *Wetlands, Economic aspects, Environmental engineering, Management planning, Marsh management, Soil properties, Tidal effects, Water resources development.

Methods of creation and restoration of tidal wetlands in the southeastern United States have been summarized from published papers, reports, and first-hand experience. Publications by the U.S. Army Corps of Engineers which report research related to marsh habitat creation with dredged material and for shoreline erosion control were significant sources of information. Critical aspects which should be considered in planning and implementing a tidal marsh creation or restoration project are: initial planning, elevation in relation to tide level, wave climate and currents, salinity, slope and tidal range, soil chemical and physical properties, timing of construction, cultural practices, and maintenance. Critical research needs include: site selection, revegetation, and documentation of tidal marsh development. Practical and economical methods are needed to evaluate success of individual marsh creation or restoration. (See also W91-03244) (Author's abstract)
W91-03246

CREATION AND RESTORATION OF COASTAL PLAIN WETLANDS IN FLORIDA.
Lewis Environmental Service, Inc., Tampa, FL.
R. R. Lewis.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 73-101, 9 fig, 75 ref, 3 append. U.S. Department of Commerce Office of Sea Grant grant R/C-E-24.

Descriptors: *Artificial wetlands, *Florida, *Tidal marshes, *Water resources management, *Wetland restoration, *Wetlands, Drainage engineering, Environmental impact, Habitat restoration, Mangrove swamps, Plant populations, Planting management, Tidal effects, Vegetation establishment, Water resources development.

Despite hundreds of mangrove and tidal marsh restoration and creation efforts in Florida over the last fifteen years, current efforts are largely more art than science. Adequate monitoring and reporting are rare, and no institutional memory exists to improve the review and monitoring process. An overview of the Floridian region is given, followed by discussions of the extent to which creation/restoration has occurred, the design of creation/restoration projects, monitoring, and information gaps and research needs. Appendices include recommended reading, a list of project profiles, and a permit review checklist for Florida coastal wetlands. Based on a critical review of actual projects and the sparse literature, five factors appear most important to successful wetland establishment; these are: (1) correct elevations for the target plant species; (2) adequate drainage provided by gradual slopes and sufficient tidal connections; (3) appropriate site selection to avoid wave damage; (4) appropriate plant materials; and (5) protection from human impacts. (See also W91-03244) (Fish-PTT)
W91-03247

CREATION AND RESTORATION OF COASTAL WETLANDS IN PUERTO RICO AND THE U.S. VIRGIN ISLANDS.
Lewis Environmental Service, Inc., Tampa, FL.
R. R. Lewis.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 103-123, 10 fig, 37 ref, 3 append.

Descriptors: *Artificial wetlands, *Puerto Rico, *Virgin Islands (US), *Water resources management, *Wetland restoration, *Wetlands, Habitat restoration, Mangrove swamps, Plant growth, Planting management, Research priorities, Vegetation establishment, Water resources development.

Major losses of coastal wetland habitat in Puerto Rico and the U.S. Virgin Islands have stimulated interest in restoring damaged areas, and in requiring mitigation in the form of wetlands creation or restoration for any future permitted losses. Unlike efforts on the mainland, documentation of efforts to date is sparse. The major emphasis to date has been on mangrove forests, but other wetland types are equally important. Observations indicate that the opening of impounded mangrove areas works well as restoration, but creation of mangrove areas is more difficult because of the need to very carefully control the final graded elevations. The optimum target elevation for mangrove establishment appears to be +12 cm National Geodetic Vertical Datum. Wetland restoration projects in the U.S. Virgin Islands and Puerto Rico need more centralized documentation in order to capitalize on the advances in understanding that come with each project. Some additional experimental work is also essential to determine the restoration potential of plant communities in which research has not yet been undertaken. (See also W91-03244) (Author's abstract)
W91-03248

CREATION, RESTORATION, AND ENHANCEMENT OF MARSHES OF THE NORTHCENTRAL GULF COAST.
Louisiana State Univ., Baton Rouge. School of Forestry, Wildlife and Fisheries.
For primary bibliographic entry see Field 2H.
W91-03249

CREATION AND RESTORATION OF COASTAL WETLANDS OF THE NORTHEASTERN UNITED STATES.
J. K. Shisler.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 143-170, 8 fig, 1 tab, 83 ref, 2 append.

Descriptors: *Artificial wetlands, *Coastal zone management, *Habitat restoration, *Water resources management, *Wetland restoration, *Wetlands, Monitoring, Performance evaluation, Vegetation establishment, Water resources development, Watershed management.

The wetlands of the coastal zone of the northeast have been managed since the colonization of the United States. Restoration work associated with mitigation of impacts has been going on in the

region for over twenty years. Despite this history, there has not been an extensive evaluation of these projects to determine their success and how they function. The mitigation process should be directed towards a management approach that is concerned with the total system instead of just the 'vegetated' wetland. Goals should be based upon a wetland system's requirements within a watershed or region. The use of adjacent wetlands as models is critical in this process. Monitoring the created or restored wetlands can provide an important database which can be used in planning future projects. Goals, clearly defined in the design process, will promote meaningful evaluations. (See also W91-03244) (Author's abstract)
W91-03250

REGIONAL ANALYSIS OF THE CREATION AND RESTORATION OF SEAGRASS SYSTEMS.
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
M. S. Fonseca.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 171-193, 1 fig, 2 tab, 55 ref, 2 append.

Descriptors: *Aquatic habitats, *Artificial wetlands, *Sea grasses, *Water resources management, *Wetland restoration, *Wetlands, Coastal zone management, Environmental impact, Habitat restoration, Monitoring, Plant growth, Planting management, Research priorities, Vegetation establishment, Water resources development.

Seagrasses occur in most coastal marine regions and are highly productive habitats. They are not a traditional wetland type but do meet the criteria for protection of aquatic habitat under Section 404 of the Clean Water Act. Goals and performance guidelines for seagrass restoration and creation projects should include: development of persistent cover, generation of equivalent acreage or increased acreage, replacement with the same seagrass species, and restoration of secondary (faunal) production. These goals are to be differentiated from measures of density and percent survival. Monitoring for cover and persistence should continue for 3 years. The primary choice for restoration sites should be areas previously impacted or lost. The secondary choices should be perturbed aquatic areas or uplands which can be excavated and converted to seagrass habitat. Population growth rate determines the species chosen. Research needs include: defining functional restoration, compiling population growth and coverage rates by ecoregion, examining the resource role of mixed species plantings, determining the impact of substituting pioneer for climax species on faunal composition and abundance, evaluating the substitution of other species on cumulative damage to habitat resources when suitable sites cannot be found for seagrass planting, developing culture techniques for propagule development, exploring transplant optimization techniques, and delineating seagrass habitat boundaries. Most important would be the implementation of a consistent policy on seagrass restoration and management among resource agencies wherein restoration technique, monitoring, and performance and compliance guidelines would be standardized. (See also W91-03244) (Author's abstract)
W91-03251

OVERVIEW AND FUTURE DIRECTIONS.
San Diego State Univ., CA. Pacific Estuarine Research Lab.
For primary bibliographic entry see Field 2H.
W91-03260

INFORMATION NEEDS IN THE PLANNING PROCESS FOR WETLAND CREATION AND RESTORATION.
E. W. Garbisch.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 423-427.

Descriptors: *Administrative regulations, *Artificial wetlands, *Management planning, *Water resources management, *Wetland restoration, *Wetlands, Administrative agencies, Data requirements, Project planning, Water law, Water resources development.

State wetland regulations and policies vary widely and many are still under development. Marked variances also occur in the administration of federal regulations in the east and probably nationwide. Consequently, it is not possible to recommend a planning process for wetland creation and restoration that will be uniformly acceptable. However, there are both factors which should be considered at various stages of the permitting process and those which should be contained in plans to create or restore wetlands. Wetland regulatory agencies need to critically evaluate proposed mitigation projects in terms of acceptability, feasibility, and soundness. The permit conditions should contain (1) details of construction and landscape plans, (2) specifications to facilitate verification by the regulatory agencies that the wetland creation/restoration project has been constructed according to the plans, and (3) the criteria by which to determine if the project has been maintained and monitored during the life of the permit. To a very large degree, the success of wetland creation/restoration projects will depend on the correctness of the plans and specifications and the execution of the construction according to these plans and specifications. To ensure that future wetland creation/restoration projects are planned and directed by qualified people, it is suggested that preliminary, draft, and final mitigation plans be approved by an individual who has been certified as a qualified wetland creation/restoration scientist. (See also W91-03244) (Fish-PTT)
W91-03262

WETLAND EVALUATION FOR RESTORATION AND CREATION.
Erwin (Kevin L.) Consulting Ecologist, Inc., Fort Myers, FL.
K. L. Erwin.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 429-458, 4 fig, 2 tab, 39 ref, append.

Descriptors: *Artificial wetlands, *Management planning, *Performance evaluation, *Project planning, *Water resources management, *Wetland restoration, *Wetlands, Administrative agencies, Decision making, Environmental policy, Evaluation, Water resources development.

Evaluation of the success of a created, restored, or enhanced wetland must be addressed in terms of the extent to which the wetland provides biological and hydrological functions similar to those of the original or desired 'reference' wetland. The selected evaluation method must adequately characterize and evaluate the functions of the created and reference wetlands given the limitations of time, budget, type of wetland, size of wetland, context, degree of alteration from original wetland, location, and expertise of investigator. A qualitative wetland evaluation plan should include: a baseline vegetation survey, annual reporting of post-construction monitoring, fixed-point panoramic photographs, rainfall and water level data, a plan view showing all sampling and recording stations, wildlife utilization observations, fish and macroinvertebrate data, a maintenance plan, and a qualified individual to conduct monitoring. Quantitative evaluation should include: surface and groundwater hydrological monitoring, and vegetation analysis. A rapidly-accessible, easily understood, and cost-effective database on wetland creation and restoration projects is needed to support environmental regulatory agency review, decision-making, and action on specific projects. Any comprehensive wetland evaluation effort must be proceeded by the establishment of criteria which the investigator and regulator believe to be fundamental to the existence, functions, and contributions of the wetland system and its surrounding landscape. Additional research is needed to establish the interrelationships between wetlands, transitional areas, and adjacent uplands. (See also W91-03244) (Author's abstract)
W91-03263

WETLAND DYNAMICS: CONSIDERATIONS FOR RESTORED AND CREATED WETLANDS.
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
D. E. Willard, and A. K. Hiller.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 459-466, 19 ref.

Descriptors: *Artificial wetlands, *Management planning, *Project planning, *Water resources management, *Wetland restoration, *Wetlands, Alternative planning, Emergency planning, Environmental impact statement, Uncertainty, Water resources development.

Wetlands are affected by intrinsic and extrinsic forces. Managers cannot always predict or control the extrinsic forces leading to wetland changes, nor can they predict the range of species adaptations to those changes. Managers should plan for extreme circumstances by including mechanisms for wetland adjustment and persistence and by maintaining multiple sites as refugia to spread the risk of catastrophe. The following considerations are recommended: creation of buffer zones and corridors; recreation of spatial and temporal habitat variability; maintaining marginal wetlands as reserve sites; planning for worst case scenarios (cumulative impacts); and management for uncertainty and risk in wetland restoration and creation. Unfortunately, the natural variability of ecosystems, the unpredictability of extrinsic forces, and the perversity of complex systems make any absolute guarantee of success impossible. (See also W91-03244) (Author's abstract)
W91-03264

WATERFOWL MANAGEMENT TECHNIQUES FOR WETLAND ENHANCEMENT, RESTORATION AND CREATION USEFUL IN MITIGATION PROCEDURES.
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
M. W. Weller.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 517-528, 87 ref.

Descriptors: *Artificial wetlands, *Water resources management, *Waterfowl, *Wetland restoration, *Wetlands, *Wildlife habitats, Aquatic weed control, Ecosystems, Environmental management, Habitat restoration, Water resources development.

Waterfowl and other wetland wildlife managers have long been involved in wetland restoration and enhancement, and have developed functional techniques for management of certain wetland types in various regions. These procedures can serve other wetland managers in many useful ways, and are worthy of experimentation for other purposes. Most use natural processes to tap natural seed banks, modify cover-water ratios, or control weeds via water level control and herbivores. Wetland types where procedures have been standardized include those dominated by palustrine persistent emergents, moist-soil nonpersistent emergents, estuarine emergents, and forested palustrine communities. These strategies may be adapted to the special situations of restoring, enhancing or creating wetlands to meet mitigation requirements. The procedures also can be used to enhance various wetland functions such as water quality, shoreline protection, and esthetic values. Major information gaps include: long-term ecological effects of management processes; methods for speeding natural events that aid in wetland restoration; and lack of quantitative information on other groups of wildlife such as fish, herptiles, and even nongame birds and mammals. (See also W91-03244) (Author's abstract)
W91-03269

NUTRIENT DYNAMICS ASSOCIATED WITH LEAF DECOMPOSITION IN A SMALL SUBTROPICAL MANGROVE COMMUNITY IN HONG KONG.
Hong Kong Polytechnic, Kowloon. Dept. of Ap-

plied Biology and Chemical Technology.
N. F. Y. Tam, L. L. P. Vrijmoed, and Y. S. Wong.
Bulletin of Marine Science BMRSAW, Vol. 47, No. 1, p 68-78, July 1990. 3 fig, 2 tab, 30 ref.

Descriptors: *Cycling nutrients, *Decomposing organic matter, *Hong Kong, *Leaves, *Litter, *Mangrove swamps, *Nutrient concentrations, Calcium, Carbon, Magnesium, Nitrogen, Phosphorus, Potassium.

A preliminary in situ decomposition study, using litter bags, was carried out in a small subtropical mangrove community in Hong Kong from December 1986 to April 1987. Losses in ash-free dry weight, organic C, N, P and other macronutrients (including K, Ca, and Mg) of mangrove leaves were followed biweekly. The results showed that among the three dominant species being studied, Aegiceras corniculatum had the lowest litter bag loss rate, followed by Avicennia marina and Kandelia candel. At the end of 12 weeks' incubation, 12.7%, 60.2% and 32.6% of the original leaf material remained in bags containing K. candel, A. corniculatum and A. marina, respectively. This indicates that A. corniculatum was the most resistant species to leaf decomposition. A. corniculatum had the lowest concentrations of N and P but the widest range of C:N ratio in its leaf when compared with the other two species. This suggests that rate of leaf decomposition might be species specific and is related to the chemical composition of the leaves. Despite the differences in litter bag loss rates among the three species, they all followed the same pattern of degradation which could be described by linear equations. There was an immediate rise in leaf C:N ratio during the first 2 weeks of incubation which then decreased gradually and remained at around 24:1 throughout the rest of the incubation period. In parallel with the decrease in C:N ratios, significant losses of N, P and other macronutrients were observed in A. marina and K. candel which might have been exported from the mangrove zone to foreshore and become an important nutrient source for other marine organisms. (Author's abstract)
W91-03300

METALS IN ULVA LACTUCA IN HONG KONG INTERTIDAL WATERS.
Hong Kong Univ. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W91-03301

STUDIES ON LITTER FALL AND DECOMPOSITION OF BRUGUIERA SEXANGULA (LOUR.) POIR, COMMUNITY ON HAINAN ISLAND, CHINA.
Xiamen Univ. (China). Inst. of Environmental Science.
C. Lu, and P. Lin.
Bulletin of Marine Science BMRSAW, Vol. 47, No. 1, p 139-148, July 1990. 5 fig, 3 tab, 21 ref.

Descriptors: *China, *Decomposing organic matter, *Decomposition, *Hainan, *Litter, *Mangrove swamps, Detritus, Ecosystems, Estuaries, Food chains, Leaves, Nutrients, Seasonal variation.

The litter fall of two Bruguiera sexangula communities at Dongzhai Harbor of Hainan Island was studied for 4 yr, from 1984 to 1987. The mean litter production amounted to 12.55 + or -1.62Mg/hr/yr and 11.04 + or -0.18 Mg/ha/yr (dry matter) respectively in two communities, artificial and natural forest. The monthly production fluctuated not only with the monthly mean air temperature but also with the typhoon and strong wind. The decomposition rate of leaf litter of B. sexangula was measured seasonally from spring to winter in 1984 and 1985 at a mangrove stand. The results showed that the leaf litter decomposition half-times in the four seasons were 21, 20, 26, and 45 days respectively, and that marine animals played an important role in the decomposition process. By providing organic detritus a great deal of mangrove litter is incorporated rapidly into estuarine and coastal ecosystems. Thus mangroves are significant contributors to the food chains of these ecosystems. (Author's abstract)
W91-03302

NUMERICAL SIMULATION OF GROUNDWATER FLOW IN FUHRBERG FIELD, HANOVER.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-03320

PHYTOPLANKTONIC BIOMASS AND PRODUCTIVITY IN THE RHONE RIVER PLUME IN SPRING TIME (BIOMASSE ET PRODUCTION PHYTOPLANCTONIQUES DANS LE FRONT DU PANACHE RHODANIEN: SITUATION PRINTANIERE).
Jaffna Univ. (Sri Lanka). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-03392

NUMERICAL MODELING OF TIDAL HYDRODYNAMICS AND SALINITY TRANSPORT IN THE INDIAN RIVER LAGOON.
Florida Univ., Gainesville. Dept. of Coastal and Oceanographic Engineering.
Y. P. Sheng, S. Peene, and Y. M. Liu.
Florida Scientist FLSCAQ, Vol. 53, No. 3, p 147-168, Summer 1990. 16 fig, 14 ref.

Descriptors: *Coastal lagoons, *Florida, *Hydrodynamics, *Indian River Lagoon, *Mathematical models, *Model studies, *Salinity, *Solute transport, *Tidal currents, *Water circulation, Mathematical equations, Simulation analysis, Wind.

A one-dimensional model of circulation and salinity transport within the Indian River lagoon system is based on the cross-sectionally averaged continuity equation, momentum equation, mass conservation equation for salt, and equation of state. A fractional step method and time-implicit scheme are used in the finite-difference model. The model is used to examine the role of pure barotrophic tidal hydrodynamics and to explore the time scales of salinity transport in the lagoon. Model simulation of barotrophic tidal circulation in the Indian River lagoon successfully reproduced the water level measured during a 3-day episode in September 1984. Model simulation of tide-induced salinity transport in the Indian River lagoon indicates a very long response time on the order of 100 tidal cycles. The presence of a uniform wind stress of 1 dyne/sq cm from the south enhances the salinity transport and reduces the response time to 10 to 20 tidal cycles. Results indicate that long-term flow and salinity data are needed for understanding and modeling the circulation and salinity transport within the Indian River lagoon. (Author's abstract)
W91-03437

GROUNDWATER SEEPAGE INTO THE INDIAN RIVER LAGOON AT PORT ST. LUCIE.
Florida Inst. of Tech., Melbourne. Dept. of Civil Engineering.
A. Pandit, and C. C. El-Khazen.
Florida Scientist FLSCAQ, Vol. 53, No. 3, p 169-179, Summer 1990. 5 fig, 4 tab, 12 ref. South Florida and St. Johns River Water Management Districts Grants 250-1547 and 250-1598.

Descriptors: *Coastal lagoons, *Estuaries, *Florida, *Groundwater, *Indian River Lagoon, *Mathematical models, *Model studies, *Seepage, *Surface-groundwater relations, Aquifer systems, Clays, Conductivity, Freshwater, Groundwater level, Groundwater movement, Port St Lucie, Saline water.

A finite element program, GROSEEP, was developed to estimate the groundwater seepage from the surficial aquifer into Indian River lagoon along a selected cross-section in Port St. Lucie, Florida. The Indian River lagoon is a semi-enclosed area of 227 sq mi in which freshwater mixes with saltwater. Groundwater levels in the surficial aquifer, along with the groundwater flow direction, are required to operate GROSEEP. The model is a general purpose model and can be used at other cross-sections. Model results using a single layer indicate that groundwater seepage could be an important freshwater source into the lagoon. The annual seepages from the mainland for 1976 and 1977 were calculated to be 1438 and 1625 cu ft per foot of lagoon shoreline, respectively. If the groundwater seepage into the lagoon, all along the shoreline, is the same as that estimated at Port St. Lucie, then the annual seepage into the lagoon from the mainland would be 1.2 billion and 1.33 billion cu ft for 1976 and 1977, respectively. Sensitivity analysis using a three-layer model predicted that the presence of windows in the clay layers, the vertical hydraulic conductivity of the clay layer, and the horizontal conductivity of the sand layer could significantly affect seepage rates into the lagoon. (MacKeen-PTT)
W91-03438

WATER QUALITY CHANGES ASSOCIATED WITH ROTARY DITCHED AND BREACHED MOSQUITO CONTROL IMPOUNDMENTS IN MOSQUITO LAGOON.
East Volusia Mosquito Control District, Daytona Beach, FL.
J. C. Gamble, J. P. Stewart, and W. R. Ehrhardt.
Florida Scientist FLSCAQ, Vol. 53, No. 3, p 180-183, Summer 1990. 1 fig, 2 tab, 1 ref.

Descriptors: *Ditches, *Florida, *Marsh management, *Marshes, *Mosquito Lagoon, *Mosquitoes, *Reservoirs, *Water quality monitoring, Coastal marshes, Dissolved oxygen, Habitats, Mosquito control, Nitrogen, Phosphates, Rotary ditching, Salinity, Turbidity.

A study was conducted for one year before and one year after construction of rotary ditches in breached impoundments to document water quality changes in high marsh pothole habitats. Data collected weekly included salinity, dissolved oxygen, nitrogen, phosphate, and turbidity. Differences between the post-construction and control sites were generally not significant. Some extreme events, particularly high salinity and low dissolved oxygen, were reduced after construction, which may indicate a more stable environment. This stabilization should support a larger population and diversity of fish, contributing to better mosquito control in these habitats. The study is a preliminary step in demonstrating the ability of Open Marsh Water Management by rotary ditching to enhance the high-marsh habitat. (Author's abstract)
W91-03439

SALT MARSH MITIGATION: AN EXAMPLE OF THE PROCESS OF BALANCING MOSQUITO CONTROL, NATURAL RESOURCE, AND DEVELOPMENT INTERESTS.
Indian River Mosquito Control District, Vero Beach, FL.
For primary bibliographic entry see Field 6G.
W91-03441

INTRODUCTION TO THE TIDES OF FLORIDA'S INDIAN RIVER LAGOON: II. CURRENTS.
Harbor Branch Oceanographic Institution, Inc., Fort Pierce, FL.
N. P. Smith.
Florida Scientist FLSCAQ, Vol. 53, No. 3, p 216-225, Summer 1990. 2 fig, 1 tab, 8 ref.

Descriptors: *Florida, *Indian River Lagoon, *Lagoons, *Tidal amplitude, *Tidal currents, *Tides, *Water currents, Fort Pierce Inlet, Phase angles, St Lucie Inlet, St Sebastian Inlet, Tidal waves.

Hourly current measurements recorded along the Atlantic Intracoastal Waterway were used to quantify amplitudes and local phase angles of the principal tidal constituents in Florida's Indian River lagoon. Twenty-seven study sites located between latitudes 27 degrees 10 minutes and 28 degrees 17 minutes N were occupied for periods of 1-2 months each during 1976-1988. Six principal tidal constituents (M2, S2, N2, K1, O1, and P1) had amplitudes greater than the precision of the measurements used to make the calculations. The semidiurnal M2 constituent dominated all other tidal constituents. M2 amplitudes exceeded 60 cm/s in the vicinity of Ft. Pierce Inlet; the amplitude just

north of St. Lucie Inlet was approximately 45 cm/s. M2 amplitudes were relatively small in the vicinity of St. Sebastian Inlet: values of 11 and 19 cm/s were computed from data obtained at study sites approximately 3 km north and south of the inlet, respectively. M2 amplitudes north of 28 degrees 11 minutes N were less than 1 cm/s. A comparison of phase angles indicated that tidal wave forms propagate at speeds of 5-10 km/h. In the central parts of the central and southern segments of the lagoon, the time delay of any phase of the tide is 6.5 and 5 h, respectively, relative to Ft. Pierce Inlet. (Author's abstract)
W91-03442

LARGE SPATIAL AND TEMPORAL BIOLOGICAL VARIABILITY OF INDIAN RIVER LAGOON.
Saint Johns River Water Management District, Palatka, FL.
For primary bibliographic entry see Field 2H.
W91-03443

DEVICE FOR REDUCING THE EFFECTS OF WAVE ACTION IN SHALLOW WATER.
Mount Allison Univ., Sackville (New Brunswick). Dept. of Biology.
T. L. McAllister, and R. B. Aiken.
Hydrobiologia HYDRB8, Vol. 202, No. 1/2, p 105-106, August 29, 1990. 1 fig, 1 ref.

Descriptors: *Baffles, *Check structures, *Estuarine environment, *Experimental design, *Tidal effects, *Tidal marshes, *Wave action, *Wetlands, Bay of Fundy, Canada, Hydraulic design, Hydraulic engineering, Shallow water, Spartina, Tidal flats, Tidal flooding.

In studies of the combined effects of mechanical wave action, reduced light, and salt water during tidal flooding on the metabolism of Spartina grass, it was necessary to experimentally control the effects of each factor. The Bay of Fundy in Atlantic Canada has some of the highest tides in the world. When the tide is approaching, there is considerable wave action and the observed metabolic adaptions may be partially due to the mechanical stress experienced by the plant. A device, consisting of two sets of perforated plywood baffles, was designed to mediate the effects if mechanical wave action during tidal flooding. In the field, the baffles are set up such that the smaller set of baffles is surrounded by the larger set. The plywood is anchored to the substrate by conduit tubing. When the tide approached this baffle system, the outer walls absorbed the initial shock of the wave and the water passed through the holes in the wall and entered the narrow space between the two sets of baffles. The water in this space then trickled through the holes in the second set of baffles and began to fill the area enclosed by the second set. The water level inside the inner set of baffles rose evenly and steadily without any noticeable wave action. Initial attempts to construct this apparatus using heavy-gage plastic were unsuccessful because the flexibility transmitted the force of the wave and created similar wave action inside and outside the baffles. This apparatus is easily built and can be set by two people in about 45 minutes. It is suggested that it could be useful for any investigator studying the effects of wave action on the inhabitants of tidal flats. (Fish-PTT)
W91-03487

ULVA LACTUCA AS BIOINDICATOR OF METAL CONTAMINATION IN INTERTIDAL WATERS IN HONG KONG.
Hong Kong Univ. Dept. of Botany.
For primary bibliographic entry see Field 5A.
W91-03498

EFFECTS OF TERRESTRIAL EFFLUENTS ON THE INCIDENCE OF AEROMONAS SPP. IN COASTAL WATERS.
Barcelona Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W91-03521

SEA LEVEL AND RAINFALL CORRELATIONS IN AUSTRALIA: TROPICAL LINKS.
Flinders Inst. for Atmospheric and Marine Sciences, Bedford Park (Australia).
For primary bibliographic entry see Field 2B.
W91-03523

ECOLOGY OF ESTUARIES. VOLUME II: BIOLOGICAL ASPECTS.
Cook Coll., New Brunswick, NJ. Fisheries and Aquaculture Technology Extension Center.
M. J. Kennish.
CRC Press, Inc., Boca Raton, Florida. 1990. 391p.

Descriptors: *Ecosystems, *Estuaries, *Estuarine environment, Aquatic environment, Aquatic plants, Bacteria, Benthic fauna, Bottom sediments, Coastal environment, Energy, Fish, Food chains, Macroinvertebrates, Phytoplankton, Reviews, Taxonomy, Zooplankton.

The rapid development of estuarine ecology as a field of scientific inquiry reflects a growing awareness of the immense societal importance of these coastal ecosystems. The study of estuaries involves both ecological and societal issues. As a result of the heightened public concern related to the water quality of coastal regions in the U.S., for example, numerous detailed and quantitative research programs were undertaken in the 1960s, 1970s, and 1980s. which provided a basic understanding of the processes operating in many estuaries. The principal objective of this book is to review the biological characteristics of estuaries. Chapter 1 focuses on the bacteria of estuaries. Chapter 2 details the phytoplankton of estuaries, providing coverage of taxonomy, species composition, succession, biomass, and production of this important autotrophic group. Chapter 3 discusses the classification, taxonomy, and ecology of estuarine zooplankton. Chapter 4 recounts the benthos of estuaries, that is, the flora and fauna inhabiting bottom sediments. The spatial distribution of benthic macroinvertebrates is addressed on three levels: (1) small-scale distributions within the estuary; (2) distribution patterns on the scale of the estuary; and (3) distribution patterns on a world scale. Physical factors strongly affect local distributions of the benthos. Chapter 5 reviews the ichthyofauna of estuaries--the largest and most motile component of the estuarine nekton of actively swimming pelagic organisms within the size range of 20 mm to 20 m. Finally, Chapter 6 examines the trophic relationships of estuarine organisms and the flow of energy among producers, consumers, and decomposers. Plants and animals living in estuaries are not isolated entities, but part of a complex food web. Two major interlocking components of the food web exist: (1) the detritus food web, and (2) the grazing food web. Differences between these two pathways of energy flow occur principally at the primary producer-primary consumer levels. (See also W87-09066) (Lantz-PTT)
W91-03658

SENSITIVITY ANALYSIS OF '2D-FED,' A MODEL FOR SEAWATER ENCROACHMENT IN LEAKY COASTAL AQUIFERS.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
M. M. Sherif, V. P. Singh, and A. M. Amer.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 343-356, October 1990. 6 fig, 1 tab, 25 ref.

Descriptors: *Coastal aquifers, *Dispersion, *Finite element method, *Flow pattern, *Groundwater movement, *Model studies, *Saline water intrusion, Aquifer characteristics, Leaky aquifers, Numerical analysis, Rotational flow, Salts, Sensitivity analysis, Simulation analysis.

In a previous study, a two-dimensional finite element model for dispersion (2D-FED) was developed and verified for some previously published problems, and applied to predict the shape of equiconcentration and equipotential lines in coastal aquifers. The 2D-FED model was used to study the effect of several parameters on the simulated dispersion zone and flow pattern in leaky coastal aquifers under steady state conditions. It was found that the aquifer thickness greatly affects the dispersion zone as well as the equipotential lines. Except for certain ranges, the effects of isotropic and anisotropic permeability coefficients and anisotropic dispersivities are relatively small. Cyclic flow is found near the shore boundary, except when the aquifer depth is relatively small, and yet salt ions find their way into the aquifer to some limited distance under the effect of dispersion. Selection of a proper mesh size is very important. Generally, smaller elements accelerate the convergence. Near the shore boundary, where cyclic flow exists, an intensive grid is required to avoid numerical problems. (Author's abstract)
W91-03757

PROPOSALS FOR MACROPHYTE RESTORATION IN EUTROPHIC COASTAL LAGOONS.
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 5G.
W91-03797

SUBAERIAL EXPOSURE AND CHANGES IN THE STABILITY OF INTERTIDAL ESTUARINE SEDIMENTS.
Bristol Univ. (England). Dept. of Botany.
D. M. Patterson, R. M. Crawford, and C. Little.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 6, p 541-556, June 1990. 9 fig, 2 tab, 24 ref. NERC special topic grant GST/02/46 and NERC grant GR/3/6402.

Descriptors: *Diatoms, *England, *Estuaries, *Estuarine environment, *Estuarine sediments, *Mud flats, Dehydration, Erosion, Sediment stability, Severn River Estuary, Tamar River Estuary, Tidal effects.

Since factors that affect the erosion of intertidal flats also influence the calculations of sediment budgets for estuarine ecosystems, one of the most important characteristics of the mud is the stability of the surface in terms of the force required to initiate resuspension. Changes in the surface stability of six intertidal mudflats, three sites on each of the Tamar and Severn estuaries in England were determined, and the diatom assemblages present during measurements taken over a full period of subaerial exposure were examined. Hourly measurements were made using a cohesive strength meter which provides an ordinal measure of sediment stability. The sediment was most easily eroded immediately after the emersion of the mudflat and there was little difference between the initial stability of the mud at different sites or stations. As the subaerial exposure continued, the sediment of mid-shore and high-shore stations began to increase in stability. No significant change was found at low-shore stations before the return of the tide. The surface density of diatom populations was also intermittently measured at each site. The greatest increase in sediment stability occurred at high-shore stations and this was most extreme where there were also dense populations of epipelic diatoms present at the surface of the sediment. This supports laboratory evidence that the extracellular products of diatom populations of sufficient density increase the stability of intertidal sediments. The mechanisms by which epipelic diatoms stabilize sediments are related to the physical characteristics of the mucilage produced for locomotion. If the mucopolysaccharide matrix at the surface becomes dehydrated, it is possible that the sediment will become more tightly bound in the thickening matrix. Therefore, dewatering of the sediment and dehydration of the matrix may act together to increase sediment stability. (White-Reimer-PTT)
W91-03813

FISH IN SHALLOW AREAS IN MORETON BAY, QUEENSLAND AND FACTORS AFFECTING THEIR DISTRIBUTION.
Queensland Dept. of Primary Industries, Brisbane (Australia). Fisheries Management Branch.
H. T. Weng.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 6, p 569-578, June 1990. 3 fig, 3 tab, 24 ref.

Descriptors: *Australia, *Estuaries, *Estuarine environment, *Estuarine fisheries, *Fish populations, *Species composition, Distribution, Habitats, Shallow water, Species diversity.

The abundance of species, species diversity, faunal similarity, and some of the factors affecting the distribution of fish in the shallow waters of Moreton Bay, Australia, were examined. Five shallow areas (<4 m in depth) were selected to examine fish communities. These areas were categorized as sand-drifting, sea grass, river mouth, mangrove fringe and sewage outlet. A total of 86 fish species were recorded. Five species (6%) were regarded as true marine fish, but these were of rare occurrence (0.5%). Four species (5%) were highly abundant (51%) and 57 species (66%) were represented by low numbers of fish (5%). The sewage outlet and the river mouth sites were found to contain the highest number of fish with relatively low numbers of species. The sand-drifting and the sea grass sites were different in fish fauna, and both were different from the remaining three sites which were of high similarity in fish faunal groups. Food availability, preference for habitats, sea grass vegetation, juvenile/adult segregation, season of juvenile recruitment and hydrological characteristics were thought to be important factors affecting the distribution of these species of fish. (Author's abstract)
W91-03814

HYDROGRAPHY AND PHYTOPLANKTON OF WATERS OFF SOUTH-WEST IRELAND.
University Coll., Galway (Ireland). Irish Phytoplankton Group.
R. Raine, J. O'Mahony, T. McMahon, and C. Roden.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 6, p 579-592, June 1990. 6 fig 3 tab, 32 ref.

Descriptors: *Coastal waters, *Ireland, *Phytoplankton, *Productivity, *Red tide, Aquaculture, Biomass, Chlorophyll, Diatoms, Dinoflagellates, Fronts, Salinity, Stratification, Temperature, Upwelling.

The danger posed to aquaculture by the periodic development of red tides off southwest Ireland, as well as the unusual plankton ecology of the area resulted in research to determine the factors governing periodic phytoplankton blooms in this area. The study area, which included Roaringwater Bay, Dunmanus Bay, and Bantry Bay, was visited on three occasions from August 1985 to July 1987. Physical, chemical and biological characteristics were measured at twenty-three stations. A number of thermal fronts were identified from both shipboard measurements and satellite imagery. The overall range in surface temperatures encountered during the three cruises was 10.9 to 16.4 C, the coldest surface water was found inside Roaringwater Bay and outside the mouth of Bantry Bay. Salinity of all samples ranged from 34.6 to 35.3 ppt and was not as significant as temperature in determining water column structure. Phytoplankton species composition, although it varied between cruises, was associated with differences in hydrographic features. High phytoplankton standing crop was associated with zones of physical discontinuity. The phytoplankton species composition in frontal regions is typically one of diatoms in mixed or upwelled water and dinoflagellates in the front and thermocline of stratified water. Upwelling was shown to be an important process in the area, and enhanced phytoplankton biomass and productivity were associated with areas of upwelling and the fronts. Although the data strongly suggest that upwelling is a causative mechanism, it does not necessarily follow that the entire area of cool water found off southwest Ireland is solely due to upwelling. Other processes, such as geostrophic effects on advective currents along shore or the propagation of internal waves originating from the shelf-break, may be important. (White-Reimer-PTT)
W91-03815

NEAR-SHORE HYPOXIA IN THE CHESAPEAKE BAY: PATTERNS AND RELATIONSHIPS AMONG PHYSICAL FACTORS.
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
D. L. Breitburg.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 6, p 593-609, June 1990. 4 fig, 5 tab, 25 ref. NOAA Office of Sea Grant, U.S. Dept. of Commerce Grants NA85AA-D-SG042, R/DO-1B, and A/DO-1B.

Descriptors: *Anoxia, *Chesapeake Bay, *Dissolved oxygen, *Estuaries, *Hypoxia, *Tidal currents, Salinity, Seasonal variation, Temperature, Wind-driven currents.

Near-shore, shallow waters in the Chesapeake Bay periodically experience episodes of anoxia or severe hypoxia during summer. In order to examine the severity and temporal pattern of hypoxia, and environmental factors that may lead to such episodes, dissolved oxygen, salinity and temperature were measured at 15-min intervals during the summers of 1987 and 1988 in a western shore oyster bed. Average bottom dissolved oxygen concentrations were lower at a 4-m site than at a 2-m site. During episodes of severe hypoxia on the western shore of the bay, oxygen minima: (1) coincided with increased salinities and ebb tides, (2) were preceded by winds from the S-SSE (minima of </= 0.5 mg/L) or SW (minima of 0.6-1.1 mg/L), and (3) were reached during 22.00-06.00 hours. Severe hypoxia at the study site therefore appeared to result from intrusions of bottom water, which were most effectively driven by southerly winds. Tidal currents were required to provide the final force that brought deep water close to shore. The diel pattern of intrusions is most likely caused by winds, which were often too strong or had too weak a southerly component to permit intrusions (without near-shore mixing and reaeration) to occur during afternoon-early evening hours, and the diel periodicity of tides. Short-term fluctuations in temperature and salinity were not as great as fluctuations in dissolved oxygen when compared to seasonal fluctuations of each parameter. For many organisms, short-term fluctuations in temperature and salinity may therefore be less likely to influence the habitability of areas such as the near-shore Chesapeake Bay than are similar duration fluctuations in dissolved oxygen concentrations. (Author's abstract)
W91-03816

ESTIMATION OF DIFFUSE INPUTS TO A COASTAL SEA: SOLUTION TO AN INVERSE MODELLING PROBLEM.
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
T. Legovic, N. Limic, and V. Valkovic.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 6, p 619-634, June 1990. 4 fig, 2 tab, 12 ref.

Descriptors: *Adriatic Sea, *Coastal areas, *Lead, *Model studies, *Path of pollutants, Sediment transport, Solute transport, Transport models.

The input of substances to coastal waters comes from a number of natural sources and activities in shipyards, harbors, and the chemical industry. Since the sources are often diffuse, the inflow rate cannot be determined in a direct way. Measurements of currents and salinity in the Punat Bay (the Adriatic Sea) were used to reconstruct the total current field and to estimate the wash-out rate of water. A two-dimensional transport model and measurements of total concentrations of lead in the water and sediments were used to estimate the sedimentation rate and input. A number of generalizations were necessary in order to apply the model to transport in coastal waters: (1) the concentration was considered as the average value over a longer time period (12 days); (2) the extinction parameter was a function with higher values closer to outfalls; (3) the extinction parameter could not be interpreted merely as the sedimentation rate but as the difference of the sedimentation and recycling rates; and (4) the input was increased by a term that corresponded to the input from the atmosphere and was constant over the whole basin. Good agreement, that verified the results, was obtained where there was an independent set of data or an alternate method of processing the data. This indicated that: (1) measurements of concentrations in both sediment and water were representative; (2) the selected model was satisfactory for quantitative description of the transport of lead in the water of Punat Bay; and (3) the method of estimating diffuse inputs works well with the selected transport model even with a relatively modest numerical resolution. (White-Reimer-PTT)
W91-03817

NATURE OF POC TRANSPORT IN A MANGROVE ECOSYSTEM: A CARBON STABLE ISOTOPIC STUDY.
Universidade Federal Fluminense, Niteroi (Brazil). Dept. de Geoquimica.
C. E. Renzende, L. D. Lacerda, A. R. C. Ovalle, C. A. R. Silva, and L. A. Martinelli.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 6, p 641-645, June 1990. 2 fig, 1 tab, 14 ref.

Descriptors: *Brazil, *Carbon cycle, *Isotope studies, *Mangrove swamps, *Organic carbon, Carbon isotopes, Suspended matter, Tidal currents.

Carbon stable isotope measurements have been used as a consistent tracer of organic carbon in mass balance studies in salt marsh and seagrass beds. They have also been used to characterize suspended organic matter in coastal waters to trace coastal food webs and the sources of soil and sediment organic carbon. The isotopic composition of particulate organic carbon (POC) was studied during five tidal cycles in a mangrove creek of Sepetiba Bay, Rio de Janeiro, Brazil. Quantification of the relative contribution of Bay's (marine) and mangrove POC in suspended matter was calculated according to a two-end-member model. The results show that a mixture of organic carbon from mangrove and marine origins is always present in the creek. Mean mangrove contribution to the POC varied from 16% to 100% and was dependent on tidal amplitude. The results suggest that oceanic carbon can be an important component of carbon balance in mangrove ecosystems. Therefore, earlier carbon balance studies from mangroves which did not include measurements of carbon isotopic composition should be interpreted with care. (White-Reimer-PTT)
W91-03818

DISTRIBUTION AND TEXTURE OF THE BOTTOM SEDIMENTS IN A SEMI-ENCLOSED COASTAL INLET, THE ISMIT BAY FROM THE EASTERN SEA OF MARMARA (TURKEY).
Middle East Technical Univ., Mersin (Turkey). Inst. of Marine Sciences.
M. Ergin, and R. Yoruk.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 6, p 647-654, June 1990. 3 fig, 29 ref.

Descriptors: *Bottom sediments, *Organic carbon, *Sea of Marmara, *Sediment distribution, *Turkey, Calcareous organisms, Carbonates, Gravel, Izmit Bay, Sand, Silt, Surficial sediments.

In order to gain a better understanding of the recent hydrographic and biological processes in Izmit Bay in the Eastern Sea of Marmara, Turkey, the types and modes of distribution of the surficial bottom sediments were studied. Thirty-one surficial sediment samples were collected from the floor of the bay with a grab sampler in the summer of 1987, and analyzed for their grain size, total carbonate, and organic carbon distribution. Low calcareous-terrigenous mud (2-45% CaCO3) with a relatively high silt percentage was the principal sediment type found on the floor of Izmit Bay. Sediments rich in sand and gravel usually occur in the narrow and shoal areas of the bay, where biogenic and topography-related hydrodynamic conditions are the dominant factors controlling the nature of bottom deposits. The carbonates are made up almost entirely of the remains of calcareous organisms. Organic carbon concentrations of the sediments (0.35-1.62%) are probably associated with the high primary production rates in this region. Thus, the rates of sedimentation in Izmit Bay calculated from the organic carbon and pri-

mary productivity data are estimated to be up to 70 cm/1000 years. (Author's abstract)
W91-03819

REMARKABLE INVASION OF SAN FRANCISCO BAY (CALIFORNIA, USA) BY THE ASIAN CLAM POTAMOCORBULA AMURENSIS. II. DISPLACEMENT OF A FORMER COMMUNITY.
Geological Survey, Menlo Park, CA. Water Resources Div.
F. H. Nichols, J. K. Thompson, and L. E. Schemel.
Marine Ecology Progress Series MESEDT, Vol. 66, No. 1/2, p 95-101, September 1990. 6 fig, 18 ref.

Descriptors: *Clams, *Estuaries, *Estuarine environment, *Introduced species, *Mollusks, *San Francisco Bay, Bivalves, Community structure, Salinity.

Long-term macrobenthic sampling at a site in northern San Francisco Bay has provided an unusual opportunity for documenting the time course of an invasion by a recently introduced Asian clam Potamocorbula amurensis. Between 1977, when sampling began, and 1986, when the new clam was first discovered, the benthic community varied predictably in response to river inflow. During years of normal or high river inflow, the community consisted of a few brackish or freshwater species. During prolonged periods of low river inflow, the number of species doubled as estuarine species (e.g. Mya arenaria) migrated up the estuary. In June 1987, at the beginning of the longest dry period in recent decades, large numbers (>12,000/sq m) of juvenile P. amurensis were discovered at the site. By mid-summer 1988 the new clam predominated (>95%) in both total number of individuals and biomass, and the expected dry-period estuarine species did not become re-established. The rapid rise of P. amurensis to numerical dominance throughout the region of the original introduction was probably facilitated by the fact that this region of the bay had been rendered nearly depauperate by a major flood in early 1986. Once introduced, the clam had sufficient time (>1 yr) to become well established before the salinity regime was appropriate for the return of the estuarine species. Subsequently, the new clam was apparently able to prevent the return of the dry-period community. Its ability to live in low salinity water (<1 ppt) suggests that P. amurensis may not be displaced with the return of normal winter river flow and, therefore, may have permanently changed benthic community dynamics in this region of San Francisco Bay. (Author's abstract)
W91-03831

MACROFAUNA RECOLONIZATION OF SUBTIDAL SEDIMENTS. EXPERIMENTAL STUDIES ON DEFAUNATED SEDIMENT CONTAMINATED WITH CRUDE OIL IN TWO NORWEGIAN FJORDS WITH UNEQUAL EUTROPHICATION STATUS. I. COMMUNITY RESPONSES.
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5C.
W91-03832

INCREASE OF BENTHIC BIOMASS IN THE SKAGERRAK-KATTEGAT DURING THE 1970S AND 1980S--EFFECTS OF ORGANIC ENRICHMENT.
Havelands Fiskeriundersoegelser, Charlottenlund (Denmark).
For primary bibliographic entry see Field 5C.
W91-03833

THE ESTUARIES TRAPS FOR ANTHROPOGENIC NUTRIENTS: EVIDENCE FROM ESTUARINE MESOCOSMS.
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
L. Nowicki, and C. A. Oviatt.
Marine Ecology Progress Series MESEDT, Vol. 66, No. 1/2, p 131-146, September 1990. 5 fig, 67 ref. EPA grant CR 812487-01-1.

Descriptors: *Cycling nutrients, *Estuaries, *Eutrophication, *Nitrogen, *Phosphorus, Mass balance, Narragansett Bay, Nutrient budget, Nutrient retention, Nutrient sources, Sediments, Water column.

A successful understanding of the role of estuaries as nutrient traps, filters, or exporters requires a knowledge of the distribution of dissolved and particulate nutrient species was well as their rates of input, loss, and accumulation in coastal waters. The results of nutrient mass balances for control and eutrophied artificial mesocosms, with and without sediment communities are presented. Nutrient budgets were prepared for 6 mesocosms by quantifying all sources and sinks of inorganic and organic dissolved and particulate N and P. Measurements included inputs of N and P in inflowing water from adjacent Narragansett Bay, in rain, snow, and atmospheric dry deposition, and outputs of N and P in outflowing water, in losses to denitrification, to burial and to increases in biomass. Regardless of treatment or season these experimental systems exported most of the N and P that they received. Control systems with sediments retained none of the inflowing N and P during summer, and 5% of N and 25% of P inputs during winter. Eutrophied systems with sediments initially retained 30% of added N and P due to increases in water column and sediment nutrient standing stocks in response to daily inorganic nutrient additions; however, after 6 mo. of daily nutrient loading, these treatments retained only 5 to 15% of nutrients added. Results of this study suggest that well-mixed estuarine systems may export to offshore waters most of the nitrogen and phosphorus that they receive. For the small percentage of nutrients that were retained, there was more storage during winter than summer, more storage in treatments without sediments, and more retention of P than N. Nitrogen losses through sediment denitrification accounted for 10 to 20% of the N input to controls, and less than 10% of the N input to eutrophied treatments. The addition of nutrients to the eutrophied treatments resulted in increases in the N and P content of surface sediments, and the rapid deposition of an N and P-rich detrital layer on the bottom of the treatments without sediments. (Author's abstract)
W91-03834

NITROGEN CYCLING IN SEDIMENTS WITH ESTUARINE POPULATIONS OF POTAMOGETON PERFOLIATUS AND ZOSTERA MARINA.
Maryland Univ., Cambridge. Horn Point Environmental Labs.
J. M. Caffrey, and W. M. Kemp.
Marine Ecology Progress Series MESEDT, Vol. 66, No. 1/2, p 147-160, 1990. 7 fig, 4 tab, 64 ref. NSF Grant BSR 8801259.

Descriptors: *Cycling nutrients, *Denitrification, *Estuaries, *Macrophytes, *Nitrification, *Nitrogen, Ammonia, Biomass, Eelgrass, Grassbeds, Nitrates, Nitrites, Potamogeton, Seasonal variation, Sediments.

Rates of nitrogen transformation and concentrations of extractable NH4(+) and NO3(-) (plus NO2(-)) were measured in estuarine sediments vegetated with the submersed macrophytes Potamogeton perfoliatus and Zostera marina, and in adjacent bare sediments, 3 or 4 times during the growing season. The sediments were collected from areas located near the Choptank River, a tributary of Chesapeake Bay. In general, rates were significantly higher in vegetated compared to bare sediments. In P. perfoliatus beds, ammonification and potential nitrification rates were correlated. Both exhibited summer maxima coinciding with peak plant biomass and productivity. Although vertically integrated (0-12 cm), ammonification rates were about twice as high in vegetated as in bare sediments; NH4(+) pools were significantly lower, probably due to high plant nitrogen demand. In contrast, denitrification rates were highest in spring when NO3(-) concentrations peaked, and were significantly correlated to nitrification rates in both spring and fall. Denitrification was only about 20% of total NO3(-) reduction, suggesting that NH4(+) production from NO3(-) may be important in conserving nitrogen within the grassbed. In sediments with Z. marina, rates of ammonification, and nitrification and denitrification potentials each exhibited a distinct seasonal cycle, indicating that rates were not as tightly coupled as in P. perfoliatus beds. High ammonification rates exceeded plant demand leading to NH4(+) accumulation. Potential nitrification rates were highest in vegetated sediments during fall. Denitrification rates, which were also greater in vegetated than in bare sediments, were highest in spring when NO3(-) concentrations were high. Potential denitrification rates comprised 10% of total NO3(-) reduction, indicating that NO3(-) reduction to NH4(+) dominated. The microbial communities responsible for key nitrogen transformations in the sediments were enhanced by both P. perfoliatus and Z. marina: ammonification by inputs of organic nitrogen; nitrification by release of O2 by plant roots; and denitrification by production of NO3(-). (Author's abstract)
W91-03835

DISSOLVED FREE AMINO ACID CYCLING IN AN ESTUARINE OUTFLOW PLUME.
University of Southern California, Los Angeles. Dept. of Biological Sciences.
J. Fuhrman.
Marine Ecology Progress Series MESEDT, Vol. 66, No. 1/2, p 197-203, 1990. 1 fig, 3 tab, 20 ref. NSF grants OCE8406712, OCE8716903, OCE8410074, and OCE8711132.

Descriptors: *Amino acids, *Carbon, *Chesapeake Bay, *Cycling nutrients, *Estuaries, *Nitrogen, Diurnal variation, Productivity, Seasonal variation.

Microbial cycling of dissolved organic C and N is a major pathway in marine ecosystems, and dissolved free amino acids (DFAAs) are significant components of this cycling. Measurements from 4 cruises (February, June, August 1985 and April 1986) in the outflow plume of Chesapeake Bay show that DFAAs cycle rapidly, with turnover times averaging 0.5 to 1 h in spring and summer and ca 3 h in winter, as measured by brief (10 min) tritiated tracer uptake and respiration experiments under extremely clean conditions. DFAA uptake and release rates, calculated from turnover and concentration measurements of four of the most abundant amino acids (glu, ser, gly, ala) as the ship followed a surface drogue, were closely coupled and varied over the day, often tending to be highest near noon and lowest at night, suggesting a connection to primary production. Rates also tended to decline as the relatively biologically-rich plume water mixed with less active coastal seawater. Winter rates were much lower than those in spring and summer. Despite concentrations in the low nM range, the release and uptake rates of these 4 amino acids represented a significant fraction (4 to 18%) of the primary production rate, and incorporation of DFAA-C was 15 to 64% of estimated bacterial secondary production. N uptake from these 4 DFAAs represented about 44 to 131% of the calculated bacterial N demand suggesting that the bacteria in this system probably regenerate inorganic N. One set of measurements in the Hudson plume in summer showed even faster DFAA cycling, with turnover times averaging <7 min. Rapid turnover indicates that the relative extent of molecular (slow) and eddy (fast) diffusion of DFAAs between sources (various plankton) and sinks (mostly bacteria) may be a major rate-controlling factor at scales on the order of mm. The rapid turnover in both plumes suggests that DFAAs are not advected more than a few km, and tend to cycle within a small volume of water. (Author's abstract)
W91-03836

DETECTION OF INITIAL EFFECTS OF POLLUTION ON MARINE BENTHOS: AN EXAMPLE FROM THE EKOFISK AND ELDFISK OILFIELDS, NORTH SEA.
Oslo Univ. (Norway). Inst. of Marine Biology.
For primary bibliographic entry see Field 5C.
W91-03837

SPATIO-TEMPORAL MOSAIC OF THE PHYTOPLANKTON SPRING BLOOM IN THE OPEN BALTIC SEA IN 1986.
Institute of Ecology and Marine Research, Tallinn (USSR).
M. Kahru, J. M. Leppanen, S. Nommann, U. Passow, and L. Postel.
Marine Ecology Progress Series MESEDT, Vol. 66, No. 3, p 301-309, September 1990. 10 fig, 22 ref.

Descriptors: *Algal blooms, *Baltic Sea, *Phytoplankton, *Seasonal variation, *Temporal variability, Chlorophyll, Cycling nutrients, Eddies, Salinity, Sedimentation.

The spatio-temporal variability of the phytoplankton spring blooms, based on chlorophyll concentrations, was studied in relation to the hydrographic structures in the open Baltic Sea during April and May 1986. It was determined that onset of the bloom was controlled by mesoscale hydrodynamic features--a pair of cyclonic and anticyclonic eddies, and water masses with different salinities. The eddies supported an exceptionally high amount of chlorophyll (>700 mg/sq m in the cyclonic eddy). The temporal development of the bloom was different in each of the mesoscale features. Chlorophyll levels in the eddies started to decrease due to sedimentation before formation of the thermocline and the depletion of inorganic nutrients. Variability of the chlorophyll distribution was highest just before the peak in the spatially averaged concentration was attained. Very high chlorophyll values such as those in the water column of the 2 eddies have not been previously reported in the Central Baltic Sea. The vernal growth period holds a key position in determining the response of the Baltic Sea ecosystem to the observed increase in winter nutrient levels. The structure and functioning of the pelagic food web during that phase determine how much nutrient from the initial reserves is transported out of the pelagic system by sedimentation, and how much is retained for recycling in the upper water layer. The spring bloom period should therefore receive more attention when evaluating trends in the trophic state of the sea. (White-Reimer-PTT)
W91-03838

OPTIMAL BATHYMETRY OF TYRRHENIAN SEA BY STOCHASTIC INTERPOLATORS.
Padua Univ. (Italy). Dipt. di Metodi e Modelli Matematici per le Scienze Applicate.
For primary bibliographic entry see Field 5B.
W91-03862

BACTERIAL CONTAMINATION AND REMEDIATION MEASURES AT MARINA DEL REY, CALIFORNIA, U.S.A.
Los Angeles County Dept. of Beaches and Harbors, CA.
For primary bibliographic entry see Field 5B.
W91-03872

PRIMARY PRODUCTIVITY AND PARTICULATE ORGANIC MATTER FLOW IN AN ESTUARINE MANGROVE-WETLAND IN HONG KONG.
Hong Kong Univ. Dept. of Zoology.
S. Y. Lee.
Marine Biology MBIOAJ, Vol. 106, No. 3, p 453-463, 1990. 4 fig, 5 tab, 83 ref.

Descriptors: *Estuaries, *Hong Kong, *Mangrove swamps, *Organic matter, *Particulate matter, *Primary productivity, *Wetlands, Algae, Biomass, Detritus, Ecosystems, Phytoplankton.

Net primary productivity and organic matter flow of a mangrove dominated wetland was estimated by following production and detritus dynamics in a tidal pond in northwest Hong Kong in 1986-1988 (9.1 ha). Total productivity was 12.47 t dry wt/ha/yr, of which > 90% was from emergent macrophytes (the mangrove Kandelia candel and the reed Phragmites communis). High turbidity and high summer temperatures probably limited respective production by phytoplankton and benthic macroalgae (dominated by Enteromorpha crinata). Despite the high total productivity, little detritus was exported from the emergent macrophyte stands due to low inundation. This created a net water column carbon deficit which was provided for by the high organic matter import (mean = 4.42 g ash free dry wt/sq m/d) from incoming water. This same sediment and particulate organic carbon input giving a high accretion rate of 1.7 cm/yr was probably also the force behind progressive dis-coupling of emergent macrophyte production from water column consumers. This resulted in a tendency to retain production in the emergent macrophyte stands while the water column community increasingly relied on allochthonous carbon. This shift from a net exporter to a net importer of carbon in landward wetlands is probably characteristic of the transition into nutrient conservative terrestrial systems. (Author's abstract)
W91-03882

ALTERATIONS IN THE ENERGY METABOLISM OF AN ESTUARINE MYSID (MYSIDOPSIS BAHIA) AS INDICATORS OF STRESS FROM CHRONIC PESTICIDE EXPOSURE.
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W91-03883

EFFECTS OF AN OIL SPILL ON THE GASTROPODS OF A TROPICAL INTERTIDAL REEF FLAT.
Smithsonian Tropical Research Inst., Balboa (Panama).
For primary bibliographic entry see Field 5C.
W91-03887

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SALINE WATER DISPOSAL OPTIONS IN THE MURRAY BASIN.
Rural Water Commission of Victoria, Armidale (Australia). Investigations Branch.
For primary bibliographic entry see Field 3C.
W91-03891

3B. Water Yield Improvement

COMPREHENSIVE WATER SHORTAGE PLANNING IN THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT.
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 6A.
W91-03040

MAIN INDUCED CHANGES IN RAINFALL-RUNOFF RELATIONSHIP FOR A MOUNTAINOUS WATERSHED.
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
For primary bibliographic entry see Field 2A.
W91-03432

WATER HARVESTING FOR PLANT PRODUCTION.
Vrije Univ., Amsterdam (Netherlands).
C. Reij, P. Mulder, and L. Begemann.
The World Bank, Washington, DC. World Bank Technical Paper No. 91, 1988. 123p, 10 fig, 4 tab, 14 photo, 384 ref.

Descriptors: *Agricultural water, *Crop production, *Sub-Saharan Africa, *Water harvesting, *Water use, Developing countries, Economic aspects, Literature review, Semiarid lands, Social aspects.

A comprehensive review of the available literature on water harvesting for plant production covers a broad range of topics, including terminology and classification, environmental factors, production aspects and socio-economic issues. Although the report covers publications from various continents, special attention is paid to information on water harvesting in Sub-Saharan Africa. It is quite commonly believed that water harvesting can significantly increase plant production in the arid and semi-arid tropics. The available information does not always support this view. In several countries, substantial research has been done on specific water harvesting techniques, and interesting yields have been obtained at research stations, but these techniques have not been adopted on a significant scale by farmers. Most water harvesting projects in Sub-Saharan Africa are still carried out on a 'trial and error basis'. They do not systematically monitor the impact of water harvesting on yields and sometimes promote packages costing more than $1,000/ha, which significantly reduces their replicability. It is recommended that water harvesting packages be based as much as possible on indigenous techniques and local environmental knowledge. (Author's abstract)
W91-03649

3C. Use Of Water Of Impaired Quality

IRRIGATING SOD FARMS WITH RECLAIMED WATER.
R. Daily.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 119-121.

Descriptors: *Farms, *Irrigation, *Reclaimed water, *Sod farms, *Wastewater utilization, *Water reuse, Algae, Filtration, Fungi, Methyl bromide, Runoff, Soil amendments, Wastewater treatment, Water conservation, Water resources management, Weeds.

A 140-acre sod farm in Temecula has been irrigated with reclaimed water, exclusively, for the last seven years. Irrigation begins early in the morning, usually 3:00 or 3:30 a.m. so that it is complete before the winds come up in the afternoon. Before the first crop is planted the ground is fumigated with methyl bromide, primarily to get rid of the weed and soil-borne fungi. It costs about $1,000 per acre. An aggressive program of soil amendment is used prior to the plow and disk. When using reclaimed water on a sod farm, it is necessary to add soil sulfur to reduce the salt. This prevents the sod from yellowing. Another important feature is perfectly level ground. Low spots cause water to pond. The sun heats the water and the sod burns and dies. A 1.5 million gallon reservoir on the farm receives the reclaimed water. Although algae had been a problem in the reservoir, a solution was found by installing two continuously-operating filters that discharge the filtered water back into the pond through two high-pressure nozzles. The water cascades through the air back into the reservoir at the leeward end where prevailing winds accumulate the algae. It appears that the caseading water puts in so much oxygen that it kills the algae. The farm was laser-leveled to drain to the centrally located reservoir such that all excess irrigation water returns to the reservoir. Thus the runoff is reclaimed and used for irrigation also. In seven years there have been no incidents of water-borne illnesses of sicknesses. (See also W91-03273) (Agostine-PTT)
W91-03287

GOLF COURSE IRRIGATION WITH RECLAIMED WATER.
Moulton Niguel Water District, Laguna Niguel, CA.
J. Smith, and L. Renteria.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 123-126.

Descriptors: *California, *Golf courses, *Irrigation, *Reclaimed water, *Water resources management, *Water reuse, Chlorination, Coagulation, Disinfection, Effluents, Filtration, Flocculation, Legal aspects, Recreation, Secondary wastewater treatment, Sludge, Wastewater treatment, Wastewater utilization, Water conservation.

The first wastewater treatment plant for the Moulton Niguel Water District was built in 1964. It served until 1982 when it was replaced by the Aliso Water Management Agency's (AWMA) Joint Regional Treatment Plant. This state-of-the-art wastewater plant can process up to 12 million gallons per day of wastewater and to 25 million gallons per day of solids (sludge). Effluent from the secondary treatment plant can go to any of three places: directly to the ocean, to the equalization pond and eventually to the ocean, to the tertiary treatment plant for filtration. The filtration system consists of flocculators for mixing coagulating chemicals, sedimentation tanks, filters and chlorination basins for disinfection that hold water for a minimum of two hours after chlorination. The water produced meets all requirements of California's Title 22 health standards and can be used in all reclaimed water applications. A distribution pipeline is used to deliver reclaimed water from Moulton Niguel to the privately owned El Niguel Country Club. The water is delivered into a large holding pond on the golf course. The irrigation system works as follows. The water is pumped to the north end of the reclamation lake, located between the tenth and seventeenth holes, right next to the maintenance yard. From there it is pumped into a VT3 Toro system, and distributed to the irrigation sets through 630 electric valves. Two years ago a separate potable water system was installed to supply the greens and clubhouse. It was suspected that the greens might be a little sick because of the reclaimed water. The negatives of the effluent are the algae buildup problems and the occasional odor problem. The plus is the price of the water. (See also W91-03273) (Agostine-PTT)
W91-03288

FREEWAY LANDSCAPE IRRIGATION IN SAN DIEGO COUNTY.
T. Ham.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 127-132.

Descriptors: *California, *Highway beautification, *Irrigation, *Landscaping, *Reclaimed water, *Water reuse, Economic aspects, Financing, Legal aspects, Wastewater facilities, Wastewater utilization, Water resources management.

Caltrans uses about 48,000 acre-feet of water every year statewide, 35,500 of which is used for highway planting. There are currently about 650 acres statewide on reclaimed water, 500 of which are in southern California. Two water reclamation projects have been completed in the Caltrans right-of-way, one in Mission Valley and one in the city of Oceanside. The Mission Valley project irrigates Route 15 north of 8 to Tierra Santa Boulevard. This project was completed in 1986. An aquaculture plant provides water to about 170 acres of planting on Route 15. A 6-inch main water transmission line was built from the pump house at the aquaculture plant to the landscape areas about four miles away. Water is pumped out at a pressure of 150 to 180 psi. The plan is for a ten year payback. The system capacity is approximately 180 gallons per minute. The Oceanside project, which began operation in 1987, waters approximately 100 acres planting along I-5 throughout Oceanside from Camp Pendleton south to highway 78 in Carlsbad. Since the water is delivered from the Fallbrook Sanitary Sewer District which is 18.5 miles away and 620 feet above Oceanside, the water can be under pressures of 250 psi or more. It is necessary to throttle it down to about 140 psi. The payback period is 12 to 15 years. The steps involved in establishing a reclaimed water project are straightforward. First there must be a source of reclaimed water. Next the approval of the Regional Water Quality Control Board is needed. Both the potable water and the reclaimed water suppliers must be coordinated. It is essential to assure absolute separation of the two supplies. Each step becomes part of the effort and cost of switching to reclaimed water. With proper planning these simple steps can lead to success in the reclaimed water irrigation business. (See also W91-03273) (Agostine-PTT)
W91-03289

INTERACTIVE EFFECTS OF SALINITY AND CALCIUM ON HYDRAULIC CONDUCTIVITY, OSMOTIC ADJUSTMENT, AND GROWTH IN PRIMARY ROOTS OF MAIZE SEEDLINGS.
Technion - Israel Inst. of Tech., Haifa. Faculty of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W91-03520

CROPPING STRATEGIES FOR EFFICIENT USE OF WATER AND NITROGEN.
For primary bibliographic entry see Field 3F.
W91-03633

SALINE WATER DISPOSAL OPTIONS IN THE MURRAY BASIN.
Rural Water Commission of Victoria, Armidale (Australia). Investigations Branch.
R. S. Evans.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 167-185, 1990. 10 fig, 5 tab, 25 ref.

Descriptors: *Australia, *Desalination, *Environmental policy, *Impaired water use, *Murray-Darling River Basin, *Saline water, *Water quality, *Water quality management, Brine disposal, Economic aspects, Ecosystems, Environmental effects, Evaporation pans, Geohydrology, Political aspects, Water reuse.

Large volumes of saline water are produced in the Murray Basin, principally from naturally-occurring saline groundwater discharge to rivers and lakes, and discharge induced by land use change and subsurface drainage effluent from irrigation areas. Disposal of this saline water is fundamental to salinity and land management strategies. River Murray options are either as uncontrolled outflow (non-point saline inflows) or controlled outflow (e.g., groundwater pumping, flushing of evaporation basins). Non-River Murray options are evaporation basins (with or without salt harvesting), aquifer disposal, desalinization, and pipelines to the sea. A key factor in the economics of disposal is salinity of the water. For low-salinity water, reuse and controlled outfall via the River Murray are clearly most economic. As salinity increases, evaporation basins become more economic. Most other options are much more expensive. Public perceptions of feasible disposal options are often poor. Environmental effects can be grouped into those with short term costs to the ecosystem and those with long term hydrogeological consequences. Investigation and evaluation of environmental effects of the major salt disposal options (principally evaporation basins) are now becoming key factors in the choice of the preferred option. An effective saline water disposal strategy for the Murray Basin is one of the highest priorities in salinity management. Economic and environmentally acceptable options now exist, although they may be politically difficult at the local scale. More consideration of how to manage the naturally-occurring discharge areas of the Mallee region may have significant long-term benefits. Best use should be made of all technically and environmentally feasible disposal sites. (Author's abstract)
W91-03891

3D. Conservation In Domestic and Municipal Use

PLANNING TOOL FOR WATER CONSERVATION.
Brown and Caldwell, Tampa, FL.
For primary bibliographic entry see Field 6A.
W91-03091

WATER RECLAMATION: HERE, NOW...AND HOW.
For primary bibliographic entry see Field 5D.
W91-03273

PLANNING FOR WATER RECLAMATION IN SOUTHERN CALIFORNIA.
Irvine Ranch Water District, CA.
R. Young.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 11-18.

Descriptors: *California, *Reclaimed water, *Wastewater treatment, *Water resources management, *Water reuse, *Water treatment, Conservation, Irrigation, Wastewater irrigation, Wastewater utilization.

Irvine Ranch Water District (IRWD) is located in Irvine, California, roughly in the middle of the metropolitan water district of southern California's service area. At 100,000 acres in size, it serves a population of 100,000, with an ultimate population forecast of over 300,000. The IRWD was formed in 1961 and has been practicing water reclamation since 1967. Last year about 9,000 acre-feet of reclaimed water was used, and that amount is growing each year. The reclaimed water is used for two general purposes: landscape irrigation and agricultural irrigation. Landscape uses account for about 6,000 acre-feet, or two-thirds of the reclaimed water demand. Reclaimed water is also put into a distribution system developed by farmers and landowners, commingled with locally captured waters and then used on row crops and truck crops. There are no restrictions on the types of crops that can be irrigated with reclaimed water provided the water meets the highest quality standards of Title 22. To meet these requirements a normal wastewater treatment process is used: primary treatment, conventional activated sludge secondary treatment, followed by direct filtration and disinfection. The water then goes to open-reservoir storage, using reservoirs that once captured local runoff. The idea of using reclaimed water to flush toilets in high-rise offices is being explored. IRDW recently provided reclaimed water to flush toilets in a new public restroom in one of the parks irrigated with reclaimed water. It has been concluded that this type of reuse can be expanded to hotels, schools and other office-type buildings. It is concluded that the processes being used treat the wastewater so that it can be safely reclaimed, that it doesn't have adverse health effects, and that it can be done as a normal standard of practice. (See also W91-03273) (Agostine-PTT)
W91-03275

3E. Conservation In Industry

WATER POLLUTION ABATEMENT EXPENDITURES IN THE WISCONSIN PAPER INDUSTRY.
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5G.
W91-03589

3F. Conservation In Agriculture

INFORMATION EXCHANGE ON MODELS AND DATA NEEDS RELATING TO THE IMPACT OF AGRICULTURAL PRACTICES ON WATER QUALITY: WORKSHOP PROCEEDINGS.
For primary bibliographic entry see Field 5G.
W91-02985

PROCESS RESEARCH STRATEGY TEAMS.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 5G.
W91-02988

DEVELOPMENT OF DECISION AIDS.
For primary bibliographic entry see Field 6B.
W91-02991

WATER USE EFFICIENCY UNDER DRIP IRRIGATION: SOME FINDINGS FROM HAWAII.
Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics.
R. B. Shrestha, and C. Gopalakrishnan.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 13B-15--13B-26, 3 tab, 12 ref.

Descriptors: *Agricultural water, *Drip irrigation, *Hawaii, *Irrigation practices, *Water conservation, Agricultural hydrology, Soil moisture retention, Soil properties, Sugars.

Drip irrigation has been adopted in Hawaii's sugar industry as a better alternative to furrow or sprinkler irrigation in order to increase yield and conserve water. However, the success of drip technology depends heavily on land quality characteristics such as soil type, water holding capacity, and field gradient, over and above other management and cultural practices. Drip irrigation is found to augment land quality characteristics, especially in the water retention function of soil. The previously marginal productivity of water has shown significant improvement under drip irrigation, resulting in enhanced sugar yield. Drip irrigation has proven to be a preferred alternative to furrow irrigation due mainly to demonstrated increases in yield of about 1.7 tons of sugar/acre (15%) and about a 12% reduction in water useage. (See also W91-03032) (Lantz-PTT)
W91-03092

SOIL EROSION AND CONSERVATION.
For primary bibliographic entry see Field 2J.
W91-03117

CONSEQUENCES OF HEAVY MECHANIZATION AND NEW ROTATION ON RUNOFF AND ON LOESSIAL DEGRADATION IN NORTHERN FRANCE.
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
For primary bibliographic entry see Field 4C.
W91-03121

SOIL AND WATER CONSERVATION PROBLEMS IN THE CENTRAL PLAINS OF VENEZUELA.
Universidad Central de Venezuela, Maracay. Facultad de Agronoma.
For primary bibliographic entry see Field 4D.
W91-03123

WITHIN-FURROW EROSION AND DEPOSITION OF SEDIMENT AND PHOSPHORUS.
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
M. J. Brown.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 113-118, 3 tab, 3 ref.

Descriptors: *Furrow irrigation, *Idaho, *Irrigation practices, *Phosphorus, *Sedimentation, *Soil erosion, Infiltration, Mulches, Nutrients, Phosphorus losses.

Under present management systems, irrigation drainage streams continually load sediment into streams and rivers. This study sought to determine (1) the erosion and/or deposition pattern within the furrow of various furrow-irrigated crops; (2) the total sediment and P losses from the furrow during each irrigation throughout the irrigation season; and (3) how effective loose straw in furrows would be as an energy dissipator to reduce erosion and increase infiltration. The irrigation system studied was in southern Idaho where potato or bean were being cultivated. During the growing season on the potato plots, six irrigations yielded 13.7 t/ha of sediment and 5 irrigations yielded 7.9 kg/ha of total P. Water flow through the furrow ranged from 15.8 L/min to 6.4 L/min. During six irrigations, 59% of the total sediment loss occurred during the first two irrigations and 85% occurred during the first three irrigations. On a bean field with flat-end furrows, the area of erosion and deposition of sediment and P changed along the furrows from irrigation to irrigation during the season. The flow rate in the furrows for eight irrigations ranged from 14.2 to 22.6 L/min. The greatest erosion and some deposition occurred in the upper half of the furrows; further erosion and most of the sediment deposition occurred in the lower one-third of the furrows. Flow rates in wheel rows ranged from 14.2 to 18.4 L/min; rates in the nonwheel rows ranged from 15.2 to 22.6 L/min. During the first two irrigations on the flat-end bean field, 49% of the total sediment eroded left the furrows. Only 23% of the total eroded sediment was lost during the last four irrigations. On the bean field with convex-end furrows, erosion was greatest in the bottom one-third of the furrows. Erosion in the upper two-thirds of the furrows was similar to that in the upper two-thirds of the flat-end field. Loose straw in the furrows reduced sediment generated from erosion by 71%; entering stream sizes were 13.2 and 10.3 L/min for the straw and no-straw furrows, respectively. Straw also increased infiltration by 82% compared to no-straw furrows. Proper use of organic matter and better water management in the early part of the season could effectively increase infiltration and reduce soil and nutrient losses. (See also W91-03117) (Rochester-PTT)
W91-03127

SOIL AND WATER CONSERVATION IN SEMIARID REGIONS.
Agricultural Research Service, Akron, CO. Central Great Plains Research Station.
For primary bibliographic entry see Field 4D.
W91-03141

IMPROVED RAINFED FARMING FOR SEMI-ARID TROPICS: IMPLICATIONS FOR SOIL AND WATER CONSERVATION.
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India). Farming Systems Research Program.
For primary bibliographic entry see Field 4D.
W91-03142

CONTROLLING EROSION AND SEDIMENT LOSS ON FURROW-IRRIGATED LAND.
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 4D.
W91-03143

ESTABLISHMENT OF PLANT COVER PARAMETERS FOR MODELLING SPLASH DETACHMENT.
National Coll. of Agricultural Engineering, Silsoe (England).
For primary bibliographic entry see Field 2J.
W91-03145

CONSERVATION TILLAGE: AN IMPORTANT, ADAPTABLE TOOL FOR SOIL AND WATER CONSERVATION.
Soil Conservation Service, Washington, DC.
For primary bibliographic entry see Field 4D.
W91-03171

RESEARCH STRATEGY FOR ASSESSING THE EFFECT OF EROSION ON FUTURE SOIL PRODUCTIVITY IN THE UNITED STATES.
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
For primary bibliographic entry see Field 4D.
W91-03174

CITANDUY PROJECT IN JAVA: TOWARD A NEW APPROACH TO WATERSHED STABILIZATION AND DEVELOPMENT.
Agency for International Development, Karachi (Pakistan).
For primary bibliographic entry see Field 4D.
W91-03176

MODELLING OF ENERGY FORESTRY: GROWTH, WATER RELATIONS AND ECONOMICS.
For primary bibliographic entry see Field 2I.
W91-03198

INTRODUCTION TO MODELLING OF PLANT WATER CONDITIONS.
Gdansk Technical Univ. (Poland). Inst. of Hyrdotechnics.
For primary bibliographic entry see Field 2I.
W91-03199

ROLE OF DRIP IRRIGATION IN GROUNDWATER MANAGEMENT IN BASALTIC TERRAIN: A CASE STUDY OF SOLAPUR DIST.
D.B.F. Dayanand Coll. of Arts and Science, Sholapur (India).
M. K. Zambre.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 969-978, 2 fig, 1 tab, 6 ref.

Descriptors: *Agricultural water, *Drip irrigation, *Groundwater irrigation, *India, *Irrigation practices, *Water conservation, Basalts, Case studies, Consumptive use, Crop yield, Drought, Performance evaluation, Sugarcane, Vine crops.

The Solapur District of Maharashtra State (India) covers about 15,000 sq km; four of eleven talukas in the district are drought prone. For maximal economic development and food production, groundwater must be used efficiently. Drip irrigation is an efficient method of providing water directly into the soil at the root zone of the plant. With drip irrigation, the water delivery can approximate the consumptive use of the plant. Out of a total cultivable area of 20.8 million hectares, at most 26% comes under a surface irrigation system. By application of groundwater resources, this figure increases to 40%. However, if drip irrigation systems were used then this percentage would increase to 60-70%. Drip irrigation began to be adopted by farmers in Solapur state in early 1986. By the end of 1987, 684 hectares of land came under drip irrigation for cultivation for grapes and sugarcane. Water saving was about 55% with drip irrigation. In South Solapur taluka, the drip system has been used for sugarcane, with a saving of about 60% in groundwater and an increase in production of about 6%. (See also W91-03311) (Rochester-PTT)
W91-03360

EVALUATION OF OPTIMAL CONSTANT-VOLUME CONTROL FOR IRRIGATION CANALS.
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 8B.
W91-03413

MATHEMATICAL ZERO-INERTIA MODELING OF SURFACE IRRIGATION: ADVANCE IN BORDERS.
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
G. H. Schmitz, and G. J. Seus.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 5, p 603-615, September/October 1990. 6 fig, 20 ref, append. German Science Foundation (DFG) Grant No. Se 316/7 and Se 316/11.

Descriptors: *Border irrigation, *Drainage engineering, *Infiltration, *Irrigation efficiency, *Irrigation engineering, *Mathematical models, Differ-

ential equations, Furrow irrigation, Hydrodynamics, Momentum equation, Numerical analysis.

The basis for comprehensive analytical models, equations, and their solutions for border or furrow irrigation advance has been derived. This basis consists of an analytical solution of the zero-inertia differential equations, which assumes a moving momentum representative cross-section in the water body. It takes into account the time-varying character of infiltration and does not contain any restrictions on the infiltration formula used. This solution was specifically developed for a zero-inertia model of border irrigation advance (ZIMBA). It proved efficient in three types of application: (1) simulation of irrigation advance in sloping borders; (2) replacement within a numerical model of the cumbersome, but widely used, mass-balance techniques for calculating the flow in the tip region of the wave; and (3) generating initial values for starting a numerical simulation of border irrigation. The results of ZIMBA were compared to observed values and to results of a full hydrodynamic model, with nearly perfect agreement. For the data that were analyzed, the prediction error always remained below 4%. (Author's abstract)
W91-03420

RATIONAL APPROACH FOR MODIFYING ROTATIONAL WATER DELIVERY SCHEDULE.
Central Soil Salinity Research Inst., Karnal (India).
S. Bhirud, N. K. Tyagi, and C. S. Jaiswal.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 5, p 632-644, September/October 1990. 7 fig, 3 tab, 13 ref.

Descriptors: *Crop yield, *Drainage engineering, *Irrigation efficiency, *Irrigation engineering, *Scheduling, *Water conservation, Evapotranspiration, Growth, Simulation analysis, Water delivery, Water demand.

Irrigation scheduling, which anticipates the temporal water need of crops, is an important management activity affecting the performance of irrigation projects. Equally important factors are the water delivery schedule and canal capacity that determine the actual application schedules. An analysis of water delivery schedules was made based on a water-balance simulation approach using a crop growth simulation models. Five rotational schedules of two, three, four, five, and six weeks were compared to an on-demand schedule in terms of evapotranspiration, total water applied, and yield. Simulated yields for on-demand and a two-week rotation schedule are comparable. Longer rotation schedules resulted in yield decreases. Modifying the rotation schedule in critical growth periods saved water and resulted in minimum yield losses. The best modified rotation schedule produced 94% of the on-demand yield. (Author's abstract)
W91-03422

OBSERVABILITY OF SURFACE IRRIGATION ADVANCE.
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
N. D. Katopodes.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 5, p 656-675, September/October 1990. 10 fig, 7 tab, 11 ref. Agricultural Research Service, U.S. Department of Agriculture, Cooperative agreement no. 58-82HW-5-01; National Science Foundation grant no. BCS-8914980.

Descriptors: *Drainage engineering, *Field tests, *Infiltration, *Irrigation efficiency, *Irrigation engineering, *Model studies, *Water conservation, Algorithms, Border irrigation, Computer models, Flow characteristics, Numerical analysis, Resistance, Surface flow.

Computer models for surface irrigation produce results that depend heavily on the field parameters applied to the models as input. The conditions of observability and field-parameter identifiability for surface irrigation advance were examined by analytical techniques and the linearized zero-inertia model. The existence and uniqueness of the inverse irrigation problem were established by numerical tests based on a nonlinear estimation algorithm. The limitations were examined for determining the field parameters of intake and surface resistance from field-measured values of advance and depth for border-strip irrigation. The linearized zero-inertia model proves to be conditionally observable, and the resistance and two infiltration parameters cannot be identified from measurements of the rate of advance alone. All three parameters on the other hand can be identified from measurements of the surface water profile. The design of appropriate experiments that lead to observability of the problem is difficult because of the physical effects of resistance and infiltration on the dynamics of flow and therefore should be independent of the specific form used to describe these processes. (Author's abstract)
W91-03424

ESTIMATION OF SURFACE IRRIGATION PARAMETERS.
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
N. D. Katopodes, J. H. Tang, and A. J. Clemmens.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 5, p 676-696, September/October 1990. 6 fig, 2 tab, 31 ref. Agricultural Research Service, U.S. Department of Agriculture, Cooperative agreement no. 58-82HW-5-01; National Science Foundation grant no. BCS-8914980.

Descriptors: *Drainage engineering, *Infiltration, *Irrigation engineering, *Mathematical models, *Model studies, *Roughness coefficient, *Surface irrigation, Algorithms, Field tests, Mathematical analysis, Numerical analysis, Parametric hydrology.

During the last 20 years, there have been significant advancements in both the understanding of the physical principles and the mathematical modeling of surface irrigation. Approximations in the mathematical model and lumping of the field parameters are interrelated in a complicated fashion, finally producing what is known as the numerical simulation. The basic concepts and procedures for the estimation of roughness and infiltration parameters encountered in surface irrigation were examined. Conjugate gradient and variable metric techniques were used for the search of the parameter set that minimizes the errors between field observations and the linearized zero-inertia model. Appropriate constraints that restrict the variation of parameters within physically-realistic limits were also imposed on the objective function. The performance and radius of convergence of the search algorithm were studied by numerical tests that demonstrate the steps in the development of the associated objective function and the strategy required for convergence to the correct values of the field parameters. It is concluded that a key role is played by the formulation of the direct problem and its numerical solution, and that the nonlinear field parameter search converges quickly when the influence of independent parameters can be decoupled during construction of the objective function. (Author's abstract)
W91-03425

SELF-ADAPTIVE CONTROL OF SURFACE IRRIGATION ADVANCE.
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
N. D. Katopodes, and J. H. Tang.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 5, p 697-713, September/October 1990. 15 fig, 15 ref. Agricultural Research Service, U.S. Department of Agriculture, Cooperative agreement no. 58-82HW-5-01; National Science Foundation grant no. BCS-8914980.

Descriptors: *Channel inflow, *Drainage engineering, *Irrigation efficiency, *Irrigation engineering, *Numerical analysis, *Surface irrigation, Computer models, Field tests, Flow rates, Infiltration, Mathematical models, Optimization.

Optimization and control of surface irrigation efficiency is a crucial agricultural activity. The controllability of surface irrigation advance was examined by analytical means and numerical tests based on the linearized zero-inertia model. First, the inflow hydrograph was proved to be identifiable from advance data. Then, it was shown that it is possible to control the advance rate by adjustment of the inflow rate. Field parameter heterogeneities are automatically taken into account, so a predetermined advance trajectory is obtained under arbitrary field conditions. The model utilizes a tentative time increment, during which a trial value for inflow is adopted. The resulting wave advance is simulated by the zero-inertia model. Discrepancies between the actual and desired advance rate are then used to construct an objective function, whose minimization leads to a correction of the inflow rate for the next time increment of inflow. Finally, examples of self-adaptive control were studied, in which an irrigation stream was led into a field of unknown parameters. The model uses real-time information for the identification of the parameters and simultaneous control of the inflow rate to achieve a desired advance rate. (Author's abstract)
W91-03426

FURROW INFILTRATION ON NONTILLED BEDS WITH CRACKING SOILS.
Agricultural Research Service, Prosser, WA. Irrigated Agriculture Research and Extension Center.
R. G. Evans, C. J. Smith, P. D. Mitchell, and P. J. Newton.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 5, p 714-733, September/October 1990. 6 fig, 5 tab, 47 ref.

Descriptors: *Australia, *Furrow irrigation, *Infiltration, *Irrigation design, *Irrigation engineering, Beds, Clays, Crops, Flow rates, Infiltrometers, Irrigation programs.

Furrow irrigation techniques are used on approximately 5-10% of the irrigated land in the Murray-Darling Basin of southeastern Australia. A recirculating furrow infiltrometer was used to determine the effect of three flow rates on infiltration for nontilled beds established on a red-brown earth soil (heavy clay soil) in the region. Flow rates were 0.13 L/s (low), 0.38 L/s (medium), and 0.61 L/s (high). Tests were repeated four times at two-week intervals over the irrigation season. Infiltration measurements were made over 10-m-long furrows for a minimum of five hours of outflow. It was found that increasing the flow rate, with commensurate increases in wetted perimeter and depth of water in the furrow, increased the volume infiltrated into the nontilled beds on these soils. Because of this effect, the depth of water in the furrow should be maintained as high as possible without flooding the surface of the beds. Narrow spacing between furrows and the presence of crop residues in the furrow may also be beneficial. The volume infiltrated, calculated from the Kostiakov-Lewis equation, decreases with time during the season and is especially evident at the high flow rate. (Author's abstract)
W91-03427

INTERACTIVE EFFECTS OF SALINITY AND CALCIUM ON HYDRAULIC CONDUCTIVITY, OSMOTIC ADJUSTMENT, AND GROWTH IN PRIMARY ROOTS OF MAIZE SEEDLINGS.
Technion - Israel Inst. of Tech., Haifa. Faculty of Agricultural Engineering.
D. Evlagon, I. Ravina, and P. Neumann.
Israel Journal of Botany IJBOAU, Vol. 39, No. 3, p 239-247, 1990. 4 tab, 22 ref.

Descriptors: *Calcium, *Irrigation design, *Plant growth, *Root development, *Saline soils, *Salinity, Conductivity, Corn, Osmotic pressure, Roots, Temperature effects, Viscosity.

Increasing the calcium ion activity in salinized root media has often been shown to ameliorate the inhibitory effect of salinity on plant growth. In order to better define the biophysical mechanisms involved in these growth responses, the interactive

effects of salinity and calcium on hydraulic conductivities and osmotic potential gradients in roots of maize seedlings were investigated. The length of the primary roots was reduced by 54% after 4 days of growth in 0.1-strength Hoagland solution salinized with 100 mM NaCl and by 20% when 10 mM calcium was also added to the salinized root medium. Roots showed 69% osmotic adjustment in response to salinization, with or without extra calcium in the root medium. The mean hydraulic conductivity, of the apical 4 cm of maize seedling roots was determined by assaying osmotically-induced backflow. The assay was sensitive enough to detect reductions in conductivity induced by lowering the assay temperature from 27 to 14 C. These reductions in conductivity exceeded those caused by temperature-induced changes in the viscosity and density of water alone and presumably reflected changes in cell membrane permeability. Salinization with 100 mM NaCl reduced root hydraulic conductivity by 80% and by 51% when 10 mM calcium was also present. Cell extension growth and hence root growth are related to the hydraulic conductivity of the water uptake pathway; the fact that salinity reduced both conductivity and root growth, while additional calcium partially reversed these reduction, suggests that changes in conductivity may have a role in the complex of events regulating root growth responses to salinity stress. (Author's abstract)
W91-03520

CROPPING STRATEGIES FOR EFFICIENT USE OF WATER AND NITROGEN.
American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. 218p. Edited by W. L Hargrove.

Descriptors: *Agricultural water, *Cropping, *Illinois, *Nitrogen, *Soil-water-plant relationships, *Water use efficiency, Agricultural hydrology, Agriculture, Leaching, Nitrogen fixation, Plant-water relationships.

Water and N are two factors that have a major influence on crop production. Water is provided by rainfall, and where rainfall is insufficient, supplemental irrigation is used. Similarly, N needs can be provided by using legumes and other N2-fixing systems, or supplemented with N fertilizer and manures. Since crop production is at the beginning of most human food chains and is an essential human activity, water and N influence human health, welfare, and economics in critical ways. Therefore, it is important to understand the interaction of water and N in cropping systems, responses to these vital inputs, and ways of managing water and N most efficiently. This book deals with water and N management from several perspectives, including crop species, crop sequences, cultural practices, inputs, and environmental quality. Papers discuss the use of cropping systems to gain N2 fixation and efficiency of utilization of this fixed N. Cropping systems, including rotations, multiple cropping, intercropping and specific cropping systems for low input agriculture as well as using specific cropping systems for reduced leaching of salts are topics included in the papers. (See W91-03634 thru W91-03645) (Lantz-PTT)
W91-03633

CROPPING STRATEGIES FOR EFFICIENT USE OF WATER AND NITROGEN: INTRODUCTION.
Georgia Agricultural Experiment Stations, Griffin.
W. L. Hargrove, A. L. Black, and J. V. Mannering.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. p 1-5, 2 fig, 1 tab, 10 ref.

Descriptors: *Agricultural water, *Crop production, *Cropping, *Economic aspects, *Illinois, *Nitrogen, *Water use efficiency, Agronomic crops, Crop yield, Erosion, Financing, Pesticides.

Currently, crop production in the USA can be characterized by low commodity prices and relatively high input costs, as well as increasing concern over the influence of modern agriculture on environmental quality. While commodity prices have been dropping, production cost have been increasing. Crop production in the USA is highly mechanized, requiring little labor, but dependent instead on large and specialized equipment, relatively large fossil fuel energy inputs, and intensive fertilizer and pesticide use. Furthermore, over the past few years, producers have incurred a high rate of indebtedness for capital and operating expenditures causing interest paid on borrowed money to become a major expense. In addition, land values have declined dramatically, greatly decreasing the landowners worth and his opportunity to borrow money. The recent decline in prices coupled with the increase in production costs, have resulted in a narrow margin of profitability for most crops. Current crop production has become less diversified. Continuous mono-cropping with little or no crop rotation is questionable economically, as well as ecologically. The lack of diversification leaves the producer vulnerable to disaster at the hands of crop pests (weeds, diseases, and insects). There are growing concerns over groundwater contamination by fertilizers and pesticides. In addition, more than 70 million ha of cropland are eroding at rates greater than the soil loss tolerance, the rate at which sustained production is possible, and 23% of cropland is eroding at twice the tolerable rate. Research has shown increases in NO3-N in groundwater concurrent with major increases in N fertilization. (See also W91-03633) (Lantz-PTT)
W91-03634

MULTIPLE CROPPING FOR EFFICIENT USE OF WATER AND NITROGEN.
Georgia Coastal Plain Experiment Station, Tifton.
J. E. Hook, and G. J. Gascho.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. p 7-20, 37 ref.

Descriptors: *Agriculture, *Cropping, *Economic aspects, *Illinois, *Nitrogen, *Water use efficiency, Conservation, Crop production, Crop rotation, Erosion control, Nitrogen fixation, Nutrients.

What most farming techniques have in common is their attempt to produce more from a parcel of land than would be obtained from one crop alone. Multiple cropping has been practiced since antiquity; however, the possibility that multiple cropping may increase the productivity of land and make more efficient use of resources has led to a renewed interest in multiple cropping. The possibility of distributing annual fixed costs over more than one crop, changing patterns of cash flow, and reducing risks of total crop failure are some of the economic incentives that have encouraged multiple cropping. Possibilities for reduction in soil erosion, for retention of soluble nutrients, and for minimizing labor needed for minimizing labor needed for land preparation favor planting a second crop, if only a cover crop. Multiple cropping systems are most effective in improving water and N RUE (Resource Use Efficiency) when those systems capture and convert water and N that would otherwise be lost during noncrop periods of monocrop culture. By increasing total production, multiple cropping can reduce the land requirements needed for a given quantity of products. While water and N RUE may be improved by multiple cropping, they also may be decreased. Improvement of N and water RUE through multiple-cropping systems is by itself insufficient justification for establishing multiple-cropping systems. That justification must come from a socioeconomic analysis of the systems. When water and N are underutilized or lost be the practice of one crop per year, the added RUE afforded by multiple cropping suggests that they should be considered in the analysis. (See also W91-03633) (Lantz-PTT)
W91-03635

CROP ROTATION AND ITS IMPACT ON EFFICIENCY OF WATER AND NITROGEN USE.
Michigan State Univ., East Lansing.
F. J. Pierce, and C. W. Rice.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. p 21-42, 3 fig, 3 tab, 68 ref.

Descriptors: *Agriculture, *Crop rotation, *Illinois, *Nitrogen fixation, *Water use efficiency, Conservation, Cropping, Nitrogen.

Crop rotations have generally been viewed as beneficial, but have not always been viewed as economical. Nitrogen applications can, in many cases, replace the rotation effect as long as supplies remain unrestricted (economically and environmentally). The impact of rotations on N use efficiency (NUE) is shown to be dependent upon the definition of NUE, crop response in rotation to available N, and the time frame of consideration, in other words, the indirect or long-term rotation effects. A true assessment of the crop rotation impact on NUE will only be obtained when all N pools are considered, and not solely through crop response to applied N. Efficient water use (EWU) is a function of water use efficiency (WUE). Many studies show a significant increase in yield or biomass when crops are grown in rotation. Rotations are often considered to improve water relationships in soils. It is generally agreed that as biomass increases, water use increases. The two models proposed here for the relationship between WUE and biomass seem to occur in the field, and indicate that rotations can effect EWU. (See also W91-03633) (Lantz-PTT)
W91-03636

PLANTING GEOMETRIES AND THE EFFICIENT USE OF WATER NUTRIENTS.
Agricultural Research Service, Kimberly, ID.
R. E. Sojka, D. L. Karlen, and E. J. Sadler.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. p 43-68, 3 fig, 4 tab, 198 ref.

Descriptors: *Agriculture, *Cropping, *Illinois, *Nutrients, *Plant-water relationships, *Soil-water-plant relationships, *Water use efficiency, Conservation, Crop yield, Evapotranspiration, Legumes, Nitrogen fixation.

For a wide range of species it appears that a greater yield advantage may exist for dense, uniformly spaced canopies than for more open canopies, provided early weed management, water availability, and fertility are adequate. This advantage is more pronounced for plants with intermediate growth habits. Manipulation of row-spacing configurations may be the most practical means of optimizing canopy geometry. Leguminous plants may require greater than expected mineral nutrient availability to maximize nodulations and N2 fixation in these denser, management intensive cropping systems. Row spacing and row orientation may effect canopy light quality and soil temperatures sufficiently to alter rhizobial-host interactions and N2 fixation of leguminous plants. The interaction of planting geometry and the nutrient relations of the soil plant system are not well documented. Due to earlier leaf area index (LAI) increases, early season (and often total season) ET (evapotranspiration) are frequently higher in denser canopies. Wider rows of some crops may have higher ET due to sensible heat transfer from dry interrow surface, although there are conflicting data on this point. Plant physiological indices of water stress frequently indicate greater stress in narrow rows or denser canopies, particularly under nonirrigated conditions, probably due to greater early season water depletion. Soil physical and equipment-engineering limitations may impose the ultimate practical and financial barriers to the adoption of high-intensity, dense canopy management systems. (See also W91-03633) (Lantz-PTT)
W91-03637

ROLE OF CROP RESIDUES--IMPROVING WATER CONSERVATION AND USE.
Agricultural Research Service, Bushland, TX.
P. W. Unger, G. W. Langdale, and R. I. Papendick.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publica-

tion Number 51, 1988. p 69-100, 1 fig, 16 tab, 121 ref.

Descriptors: *Agricultural water, *Conservation tillage, *Illinois, *Water conservation, *Water use, *Water use efficiency, Agriculture, Conservation, Evapotranspiration, Plant-water relationships, Tillage.

Crop residue management or conservation tillage systems are widely recognized for their soil conservation benefits. They also effectively conserve water in many situations. However, much of the water that potentially could be conserved and used for crop production still is lost through runoff, evaporation, or transpiration by noncrop plants. Examples of more effective and adaptable conservation tillage systems are: (1) More effective herbicides--highly effective and specific herbicides are needed to control weeds and volunteer crop plants; (2) Improved equipment--vast improvements in equipment capable of operation under high residue conditions have been made in recent years. The improved equipment should provide trouble free operations, provide effective separation between seeds and residues, cause minimum destruction of surface residues, and place seeds at uniform depth; (3) Improved residue maintenance--crop residues often are limited and subject to decay; (4) Improved cropping sequences--research is needed to develop cropping sequences that result in more effective timing among periods of soil water shortage, water availability, and crop growing seasons; and (5) An improved understanding of basic soil-water-plant relationships. (See also W91-03633) (Lantz-PTT)
W91-03638

ROLE OF CROP RESIDUE MANAGEMENT IN NITROGEN CYCLING USE.
Agricultural Research Service, Lincoln, NE.
For primary bibliographic entry see Field 3F.
W91-03639

ROLE OF CROP RESIDUE MANAGEMENT IN NITROGEN CYCLING USE.
Agricultural Research Service, Lincoln, NE.
J. F. Power, and J. W. Doran.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. p 101-113, 7 tab, 43 ref.

Descriptors: *Agriculture, *Crop production, *Cycling nutrients, *Illinois, *Nitrogen cycle, *Soil properties, Evaporation, Fertilizers, Resources management, Tillage.

Crop residue management alters the soil environment, thereby influencing microbiological populations and activity in soil and subsequent N transformations. It is through this change of events that crop residue management affects the efficiency with which fertilizers, water and other resources are used in cropping systems. In spite of the complexities involved, a few generalized conclusions regarding crop residue management are possible. First, leaving crop residue on the soil surface reduces evaporation rate, thereby maintaining soil water regimes that are more favorable for microbiological activity over longer periods of time. Another consequence is that of enhanced size and duration of the soil microbial mass, and greater quantities of N temporarily immobilized in the biomass. Research suggests that under certain environmental conditions, the N immobilized in microbial biomass is a primary source of the N mineralized and made available to crops during the growing season. There are several other methods by which crop residue management may effect N cycling and efficiency of use, such as reduced losses of soil organic nitrogen through soil erosion, thereby maintaining organic nitrogen pool sizes and turnover rates. (See also W91-03633) (Lantz-PTT)
W91-03639

ROLE OF NONLEGUMINOUS COVER CROPS IN THE EFFICIENT USE OF WATER AND NITROGEN.
North Carolina State Univ., Raleigh.
M. G. Wagger, and D. B. Mengel.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. p 115-127, 6 tab, 39 ref.

Descriptors: *Cover crops, *Illinois, *Nitrogen, *Vegetation effects, *Water use efficiency, Agricultural water, Agriculture, Barley, Grain crops, Nitrogen fixation, Nutrients, Oats, Rye, Water use, Wheat.

The importance of nonleguminous cover crops in soil erosion control and the enhancement of soil productivity via organic matter maintenance or even buildup, has long been recognized in agriculture. Commonly used nonleguminous cover crops are the small grains, and include: rye, wheat, oats and barley. In some areas, perennial sod and annual forage crops have been used to provide a vegetative cover. The components of a nonleguminous cover crop management system may offer a complex set of interrelated factors that affect plant growth and development, and hence, crop yield. Nonleguminous cover crops offer the opportunity to enhance N-use efficiency, conserve soil and water, and preserve water quality by acting as sink for residual N that might otherwise leave the soil system. This would also preserve an N resource for use by subsequent crops. Research needs include: (1) a definition of the effects of cover crops on runoff, infiltration, and water storage; (2) clarification of the role of cover crops as sinks for residual N (to include long-term effects on soil organic carbon and nitrogen levels; and (3) a better understanding of N-fertilizer management in cover crop systems to maximize N-use efficiency. (See also W91-03633) (Lantz-PTT)
W91-03640

ROLE OF ANNUAL LEGUME COVER CROPS IN EFFICIENT USE OF WATER AND NITROGEN.
Kentucky Univ., Lexington.
W. W. Frye, R. L. Blevins, M. S. Smith, S. J. Corak, and J. J. Varco.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. p 129-154, 2 fig, 14 tab, 49 ref.

Descriptors: *Agricultural water, *Cropping, *Illinois, *Legumes, *Nitrogen, *Water use efficiency, Clovers, Mulching, Nitrogen fixation, Vegetation effects, Vetch, Water conservation, Water use.

Annual legume winter cover crops can conserve water and supply a substantial part of the N needed for optimum yields of nonleguminous summer crops. Several legume species are adaptable in such cropping strategies, but hairy vetch appears to perform best in the midsection of the USA from Delaware, Maryland and Kentucky, to Nebraska, while crimson clover as well as hairy vetch appears to be well adapted to the southern part of the Southeast. Cover crops can be established by surface inter-seeding into a summer crop just before leaf drop, or they can be planted after a summer crop has been harvested. A cover crop may be plowed under as a green manure or chemically killed to form a mulch for no-tillage or another form of no-tillage. Plowing the legume under enhances N recovery by the summer crop, but killing it for a surface mulch enhances its soil and water conservation value. Benefits from a legume winter cover crop include: (1) Provides biologically fixed N to succeeding summer crops; (2) Increases soil organic carbon and organic nitrogen relative to winter fallow; (3) Improves soil structure, increases water filtration, decreases runoff, and decreases evaporation losses of water if left as a surface mulch; and (4) Increases soil productivity. The two most important liabilities of using legume winter cover crops are depletion of stored soil water in the early spring and the cost of seeding. (See also W91-03633) (Lantz-PTT)
W91-03641

EXPLOITING FORAGE LEGUMES FOR NITROGEN CONTRIBUTION IN CROPPING SYSTEMS.
Michigan State Univ., East Lansing.
O. B. Hesterman.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. p 155-165, 1 fig, 10 tab, 34 ref.

Descriptors: *Agriculture, *Cropping, *Illinois, *Legumes, *Nitrogen fixation, Corn, Cycling nutrients, Fertilizers, Nitrogen, Nutrients, Research priorities, Vegetation effects.

Most cropping systems have been found to benefit from the inclusion of a forage legume, with corn yield increases averaging between 38% and 152% from the different cropping strategies. When N fertilizer was used, only the conventional rotations consistently demonstrated a positive corn yield response to the legume. Overseeding may hold potential for exploiting the contribution of legume N, but more research with this system is needed. Unless N fertilizer is not available, interseeding systems do not show promise. Farmers have been exploiting forage legumes for N contribution in cropping systems for many centuries. Scientists have recently been able to quantify these N contributions using various methods, some with more accuracy and success than others. The potential for further exploitation of forage legumes for N contributions is great, however, to exploit these legumes both scientists and farmers need to know more about legume species other than those few that researchers have tested to this point. More knowledge is needed about the interactions of legumes in the systems with different methods of tillage, with different pest problems, and with different pest-control strategies. Finally, and perhaps most importantly in terms of adopting these systems on a large scale, more must be known about the economics of legume N compared with the economics of N from synthetic fertilizer sources under various fertilizer costs and commodity price situations. Only when it can be demonstrated that cropping systems that utilize legume N are more profitable will these systems become commonplace. (See also W91-03633) (Lantz-PTT)
W91-03642

ROLE OF CROPPING SYSTEMS IN ENVIRONMENTAL QUALITY: GROUNDWATER NITROGEN.
Agricultural Research Service, Lincoln, NE.
J. S. Schepers.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. p 167-178, 4 fig, 1 tab, 15 ref.

Descriptors: *Cropping, *Environmental protection, *Groundwater quality, *Illinois, *Nitrogen, *Nonpoint pollution sources, *Water pollution sources, Crop production, Groundwater pollution, Leaching, Nitrates.

Leaching of NO3 to groundwater occurs when the water content of soil exceeds the soil's ability to retain the water. Nitrate is known to leach through the soils and into groundwater within a matter of days in some cases, while it may require many years in other ecosystems. Because of the dynamics of N and water, an annual budget of each may not be appropriate and therefore cropping systems of the future may be sensitive to all aspects of the hydrologic and N cycling on a short-term and long-term basis. The potential for NO3 leaching may be accelerated because of variations in monthly precipitation patterns, especially if no crop is growing. Both high intensity rainfall and above average amounts of precipitation increase the potential for N losses via runoff and leaching. Society is becoming frustrated with reports of NO3 contamination of groundwater and what may appear as a lack of remedial measures on the part of producers. Agriculture must assume a major portion of the responsibility for the problem, and is therefore expected to make a concerted effort to

remedy the situation. (See also W91-03633) (Lantz-PTT)
W91-03643

ROLE OF CROPPING SYSTEMS IN ENVIRONMENTAL QUALITY: SALINE SEEP CONTROL.
Agricultural Research Service, Akron, CO.
A. D. Halvorson.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. p 179-191, 3 fig, 4 tab, 51 ref.

Descriptors: *Cropping, *Environmental protection, *Illinois, *Saline water intrusion, *Soil-water-plant relationships, *Water conservation, *Water use, Agriculture, Plant-water relationships, Soil water, Water use efficiency.

Saline seeps are caused by a combination of geologic, climatic, and cultural conditions. The term saline seep describes a salinization process accelerated by dryland farming practices that utilize water inefficiently, allowing water to move through salt laden substrata below the root zone. Saline seep is accepted to mean intermittent or continuous saline water discharge, at or near the soil surface down-slope from recharged areas under dryland conditions. If more intensive cropping systems than the conventional crop fallow are to be successful in the dryland saline seep areas of the Great Plains, farmers need to know: the soil water status for planting, an estimate of growing season precipitation, crop rooting depths and soil-water use characteristics, soil fertility, weed and pest control practices, water conservation strategies, yield and disease characteristics of crop varieties, crop rotations, and other soil and crop management factors. Timely farm operations will be essential along with soil-test information and a knowledge of the depth of impermeable geologic strata and water tables to make a flexible, intensive crop management system work. (See also W91-03633) (Lantz-PTT)
W91-03644

LOW-INPUT CROPPING SYSTEMS AND EFFICIENCY OF WATER AND NITROGEN USE.
Agricultural Research Service, Kutztown, PA.
J. K. Radke, R. W. Andrews, R. R. Janke, and S. E. Peters.
IN: Cropping Strategies for Efficient Use of Water and Nitrogen. American Society of Agronomy, Inc., Madison, Wisconsin. ASA Special Publication Number 51, 1988. p 193-218, 6 fig, 4 tab, 52 ref.

Descriptors: *Agriculture, *Cropping, *Illinois, *Nitrogen, *Water use efficiency, Nitrogen fixation, Nutrients, Soil properties, Water conservation, Water use.

In recent years there has been an increasing concern with modern, intensive farming methods, which rely heavily on pesticides and chemical fertilizers. The concept of N-use efficiency needs to be modified to be useful in evaluating low-input (LIP) systems that rely on legume and animal manure sources of N. Realistic estimates of N availability and loss in these systems will probably involve complicated N budgets that take into account the slow release of organic sources of N, transformations of N in the soil, and cycling processes that involve soil micro-fauna and macro-fauna. Intensified N cycling through an increase in soil biological activity in low-input systems may also contribute to greater N use efficiency over the long-term. Results of a Rodale cropping systems study reveal that: (1) Efficiency of N use is increased by starting an LIP rotation with crops that demand less N than corn; (2) Multiple cropping is an efficient way to establish green manure crops without sacrificing cash crop production, and looks promising for increasing economic returns from low-input cash grain (LIP-CG) systems by allowing for more intensive crop rotations; and (3) To provide good crop yields and high net returns, careful management and planning of LIP cropping systems is essential. A balanced cropping rotation is needed to assure adequate internal resources, including N, water, and weed control. (See also W91-03633) (Lantz-PTT)
W91-03645

TANK IRRIGATION IN SEMI-ARID TROPICAL INDIA: ECONOMIC EVALUATION AND ALTERNATIVES FOR IMPROVEMENT.
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
W. von Oppen, and K. V. Subba Rao.
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh India. Research Bulletin No. 10, 1987. 38p, 10 fig, 17 tab, 29 ref, append.

Descriptors: *India, *Irrigation practices, *Semi-arid lands, *Tank irrigation, *Tropical regions, *Water conservation, *Water resources management, Agriculture, Developing countries, Economic aspects, Irrigation, Simulation analysis, Storage tanks, Water resources development.

A survey of 32 tanks and farm data from Andhra Pradesh and Maharashtra states was used to assess the economic performance of irrigation tanks in the semi-arid tropics in India. District data on climatic and Institutional variables were used to analyze the factors affecting tank irrigation density. Results indicate that the spatial distribution of irrigation tanks is determined primarily by physical factors--hard rock substratum, postmonsoon rains, low moisture holding capacity of soils--and by population density. Tank irrigation, formerly a source of relative stability, has become a source of instability for agricultural production in many parts of India. Important factors for the decline in tank irrigation are: environmental degradation such as deforestation, soil erosion, siltation, tank bed cultivation, and lack of administrative setup to provide timely repair and maintenance of tanks, and to ensure proper water control and tank management. Simulation results show that with improved water control and by keeping sluices closed on rainy days, a 20% larger command area can be irrigated. A Tank Irrigation Authority is proposed for better water control and management. Another concept proposed is Composite Watershed Management on Alfisols involving a system of runoff and erosion controlling land management for enhanced groundwater recharge and sustained well irrigation. This concept, analyzed at ICRISAT Center in a modeling exercise, has considerable economic potential. (Author's abstract)
W91-03648

WASTEWATER IRRIGATION IN DEVELOPING COUNTRIES: HEALTH EFFECTS AND TECHNICAL SOLUTIONS.
Hebrew Univ. of Jerusalem (Israel). School of Public Health.
H. I. Shuval, A. Adin, B. Fattal, E. Rawitz, and P. Yekutiel.
The World Bank, Washington, DC. World Bank Technical Paper No. 51, 1986. 324p, 70 fig, 53 tab, 216 ref.

Descriptors: *Developing countries, *Irrigation water, *Public health, *Wastewater irrigation, *Wastewater treatment, Bacteria, Economic aspects, Epidemiology, Fecal coliforms, Helminths, Human diseases, Irrigation practices, Model studies, Pathogens, Viruses, Water pollution effects.

Wastewater reuse for agriculture in developing and developed countries is summarized. The potential health effects from such reuse are evaluated, and effective and economic methods of control are proposed that are particularly suited to developing countries. A theoretical model was developed, based on a review of available credible epidemiological studies and reports, to assist in predicting the degree of risk of disease transmission associated with various wastewater reuse practices. The empirical evidence and the model suggest that the highest risk of pathogen transmission, infection, and sickness is associated with the helminths, followed in order by bacterial infections and last by viral infections. The model provides a basis for evaluating control options. Although certain health risks are clearly associated with the use of raw wastewater in agriculture, the epidemiological evidence assembled for this study also suggests that the very stringent wastewater irrigation standards developed in many of the industrialized countries are overly restrictive. The study suggests a guideline for unrestricted wastewater irrigation based on an effluent with less than one nematode egg (Ascaris or Trichuris) per liter and a geometric mean fecal coliform concentration of 1,000/100 mL. Technological and policy options for reducing and controlling any health risks of wastewater reuse in agriculture are evaluated. In particular, multicell stabilization ponds with 20 days' detention time effectively remove bacterial, viral, and helminth pathogens in a low-cost, robust, easy-to-operate system that is especially suitable for developing countries. Appropriate wastewater treatment in combination with controlled irrigation techniques and restrictive cropping practices represent effective remedial measures. (Author's abstract)
W91-03650

EFFICIENT USE OF WATER IN IRRIGATION: PRINCIPLES AND PRACTICES FOR IMPROVING IRRIGATION IN ARID AND SEMIARID REGIONS.
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
D. Hillel.
The World Bank, Washington, DC. World Bank Technical Paper No. 64, 1988. 107p, 42 fig, 7 tab, 102 ref.

Descriptors: *Arid lands, *Developing countries, *Irrigation efficiency, *Semiarid lands, *Water conservation, *Water use, Agriculture, Irrigation practices, Irrigation water, Salinity, Social aspects, Water resources management.

A basic review and analysis is provided concerning the principles governing soil-crop-water-climate relationships, irrigation, and the efficient utilization of water in arid and semiarid regions. It presents a critique of traditional and current irrigation concepts and practices, pointing out the needs and potentialities for improving the efficiency of land and water use in developing countries. Starting from a basic analysis of the environmental, physiological, and agronomic factors affecting irrigation, historical approaches to management are contrasted with modern approaches. Methods are described for scheduling irrigation and measuring irrigation water; these are then compared with alternative irrigation systems, along with the specific requirements and methods of drainage and salinity control. Finally, there is a discussion about some of the human consideration involved in the vital task of developing sound, appropriate, and sustainable irrigation systems. (Lantz-PTT)
W91-03651

LAND HUSBANDRY: A FRAMEWORK FOR SOIL AND WATER CONSERVATION.
For primary bibliographic entry see Field 4D.
W91-03652

MANAGING CANAL IRRIGATION: PRACTICAL ANALYSIS FROM SOUTH ASIA.
Sussex Univ., Brighton (England). Inst. of Development Studies.
R. Chambers.
Cambridge University Press, New York. 1988. 279p.

Descriptors: *Developing countries, *Irrigation canals, *Irrigation management, *Water resources management, Canal linings, Economic aspects, Evaluation, Irrigation efficiency, Irrigation practices.

The many billions of dollars invested in canal irrigation in recent decades have had disappointing results. Rarely have projected benefits in well-being or production been achieved. In consequence, in the mid-1980s, further vast sums are being spent throughout the Third World on programs for rehabilitation, canal lining, on farm development, and farmers' organization. Much of this policy and practice is based on misleading research

and misdiagnosis. When applied to the complexity and uniqueness of canal irrigation systems, the normal professionalism of civil and agricultural engineers, agronomists, economists, and sociologists, leaves gaps which are keys to better performance. In successive chapters, five such gaps are analyzed and presented: main system management, including the scheduling and delivery of water, and communications; canal irrigation at night; management of canal systems jointly by farmers and officials; professional conditions and incentives for irrigation managers; and methods for diagnostic analysis to identify cost-effective actions for improvement. (Lantz-PTT)
W91-03655

ECONOMIC IMPLICATIONS OF THE FOOD SECURITY ACT OF 1985'S DISCRETIONARY ENVIRONMENTAL PROVISIONS.
Economic Research Service, Washington, DC.
For primary bibliographic entry see Field 6E.
W91-03710

WATER QUALITY AND THE CONSERVATION RESERVE PROGRAM: IMPLICATIONS OF TARGETING SALINE CROPLANDS.
Economic Research Service, Washington, DC.
For primary bibliographic entry see Field 5G.
W91-03732

IRRIGATION RECHARGE.
Rural Water Commission of Victoria, Armidale (Australia).
W. Trewhella.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 187-194, 1990. 3 fig, 6 tab, 10 ref.

Descriptors: *Australia, *Groundwater recharge, *Irrigation effects, *Irrigation practices, *Recharge, Geohydrology, Groundwater budget, Irrigation programs, Murray-Darling River Basin, Regional planning, Subsoil drainage, Tile drainage.

Irrigation has dramatically changed the water budget of many areas in the Murray Basin in southeastern Australia. There is a need for a clear understanding of how recharge data have been obtained and used, clearly identifing the aquifer which is being recharged, and specifying appropriate time and space scales. Available data are considered adequate for establishing regional priorities for action to reduce recharge. However, site-specific data are required for the design of projects at the local or sub-regional scale. Monitoring of system performance during and after implementation is necessary to verify the accuracy of data used. Recharge in the Mallee zone is very high, and significant reductions can readily be achieved. Many irrigated areas in the Mallee zone are already tile-drained, so the main benefits of recharge reduction will be lower regional water tables and reduced groundwater discharge to the River Murray. Recharge rates in the Riverine Plains zone are generally much lower, although some areas of high recharge do occur. Options for recharge reduction are identified for use in appropriate circumstances, but residual recharge rates are likely to exceed the safe discharge capacity of the underlying aquifers. Subsurface drainage of the more intensively irrigated areas will be required (as in the Mallee zone), to avoid significant losses of production and land degradation. (Author's abstract)
W91-03892

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

BASIN CHARACTERISTICS, HISTORY OF STREAM GAGING, AND STATISTICAL SUMMARY OF SELECTED STREAMFLOW RECORDS FOR THE RAPID CREEK BASIN, WESTERN SOUTH DAKOTA.
Geological Survey, Rapid City, SD. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-02968

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO.
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-02972

FLOOD OF DECEMBER 1987 IN CENTRAL AND EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
B. L. Neely.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4188, 1990. 16p, 9 fig, 4 ref.

Descriptors: *Flood discharge, *Flood frequency, *Flood hydrographs, *Flood profiles, *Rainfall, *Rainfall intensity, Arkansas.

Heavy rain fell across Arkansas during December 24-28, 1987. During this period, 6 to 12 inches of rain fell in a 100-mile wide belt extending roughly from Texarkana to West Memphis, Arkansas. The intense rainfall produced flooding throughout much of central and eastern Arkansas. Peak discharges associated with the flood had recurrence intervals of 100 years at two gaging stations. Peak stages, discharges, and recurrence intervals for this flood are documented profiles for 41 gaging stations. Also included in this report are flood profiles for Bayou Meto, Bayou Two Prairie, Cache River, L'Anguille River, and flood hydrographs for gaging stations on Bayou Meto near Lonoke and Cache River at Patterson. (USGS)
W91-02978

WATER RESOURCES OF THE ELK RIVER BASIN, WEST VIRGINIA.
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
For primary bibliographic entry see Field 2E.
W91-02982

NOGALES WASH AND TRIBUTARIES. FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT.
Army Engineer District, Los Angeles, CA.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A209 732. Price codes: A16 in paper copy, A01 in microfiche. September 1988. 380p, 28 fig, 28 tab, 8 plates, 3 append.

Descriptors: *Flood control, *Floods, *Nogales Creek, *Potrero Creek, *Project planning, Arizona, Cost-benefit analysis, Costs, Flood channels, Flood protection, Flood rating, Mexico.

Nogales and Potrero Creeks have suffered major damage from recent floods. A wide array of flood protection measures are considered in this report, including non-structural and structural alternatives and a no-action plan. Studies have considered flood protection and other water resource measures along the entire Nogales Wash/Potrero Creek watercourse from the International Boundary to the Santa Cruz River. One recommended plan provides for channel improvements at two locations. The first is the 'lateral collector channel' located on the US side of the International Boundary, which would capture overland flow emanating from Mexico. The second channel system located at Chula Vista would capture breakouts from the Nogales and Potrero Creeks and carry the flood flows around the community to a new 3300 foot long grouted stone/concrete channel. The total first cost of the project was estimated at $6,162,000. Annual operation and maintenance is estimated at $11,200. (Lantz-PTT)
W91-03030

C AND SF PROJECT: ADAPTING A WATER RESOURCES PROJECT TO CHANGING PRIORITIES.
Army Engineer District, Jacksonville, FL.
For primary bibliographic entry see Field 6B.
W91-03035

METHOD FOR COMPUTING SHEETFLOW RUNOFF FOR FLAT SLOPES.
South Florida Water Management District, West Palm Beach. Dept. of Resource Management.
For primary bibliographic entry see Field 7B.
W91-03065

EVALUATING THE IMPLEMENTATION AND EFFECTIVENESS OF BASIN PLANS IN KING COUNTY, WASHINGTON.
King County Surface Water Management Div., Seattle, WA.
For primary bibliographic entry see Field 6B.
W91-03093

SOUTHWEST FLORIDA MANAGEMENT DISTRICT SAVE OUR RIVERS PROGRAM.
W. M. Helfferich.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 14B-49--14B-55, 1 fig, 4 ref.

Descriptors: *Environmental protection, *Florida, *Save Our Rivers Program, *Southwest Florida Water Management District, *Surface water, *Water quality, *Water resources management, Big Pine Keys, Bird Rookery Swamp, Kissimmee River, Land use, Water conservation, Wetlands.

Florida's Water Management Lands Trust Fund, commonly known as the Save Our Rivers (SOR) Fund, provides monies to the state's five water management districts for the acquisition and management of lands necessary for water management, water supply and conservation, and protection of water resources. Formed by the legislature in 1981, the SOR program is funded by documentary tax stamps levied on all real estate transactions. The SOR program allows entire drainage systems to be put in public ownership. The South Florida Water Management District (SFWMD) has undertaken an active program to identify and prioritize those lands within the district which meet the criteria for acquisition. An evaluation matrix was developed which allows an objective analysis to be made of each parcel's water management and environmental values. Acquisition efforts are continuing along the Kissimmee River and in the water conservation areas. New acquisition areas include Bird Rookery Swamp in Lee and Collier Counties and the freshwater wetlands of Big Pine Keys. As acquisitions become complete more effort is being placed on long-term management and restoration. Where possible, historic drainage patterns should be reestablished. Efforts are underway to conduct a hydrologic restoration of the 22,000 acre DuPuis Reserve, as well as the more nationally known Kissimmee River Restoration. (See also W91-03032) (Lantz-PTT)
W91-03096

SPECIAL FLOOD HAZARD EVALUATION REPORT: CANASERAGA CREEK, TOWN OF GROVE, ALLEGANY COUNTY, NEW YORK.
Army Engineer District, Buffalo, NY.
For primary bibliographic entry see Field 6F.
W91-03225

GENERALIZED MODEL OF THE REQUIRED STORAGE CAPACITY.
Sarajevo Univ. (Yugoslavia). Inst. of Water Resources Engineering.
H. Hrelja, and D. Isailovic.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 153-167, September 1990. 13 fig, 1 tab, 11 ref.

Group 4A—Control Of Water On The Surface

Descriptors: *Model studies, *Project planning, *Reservoir capacity, *Reservoir design, *Reservoirs, *Storage capacity, *Storage requirements, Economic life, Hydrologic data, Input-output analysis, Water deficit, Water demand.

The required reservoir capacity is defined as the maximum deficit of the net reservoir input. Its size is obviously highly dependent on the input-output characteristics. Total storage is divided into two parts: (1) the stochastic storage associated with the stochastic component of an input series; and (2) the difference storage resulting from that part of input which can be considered as deterministic (periodic). An attempt was made to describe the general behavior of these storages for the regulation of partial flow. To do this, the required reservoir capacity was related to the input series length (i.e. length of expected economic life of a reservoir) and other important parameters of the inflow series. The analyses were based on the generated monthly inflow series from which the mean maximum deficit was estimated. Output series were also represented by the monthly values, and were assumed to be deterministic, either constant or periodic. It has been shown that total storage capacity for partial flow regulation can be linearly related to the product of the mean monthly standard deviation of the input series and the logarithm of the length of these series. (Author's abstract)
W91-03546

GREAT LAKES WATER LEVELS, PAST, PRESENT, AND FUTURE.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W91-03681

AESTHETIC IMPLEMENTATION OF NON-POINT SOURCE CONTROLS.
Camp, Dresser and McKee, Inc., Cincinnati, OH.
For primary bibliographic entry see Field 5G.
W91-03728

STORM WATER MANAGEMENT MODEL FOR URBAN AREAS IN KUWAIT.
Kuwait Univ., Safat. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-03852

4B. Groundwater Management

HYDROGEOLOGY AND WATER RESOURCES OF THE LOS OSOS VALLEY GROUNDWATER BASIN, SAN LUIS OBISPO COUNTY.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02971

SIMULATION OF GROUND-WATER FLOW IN THE MISSISSIPPI RIVER VALLEY ALLUVIAL AQUIFER IN EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02976

WATER USE REGULATION FOR THE '90'S - THE SOUTHWEST FLORIDA EXPERIENCE.
Southwest Florida Water Management District, Brooksville. Resource Regulation Dept.
For primary bibliographic entry see Field 6D.
W91-03052

MANAGING GROUNDWATER IN TEXAS: THE CHANGING PACE OF REGULATION.
Texas Tech Univ., Lubbock. Dept. of Geography.
O. W. Templer.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 4B-7--4B-16, 1 fig, 27 ref.

Descriptors: *Groundwater management, *Legal aspects, *Regulations, *Texas, *Water management, *Water resources management, Competing use, Groundwater quality, Groundwater recharge, Groundwater resources, Overdraft, Saline water intrusion, Water demand.

Texas has experienced a gradual decrease in groundwater use in recent years, due in part to new surface water development, various economic factors, and the gradual depletion of some nonrenewable aquifers. However, underground water still accounts for the bulk of water use, and it remains a vitally important resource, especially in arid and semiarid west Texas. Texas courts have adopted the rule that percolating groundwater is the property of the overlying landowner. This doctrine, with only minor modifications, remains in effect today, making Texas unique among the western states in adherence to the strict common law doctrine. Three diverse types of management problems caused by excessive groundwater pumping, each affecting different areas of the state, are: (1) surface subsidence and salt water intrusion; (2) depletion of some nonrenewable aquifers; and (3) reduction of interrelated springflow and streamflow. The first problem pertains primarily to the upper Gulf Coast of Texas, particularly in the area around Houston. The second problem is most generally associated with the extensive Ogallala aquifer of the Texas High Plains. The third problem area is best exemplified by the unique Edwards Limestone aquifer of the Balcones Fault Zone in South Central Texas. This is unquestionably the state's most complex and controversial groundwater problem area, and indications of the future evolution of Texas groundwater law are most apparent here. Since early in this century there have been repeated demands for more stringent groundwater control to prevent overdrafting and encourage conservation. Recently, the pace of regulation has begun to accelerate, as evidenced by several new groundwater management provisions contained in comprehensive water legislation passed in 1985. Still, several areas of Texas are faced with pressing groundwater problems. Their eventual solution will inevitably result in greater regulation, at least for application to these local areas. (See also W91-03032) (Author's abstract)
W91-03053

STATE AND LOCAL GROUND-WATER PROGRAMS RELATED TO WELLHEAD PROTECTION.
Environmental Protection Agency, Washington, DC. Office of Ground-Water Protection.
R. M. Lew, and S. P. Roy.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 8B-3--8B-14, 2 fig, 1 tab, 6 ref.

Descriptors: *Groundwater pollution, *Local governments, *State jurisdiction, *Water quality control, *Wellhead protection, Groundwater recharge, Legislation, Public waters, Water pollution control, Water quality management.

Under the Safe Drinking Water Act (SDWA), Section 1428, each State must prepare a Wellhead Protection (WHP) Program and submit it to EPA by June 19, 1989. The purpose of the program is to protect the recharge areas of public water supplies from sources of contamination. Although not a new concept, development and implementation of State and local activities related to Wellhead Protection are now proliferating across the country. Twenty-one states are currently planning to submit a program by the statutory deadline; others have chosen not to for various reasons including a lack of funding. A comparison of WHP activities and groundwater protection legislation (enacted from 1985 to 1987) in states planning to submit a program by the deadline, versus states not planning to submit, shows greater activity and legislation in states planning to submit a program. Wellhead Protection programs as targeted components of a comprehensive groundwater protection strategy can provide the organization and focus necessary to effectively protect public water supplies. Despite a lack of Federal funds, states and regional agencies, along with local communities, are actively attempting to protect public water supply wells from sources of contamination. (See also W91-03032) (Lantz-PTT)
W91-03070

STATISTICAL-BASED METHODOLOGY FOR PRIORITIZING THE VULNERABILITY OF COMMUNITY GROUND-WATER SUPPLIES TO CONTAMINATION.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W91-03071

NONTRIBUTARY GROUND WATER AS A MUNICIPAL SUPPLY IN THE DENVER METROPOLITAN AREA.
Denver Water Dept., CO.
J. McCurdy, D. Little, and C. Schuyler-Rossie.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 11B-19--11B-28, 2 fig, 1 tab, 6 ref.

Descriptors: *Denver, *Groundwater management, *Legislation, *Municipal water, *Water resources management, *Water supply development, Aquifers, Artificial recharge, Case studies, Regulations, Water supply.

In 1985, the Colorado legislature established a law (Senate Bill No. 5) to regulate the use of nontributary groundwater. Nontributary groundwater is defined by the law as that water which when withdrawn from the ground will not significantly deplete the surface water system within 100 years. The allowed rate of use of the groundwater supply assumes a 100 year aquifer life. The right to appropriate groundwater in nontributary aquifers is tied to overlying land ownership. However, a condition in the law allows municipal entities to appropriate nontributary groundwater in aquifers underlying their boundaries by the implied consent of landowners. Although there is a vast supply of nontributary groundwater available on a regional basis, many Denver municipal entities cannot rely on a finite resource to meet future demands. A case study was conducted in the Denver Metropolitan Water Supply Environmental Impact Analysis to see how nontributary groundwater could be used as a primary source to meet demands of the Denver Metropolitan area from 1985-2035. Sound planning dictates that the use of nontributary groundwater must be pursued in a conservative manner. Innovative methods to extend the useful life of these supplies, such as integrated use and artificial recharge, should be further pursued and thoroughly researched. (See also W91-03032) (Lantz-PTT)
W91-03086

DROUGHT MANAGEMENT PLAN: MANAGING AND PROTECTING A RESOURCE.
Camp, Dresser and McKee, Inc., Austin, TX.
S. L. Mays, C. A. Teinert, P. W. Glass, and T. P. Fox.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 12B-11--12B-25, 4 tab.

Descriptors: *Drought, *Edwards Aquifer, *Groundwater management, *Texas, *Water resources management, Economic aspects, Public health, Public participation, Water conservation, Water deficit, Water demand.

The Edwards Underground Water District (EUWD) was authorized by H.B. 1942 to develop, implement and enforce a drought management plan (DMP) for the Edwards Aquifer within the boundaries of the District. Certain goals and principles developed during a public hearing process were carried into the planning process. Some of these goals were to: protect human health and safety; protect water quality in the Edwards aquifer; share the impacts and hardship caused by drought; minimize economy disruption within the district so that employment and jobs are protected; and prevent Marcos Springs from going dry. Principles set forth were to: provide advance knowledge to the public of how water demands will be reduced during drought; provide for local manage-

ment and implementation of demand reduction measures; provide flexibility to change DMP as new information and alternative or supplemental water resources become available; control the rate of aquifer water levels by monitoring and reducing the volume of water pumped. The drought management plan provides objective numerical criteria for determining that drought conditions exist, how long they continue, and when a drought has ended. There are five stages of drought identified, each with associated trigger conditions and demand reduction goals. The next step for the EUWD is the adoption of these goals and objectives by users in the district. Plans must be submitted by August 1989. (See also W91-03032) (Lantz-PTT)
W91-03089

AQUIFER STORAGE RECOVERY: A NEW WATER SUPPLY ALTERNATIVE.
CH2M Hill, Inc., Gainesville, FL.
R. D. G. Pyne.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 12B-27--12B-31.

Descriptors: *Aquifer Storage Recovery, *Groundwater management, *Groundwater storage, *Water resources management, Alternative planning, Aquifers, Economic aspects, Florida, Groundwater budget, Groundwater quality, Groundwater resources, Saline water intrusion.

Aquifer Storage Recovery (ASR) is a relatively new concept to store potable water in a suitable aquifer during months when supply exceeds demand, and recovery from the same wells to meet peak seasonal, emergency or long-term demands. Eight ASR systems are operational in the US, with either development or testing underway at 14 additional sites in ten states. Florida has four operational ASR facilities and three more in testing or development. Typically all of the water restored is recovered and can be used without retreatment other than disinfection. By typically reducing the capital cost for water facilities expansion by at least 50%, ASR is increasingly being accepted by water utility managers as a desirable component of utility expansion plans. In some applications, an important advantage of ASR is the ability to improve system reliability in areas subject to emergency loss or contamination. In other areas, ASR can be used to prevent salt water intrusion, raise groundwater levels or control subsidence. By shifting the impact of surface water withdrawals from dry periods to wet periods, ASR is recognized as a positive and environmentally desirable water management tool; whether the period is seasonal or long-term. (See also W91-03032) (Author's abstract)
W91-03090

NATURAL RECHARGE OF BASEMENT AQUIFERS IN A SAHEL AND SUDAN CLIMATE: EXPERIMENTAL STUDY IN BURKINA FASO.
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 2F.
W91-03182

ARTIFICIAL RECHARGE OF GROUND WATER: STATE OF ART AND LIMITATIONS.
Central Ground Water Board, Ahmedabad (India).
P. N. Phadtare.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 299-314, 1 tab, 9 ref.

Descriptors: *Artificial recharge, *Developing countries, *Groundwater management, *Groundwater potential, *India, *Water resources development, *Water resources management, Drought, Economic aspects, Geologic control, Groundwater recharge, Management planning, Water quality, Water storage, Water supply development.

Artificial recharge is an important element in water resources management, by replenishing over-exploited aquifers, storing surplus surface water from wet seasons to dry seasons, improvement of water quality of groundwater or reclaimed wastewater, and to check ingress of saline water. Artificial recharge is carried out on a large scale only in a few countries around the world. In India very little has been done thus far in artificial recharge, but the scope for this technology is very large. Artificial recharge is achieved by three methods: spreading (highly permeable surface formations, shallow aquifers, source of water of inferior quality, deep aquifers with permeable or semi-permeable overburden, and source water of very good quality), induced recharge (aquifers with limited storage capacity), and injection (deep aquifers with impervious overburden, and source water of very good quality). A thorough and detailed knowledge of the geological, hydrological, and morphological features of the area are necessary for selecting sites for recharge structures. The cost of construction and cost of operation of the recharge structures, except in the case of injection wells in alluvial areas and tidal regulators, are reasonable in India compared to costs of such experiments in other countries. It has been found that rock formations with moderate permeabilities are most desirable for artificial recharge, which should be carried out only for augmenting domestic water supply as it is not economically viable for irrigation purposes. Drought relief work should be planned in advance and should include construction of new artificial recharge structures, renovation of old ones, and basinal development schemes. (See also W91-03178) (Fish-PTT)
W91-03196

SYSTEMS FOR ARTIFICIAL RECHARGE OF GROUND WATER.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 315-324, 2 fig, 8 ref.

Descriptors: *Artificial recharge, *Groundwater management, *Groundwater recharge, *Water resources development, *Water resources management, *Water supply development, Groundwater potential, Infiltration, Infiltration rate, Injection wells, Permeability, Recharge basins, Water quality, Water storage.

With artificial recharge of groundwater, surface water is infiltrated into the ground for storage in aquifers and eventual recovery from wells. Infiltration and flow to aquifers can be achieved with infiltration facilities on the surface. Such systems require permeable surface soils to obtain adequate infiltration rates, vadose zones without clay or other flow-restricting layers, and unconfined transmissive aquifers. Where these conditions do not exist, or where suitable land is too expensive, artificial recharge of groundwater can be achieved with wells. Recharge or injection wells are similar in construction to pumped wells. Infiltration facilities for groundwater recharge can be classified as in-channel (weirs, dams, levees) or off-channel (basins) systems. Because a number of factors govern the relation between water depth and infiltration rate, the water depth giving maximum infiltration rates must be evaluated by on-site experimentation. Since infiltration basins require permeable soils, identification of permeable soil profiles and site selection are extremely important. Aquifers should be sufficiently transmissive to keep groundwater mounds below the bottom of infiltration basins. Where hydraulic loading rates need to be maximized, infiltration systems should consist of a number of basins. The most important quality standard parameters of the water going into infiltration basins are the total dissolved solids and the sodium adsorption ratio, which control whether clay in the soil is flocculated (more permeable) or dispersed. There are hundreds of successful artificial groundwater recharge projects in the U.S. and in the rest of the world. (See also W91-03178) (Fish-PTT)
W91-03197

NNEPS (NATIONAL NETWORK FOR ENVIRONMENTAL POLICY STUDIES) FINAL REPORT: EPA (ENVIRONMENTAL PROTECTION AGENCY) REGION 1 WELLHEAD PROTECTION EFFORTS.
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5G.
W91-03227

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES.
For primary bibliographic entry see Field 2F.
W91-03311

ROLE OF VERTICAL FLOW IN SEDIMENTARY AQUIFERS.
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-03315

ESTIMATING GEOHYDROLOGIC PARAMETERS FOR GROUNDWATER MANAGEMENT AND LAND SUBSIDENCE CONTROL IN KANTO PLAIN, JAPAN.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-03316

OPTIMAL PUMPING POLICY AND GROUNDWATER BALANCE FOR THE BLUE LAKE AQUIFER INVOLVING NON-LINEAR GROUNDWATER HYDRAULICS.
Indian Inst. of Tech., Bombay. Dept. of Civil Engineering.
A. K. Rastogi.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 545-568, 10 fig, 31 ref, append.

Descriptors: *Aquifers, *Blue Lake Aquifer, *California, *Drawdown, *Groundwater management, *Pumping, *Water resources development, Algorithms, Costs, Hydrologic budget, Mad River, Mathematical models, Optimization, Simulation, Water demand, Water yield.

Blue Lake Aquifer is an unconfined sloping aquifer in northern California overrun by the Mad River, which is regulated by Ruth Reservoir. High pumpage from the existing six wells of a few million gal/day (MGD) causes appreciable drawdown compared to the saturated thickness of the aquifer. Another set of 10 wells has been proposed for meeting an anticipated daily demand of 23 MGD. For this reason, reduction of the governing nonlinear groundwater flow equation into a linear equation was not considered appropriate. An existing explicit scheme was found most suitable for the solution of an inherently nonlinear equation. Many modifications to this existing algorithm were required before a groundwater balance was obtained for the Blue Lake Aquifer. The water management district wanted to minimize the pumping cost for lifting the proposed 23 MGD from 10 wells. This nonlinear optimization problem was solved using the most recent modified embedded approach incorporating the appropriate constraints based on the real system and on the optimization requirements. It was estimated that an annual savings of $20,000 was attainable by implementing the optimal pumping policy, which employed monthly planning periods, compared to a non-optimized policy (i.e., equal pumping of 2.3 MGD from each of 10 wells). (See also W91-03311) (Author's abstract)
W91-03317

NUMERICAL SIMULATION OF GROUNDWATER FLOW IN FUHRBERG FIELD, HANOVER.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-03320

COMPARATIVE MODEL STUDY FOR GROUNDWATER RESOURCES EVALUATION IN KELANTAN, MALAYSIA: PART 1. MODEL EVALUATION.
National Univ. of Malaysia, Bangi.
For primary bibliographic entry see Field 2F.
W91-03322

MODELLING THE EFFECTS OF PROPOSED PUMPING FROM THE TAMBRAPARNI RIVER BASIN, TAMILNADU, INDIA.
V.O.C. Coll., Tuticorin (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-03323

MANAGEMENT OF GROUND WATER RESOURCES IN COMPLEX AQUIFER SYSTEM OF RAJMAHAL TRAPS OF SAHEBGANJ DISTRICT, BIHAR.
S. H. A. Khan, and J. Raja.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 649-660, 1 tab, 4 ref, 2 map.

Descriptors: *Geohydrology, *Groundwater management, *Groundwater potential, *Groundwater resources, *India, *Water resources management, Arid lands, Basalts, Drought, Geologic fractures, Groundwater reservoirs, Groundwater storage, Gumani River, Rajmahal Traps.

The Sahebganj district of Bihar (India) is chronically drought prone, making the development of groundwater resources for assured and continuous water supply an important objective. A hydrogeological survey coupled with exploratory drilling in the Gumani River sub-basin of Sahebganj district revealed that a major part of the area is underlain by Rajmahal trap of upper Gondwana, having a huge thickness of basaltic flow. The Rajmahal traps comprise seven basaltic flows with white clay and chert separating intertrap beds. An attempt has been made to examine the groundwater possibilities in the typical trap country of Sahebganj district. It was shown that the basalts are productive when weathered or fractured. Fracture zones have been delineated both laterally and in depth. The existence of potential fracture zones at 30-35 m and 70-100 m has been established. In general, the Rajmahal traps show vertical to horizontal joints trending east-west and north-south. At places columnar joints also are well developed. These rocks are weathered with characteristic spheroidal exfoliation, which gives rise to large rounded boulders as the outcrop. Tensile fractures, which caused the development of secondary porosity in these otherwise impermeable rocks, provide suitable reservoirs for groundwater storage. The quantitative interpretation of aquifer parameters indicates the presence of a productive fractured zone. The estimated groundwater resource of the Sahebganj district is 241.95 million cubic meters (MCM). Since the net groundwater draft is only about 12.48, a remainder of 228.47 MCM is available for groundwater development. (See also W91-03311) (Rochester-PTT)
W91-03325

GONDWANA ARTESIAN BASIN IN WEST GODAVARI DISTRICT, ANDHRA PRADESH, INDIA.
For primary bibliographic entry see Field 2F.
W91-03327

GROUNDWATER DEVELOPMENT FOR DROUGHT RELIEF IN CHANDRAPUR DISTRICT, MAHARASHTRA.
Central Ground Water Board, Nagpur (India).
For primary bibliographic entry see Field 2F.
W91-03328

INDRAVATI-KOLAB BASINS OF KORAPUT AS POTENTIAL GROUND WATER RESERVOIRS OF THE PURANAS IN ORISSA.
National Environmental Engineering Research Inst., Nagpur (India).
For primary bibliographic entry see Field 2F.
W91-03330

GROUNDWATER MANAGEMENT PLANNING OF ALAPAKKAM AREA, TAMILNADU, INDIA.
Sri Venkateswara Univ., Tirupati (India).
M. Y. A. Baig, and A. Chandrasekhar Rao.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 685-688, 1 fig, 8 ref.

Descriptors: *Geohydrology, *Groundwater management, *India, *Safe yield, *Water resources development, *Water yield, Aquifers, Bay of Bengal, Coastal aquifers, Groundwater barriers, Kazmann method, Pumping, Saline water barriers, Saline water intrusion, South Arcot District, Specific yield, Water table rise, Well yield.

Groundwater conditions have been studied in extensively in part of the South Arcot district, along the coast of the Bay of Bengal, India. A groundwater reserve of about 55,960 ha m was determined for this area. Since the average thickness of the aquifer is 34 m, assuming an average value of specific yield of 0.15, the aquifer has 5100 mm in static storage versus an annual recharge of 269.6 mm. This static storage is about 4 yr total 4 yr total rainfall or 19 yr recharge. The Kazmann method was employed to determine safe yield; it is based on specific yield and the average rise in water table. The safe yield has been calculated as 1.52 cu m/sec, whereas the total withdrawal from the area is around 1.65 cu m/sec. This has resulted in an overdraft from the basin causing sea water intrusion in certain areas. Using the chloride-bicarbonate ratio to evaluate sea water intrusion, a steady increase in ratio from 0.5 to 2.9 over the period 1980-1986 was observed at one of the control wells about 8 km from the coast. At this rate, the entire belt is likely to be contaminated by sea water intrusion if the pumping pattern is not regulated. To control sea water intrusion, a subsurface physical barrier should be erected near the coast. A trench backfilled with compacted silty clay material might serve this purpose. (See also W91-03311) (Rochester-PTT)
W91-03331

GROUND WATER FLOW IN SOUTHERN PART OF KOSI ALLUVIAL FAN AND ITS EFFECT ON WATERLOGGING, WITH POSSIBLE REMEDIAL MEASURES, DISTRICT SAHARSA, BIHAR, INDIA.
Central Ground Water Board, Patna (India).
For primary bibliographic entry see Field 2F.
W91-03332

MEASURES TO OVERCOME THE SALINITY PROBLEMS OF THE COASTAL AREAS IN GUJURAT.
Gujarat Water Resources Dept., Gandhinagar (India).
J. F. Mistry.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 829-840, 2 fig, 2 ref, 2 append.

Descriptors: *Coastal areas, *Groundwater management, *Groundwater recharge, *India, *Saline water intrusion, Check dams, Dissolved solids, Geohydrology, Gujarat state, Gully plugs, Karst hydrology, Limestone, Pit recharge, Recharge wells, Tide gates, Water quality, Water table rise.

Misuse of land and groundwater in the vicinity of the coast in the Saurashtra region of Gujarat state (India) has created an ecological imbalance resulting in sea water intrusion. This has affected the quality of groundwater in about 120 villages. The most heavily affected region lies within a coastal strip of 160 km in length between Una and Madhavpur. About 12,562 wells are no longer usable in this area. The problem is exacerbated by the local geology, a highly cavernous and permeable limestone. Several steps have been taken to manage the problems in this area, including: establishment of committees to identify the problems and propose solutions; institution of salinity control measures (check dams, recharge tanks, recharge wells, and gully plugs); and monitoring of salinity advancement. Due to partial implementation of the mitigation scheme (138 check dams, 2 tidal regulators, 7 bandharas, 5 recharge tanks, 20 recharge wells, and 1516 nala plugs) as well as good rains in the 1988 monsoon, the recharge process in the Una-Madhavpur area has been reactivated. Post-monsoon monitoring of the water table and water quality indicates a rise in the water table and an improvement in water quality. Total dissolved solids of < 2000 ppm are found now in an area of approx 25,000 ha that had higher values prior to May 1988. (See also W91-03311) (Rochester-PTT)
W91-03345

SAFEGUARDS FOR GROUNDWATER POLLUTION IN INDIA.
Malvia Regional Engineering Coll., Jaipur (India).
For primary bibliographic entry see Field 5G.
W91-03346

UNDERGROUND STORAGE OF SURPLUS FLOOD WATERS IN GANGETIC PLAIN.
Tata Inst. of Fundamental Research, Bombay (India).
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 923-929, 5 fig.

Descriptors: *Artificial recharge, *Conjunctive use, *Floods, *Groundwater reservoirs, *Groundwater storage, *India, *Surface-groundwater relations, Drought, Ganges River, Groundwater level, Intermittent streams, Irrigation water, Monsoons, Seasonal distribution.

Generous rainfall during the months of July, August, and September causes floods in the Ganges River basin (India), followed by a shortage of water during dry months. The physiography and topography of the region provide a very limited scope for surface storage. There is some potential for storing surplus runoff in underground reservoirs for use during the dry period. A scheme has been devised in which existing natural reservoirs are emptied and then allowed to fill naturally without any extra engineering. The artificial part of the scheme consists of generating productive consumption by intensive irrigation, for the large quantity of water withdrawn. The emptied reservoir is expected to absorb part of the flood pulse as well. The most promising reservoirs appear to be the sandy aquifers connected with the beds of seasonal streams. Only one site (near Saharanpur) has been investigated so far. About 60 boreholes made to a depth of 50 m have encountered some clay lenses, which are not extensive. A drought in 1987 lowered the water table by 5-6 m in the project area, but floods during the 1988 monsoon restored the groundwater level. (See also W91-03311) (Rochester-PTT)
W91-03356

AUGMENTATION OF WATER RESOURCES IN CANAL COMMANDED AREA.
Roorkee Univ. (India). Water Resources Develop-

ment Training Center.
A. S. Chawla, and S. A. S. Ansari.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 931-943, 9 fig, 9 ref.

Descriptors: *Artificial recharge, *Canals, *Conjunctive use, *Groundwater management, *Hydraulic engineering, *Seepage, *Surface-groundwater relations, *Wells, Groundwater resources, Mathematical models, Optimization, Pumping, Storage coefficient, Well yield.

Optimizing the distance of augmentation wells from canals involves both factors of hydraulics and economics. Optimum distance of wells from a canal and the optimal spacing among wells were determined for the minimum unit cost of net pumped water. The effects of various aquifer and operational parameters were investigated. The average induced seepage from the canal due to pumping from a system of wells placed along the canal increases with decrease in the value of distance from the canal (a) and storage coefficient (S) and with increase in the continuous duration of pumping. The number and spacing of wells do not affect the induced seepage. The optimal distance of wells from the canal and spacing among the wells decrease with decrease in the values of S and increase in continuous pumping duration. The optimum distance of wells from the canal increases with decrease in S, increase in the value of the transmissibility and increase in duration of pumping. The value of the optimal distance from the canal increases with the increase in the value of the coefficient of transmissibility and the value of the optimal spacing between wells increases with the value of the annual pumping hours. However, value of the optimal distance from the canal is not affected by the change in the value of the annual pumping hours. The number of wells does not affect the optimal distance and spacing. Optimal spacing among wells is affected by the discharge of the wells. (See also W91-03311) (Rochester-PTT)
W91-03357

WATER CONSERVATION AND ARTIFICIAL RECHARGE TECHNIQUES IN HARD ROCK AREAS.
Central Ground Water Board, Bhopal (India).
S. Romani, and P. N. Sharma.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 959-968, 5 fig, 1 ref.

Descriptors: *Artificial recharge, *Geohydrology, *Groundwater recharge, *India, *Water conservation, Case studies, Drought, Reservoirs, Runoff, Surface-groundwater relations.

The Jhabua district in Madhya Pradesh (India) presents a situation where barren hard rocks with steep gradients are conducive to heavy runoff of surface water within a short period after rainfall. This drought-prone tribal district was studied and techniques were developed for water conservation and artificial recharge in the hard rock terrain of Jhabua district. Case histories are given here for sites representing lateral recharge (Sarangi), vertical recharge (Dhawarapara), and recharge by submergence (Jameri and Jawania). The technique of artificial recharge of groundwater by creating small surface reservoirs in favorable hydrogeological areas would help achieve optimal utilization of the water resources of the area. The role of hydrogeology in identifying the areas for water conservation and management is often neglected, leading to poor results. Selection and adoption of appropriate methods, as demonstrated in the four case histories, can bring about the best interaction between surface and groundwater in planning water conservation programs. (See also W91-03311) (Rochester-PTT)
W91-03359

POSSIBILITIES OF INDUCED RECHARGE AND DEVELOPMENT OF DEEPER AQUIFERS FOR AUGMENTING WATER SUPPLY TO AMBALA URBAN AREA, HARYANA STATE.
T. G. Firozuddin, G. Suryanarayana, D. S. S. Murthy, and K. V. J. R. Krupanidhi.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 979-988, 5 fig, 2 tab, 4 ref.

Descriptors: *Developing countries, *Groundwater management, *India, *Induced infiltration, *Water supply development, Ambala, Aquifers, Dangri River, Drawdown, Pumping, Urban areas, Well yield.

Concern is mounting regarding the problem of developing adequate water supplies in to the Ambala urban area because the locally available groundwater supplies via tubewells will not be able to meet growing demands. Studies were conducted to delineate the water table aquifer along the riverine tract of the Dangri River (India), the geometry and productivity of the aquifer, its capacity to hold the required amount of water, and possibilities for induced recharge. It is estimated that 2.66 million cubic meters (MCM) could be pumped out of the aquifer during the dry season. A tract along the Dangri River has an average saturated thickness of 14 m, and it is suggested that a well field could be constructed with an average discharge of 726 cu m/day for reach well. The well field should be laid parallel to the river on its western bank at a distance of 100 m from the river, keeping a spacing of 400 m between tubewells of 30 m depth. The corresponding drawdown in the center of the well field has been calculated as 7.77 m. About 10,800 cu m/day of groundwater could be withdrawn in summer to augment water supply in the Ambala urban area. With intensive development, water levels will go down, creating additional storage space for induced infiltration. The estimated induced recharge from the river to the aquifer is about 0.833 MCM during the monsoon season. The possibility also has been considered of developing 7.30 MCM of the deeper aquifers occurring below 150 m as an additional source of water supply. (See also W91-03311) (Rochester-PTT)
W91-03361

INDUCED RECHARGE BY PERCOLATION TANKS IN PARTS OF MAHARASHTRA.
Y. J. Pardhasaradhi.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 989-996, 3 fig, 2 tab, 2 ref.

Descriptors: *Artificial recharge, *Conjunctive use, *Groundwater recharge, *India, *Induced infiltration, *Pit recharge, Agricultural runoff, Aquifers, Developing countries, Evaporation, Maharashtra state, Monsoons, Seepage, Surface-groundwater relations, Watersheds.

Many percolation tanks have been constructed in Maharashtra state (India) by impounding minor water courses. The average catchment area is 3.5 sq km with an average gross storage of 200 thousand cubic meters (TCM). There are about 475 such tanks in the Sina and Man basins, where a representative study was made by selective monitoring of tank levels, contents, groundwater levels in wells, and evaporation rate. Evaporation on average accounts for 10.7% of total depletion of tank contents. An average percolation rate of 45 mm/day was estimated for the post-monsoon period. Some seepage may appear in water courses downstream. Those wells that are influenced by percolation show increased yield to 10-30% when water levels and the time factor are considered. The percolation observed generally was less during the monsoon period and immediately thereafter. This could be due to the saturated condition of the aquifers and the invisible subsurface inflow to the tank from the catchment. Clogging of the pores in the tank by silt and clay, as well as increased evaporation during the dry summer periods diminish the recharge from the percolation tanks from March onward. Selection of percolation tank sites above viable aquifers and regular removal of silt from the tank be before the onset of each monsoon should improve the performance of the percolation tank. Construction of a series of check dams across the stream course represent an alternative to percolation tanks. A drawback to percolation tanks is the temporary submergence of useful land while recharge is occurring. (See also W91-03311) (Rochester-PTT)
W91-03362

ARTIFICIAL GROUND WATER RECHARGE IN DROUGHT PRONE AREAS.
Central Ground Water Board, Hyderabad (India).
K. M. Subrahmanyam, and P. Prakasam.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 997-1004, 3 fig, 3 ref.

Descriptors: *Artificial recharge, *Drought, *Groundwater recharge, *India, *Induced infiltration, Agricultural runoff, Check dams, Groundwater storage, Percolation canals, Pit recharge, Surface-groundwater relations, Watersheds.

Artificial recharge of groundwater has assumed significance in drought-prone areas of Andhra Pradesh (India) during the last decade. Most of these drought-prone areas have limited surface water potential compelling heavy dependence on the groundwater resources to compelling heavy dependence on the groundwater resources to meet various requirements. These areas are mostly underlain by hard rocks, which form shallow aquifers of limited storage capacity. This geology, combined with erratic rainfall, make artificial groundwater recharge imperative in these areas. Construction of percolation tanks has occurred extensively at suitable locations. These tanks are economically viable and are of immense utility in augmenting groundwater resources. Public acceptance of percolation tanks is high, resulting in the demand that many existing minor irrigation tanks be converted to percolation tanks. A series of check dams is another way to substantially augment groundwater recharge while conserving soil and runoff in these watersheds. Recharge through percolation tanks and check dams has proven appropriate for local conditions. Percolation canals also have served well for aquifer recharge under certain conditions. (See also W91-03311) (Rochester-PTT)
W91-03363

HYDRAULIC FRACTURING TEST FOR GROUNDWATER SIMULATION IN A KARSTIC LIMESTONE AQUIFER, HATTINGEN/BADEN-WEURTTENBURG, WEST GERMANY.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
R. Jung, and S. Sankaran.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 1005-1015, 11 fig, 2 tab, 4 ref, 2 append.

Descriptors: *Germany, *Groundwater management, *Groundwater movement, *Hydraulic fracturing, *Karst hydrology, *Simulation, *Well development, *Well yield, Geologic fractures, Hydraulic machinery, Performance evaluation, Transmissivity.

In areas of low-permeability rocks, groundwater is transported mainly through bedding planes, natural joints, and fracture zones. Hydraulic fracturing employs high hydraulic pressure to the walls of

selected zones in a borehole until failure of the surrounding rock occurs. The aim is to increase well yield. Hydraulic fracturing tests were conducted at a depth of about 100 m in a borehole near Hattingen (Germany) in karstic limestone. The injection unit was a pump with a maximum pressure of 300 bars and a maximum flow rate of 400 L/min. Water level measurements made before and after the test showed that it was possible to connect a non-productive borehole in karstic limestone to water-carrying joints by inducing fractures hydraulically. The size of the fracture and the length of the intersection between the induced fracture and the natural joints could be increased after establishing the connection by injecting water with higher flow rates. The maximum pressure required to initiate fractures was 32 bars. A maximum width of 0.55 mm at fracture propagation was achieved with a flow rate of 6.64 L/min. The maximum transmissivity was achieved at 14.2 Darcy Meter. The exponential decay of fluid pressure after shut-in was analyzed to estimate the hydraulic parameters. The estimated residual transmissivity and fracture width were too low. This limited the specific yield to a value too low for large-scale groundwater supply. To achieve higher transmissivity and fracture width, acidifying the fracture or use of gels with or without propping materials are possible solutions. (See also W91-03311) (Author's abstract)
W91-03364

SIMULATION STUDY CONCERNING STIMULATION OF GROUNDWATER BORE WELLS BY HYDRAULIC FRACTURING.
National Geophysical Research Inst., Hyderabad (India).
T. N. Gowd, and M. Govardhan.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 1017-1024, 4 fig, 3 tab, 6 ref.

Descriptors: *Aquifers, *Groundwater management, *Hydraulic fracturing, *Model studies, *Simulation, *Well development, *Well yield, Frac fluids, Groundwater resources, Low-flow augmentation, Stimulation.

Vertical hydrofracture growth in the low-permeability aquifers (permeability 1, 25, 50, 75, or 100 md) was simulated using the Perkins-Kern-Carter two-dimensional hydrofrac model. The results indicate that the frac penetration of 60-100% of the drainage radius (about 235 ft) of groundwater borewells and a frac width of about 10 mm can be achieved by injecting a viscous frac fluid (viscosity = 50 CP) at a rate of 500 L/min for 40 min. Estimates of likely increases in well yield show an increase of 10-16 fold after stimulation. These results provide the theoretical basis for designing hydrofrac stimulation equipment and stimulation procedures. A hydrofrac pump with a discharge rate of 500 L/min at a pressure of 1500 psi should be employed for stimulating water wells by hydraulic fracturing. Gelled water with a viscosity of 50 CP should be used as a frac fluid to achieve desired frac length and frac width and to transport sand proppant into the fracture. Sand of 20-40 mesh size sand should be mixed with frac fluid in such a proportion that a 5-mm thick sand pack could be created in the fracture to achieve the desired relative conductivities. (See also W91-03311) (Rochester-PTT)
W91-03365

RIVER RECHARGE.
Caswell, Eichler and Hill, Inc., West Topsham, VT.
B. Caswell.
Water Well Journal WWJOA9, Vol. 44, No. 11, p 34-37, November 1990. 4 fig.

Descriptors: *Connecticut River, *Groundwater management, *Induced recharge, *Recharge, *Surface-groundwater relations, *Vermont, *Water resources development, *Wellhead protection, Aquifers, Federal jurisdiction, Glacial aquifers, Land use, State jurisdiction, Transmissivity, Water quality.

Important municipal groundwater supply issues today include delineation of Wellhead Protection Areas (WHPAs) and differentiation between 'true' groundwater and groundwater that is influenced by surface water. A Vermont community found itself facing these two issues when it decided to replace its existing municipal well. State regulations required that the community undertake a geohydrologic investigation of its aquifer as an integral part of the proposed new well construction. Delineation of a Wellhead Protection Area using test boring and test pumping information clearly showed that this groundwater source induces significant recharge from the nearby Connecticut River. Using the same information, the brook that is also adjacent to the well site was shown not to be an important source of induced recharge. This brook watershed was not recommended to be included within the Wellhead Protection Area. Because of the high transmissivity of this glacial stream aquifer and its close hydraulic coupling with the Connecticut River, the two zones of the Wellhead Protection Area are small, and thereby, require relatively little land purchase or land-use zoning by the community. Maintenance of good quality river water, however, should be addressed at state and federal levels of government. Even if the upstream Connecticut River basin is included in the Wellhead Protection Area, there is little that one town can do to control development of the large watershed and possible cumulative degradation of river water quality over time. Under current conditions, this riverside aquifer can provide a large volume of high quality groundwater. These conditions should be preserved. (Lantz-PTT)
W91-03390

POTENTIAL FOR AQUIFER COMPACTION, LAND SUBSIDENCE, AND EARTH FISSURES IN AVRA VALLEY, PIMA AND PINAL COUNTIES, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-03670

GROUND WATER RECHARGE: DEMONSTRATION PROGRAM AND POLICY ISSUES.
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 6B.
W91-03718

BIRTH OF A MEGAPROJECT: POLITICAL ECONOMY OF FLOOD CONTROL IN BANGLADESH.
Massachusetts Univ., Amherst. Dept. of Economics.
J. K. Boyce.
Environmental Management EMNGDC, Vol. 14, No. 4, p 419-428, 1990. 2 fig, 43 ref.

Descriptors: *Bangladesh, *Economic aspects, *Flood control, *Political aspects, *Project planning, Decision making, Evaluation, Flooding, Long-term planning, Public participation, Water management.

A major flood control initiative has been launched in Bangladesh under the coordination of The World Bank. The Bank's five year action plan is intended to initiate a long-term investment program, the specifics of which remain to be determined. Long-term proposals under consideration include the construction of massive embankments along the rivers of the Bangladesh delta. The wisdom of such a structural solution to Bangladesh's problems can be questioned on economic, environmental and technical grounds. So far, the supposed beneficiaries of flood control in Bangladesh--the country's poor majority--have been virtually excluded from the decision making process. The World Bank concedes that past embankment projects have been undermined by deliberate cutting of embankments by disgruntled farmers and fishermen, and hence calls for 'closer involvement of the beneficiaries' and 'more cooperation among farmers.' It provides no inkling, however, of how these are to be achieved in a context of military-based rule and a highly inequitable land ownership pattern. In the future, officials of the international agencies and the Bangladesh government will further consider how to treat the 'wounds of nature' in the delta, erecting a long-term strategy upon the foundation of the current five-year plan. (Lantz-PTT)
W91-03873

TATIARA PROCLAIMED REGION, SOUTH-EASTERN SOUTH AUSTRALIA: HYDROGEOLOGICAL INVESTIGATIONS AND GROUNDWATER MANAGEMENT.
South Australian Dept. of Mines and Energy, Adelaide.
F. Stadter, and A. J. Love.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 253-259, 1990. 7 fig, 1 tab, 8 ref.

Descriptors: *Australia, *Groundwater budget, *Groundwater management, *Groundwater mining, *Groundwater recharge, *Water resources management, Geohydrology, Groundwater irrigation, Groundwater quality, Hydrologic budget, Irrigation water, Leaching, Saline groundwater, Salts, Unconfined aquifers.

In 1984 a significant area of the upper southeast of South Australia was proclaimed under the South Australia Water Resources Act, to manage groundwater withdrawals in the region. Following the proclamation of the Tatiara region, geohydrological investigations were undertaken to assess the groundwater availability of the region; groundwater supplies are obtained from an extensive unconfined aquifer. Geohydrological conditions vary significantly throughout the region, with changes in aquifer lithology, depth of water table and groundwater quality. Preliminary groundwater assessments indicate that groundwater use for irrigation purposes in some areas was close to or possibly exceeded acceptable levels of groundwater extraction. Monitoring of groundwater quality has shown increased groundwater salinity in a number of observation wells, particularly in the western part of the region. These increases are mainly due to the localized leaching of salts left in the soil profile following irrigation. An assessment of groundwater resources was made by determining the water balance of several areas within the region, total groundwater availability being the sum of the recharge to the aquifer and the lateral groundwater inflow. In order to maintain the maximum possible groundwater throughflow in these areas, groundwater use should not exceed localized recharge. (Author's abstract)
W91-03899

EVALUATION OF AQUIFER BEHAVIOR AND CHARACTERISTICS IN THE SINGRAULI COALFIELD, CENTRAL INDIA.
Indian School of Mines, Dhanbad. Dept. of Applied Geology.
For primary bibliographic entry see Field 2F.
W91-03914

4C. Effects On Water Of Man's Non-Water Activities

EVALUATION OF FARMING SYSTEMS.
Agricultural Research Service, Lincoln, NE.
J. S. Schepers.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 23-24.

Descriptors: *Agriculture, *Environmental impact, *Farm management, *Nonpoint pollution sources, *Water pollution control, Biological studies, Chemical interactions, Cultivated lands, Cultural control, Economic aspects, Multiobjective planning, Physical control, Research priorities.

Evaluation of farming systems for their impact on the environment goes well beyond the simple consideration of soil erosion and nutrient transport. When developing an evaluation scheme it is meaningful to start by considering generalized concepts and progressing to the level of specificity necessary to address the concern, rather than take existing data and be limited to hit and miss evaluations. As the evaluation becomes more detailed, it usually becomes necessary to involve an increasing number of disciplines. It is rare that scientists ever have the desired level of technical information considered necessary to fully evaluate farming systems. It should be recognized that isolation of factors contributing to a concern or problem usually involves a complex aggregation of biological, chemical, and physical processes. Therefore an integrated and multidisciplinary approach is highly desirable when evaluating farming systems. Types of data needed to evaluate cropping systems are quite diverse, but the environmental considerations must ultimately address the feasibility of modified cultural practices and the economic viability of farming practices. To be successful, evaluation requires time and appropriate funding to assemble a well-trained group of scientists to research farming systems. These research activities should be conducted concurrently with development of decision aids to facilitate technology transfer. (See also W91-02985) (Fish-PTT)
W91-02990

REGIONAL WATER MANAGEMENT AGENCY INVOLVEMENT IN LOCAL GOVERNMENT COMPREHENSIVE PLANNING.
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 6A.
W91-03036

ESTABLISHING VARIABLE WIDTH BUFFER ZONES BASED UPON SITE CHARACTERISTICS AND DEVELOPMENT TYPE.
Dames and Moore, Tallahassee, FL.
For primary bibliographic entry see Field 4D.
W91-03049

ANALYSIS OF WETLAND LOSS IN LAKE GEORGE BASIN USING HISTORICAL AERIAL PHOTOGRAPHY.
State Univ. of New York Coll. at Plattsburgh. Center for Earth and Environmental Science.
For primary bibliographic entry see Field 2H.
W9I-03051

MODELING THE HYDROLOGIC IMPACTS OF PHOSPHATE MINING AND RECLAMATION IN CENTRAL FLORIDA.
Bromwell and Carrier, Inc., Lakeland, FL.
R. M. Powers, P. R. Davis, and M. Ross.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 13A-23--13A-33, 1 tab, 8 ref.

Descriptors: *Environmental effects, *Mine wastes, *Model studies, *Phosphates, *Regulations, Computer models, Florida, Geographic information systems, Groundwater quality, Permits, Research priorities, Water resources management.

In May of 1988, the Florida Institute of Phosphate Research (FIPR) funded a four year research project to develop a computer model that would accurately predict the hydrologic impacts of phosphate mining on surface and groundwater systems. The research project is directed by a Hydrology Advisory Committee, with the goal of developing a user friendly, interactive hydrologic model that will serve as the standard for evaluating future hydrologic permitting activities between the phosphate mining industry and local and state regulatory agencies. The core of the model will be a highly analytical geographic information system (GIS). Selection of the appropriate GIS is critical to the success of the hydrologic modeling project, as it will function as a central database and data exchange medium for the surface and groundwater models. The interactive GIS/hydrologic model will utilize the EPA's Hydrology Simulation Program-Fortran (HSPF) surface water model and the MacDonald-Harbaugh groundwater model (MODFLOW) as the basis for hydrologic analysis. The model will be calibrated, completed, and available for distribution to the user community in May, 1991. (See also W91-03032) (Lantz-PTT)
W91-03082

FISHERY FUNCTIONS AND VALUES OF FORESTED RIPARIAN WETLANDS.
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 2H.
W91-03084

DESERT ENCROACHMENT IN EGYPT'S NILE VALLEY.
Minya Univ. (Egypt). Soil Science Dept.
For primary bibliographic entry see Field 2G.
W91-03120

CONSEQUENCES OF HEAVY MECHANIZATION AND NEW ROTATION ON RUNOFF AND ON LOESSIAL DEGRADATION IN NORTHERN FRANCE.
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
E. J. Roose, and F. X. Masson.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 24-33, 1 fig, 2 tab, 22 ref.

Descriptors: *Agricultural practices, *France, *Loess, *Runoff, *Soil erosion, *Tillage, Agriculture, Organic matter, Regional studies, Soil degradation, Val de Canche.

Erosion problems have increased substantially over the last 10 yr in northern France, prompting farmers to ask for assistance. The effect of mechanization on soil degradation is a widespread problem. It was investigated in the Val de Canche area of France, using three levels of analysis: area administration level, farmer and plot level, and at the regional geographic level using scientific techniques. As problems and solutions seemed clearer, field tests were made with volunteer farmers to evaluate the influence of intermediate crops on soil cover in winter and the effect of excessive tilling on germination and cereal production. Simulated rainfall tests and soil erodibility measurements also were made as part of this program. Investigations made with area administration and local farmers showed that erosion occurred mainly in the zone of loessial plateaus. However, erosion intensity varied with the type of cultivation. Organic matter content was lowest and soils were the most degraded where mechanized cultivation had occurred for the longest period of time, as in the regions of Artois and Cambraisis. The old system of cultivation mixed animal raising with crop raising; the modern approach is to use heavy equipment to plant and harvest various commercial crops. Tests showed that runoff began later and remained lower in places where the old cropping system was in use. A second test showed that the more the topsoil was pulverized by successive vibro-driven and rapid passes of various types of harrows, the higher was runoff and the less likely were cereal seeds to germinate (asphyxia) and push through the sealing crust. (See also W91-03117) (Rochester-PTT)
W91-03121

EFFECTS OF GRAZING AND TRAMPLING ON SOIL DETERIORATION AROUND RECENTLY DRILLED WATER HOLES IN THE SAHELIAN ZONE.
Office de la Recherche Scientifique et Technique Outre-Mer, Abidjan (Ivory Coast).
C. Valentin.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 51-65, 10 fig, 2 tab, 26 ref..

Descriptors: *Livestock, *Sahel, *Senegal, *Soil erosion, *Water holes, Arid lands, Ferlo Region, Grazing, Soil compaction, Soil physical properties, Wells.

As recently as 30 yr ago, a large region in northern Senegal was known as the 'Ferlo Desert' and this area was used by nomadic livestock raisers. Herdsman left the area when ponds dried up, so they were gone 9 months in each year. Since the 1950s, when numerous deep wells were drilled, seasonal migrations declined substantially and year-round stock raising became the rule. A cooperative study was conducted recently focusing on the changes that have occurred; major findings relevant to grazing and trampling around waterholes that degrades soils, namely sealing, soil compaction, and wind and water erosion, are presented. Three representative drilled waterholes were selected for the study, two in sandy areas and one on the cuirassed Ferlo. Heavy trampling and intense grazing around waterholes cause land degradation in the Sahel belt. However, the magnitude of the deterioration depends on the ecological surroundings. On the sandy Ferlo, plant degeneration is not always induced by animal husbandry. Regeneration can occur surprisingly rapidly, provided rainfall returns to normal. In these sand regions, land damage occurs mainly in the form of wind erosion. In contrast, any change that disturbs the frail balance in the cuirassed Ferlo (e.g., drought, enhancement of pastoral practices) leads to the much more extensive destruction associated with accelerated water erosion. Some processes, such as soil crusting, result much more from a combination of natural factors than from any impact of animal husbandry, which is often incorrectly blamed. Some practices, such as limited nomadism during the rainy season, represent a spontaneous answer to the problem of overgrazing around wells. (See also W91-03117) (Rochester-PTT)
W91-03122

EFFECTS OF VARIOUS VEGETATION LAYERS IN AN ACACIA AURICULIFORMIS FOREST PLANTATION ON SURFACE EROSION IN JAVA, INDONESIA.
Agricultural Univ., Wageningen (Netherlands). Dept. of Forest Management.
For primary bibliographic entry see Field 2J.
W91-03124

SOIL EROSION STUDIES IN THE NORTHERN MOUNTAIN RANGE, TRINIDAD, UNDER DIFFERENT CROP AND SOIL MANAGEMENT.
University of the West Indies, St. Augustine (Trinidad and Tobago). Faculty of Agriculture.
F. A. Gumbs, J. I. Lindsay, M. Nasir, and A. Mohammed.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 90-98, 1 fig, 6 tab, 14 ref.

Descriptors: *Slope protection, *Soil conservation, *Soil erosion, *Soil management, *Trinidad, *Vegetation effects, Corn, Cowpea, Farming, Flooding, Nitrogen losses, Runoff, Tillage.

Steep slopes (> 40%) dominate Trinidad's northern mountain range. Farmers practice shifting cultivation. They clean-fell and burn the vegetation before planting at the start of the wet season. Uncontrolled and malicious fires contribute to the exposure of bare soil, accelerated erosion, and a rapid increase in the incidence and severity of flooding. Runoff, soil losses, inorganic N losses in runoff and eroded sediments, and crop yields were studied on experimental plots on Maracas soils (Orthoxic Tropudult (Ultisol) of the isohyperthermic clayey oxidic family). Plots were laid down on slopes of three mean values (11, 22, and 52%). Corn (Zea mays) or cowpea (Vigna unguiculata) were planted, with bare soil and tilled and untilled plots. There was significantly more runoff and inorganic N loss in runoff from bare plots than from cropped plots. The higher concentration of inorganic N in runoff water from bare plots also contributed to the higher N losses per hectare. Runoff did not increase significantly with increased slope from 11 to 22% or from 22 to 52%, but tillage on the 22% slope significantly decreased runoff from the bare soil. Total inorganic N losses in runoff during the rainy season were low (max 6.8 kg/ha on 52% slope). Soil losses from bare,

uncropped plots increased significantly with increased slope from 11 to 22% and 22 to 52%. Tillage on the 22% slope significantly increased soil loss. There was no significant effect of slope or of tillage on maize and cowpea yields on the 22% slope. This was expected because there was no significant difference in soil loss or N loss. The greater runoff and soil loss from bare soil than from cropped soils demonstrates the need to keep soil covered with vegetation. Clean cultivation of maize and cowpea, even on 52% slopes, was enough to reduce soil loss to tolerable levels under the rainfall conditions of 1977. (See also W91-03117) (Rochester-PTT)
W91-03125

QUANTIFYING EROSION-CAUSING PARAMETERS IN A NEW ZEALAND WATERSHED.
South Canterbury Catchment Board and Regional Water Board, Limaru, New Zealand.
For primary bibliographic entry see Field 2J.
W91-03126

CROP YIELD REDUCTION DUE TO REDUCED PLANT AVAILABLE WATER CAUSED BY WATER EROSION.
Technische Univ., Munich (Germany, F.R.). Lehrstuhl fuer Bodenkunde.
H. H. Becher, U. Schwertmann, and H. Sturmer.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 365-373, 1 fig, 1 tab, 16 ref.

Descriptors: *Agricultural watersheds, *Available water, *Crop yield, *Soil erosion, *Soil-water-plant relationships, Contour cropping, Corn, Germany, Loess, Slope effects.

In southern Bavaria (Germany), corn (Zea mays) production has increased from 0 in 1950 to about 30% of the cultivated acreage in 1980. This has led to increased soil erosion because crop canopy cover is sparse in the spring. Water erosion of the loess layer exposes sandy Tertiary sediments on the steeper parts of slopes, leading to considerable reductions in crop yields. An attempt was made to quantify these yield decreases by studying six farmer-operated hill slopes cropped with corn for silage in the years 1978, 1979, and 1980. On each of the slopes, yields of gravelly plots always were much lower than on loessial plots, by 20 to 40% in 1978 and 1979 and by as much as 50% in 1980, the year with normal rainfall (414 mm). Plants were taller on loessial plots in all three years. Ear numbers were somewhat less on gravelly plots and ear weights were substantially less 1.13 kg/sq m versus 1.97 kg/sq m. To reduce soil loss in this area, contour cropping, less corn in the rotation, and planting winter barley in strips 8-10 m apart on the contour simultaneously with corn are recommended. (See also W91-03117) (Rochester-PTT)
W91-03144

SIMPLIFIED SEDIMENT YIELD MODEL FOR SMALL AREA DISTURBANCES ON SURFACE-MINED LANDS.
Simons, Li and Associates, Inc., Fort Collins, CO.
G. K. Cotton, and R. M. Li.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 585-597, 6 fig, 2 tab, 12 ref. Office of Surface Mining Contract J5110061.

Descriptors: *Erosion control, *Hydrologic models, *Model studies, *Sediment control, *Sediment yield, *Soil erosion, *Strip mines, Calculators, Mine runoff, Performance evaluation, SIMSED model, Sediment discharge.

A physical model is more useful than a statistical model for describing the behavior of sediment-control structures than models based on broad regression analysis. Physical models however, are complex and usually require access to a computer. SIMSED is a physically-based model that can be solved with a hand-held calculator. It can be applied over a wide range of soils, covers, and treatment conditions. The mathematical bases for SIMSED are equations for sediment and water continuity, uniform overland flow, and sediment detachment and transport capacity. Four groups of measures and structures are used commonly to control sediment yield from a catchment: (1) surface protection measures, such as mulches, vegetation, and mats; (2) mechanical treatment, such as ripping, pitting, and land surface manipulation; (3) diversion structures, such as terraces; and (4) detention structures. These measure or structures control one or more physical characteristics of the catchment and, therefore, affect sediment detachment or transport capacity. For example, surface protection measures provide ground cover, which absorbs raindrop impact and reduces raindrop-induced soil detachment. These measures increase initial abstraction capacity and infiltration rate of the soil. They also increase overland flow roughness, thereby reducing the level of sediment transport capacity of the overland flow. With information on the amount of ground cover provided by a surface protection measure, the SIMSED procedure can be executed. An eight-step procedure is used to determine the total sediment yield from a small area. Use of SIMSED allows a realistic comparison of sediment control structures. Mechanical treatment increases initial abstraction volume, infiltration, and roughness, but it does not control raindrop detachment. Diversion structures reduce slope length and, therefore, the overland flow discharge, but they do not modify the initial abstraction volume, infiltration, or raindrop detachment. Detention structures provide a location for sediment deposition. The effective design of these structures depends on the particle size and other characteristics of sediment and upon the quantity of sediment reaching the detention area. (See also W91-03117) (Rochester-PTT)
W91-03166

OVERCOMING MYTHS ABOUT SOIL AND WATER IMPACTS OF TROPICAL FOREST LAND USES.
East-West Center, Honolulu, HI.
L. S. Hamilton.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 680-690, 34 ref.

Descriptors: *Deforestation, *Developing countries, *Forest hydrology, *Policy making, *Tropical regions, Afforestation, Climates, Myths, Reforestation, Soil conservation.

In many developing countries forest land use policies are predicated the forest's assumed effects on certain watershed hydrologic characteristics and soil erosion control and sediment reduction benefits. In some cases there is a scientific basis for these assumptions, but others are based on folklore, myth, or misinterpretation of research. Some policies are discussed that have been advocated based on supposedly sound soil or water conservation rationales, but which in fact have little, or even countervailing, scientific support. The issues considered are: cutting reduces rainfall; cutting reduces water supplies; cutting causes floods; shifting agriculture causes erosion and reservoir sedimentation; grassland is better than forests; and reforestation or afforestation is a panacea for water problems. There are many sound reasons for forest conservation and reforestation in the tropical developing countries. Foresters should not condone the use of unsupportable or questionable hydrologic and erosional relationships in this important policy area. (See also W91-03117) (Rochester-PTT)
W91-03173

SECONDARY ECONOMIC IMPACT OF ACID DEPOSITION CONTROL LEGISLATION IN SIX COAL PRODUCING STATES.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5G.
W91-03220

IMPACT: AN EXPERT SYSTEM FOR ENVIRONMENTAL IMPACT ASSESSMENT.
Westinghouse Savannah River Co., Aiken,SC.
For primary bibliographic entry see Field 6G.
W91-03240

REGIONAL ASPECTS OF WETLANDS RESTORATION AND ENHANCEMENT IN THE URBAN WATERFRONT ENVIRONMENT.
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. R. Clark.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 497-515, 9 fig, 1 tab, 24 ref.

Descriptors: *Ecosystems, *Urban watersheds, *Water resources management, *Wetland restoration, *Wetlands, Aquatic productivity, Governmental interrelations, Management planning, Regional planning, Water resources development.

In urban settings, wetland resources are typically degraded and often seriously dysfunctional. Loss of wetland function in this manner reduces the productivity of the larger aquatic ecosystems of which the wetlands are a component. Therefore, in urban settings a high priority must be given to restoration and enhancement of aquatic ecosystems and to their component wetlands. Success in system-wide restoration requires formulation of a regional strategy with goals, objectives, methodologies, and predesignated restoration sites. Such strategies must be locally generated and cannot be substituted by existing one-agency programs. All levels of government and private interests must be involved. Moreover, the existing system of site-by-site permit review must be altered to ensure that permit decisions are oriented toward the regional restoration strategy. It is particularly important to recognize that the developers' resources will be the main source of restoration project funds through voluntary or mitigative restoration and enhancement. Therefore, mitigation has to be given a role at the beginning of the review process and not held until the end as a 'last resort.' (See also W91-03244) (Author's abstract)
W91-03268

WETLAND AND WATERBODY RESTORATION AND CREATION ASSOCIATED WITH MINING.
Pennsylvania State Univ., University Park. Forest Resources Lab.
R. P. Brooks.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 529-548, 3 fig, 93 ref.

Descriptors: *Artificial wetlands, *Management planning, *Mining engineering, *Strip mine lakes, *Water resources management, *Wetland restoration, *Wetlands, Environmental engineering, Habitat restoration, Hydrological regime, Literature review, Water resources development.

Published and unpublished reports are reviewed and the strategies and techniques used to facilitate the establishment of wetlands and waterbodies during mine reclamation are summarized. Although the emphasis is on coal, phosphate, and sand and gravel operations, the methods are relevant to other types of mining and mitigation activities. The following key points should receive attention during planning and mitigation processes: (1) development of site-specific objectives that are related to regional wetland trends; (2) integration of wetland mitigation plans with mining operations and reclamation at the beginning of any project; (3) wetland designs that mimic natural systems and provide flexibility for unforeseen events; (4) ensurance that basin morphometry and control of the hydrologic regime are properly addressed before considering other aspects of a project; and (5) identification of mandatory monitoring as a known cost. Well-designed studies that use comparative approaches (e.g., pre-mining versus post-mining, natural versus restored systems) are needed to increase the database on wetland restoration technology. Meanwhile, regional success criteria for different classes of wetlands need to be developed by consensus agreement among professionals. The rationale for a particular mitigation strategy must have a sound, scientific basis if the needs of mining industries are to be balanced against the necessity of wetland operation. (See also W91-03244) (Author's abstract)

W91-03270

SIMULATION OF REGIONAL HYDRODYNAMICS IN THE NEYVELI AQUIFER.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-03321

DROUGHTS AS MEANS OF DELINEATION OF AREAS PRONE TO SEA WATER INTRUSION.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-03336

GROUNDWATER QUALITY MONITORING: STATISTICAL MODELING.
Kakatiya Inst. of Tech. and Science, Warangal (India).
K. S. V. Basivi Reddy, and M. Pandu Ranga Rao.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 755-759.

Descriptors: *Groundwater quality, *India, *Model studies, *Monitoring, *Water quality, Bicarbonates, Calcium, Chlorides, Dissolved solids, Magnesium, Mathematical models, Potassium, Prediction, Salinity, Sodium, Statistics, Wells.

Water quality obtained from the Warangal (India) urban area was subjected to multiple regression analysis. Fifty-eight wells were monitored for five seasons and each sample was analyzed for 13 parameters. The results of the analysis were used to suggest models for predicting water quality. Overall, it appears that sodium, either independently or in association with potassium, magnesium, calcium, and bicarbonates, determines the total dissolved solids (TDS). Chlorides, either independently or in association with bicarbonates and magnesium, appears to be important contributors to TDS. Using predictive models developed from the regression analysis, the behavior of an indicator of water quality, such as specific conductivity could be predicted as a way of indicating TDS. A single simple test is sufficient for predicting water quality in this area. (See also W91-03311) (Rochester-PTT)
W91-03338

LANDSLIDES IN THE UPPER JORDAN GORGE.
Haifa Univ. (Israel). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W91-03433

SALT MARSH MITIGATION: AN EXAMPLE OF THE PROCESS OF BALANCING MOSQUITO CONTROL, NATURAL RESOURCE, AND DEVELOPMENT INTERESTS.
Indian River Mosquito Control District, Vero Beach, FL.
For primary bibliographic entry see Field 6G.
W91-03441

LAND-USE CHANGES: EFFECT ON WATER QUALITY IN THE PINE CREEK WATERSHED.
Lapeer County Drain Commission, MI.
D. E. Birkle.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 227-234, 1 fig, 3 tab, 5 ref.

Descriptors: *Great Lakes, *Land use, *Nonpoint pollution sources, *Water pollution sources, Water quality management, *Water resources management, *Watershed management, Agricultural runoff, Clean Water Act, Drainage water, Farm wastes, Water quality.

The Pine Creek (Michigan) watershed has 11,542 acres which were used predominantly as farmland until 1965. In 1964, 61 parcels of land were 80 acres or larger and only 43 parcels were 20 acres or smaller. Today only 23 parcels of land remain which are 80 acres or larger. A study under the 208 Program of the Clean Water Act indicated that Pine Creek could be a significant source of nonpoint pollution due to tight soils and high artificial drainage characteristics. Since that time major reconstruction has occurred on 7.1 miles of watercourse and Interstate 69 has transected the watershed. Soil erosion and sedimentation control devices were included. The overall impact of these projects does not seem to have affected the water quality at the point of discharge or in upper portions of the watershed. (See also W91-03672) (Author's abstract)
W91-03697

EFFECTS OF CO 2-INDUCED CLIMATIC CHANGES ON SNOWPACK AND STREAMFLOW.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
K. R. Cooley.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 5, p 511-522, October 1990. 5 fig, 3 tab, 26 ref.

Descriptors: *Climatic changes, *Environmental effects, *Global warming, *Hydrologic models, *Montana, *Precipitation, *Rainfall-runoff relationships, *Snowpack, *Streamflow, Carbon dioxide, Climatology, Mathematical models, Snowmelt, Streamflow forecasting.

Atmospheric concentrations of carbon dioxide (CO2) may double during the next century, causing changes in the Earth's climate. Warming of up to 4 degrees, slight cooling, and 10% changes in precipitation have been projected. The effects of climatic change on streamflow from a snowmelt-dominated basin in southwestern Montana, were investigated. The National Weather Service River Forecast System model was first calibrated using data for the 1973-1984 period. Daily temperature and precipitation values were then changed, and the model run again to assess the effects on snowpack and streamflow of some possible climatic changes. Changing the air temperature by only 2-4 degrees may have a significant impact on the accumulation and melt of a snowpack depending on the original temperature regime of the site. For example, if the normal temperature range is near the threshold temperature that delineates rain from snow, a small change in temperature could change the snowpack considerably. Changes in streamflow are somewhat less than changes in snowpack since some of the snow that is changed to rain upon warming still finds its way to the stream. Results indicate that streamflow may vary by from -22 to +45% depending on the combination of climatic changes imposed. (Hoskin-PTT)
W91-03842

BIODIVERSITY LOSS IN THE TEMPERATE ZONE: DECLINE OF THE NATIVE FISH FAUNA OF CALIFORNIA.
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 6G.
W91-03870

PREDICTION, VALIDATION, MONITORING, AND MITIGATION OF ANTHROPOGENIC EFFECTS UPON NATURAL SYSTEMS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5C.
W91-03871

INTEGRATING FORAGE, WILDLIFE, WATER, AND FISH PROJECTIONS WITH TIMBER PROJECTIONS AT THE REGIONAL LEVEL: A CASE STUDY IN SOUTHERN UNITED STATES.
Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
L. A. Joyce, C. H. Flather, P. A. Flebbe, T. W. Hoekstra, and S. J. Ursic.
Environmental Management EMNGDC, Vol. 14, No. 4, p 489-500, 1990. 2 fig, 3 tab, 49 ref.

Descriptors: *Case studies, *Ecological effects, *Fish populations, *Forestry, *Land use, *Resource management, *Water resources, *Wildlife, Forecasting, Model studies, Public policy.

The impact of timber management and land use change on forage production, turkey and deer abundance, red cockaded woodpecker colonies, water yield and trout abundance was projected as part of a policy study focusing on the southern United States. The multi-resource modeling framework used in this study linked extant timber management and land area policy models with newly developed models for forage, wildlife fish and water. Resource production was integrated through a commonly defined land base that could be geographically partitioned according to individual resource needs. The most basic recommendations for the future are: (1) to make all resource areas equally important in the specification of information for an accurate description of the environmental system under study; and (2) to deal with feedback concepts. The current multiple resource framework only addresses the impacts of land use and timber management on other resources. Modifications of the growth and yield functions based on changes in other resource production levels would initiate an evolution toward an interactive analysis and improve the capability to represent the complexity of multiple resource systems. A related recommendation involves expansion of economic factors affecting land management activities to include the economics of managing forage, water, trout, or wildlife. The economic value of these resources affects the transition of land to other uses and how timber is managed. Currently, the value of these other resources is not considered when analyzing how private landowners allocate their land resources to various uses and intensities of timber management. (Lantz-PTT)
W91-03877

QUANTIFICATION OF HYDROCHLORIC ACID AND PARTICULATE DEPOSITION RESULTING FROM SPACE SHUTTLE LAUNCHES AT JOHN F. KENNEDY SPACE CENTER, FLORIDA, USA.
Bionetics Corp., Cocoa Beach, FL.
For primary bibliographic entry see Field 5B.
W91-03878

EFFECT OF LAND CLEARANCE IN THE MALLEE REGION ON RIVER MURRAY SALINITY AND LAND SALINISATION.
South Australian Dept. of Mines and Energy, Adelaide.
S. R. Barnett.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 205-208, 1990. 8 fig, 2 tab, 7 ref.

Descriptors: *Australia, *Groundwater budget, *Groundwater recharge, *Land clearing, *Land use, *Murray-Darling River Basin, *River basin development, *Saline groundwater, Computer models, Environmental effects, Geohydrology, Groundwater level, Revegetation, Saline water intrusion.

Widespread clearing of native vegetation has dramatically increased recharge in the Mallee region of the River Murray basin in South Australia by up to two orders of magnitude. The resultant rising water tables have caused land salinization problems in low-lying areas and, in the long-term, will increase saline groundwater inflows to the River Murray with a consequent rise in river salinity. Computer modeling suggests that, 50 years after the water table begins responding to the increase in recharge, an increase of 70 electrical conductivity units in river salinity will occur at the town of Morgan, in the northwest sector. Broadscale revegetation in strategic areas adjacent to the river will reduce saline groundwater inflows, and the eco-

nomic and social aspects of this measure should be investigated. (Author's abstract)
W91-03894

IS BROADSCALE REVEGETATION ECONOMIC AND PRACTICAL AS A GROUNDWATER AND SALINITY MANAGEMENT TOOL IN THE MURRAY-DARLING BASIN.
La Trobe Univ., Bundoora (Australia). School of Agriculture.
R.G. Dumsday, R. Pegler, and D. A. Oram.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 209-218, 1990. 69 ref, 2 append.

Descriptors: *Australia, *Forest management, *Land use, *Resource management, *Revegetation, *Saline groundwater, *Saline soils, *Surface-groundwater relations, Economic feasibility, Farming, Forestry, Geohydrology, Groundwater recharge, Murray-Darling River Basin, River basins, Saline water intrusion, Vegetation effects, Water quality.

In the Murray-Darling Basin of South Australia, land degradation has caused an estimated loss of $214.6 million/year. Clearing and the replacement of deep-rooted native vegetation by shallow-rooted annuals have been identified as major causes of increased groundwater recharge and land and water degradation. Improved vegetation management and revegetation of degraded lands will lead to significant improvement in surface water quality. Recharge strategies include reforestation and agroforestry, agronomic and engineering strategies. Current arrangements for marketing commercial timber, setting prices, and levying taxes discourage private tree plantings, as do a lack of labor and management skills, the relative profitability of alternatives, and availability of capital. Though there are apparent benefits from forestry-based activities, which simultaneously control groundwater levels and dryland salinity, farmers need incentives to move to forestry-based systems. Most research predicts a net social gain from reduction in salinity problems, but the importance of water yield has been neglected. Model specification is important to the selection of appropriate land use. Broadscale revegetation using tree-based systems is not economic or practical as a groundwater and salinity management tool, but should be evaluated in terms of local conditions. In addition, vegetation management should be more widely interpreted to include all vegetation which may be used to control groundwater and salinity. (Author's abstract)
W91-03895

4D. Watershed Protection

ESTABLISHING VARIABLE WIDTH BUFFER ZONES BASED UPON SITE CHARACTERISTICS AND DEVELOPMENT TYPE.
Dames and Moore, Tallahassee, FL.
R. R. Potts, and J. L. Bai.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 6A-3--6A-14, 8 fig, 2 tab, 5 ref.

Descriptors: *Buffer zones, *Environmental protection, *Florida, *Land use, *Water management, *Water resources management, Model studies, Runoff, Site selection, Suwannee River, Urbanization, Vegetation.

A technique for establishing variable width buffer zones for land development along the Suwannee River in Florida is described. A minimum buffer zone width of 75 feet was established by the Suwannee River Water Management District, a regional regulatory agency. The amount of additional buffer zone width required at any location along the river was established by use of a model using SCS runoff curve numbers, which account for soil type, natural vegetation, development type, and area of proposed impervious surface. The model generates a series of curves which can be used to easily determine the minimum buffer zone width required for any type of development and site characteristics found along the river. For a given set of pre-existing site conditions the buffer zone width is dictated by the development type. Data for three locations along the Suwannee River are presented as examples. The technique can be easily adapted to other water bodies with a minimum of effort and shows potential as a valuable tool for water resources planning and management. (Author's abstract)
W91-03049

SOIL EROSION AND CONSERVATION.
For primary bibliographic entry see Field 2J.
W91-03117

SOIL CONSERVATION IN INDIA.
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
V. V. Dhruva Narayana, and G. Sastry.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 3-9, 5 tab, 16 ref.

Descriptors: *Agricultural practices, *Erosion control, *India, *Soil conservation, *Soil erosion, *Soil stabilization, Ditches, Doon Valley, Gully erosion, Landslides, Monsoons, Research, Terraces.

In India, about 175 million of the nation's 328 million ha of land are degraded by soil erosion. According to recent estimates, nearly 6,000 million tons of soil are displaced and transported annually; most is lost to the sea. The Central and Soil and Water Conservation Research and Training Institute and its Research Centers have developed various conservation practices, which are described here. Contour terraces and graded terraces are important soil and water conservation measures in areas with up to 600 mm of annual precipitation and high infiltration and permeability rates. As an alternative to contour and graded terraces, conservation ditching was tried in the deep black soils of peninsular India. This practice employs trapezoidal ditches laid out on the contour at the same vertical interval as the contour or graded terraces. Graded trenches or diversions on arable land with 10-16% slopes also reduce runoff and soil losses. Experiments in the Doon Valley showed that about 16% of monsoon rainfall can be harvested from agricultural watersheds treated with drainage-type terraces. Trees have been shown to be beneficial in protecting non-arable land by intercepting rainfall and reducing the energy of raindrops striking the soil surface, thus reducing soil detachment. Special soil erosion problems include ravines (severe gully erosion), which affects an estimated 4 million ha of land, and landslides, which account for an estimated annual loss of 350 million rupees. Measures have been developed for stabilizing gullies and for minimizing the economic damage caused by landslides. (See also W91-03117) (Rochester-PTT)
W91-03118

SOIL AND WATER CONSERVATION PROBLEMS IN THE CENTRAL PLAINS OF VENEZUELA.
Universidad Central de Venezuela, Maracay. Facultad de Agronoma.
I. Pla, A. Florentino, and D. Lobo.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 66-78, 4 fig, 1 tab, 16 ref.

Descriptors: *Crop yield, *Mulches, *Soil conservation, *Venezuela, *Water conservation, Corn, Runoff, Soil moisture deficiency, Soil water, Sorghum.

In the northern Central Plains of Venezuela, rainfed crop production, mainly sorghum and recently corn, has developed during the last 15 yr. The actual cropped area is around 100,000 ha. An attempt was made to measure and distinguish, under natural field conditions, the influence of soil and water conservation on rainfed crop production in a representative soil of the northern Central Plains of Venezuela. Data for three consecutive years (1979-1981), which had different amounts and distribution of rainfall, were related to permanent experimental plots planted to sorghum. From the first harvest, the highest yields were in all cases obtained in treatment A (100% of soil surface covered by asphalt mulch), whereas the lowest yields were obtained with treatment B (bare soil). The treatment with 50% cover of asphalt mulch (A-B) produced a much lower yield than treatment A, but larger than B, especially in the relatively dry 1980 season. Runoff and soil losses were not appreciable in treatment A during the growing seasons of 1979 and 1980. The relatively large soil losses in treatment B in 1979 did not appear to be the primary cause of the observed reduced yield compared with treatment A. Soil moisture deficit, which existed for only a few days in 1979, but occurred during the critical periods for soil water stress (floral initiation, anthesis, and grain filling), appeared to have been long enough to explain most of the yield reduction. Similarly, in 1980, the soil moisture deficit was least in treatment A, greatest in treatment B, and intermediate in treatment A-B. This factor seemed to explain the differences in grain year in 1980. This study demonstrated that soil moisture regime affects yield significantly in these soils and that water conservation measures can have a beneficial effect on yield. (See also W91-03117) (Rochester-PTT)
W91-03123

EFFECTS OF VARIOUS VEGETATION LAYERS IN AN ACACIA AURICULIFORMIS FOREST PLANTATION ON SURFACE EROSION IN JAVA, INDONESIA.
Agricultural Univ., Wageningen (Netherlands). Dept. of Forest Management.
For primary bibliographic entry see Field 2J.
W91-03124

SOIL EROSION STUDIES IN THE NORTHERN MOUNTAIN RANGE, TRINIDAD, UNDER DIFFERENT CROP AND SOIL MANAGEMENT.
University of the West Indies, St. Augustine (Trinidad and Tobago). Faculty of Agriculture.
For primary bibliographic entry see Field 4C.
W91-03125

MODEL FOR QUANTIFYING INCENTIVE PAYMENTS FOR SOIL CONSERVATION IN CROPPING REGIONS SUBJECT TO WATER EROSION.
La Trobe Univ., Bundoora (Australia). School of Agriculture.
R. G. Dumsday, and W. D. Seitz.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 296-306, 2 fig, 4 tab, 10 ref.

Descriptors: *Contracts, *Payment, *Public policy, *Soil conservation, *Soil erosion, Administration, Computer models, Economic aspects, Erosion control, Illinois.

About 50% of the soil conservation practices supported by the United States federal government from 1975 through 1978 were on land that already met 'tolerable' standards of soil conservation. This fact has led to calls for better targeting of funds, accompanied in many cases by mandatory controls over land use and management practices. An attempt was made to develop 'conservation achievement contracts' between governments and landowners. Under these contracts, landowners agree to adopt farming systems that meet the goals of soil and water conservation agencies acting on behalf of society in return for financial compensation, if necessary. The contracts run for 5-10 yr, subject to renegotiation clauses. To quantify the payments to be made under a conservation achievement contract program, a deterministic computer model (SOILEC) was employed; it encompassed the on-site physical and financial consequences of soil erosion. Data from 16 soil types in Illinois were used to test the model and the procedures for establishing conservation achievement contracts. For all locations but one, the marginal costs of erosion reduction increase sharply as soil loss decreases. The one exception is an extreme case in a physical sense, incurring heavy soil losses under all by the most stringent loss minimizing approach

with a net annual revenue of only $42.84 per hectare. The structure and operation of SOILEC should allow the adoption of a system of individual conservation achievement contracts between farmers and governments to achieve social goal of soil and water conservation programs. However, the costs of administering such a scheme have yet to be estimated. (See also W91-03117) (Rochester-PTT)
W91-03140

SOIL AND WATER CONSERVATION IN SEMIARID REGIONS.
Agricultural Research Service, Akron, CO. Central Great Plains Research Station.
B. A. Stewart, P. W. Unger, and O. R. Jones.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 328-337, 4 fig, 13 ref.

Descriptors: *Great Plains, *Semiarid lands, *Soil conservation, *Tillage, *Water conservation, Agricultural runoff, Conservation tillage, Crop yield, Furrow dams, Herbicides, Irrigation, Seasonal distribution, Soil water, Texas, Water use efficiency.

Annual precipitation in semiarid regions of the United States averages 250 to 500 mm. Precipitation in any given year may vary from 200% above to 50% below these average amounts. The most successful way to control erosion in semiarid regions is to develop better water management strategies. Emerging technologies permit more effective water use, reduced erosion, and increased crop yield. Examples cited here are mainly from the Southern Great Plains of the United States, but the concepts apply to many areas of the world where similar conditions exist. Technologies that have increased the efficient use of limited water resources include: (1) management of crop residues as a mulch to increase soil water storage; (2) use of furrow dams to prevent stormwater runoff; and (3) conjunctive use of limited irrigation with inherently unpredictable rainfall. Conservation tillage is not widely used in the Great Plains, accounting for only 7% of the cropland. Studies conducted in Texas have demonstrated that use of stubble mulch tillage resulted in less wind erosion, higher soil water content, and greater wheat yields than with conventional tillage. Use of herbicides to replace tillage affords both erosion protection and better water management, along with producing better yields that compensate for the cost of the herbicides. Furrow dams were first used in the Great Plains in the 1930s. Conservation of runoff with furrow dams can result in large yield increases (for example, 1,660 and 1,210 kg/ha in 1980 and 1981, respectively, in one test at Etter, Texas. The limited-irrigation-dryland (LID) concept is designed to allow more land to be irrigated in years of above-average rainfall. Also, furrow irrigation is used without causing runoff from the field and to prevent runoff of in-season rainfall. Research results to date show that in most years the fields managed under the LID system can successfully retain and use all seasonal rainfall and limited amounts of irrigation water without releasing runoff. In the rare run this could result in substantial improvement in water-use efficiency. (See also W91-03117) (Rochester-PTT)
W91-03141

IMPROVED RAINFED FARMING FOR SEMI-ARID TROPICS: IMPLICATIONS FOR SOIL AND WATER CONSERVATION.
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India). Farming Systems Research Program.
Rathak, S. M. Miranda, and S. A. El-Swaify.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 354, 7 fig, 9 tab, 6 ref.

Descriptors: *India, *Semiarid lands, *Soil conservation, *Tropical regions, *Water conservation, Agricultural watersheds, Alfisols, Dry farming, Economic aspects, Farm equipment, Infiltration, Solutions, Monsoons, Vertisols.

Alfisols and Vertisols are major soil orders found in the semiarid tropics. The International Crops Research Institute for the Semi Arid Tropics (ICRISAT), in Hyderabad, India, has studied a wide range of soil and water conservation and cropping management systems in small, natural watersheds on Vertisols and Alfisols in an area with mean annual rainfall of about 760 mm. Determinations were made of runoff, soil erosion, crop production, rainfall use efficiency, labor use efficiency, and profitability in operational-scale research using both improved and traditional animal-drawn implements. Although Alfisols and Vertisols of the semiarid tropics often occur in close association, there management requirements and hydrologic characteristics are very different. On Vertisols the broadbed and furrow systems effectively controlled soil and water loss while the reverse was true with Alfisols. On Alfisols the raised land configurations (narrow ridge, wavy type bed, and others) that expose the lower soil layer (relatively less pervious) resulted in higher runoff and soil loss compared with the flat, ongrade system. On Vertisols most of the raised land configurations provide well-structured and drained media and are quite stable. Water intake capacity of Vertisols early in the monsoon season is high due to deep cracks and high depression-storage capacity. Micro-cracks have a significant effect on reducing runoff. In contrast, Alfisols have an initially high infiltration rate but are subject to surface sealing early in the rainy season caused by raindrop impact and fine-particle translocations on bare soil. Thus, early cover is more important on Alfisols than Vertisols. Vertisols have a problem of surface drainage. (See also W91-03117) (Rochester-PTT)
W91-03142

CONTROLLING EROSION AND SEDIMENT LOSS ON FURROW-IRRIGATED LAND.
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
D. L. Carter.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 355-364, 5 fig, 3 tab, 8 ref.

Descriptors: *Agricultural practices, *Agricultural runoff, *Erosion control, *Furrow irrigation, *Soil erosion, Cost analysis, Minibasins, Mulching, Runoff control systems, Sediment basins, Sediment discharge, Vegetation effects, Vegetative filters.

During the past 5 yr, considerable research has been directed toward evaluating present practices for reducing erosion and sediment loss on furrow-irrigated land. Currently emphasis is being placed on reducing erosion and sediment loss on individual fields. The erosion control and sediment removal efficiency of five practices (sediment basins, minibasins, vegetative filters, straw in furrows, and buried-pipe runoff control systems) were examined and the advantages and disadvantages of each approach were considered. The buried-pipe runoff control system is the most cost-effective practice evaluated to date. It is the preferred practice in most instances, particularly where convex ends are present. Vegetative filters and minibasins are useful control practices, but both require more intensive management than the buried-pipe runoff control system. The two practices are considerably less costly, however, and thus should be considered as short-term controls. Placing straw in furrows on critical slope areas can be a useful control practice. Sediment basins always will have a place in sediment removal schemes on furrow-irrigated silt-loam soils. They are costly to clean, but their use greatly reduces sediment loss into rivers and streams. Furthermore, when other practices fail, sediment basins are a good back-up control. Applying the practices available to a basin will decrease sediment loss by about 80%. (See also W91-03117) (Rochester-PTT)
W91-03143

EROSION CONTROL IN URBAN RIVER VALLEYS: TORONTO, ONTARIO.
Surrey District, Vancouver (British Columbia).
A. S. Stratton.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 393-398.

Descriptors: *Erosion control, *Management planning, *Ontario, *Urban hydrology, *Urban watersheds, Economic aspects, Government finance, Policy making, Sedimentation, Urbanization.

Rapid urbanization of the Toronto metropolitan area has led to a proportionate increase in erosion problems in Toronto's urban river valleys. The effects of this valley erosion have produced several areas of concern, including danger to dwellings, loss of private property adjacent to valleys, loss of 'active and passive' parklands and associated structures, degradation of ravines and loss of valuable urban space, loss of fertile soil and mature vegetation, and sedimentation. The resulting sedimentation has contributed to reduced capacity of channels, sewers, flood control reservoirs, and other impoundments. It has interfered with navigable waterways and the Toronto harbor, and has affected water quality and fish habitat. Several specific causes of sedimentation and erosion have been identified, including inadequate construction setbacks, fill problems, stormwater management, destruction of vegetation, and inadequate planning and design of structures. The Metropolitan Toronto and Region Conservation Authority devised a management plan that includes a protective component and a preventive component, each with several specific steps for action. To make sure the program is effective, the following are recommended: (1) action must be taken early to be effective; (2) appropriate funding is imperative to correct existing problems, which will increase at a greater rate as the urban population expands; (3) all levels of government must adopt consistent policies, legislation, and bylaws to prevent or control future problems; (4) adequate administration of regulations and bylaws must be ensured; and (5) the public should be made aware of the valley system and the proper use of its invaluable resources. (See also W91-03117) (Rochester-PTT)
W91-03147

QUANTIFICATION OF EROSION CONTROL BY VEGETATION ON PROBLEM SOILS.
Corps of Engineers, Vicksburg, MS.
C. R. Lee, and J. G. Skogerboe.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 437-444, 6 fig, 4 tab, 4 ref.

Descriptors: *Construction sites, *Erosion control, *Rainfall simulators, *Vegetation effects, *Vegetation establishment, Acidic soils, Correlation analysis, Fertilizers, Grasses, Hydrogen ion concentration, Performance evaluation, Soil erosion, Soil water.

Most methods for long-term erosion control on construction sites emphasize establishment of vegetation as soon as possible after construction. However, some soils, such as acid pyritic materials, are difficult to vegetate. Laboratory and field experiments were conducted to quantify the erosion control afforded by vegetation using a rainfall simulator developed at the Waterways Experiment Station. In the laboratory, storm events were simulated on a vegetated soil bed lysimeter to evaluate the influence of plant cover, slope, and soil moisture on surface water quality. The simulator was then taken to the field, where similar storm events were simulated and runoff water quality was measured to verify laboratory results. The simulator is a rotating disk type with two nozzles, each capable of spraying 130 L/min. A slitted disk rotates under each nozzle at 200 rpm, creating a maximum rainfall intensity of 7.4 cm/hr over a 5.57 sq m area. The field plots (15 x 15 m) were established near Corinth, Mississippi, to demonstrated the effectiveness of current techniques for revegetating acid pyritic soil (pH 2.9 initially). Amendments of lime, lime + phosphate, lime + manure, and lime + phosphate + manure were used with weeping lovegrass, bahiagrass, or sericea lespedeza. Raising the soil pH to 5.5 with amendments resulted in good growth of all species. Manure enhanced growth, but manured plots contained large amounts of weeds. A good correlation was demonstrated in the laboratory between increased biomass over the range 0 to > 3000 kg/ha and decreased suspended solids load. A similar rela-

tionship was observed in the field. The good correlation between laboratory and field results means that laboratory procedures can determine the minimum biomass cover required for effective erosion control at a project site and the effectiveness of various plant species can be compared. (See also W91-03117) (Rochester-PTT)
W91-03152

PERCENT CROWN COVER RELATED TO WATER AND SOIL LOSSES IN MOUNTAINOUS FOREST IN THAILAND.
Kasetsart Univ., Bangkok (Thailand). Faculty of Forestry.
For primary bibliographic entry see Field 2J.
W91-03154

IMPACT OF CHECK DAMS ON STEEP MOUNTAIN CHANNELS IN NORTHEASTERN TAIWAN.
Taiwan Forestry Research Inst., Taipei.
C.-M. Liu.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 540-548, 5 fig, 4 tab, 16 ref.

Descriptors: *Channel erosion, *Check dams, *Dam effects, *Erosion control, *Mountain streams, *Sediment control, *Storm runoff, *Taiwan, Channel scour, Channel storage, Sediment discharge, Sediment yield, Slope effects, Typhoons.

Two-thirds of Taiwan is steep mountains. Three or four times each year, Pacific typhoons drench Taiwan with torrential storms. Check dams have been the most common structures for upstream sediment control. Detailed observations were conducted, beginning in 1979, to determine the changes in channel cross-section, channel gradient, and bed-load size composition after check-dam construction and to evaluate the effectiveness of check dams. A detailed survey was performed of the original profiles in streams of three watersheds and bedload particle size composition was analyzed to help understand the influence of check dams on channels. Periodically, selected channel cross-sections downstream from dam sites were surveyed. Accumulated sediment and its depositional pattern behind the check dams were obtained from periodic surveys upstream from dam sites. In the upper reaches of the dam sites, deposited material caused aggradation of the channel, reduced local stream gradient, increased channel width, and changed sediment size distribution. In the lower reaches, channel scouring was accelerated. Sediment yield rates decreased until a dam filled, but downstream scour tended to offset the benefits of storage of deposits. Check dams also might have fostered unforeseen adjustment downstream, possibly destabilizing streambanks and bridge foundations. Check dams can be a stabilizing or destabilizing agent. In recent years, dam construction in upstream channels has become a common tool of sediment control in this area. Results suggest that this tool requires reevaluation. The sediment control effort might benefit from improved understanding of characteristics of stream channels in which mass erosion is the dominant factor of sediment production. (See also W91-03117) (Rochester-PTT)
W91-03161

GULLY SIDEWALL DEVELOPMENT IN NEW SOUTH WALES, AUSTRALIA.
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
For primary bibliographic entry see Field 2J.
W91-03165

SIMPLIFIED SEDIMENT YIELD MODEL FOR SMALL AREA DISTURBANCES ON SURFACE-MINED LANDS.
Simons, Li and Associates, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 4C.
W91-03166

CROP RESIDUE MULCH FOR CONSERVING SOIL IN UPLANDS OF INDONESIA.
Center for Soils Research, Bogor (Indonesia).
Suwardjo, and S. Abujamin.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 607-614, 3 fig, 4 tab, 9 ref.

Descriptors: *Agricultural runoff, *Erosion control, *Indonesia, *Mulching, *Soil conservation, *Tillage, Beans, Cassava, Corn, Fertility, Organic matter, Peanuts, Rice, Soil physical properties.

Land degradation in Indonesia is a serious problem in upland agriculture. In Java, were the supply of new land is very limited, farmers commonly plant steep slopes with annual food crops. Soil productivity decreases rapidly, because most farmers do not use soil conservation practices. Experiments were conducted to determine the effects of residue mulch on erosion, organic matter content, soil physical conditions, and soil productivity. Investigations were carried out at five locations: Citayam (Haplorthox soils), Lampung (Tropudult soils), Putat (Tropudalf soils), Citaman (Tropudalfs), and Punung (Tropudalfs). Bare, mulched, and unmulched plots (22 x 3 m and 22 x 2 m) were studied. The mulch was crop residue, which, except for the first planting, was applied at a rate of about 8-12 t/ha each year. Minimal tillage was used on the mulched plots; unmulched plots were plowed at planting times. Annual food crops, such as upland rice, maize, peanut, cassava, and beans were planted in a rotation system. Mulch and minimum tillage reduced erosion and runoff and improved physical characteristics of the Haplorthoxes and Tropudult soils. The mulch reduced kinetic energy of rainfall and flow rate of runoff. It also helped increase aggregate percentage and crust formation and improve the stability index. The percentages of aeration pores were 18-20 on mulched plots, whereas the soil on unmulched plots was slightly compacted and had aeration percentages of less than 12. The residue encourages biological activity and therefore promotes better soil structure. Organic matter content of the mulched plots was stable, whereas that of the unmulched plots declined. Mulch can reduce maximum soil temperatures by 6-12 C at 5 cm soil depth and 4-6 C at 10 cm soil depth. The present experiments showed that land degradation in uplands of Indonesia is caused mainly by soil erosion and loss of soil organic matter. Crop residue mulch applied at a rate of about 10 t/ha/yr reduced soil loss on slopes up to 15%. The mulch also helped maintain organic matter content, improve soil physical properties, and maintain soil productivity. (See also W91-03117) (Rochester-PTT)
W91-03167

SOIL CONSERVATION AND LAND DEVELOPMENT IN NORTHERN THAILAND.
New South Wales Dept. of Agriculture, Deniliquin (Australia).
D. Marston, C. Anecksamphant, and R. Chirasathaworn.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 634-643, 6 fig, 1 tab, 10 ref.

Descriptors: *Developing countries, *Erosion control, *International agreements, *Soil conservation, *Thailand, Bank erosion, Mulching, Performance evaluation, Silting, Swiddening, Tillage.

The Thai-Australia World Bank Land Development (TAWLD) Project is concerned with the large-scale conversion of uplands in northern Thailand from shifting cultivation to permanent, annual rainfed cropping and some associated woodlot. In the development phase, heavy earthmoving equipment is used to clear the vegetation, which consists mainly of secondary undergrowth. For this project and the Thai-Australia Land Development (TALD) Project, soil conservation measures have been earthwork structures, which have not always provided good control of soil erosion. Current research is aimed at developing appropriate crop management practices for farmers to use in conjunction with earthworks where necessary. The project sites are in the nine provinces of northern Thailand. Three types of soil conservation structures are used in current TAWLD Project areas: graded contour banks (terraces), level (absorption) banks, and gully control structures (check dams). Although research on the effectiveness of these and other techniques is not sufficient for definite conclusions, some useful information has emerged. For example, it has been demonstrated that substantial erosion control benefits can be obtained from stubble mulching and no-tillage compared with conventional clean cultivation. Modified broadbed-and-furrow systems, in contrast, did not show any substantial benefits. Excessive interbank erosion, channel siltation, and bank failures are continual problems in many years because of land clearing methods, lack of farmer education in the use of conservation management practices, and administrative constraints that prevent the use of appropriate soil conservation measures on steeper slopes above or within project areas. The traditional farming practice of swiddening evolved to allow for periodic build-up of nutrients, organic matter, and soil structure. Annual cropping systems must consider these aspects through appropriate crop management. (See also W91-03117) (Rochester-PTT)
W91-03169

CROP GEOMETRY: A NONMONETARY INPUT FOR REDUCING EROSION IN CORN ON FOUR PERCENT SLOPE.
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
S. P. Bhardwaj, M. L. Khybri, S. Ram, and S. N. Prasad.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 644-648, 3 fig, 1 tab, 5 ref.

Descriptors: *Agricultural watersheds, *Corn, *Erosion control, *India, *Plant spacing, Crop geometry, Crop yield, Doon Valley, Planting management, Slope effects, Storm runoff, Vegetation effects.

In northern India's Doon Valley and the adjoining hilly region of Outer Himalaya, corn is an important crop and erosion is a serious problem. The rainy season brings heavy downpours and the sloping, silty soils are highly erodible. A study was conducted to determine how increasing the distance between rows and decreasing the distance between plants would affect erosion and runoff. Plant population was kept constant. Eight runoff plots of 100 x 20 m were each equipped with a stage-level recorder, H flume, and Coshocton silt sampler for measurement of runoff and soil loss. Four sets of plantings were used: 45 x 40 cm, 60 x 30 cm, 75 x 24 cm, and 90 x 20 cm (between x within rows, respectively). Corn was rain fed and fertilized. Treatment plots with the widest interrow spacing (90 cm) and closest intrarow spacing (20 cm) had the lowest average annual runoff and soil loss in each of the three years of the study. Grain yield differences among the four treatments did not appear significant. Wider row spacing may permit easier and faster sowing and cultural operations and may increase the potential for intercropping. (See also W91-03117) (Rochester-PTT)
W91-03170

CONSERVATION TILLAGE: AN IMPORTANT, ADAPTABLE TOOL FOR SOIL AND WATER CONSERVATION.
Soil Conservation Service, Washington, DC.
G. M. Darby.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 649-653, 1 tab, 17 ref.

Descriptors: *Agricultural practices, *Agricultural runoff, *Conservation tillage, *Erosion control, *Mulches, Herbicides, Rill erosion, Sheet erosion, Tillage, Wind erosion.

Conservation tillage is a system of tillage that leaves protective amounts of crop residue on the soil surface during periods when growing crops do not provide cover and when erosive rains, runoff, snowmelt, or winds normally occur. The major types of conservation tillage systems are no-till, strip tillage, or till-planting, stubble mulching, and chemical fallow or ecofallow. No-till involves

planting with a special planter equipped with residue-cutting coulters. Normally, no other soil disturbance occurs. Weeds are controlled with herbicides instead of tillage. In strip tillage, till-planters sweep some residue aside and prepare narrow seedbed strips, sometimes on raised ridges of soil, free of crop residue. No more than one-third of the surface is disturbed. This system leaves more bare soil than no-till, but prevents excessive erosion when farming operations are on the contour. Stubble mulch tillage is a system that uses chisel and sweep-type implements for seedbed preparation and weed control. Protective amounts of crop residue are left on the surface. Weeds are controlled solely through tillage. Chemical and ecofallow is a system of fallow that relies on herbicides rather than on tillage. It is used in subhumid and semiarid zones. Conservation tillage is an effective way of controlling wind erosion and reducing rill and interrill erosion. On some land, this agronomic practice alone will control soil erosion. Farmers and researchers are developing conservation tillage technologies that can be used on different soils and in different climates. For example, strip tillage in Indiana may be suitable for fine-textured, poorly drained soils if residue-free strips on low ridges are used. The ridges aid drainage and the warming and drying of the soil in spring. (See also W91-03117) (Rochester-PTT)
W91-03171

PROGRAM APPROACH TO SOIL CONSERVATION.
Victoria Soil Conservation Authority, Kew (Australia).
D. N. Cahill.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 674-679, 1 tab.

Descriptors: *Developing countries, *Erosion control, *India, *Policy making, *Soil conservation, Watershed management, Management planning, National soil conservation policy, Public policy, Social aspects, Soil conservation programs.

A national soil conservation policy, to be effective, must be based on a perspective of a nation's problems. Three essential ingredients of soil conservation are finance, technology, and a strategy of approach. In developing countries, soil conservation needs often are widespread and thus demand a nationwide solution. This means that projects that work successfully for a limited area may not be valid because resources do not exist to expand them country-wide. By long association, watershed management has become indistinguishable from its common means of implementation, the watershed management project. While the soundness of the watershed concept cannot be questioned, the project approach exacts certain penalties, including: projects are slow on a catchment-by-catchment basis; projects are expensive; projects present complex extension message when the need is for extension recipes; and projects discriminate against the more marginal elements of the economy. The ample answer to these problems is for the recipient aid to define what he wants. He needs a policy framework against which to view proposed investments in their true, national perspective. There are two ways to establish this framework: (1) intuitive-which often produces inadequate results, and (2) by analysis of the facts of the situation to establish a logical basis for action programs. Such an exercise was conducted for India. The analysis indicates the need for a program of vegetation measures of low per-hectare cost carried out over a broad area, with companion projects for reducing social constraints. The current approach, in contrast, consists almost exclusively of projects that are characterized by an intensive and wide use of works carried out in limited areas in a hurried time at a high per-hectare cost with no provision for social back-up. National soil conservation policy must be based on perspective and a recognition of scale. The project approach, by focusing on a limited area, diverts attention from the broad, national view. The program approach, based on an analysis of the overall situation, encompasses a perspective of the whole system. (See also W91-03117) (Rochester-PTT)
W91-03172

RESEARCH STRATEGY FOR ASSESSING THE EFFECT OF EROSION ON FUTURE SOIL PRODUCTIVITY IN THE UNITED STATES.
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
K. G. Renard, and R. F. Follett.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 691-702, 15 ref.

Descriptors: *Public policy, *Research priorities, *Soil and Water Resources Conservation A, *Soil conservation, *Soil erosion, Erosion-Productivity Impact Calculator M, Management planning, Model studies, Performance evaluation, Tillage.

The 1977 Soil and Water Resources Conservation Act (commonly known as RCA) directs the Secretary of Agriculture to make periodic appraisals of soil, water, and related resources and their conservation on agricultural lands, and to make informed, long-range policy decisions regarding the use and protection of these resources. A linear programming model has been instituted for determining the best national management policies. However, several additional areas of research need exist, including: erosion-productivity research, soil erosion-soil productivity modeling, erosion/productivity experimentation, studies of water and wind erosion mechanics, and research on conservation tillage (in the areas of regional or local autonomy, a unifying concept to guide tillage research, and a multidisciplinary research approach). The research needed to quantify soil erosion-soil productivity relationships has been formulated to provide a national perspective for the problem. Some facets of the new research already are under way; others are being planned or require availability of new resources. The EPIC (Erosion-Productivity Impact Calculator) model, which is in its final phase of testing, will permit significant improvement in projections for the 1985 RCA report over those in the 1980 report. (See also W91-03117) (Rochester-PTT)
W91-03174

SOIL EROSION AND ITS CONTROL IN DEVELOPING COUNTRIES.
Food and Agriculture Organization of the United Nations, Rome (Italy).
F. W. Hauck.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 718-728, 5 ref.

Descriptors: *Agriculture, *Developing countries, *Erosion control, *Soil erosion, *World Soil Charter, Food and Agriculture Organization, Future planning, Management planning, Policy making, United Nations.

Despite major technological advances in agricultural production, millions of people in the world still starve or do not have enough to eat. Among the causes of this paradox is the rate at which the productive capacity of land and the quantity and quality of water resources have been or are still being reduced or destroyed by soil erosion and other forms of land degradation. Projections of future population growth suggest that by the time the world comes reasonably close to population stability, the demand for food and agricultural products could be three times its present level. Sufficient land resources to meet this need appear to be available if all cultivable land is used in an optimum way and there is unrestricted movement of produce. However, a major problem is that large areas of the world's agricultural land is being degraded by severe soil erosion and other problems. Historically, between 5 and 7 million ha of land have been lost annually through soil degradation, necessitating bringing into production an additional 200 million ha just to compensate for losses of productive land a current rates. The World Soil Charter, which was adopted by the 21st annual conference of the United Nations Food and Agriculture Organization in 1981, outlines a number of principles and guidelines that should provide the necessary framework for sound policy decisions and the development of national programs that will lead to the rational use of land resources and the control of soil degradation. In FAO's view, stopping or reversing the land degradation process is matter of the utmost urgency. The immediate task is to increase awareness among governments, policy makers, planners, and farmers of the problems and consequences of soil erosion. (See also W91-03117) (Rochester-PTT)
W91-03175

CITANDUY PROJECT IN JAVA: TOWARD A NEW APPROACH TO WATERSHED STABILIZATION AND DEVELOPMENT.
Agency for International Development, Karachi (Pakistan).
E. M. Barrau, and K. Djati.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 729-739.

Descriptors: *Agricultural runoff, *Dry farming, *Erosion control, *Indonesia, *Irrigation, *Soil erosion, *Watershed protection, Citanduy Project, Economic aspects, Extension programs, Social aspects, Terraces.

Watersheds of Java, Bali, and Madura (Indonesia) support dense populations (e.g., 600-1000 persons/sq km in Java, with less than 25% of the land under forest or other permanent cover). Several factors contribute to high rates of erosion and an agricultural situation that is not conducive to alleviating the erosion problem. These include: runoff from dryland farms, lack of water for irrigation of terraces, poor economic conditions at the farm level, limited sources of seed and credit, limitations on scope of technology transfer programs, limited research programs, unprofitability of conservation efforts due to existing low productivity of dryland farms, and inadequacy of extension efforts. Grass and forage programs have the potential to help control erosion, but availability of suitable species is limited and knowledge about their proper management has been slow to spread among farmers. The Citanduy II project covers two watersheds, the Citanduy (350,000 ha) and the Segara Anakan (96,000 ha). The project has three main components: (1) upper watershed development to provide a package of upland conservation and production technology to upland farmers, (2) development of irrigation systems to rehabilitate upper Citanduy irrigation systems and their management, and (3) local development planning and management to help district government personnel. The objective of the watershed stabilization and development program is not just to build bench terraces on the hillsides, but to prove to the dryland farmers that with the proper techniques and additional resources (high-yielding seeds, fertilizers, forage, and livestock) their dryland bench terraces can be as productive as their irrigated bench terraces. Only then will the farmers build and maintain dryland terraces as well as irrigated terraces. Achieving this result depends on the ability of the government to make readily available the supplies and other necessary resources and to deliver, disseminate, and coordinate these resources. (See also W91-03117) (Rochester-PTT)
W91-03176

ECOSYSTEM APPROACH TO SOIL CONSERVATION.
Bern Univ. (Switzerland). Geographisches Inst.
H. Hurni.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 759-771, 6 fig, 2 tab, 20 ref.

Descriptors: *Ecosystems, *Erosion control, *Public policy, *Social aspects, *Soil conservation, *Watershed management, Case studies, Ethiopia, Geoecosystem approach, Mountains, Nepal, Thailand.

Although the reasons for soil erosion are relatively clear (population growth, deforestation, and the resulting changes in land use), programs designed to solve these problems frequently fail because conservation programs and land use plans fail to spread from a pilot project area to its surrounding area. Success often comes because bottlenecks (hindrances to the conservation process) are de-

tected and bypassed. A systematic guide is presented here for detecting such bottlenecks. The approach was developed from findings of the recently launched UNESCO Man and the Biosphere programs. A geoecosystem approach to soil conservation consists of recognizing the elements in each of four complexes, the natural complex, the land use complex, the human complex, and the external complex, and then determining all possible relations among the complexes. For identified negative processes causing damage, natural and technological mitigating processes should be identified. The use of the geoecosystem approach can be seen in analyses of three case studies: the Ethiopian highlands, the Nepalese middle mountains, and the northern Thai mountains. For each case, natural conditions, land use, man's role, and interrelations have been identified. Bottlenecks blocking conservation progress are apparent for each case. Examples of bottlenecks include: low recognition of the problem among peasants and lack of training in terracing techniques (Ethiopia), lack of cooperation among ethnic groups and almost uncontrollable high natural erosion rates (Nepal), and immigration-induced changes in traditional land use systems (Thailand). Through an integrated, geoecosystem approach, the factors and relations revealing bottlenecks in soil conservation can be assessed qualitatively, sometimes subjectively or quantitatively. The approach also can be used to find methods of by-passing individual problems. (See also W91-03117) (Rochester-PTT)
W91-03177

SEDIMENT CONTROL BY SUBMERGED VANES: DESIGN BASIS.
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2J.
W91-03208

SCUDDER'S POND RESTORATION PROJECT FOR VILLAGE OF SEA CLIFF AND TOWN OF OYSTER BAY, NASSAU COUNTY, NEW YORK.
Envirodyne Engineers, Inc., New York.
For primary bibliographic entry see Field 5G.
W91-03218

CONTROLLING SOIL EROSION IN THE ILLINOIS RIVER BASIN.
Illinois Dept. of Agriculture, Springfield. Div. of Natural Resources.
R. W. Nichols.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 28-35, 2 tab, 1 ref.

Descriptors: *Erosion control, *Illinois, *Illinois River Basin, *Management planning, *Resources management, *Soil erosion, Erosion, Illinois River, Land use, Sedimentation, Water conservation.

The Illinois River Basin encompasses nineteen subbasin areas containing a combined total of 15,646,100 acres. Soil erosion and deposition of sediment into surface waters is a natural process that has been accelerated by land altering changes brought about by man. Intensive agriculture, land clearing, urban construction, drainage of wetlands, levee construction and alteration of stream segments in the Illinois River drainage basin have significantly increased the rate of erosion and the amount of sediment entering stream tributaries, the Illinois River and its backwater lakes and sloughs. Soil and Water Conservation Districts (SWCDs) have intensified their efforts to protect erosion prone lands. As a part of their efforts, each of the state's 98 SWCDs undertook the task of identifying the status of the resource base within their respective boundaries. Six districts surrounding Peoria Lake were selected for a demonstration project involving protection of the resource base through the application of standard soil conservation practice while at the same time implementing nontraditional/innovative techniques for controlling the flow of sediment into the lake as well as stabilizing the streams that are importing that sediment. The success of the demonstration project will depend on the interest and desires of those affected. Accordingly, the following recommendations are provided for consideration: utilize the existing technical, financial, and educational assistance mechanisms; organize local resource planning committees in each small hydrologic unit within the larger river basin; concentrate soil conservation efforts in the watershed areas above and surrounding Peoria Lake; give highest priority for erosion control to steep slopes and areas with excessive streambank erosion; encourage the use of federal Conservation Reserve Practices (CRP) such as tree planting, establishing permanent vegetative cover, and filter strips on highly-erodible ground; expand streambank stabilization projects on tributaries; encourage voluntary soil conservation practices by landowners, and; designate the Illinois River Soil Conservation Task Force as the local organization for coordination of resource planning. (See also W91-03608) (Lantz-PTT)
W91-03611

ILLINOIS RIVER AND PEORIA LAKES: IT'S TIME TO ACT.
Caterpillar Tractor Co., Peoria, IL.
For primary bibliographic entry see Field 6A.
W91-03621

ILLINOIS RIVER SOIL CONSERVATION TASK FORCE.
D. Condit.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 106-109.

Descriptors: *Erosion control, *Illinois, *Illinois River, *Project planning, *Resources management, *Soil conservation, Economic aspects, Environmental protection, Institutions, Public policy, Soil erosion, State jurisdiction.

The Illinois River Soil Conservation Task Force (IRSCTF) was formed in June 1985. This not for profit 501C3 Corporation was made up of elected Soil and Water Conservation District directors from 7 soil and water districts, as well as agency, industry and organizational advisors. The Task Force operates on grant monies; the project coordinators and construction supervisors are self-employed consultants to the Task Force. Project Chance people are used for the labor force. As the Task Force completes its fourth project this fall, with the low-cost stabilization of gullies and streambanks, their desire would be to have landowners become involved in their projects. As an action group, the Task Force has the districts working together to build support for a combined local, state and federal effort aimed at reducing farmland erosion to the lowest practical levels. (See W91-03608) (Lantz-PTT)
W91-03622

STREAM BANK STABILIZATION AND THE ILLINOIS RIVER SOIL CONSERVATION TASK FORCE.
Illinois River Soil Conservation Task Force, Eureka, IL.
D. Condit.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 110-132, 12 fig, 3 tab, append.

Descriptors: *Bank protection, *Illinois, *Illinois River Basin, *Institutions, *Resources management, *Soil conservation, *Stream banks, Conservation, Illinois River, Local governments, Peoria Lake, State jurisdiction, Watershed management.

The Illinois River Soil Conservation Task Force provides an action program to stimulate, accelerate and implement conservation practices on the Illinois River watershed. In June 1985, the task force was formally organized by seven Soil and Water Conservation Districts from watersheds along the Peoria Pool segment of the Illinois River. This action group is working together to build support for a combined local, federal and state effort, which will reduce farmland erosion to the lowest practical level. The Task Force supports traditionally funded erosion control practices as conservation tillage and terraces. The task force also supports the development and funding of alternative erosion control methods such as low cost streambank and ravine stabilization practices. The Task Force supports alternative erosion practices where massive streambank or gully erosion sites are transporting high percentages of such farmland erosion to Peoria Lake. Streambank stabilization practices were applied first near Galesburg by the Department of Conservation. The Galesburg Watershed had demonstrated the high sediment yields resulting from streambank erosion. With ENR funding and technical assistance from the Soil Conservation Service, the Task Force has applied the vegetative stream stabilization techniques at additional field conservation trial sites on Richland, Senachawine, and Partridge Creeks, which flow into Peoria Lake. Labor for application of conservation practices was volunteers from the Project Change program of the Illinois Department of Public Aid. Over 20 of the volunteers have found employment after demonstrating and ability to work under difficult conditions. (See also W91-03608) (Lantz-PTT)
W91-03623

SEDIMENT MANAGEMENT.
Illinois Univ., Urbana. Water Resources Center.
G. Stout.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 147-149.

Descriptors: *Illinois, *Organic matter, *Resources management, *Sediment load, Agriculture, Crop production, Crop yield, Economic aspects, Fertilizers, Land use, Waste disposal.

The concept of sediment as a potential resource is examined. The organic rich material may be used to rebuild soil or add depth to existing farm land, enhancing agricultural production. Sediment may also be used to build roads, for landscaping, or as a soil enrichment for lawns. In the late 1970s, a quantitative demonstration project was executed by the Water Resource Center and the University of Illinois Agricultural Engineering Department at Lake Paradise; 2100 cu yds of sediment were pumped one mile from the lake to a site which was considered typical of the watershed near the lake. Lagoons were built to collect three feet of sediment with a subsurface drainage system. The land was leveled off the next year and returned to crop production. Corn yields exceeded 25% from previous years. Test plots showed that 18 inches of sediment increased yields by 40%. The study showed that while returns from corn production was low based on 1982 prices, there was a predicted $100/acre increase in returns for the test plots with 18 inch sediment treatments compared to the zero sediment treatment. The predicted increase was due to the increased yields and the lower fertilizer requirements of the test plots. (See also W91-03608) (Lantz-PTT)
W91-03627

EROSION CONTROL IN THE ILLINOIS RIVER BASIN PAST, PRESENT, AND FUTURE.
Soil Conservation Service, Champaign, IL.
G. N. Parker.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 168-170.

Descriptors: *Erosion control, *Illinois, *Illinois River Basin, *Soil conservation, Agriculture,

Cropping, Erosion, Forests, Illinois River, Land use, Management planning, Peoria Lakes, Public participation, Resources management, Soil erosion, Tillage, Urbanization.

The Soil Conservation Service recently completed a River Basin Study of the Illinois River from Peoria to Lasalle. Of the approximately 1 million acres in this drainage area, 87.5% are cropland, 10% are woodland, and the remaining acres are pastureland and various urban land uses. Approximately 55% of the croplands' erosion rates are < 5 tons/acre/year. That leaves 400,000 acres of cropland eroding at rates in excess of 5 tons/acre/year. 1300 landowners install conservation practices on 160,000 acres annually, reducing erosion by 750,000 tons. At this rate all of the cropland will be treated within 5 years. Since erosion control programs have been on-going for many years, there should be dramatic reductions seen in sediment rates. Erosion control programs need to be targeted to the most critical subwatersheds in order to achieve significant reductions in sediment delivery. An effective sediment reduction program must include both a sediment trapping element, as well as an erosion reduction element. Some suggestions for future land treatment programs in the Peoria Lake Basin are: (1) Concentrate soil conservation efforts in the watershed areas above the surrounding Peoria Lakes; (2) Actively encourage and promote the adoption of cropping systems which reduce tillage and increase crop residues; (3) In priority watersheds, employ large sediment basins and man-made wetlands to trap sediment before it reaches the Lake; (4) Utilize a coordinated, multi-county approach to target efforts at the most critical sites; (5) Erosion control on some steeper cropland adjacent to streams and near the lake can only be achieved economically by removing that land from production and establishing permanent cover; and (6) Organize citizen-based steering committees in each subwater shed to develop an action plan specific to each subwatershed. (See also W91-03608) (Lantz-PTT)
W91-03630

LAND HUSBANDRY: A FRAMEWORK FOR SOIL AND WATER CONSERVATION.
T. F. Shaxson, N. W. Hudson, D. W. Sanders, E. Roose, and W. C. Moldenhauer.
Available from the Soil and Water Conservation Society, Ankeny, Iowa. Price: $12.00. 1989. 60p, 20 fig, 2 tab.

Descriptors: *Developing countries, *Erosion control, *Land management, *Soil erosion, *Water conservation, Agriculture, Cropping, Erosion, Farming, Runoff, Social aspects, Soil conservation.

Where steep slopes must be farmed for food, feed, or fiber production, soil erosion results in both on-site and off-site impacts. There are many cases where all of the productive soil has washed from fields or where expensive reservoirs have filled rapidly with sediment. These erosion problems continue in spite of expensive control programs and interventions. While recognizing the fact that the supplementary need for structural measures must not be forgotten or underrated, it is much more effective to develop a plan or strategy for increased production and efficiency with the farmer, using structural measures, if necessary, to complement an effective system of land husbandry. Better management of crops, pastures, forests, and soil retains more water for productive use by plants and for maintaining streamflow. Lowering raindrop splash and runoff reduces the amount of soil that is dislocated and transported away from where it is needed--around plant roots. To achieve effective soil and water conservation through proper land husbandry, three basic ideas are important: (1) farmers--it is imperative to identify, engage, develop, and encourage the enthusiasm of individual farmers and communities in plant production activities; (2) husbandry--the more fragile and erosion-prone an area is, the more urgent it is to give attention to producing, improving, and maintaining dense and long-lasting soil cover with useful plants and their residues; and (3) runoff--it flowing runoff is unavoidable, arrange for its safe disposal without causing erosion damage. While is appeared that a publication was justified to elaborate these principles, it was also decided that this publication must be broad enough to apply worldwide but not so general as to be of little use. Therefore, this publication is meant to provide a framework into which site-specific technical details can be fitted. (Lantz-PTT)
W91-03652

IMPACT OF RISK AND PLANNING HORIZONS ON THE SELECTION OF SOIL CONSERVATION MANAGEMENT SYSTEMS.
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
R. R. Venkataraman, and G. V. Johnson.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 107-116, 4 tab, 8 ref.

Descriptors: *Environmental policy, *Model studies, *Nonpoint pollution sources, *Planning, *Risks, *Soil conservation, *Soil management, *Water resources management, Agriculture, Computer models, Crop production, Illinois, Management planning, Soil erosion, Water quality control, Water quality management.

Soil conservation issues resurfaced in the U.S. during the 1970s when crop acreage expanded by more than 120 percent to meet a 132 percent rise in agricultural exports. This large, rapid expansion in cropland acreage generated concern that an increase in soil erosion might impair the nation's long term food producing capability. Accelerated soil erosion exerts a great influence on productivity, and it detrimentally affects water quality in a number of ways. The interrelationship between planning horizons and selection of optimal soil conservation management systems was examined at the micro level. An investigation is planned to determine the extent to which weather, yield, product price, and soil loss uncertainties would affect the adoption of these systems in the short and long run. The effect of taxes and subsidies in the selection of optimal soil conservation management systems will also be considered. The model employed for this study will select those management systems that maximize net returns while reducing soil erosion. Since soil erosion is directly related to water quality, the management systems selected by the model can be considered as those improving water quality by reducing soil erosion. Results of preliminary tests of the model using data from southern Illinois indicate that incorporation of risk in soil conservation decision would influence the selection of soil conservation management systems. The model is essentially a static one and ignores the dynamics of time. Future research should focus on expanding this model to incorporate the dynamic effects (for example, multiperiod optimization with a stochastic soil loss constraint) considering all the uncertainties involved. (See also W91-03704) (Author's abstract)
W91-03716

NONPOINT SOURCE REGULATION--A WATERSHED APPROACH.
Environmental Protection Agency, Chicago, IL. Region V.
T. E. Davenport.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 117-121, 3 ref.

Descriptors: *Nonpoint pollution sources, *Regulations, *Water policy, *Water pollution control, *Water quality management, *Water resources management, *Watershed management, Clean Water Act, Compliance, Law enforcement, Management planning, Waste load allocation, Wastewater disposal, Water Quality Act, Water quality standards.

For some waterbodies, nonpoint source pollution (NPS) prevents attainment of water quality standards and impairs designated uses. The traditional voluntary approach to NPS management has not been uniformly successful in controlling NPSs and some NPS problems still needed to be controlled to attain the goals of the Clean Water Act (CWA). The recently-passed Water Quality Act of 1987 creates a National Nonpoint Source Pollution Control Program, that mandates control of NPS pollution on a watershed basis to the maximum extent possible. Presently, technology exists to control point sources on a watershed basis. The present approach is to require compliance with water quality standards and application of a waste load allocation. The waste load allocation process apportions the assimilative capacity of the waterbody between dischargers and guarantees a margin of safety to protect the waterbody. Unlike point source controls, the Agency does not have direct regulatory or enforcement authority to ensure implementation or maintenance of nonpoint source controls. By combining the point source control approach with a watershed management planning and implementation program that can be tied to other regulatory mechanisms such as the conservation plans under the 1985 Farm Bill and Water Quality Management Plans required under Section 303 of CWA or National Pollution Discharge Elimination Permit System and 404 permit NPS controls may be imposed in some instances akin to other CWA regulatory requirements. (See also W91-03704) (Author's abstract)
W91-03717

INTEGRATED EXPERIENCE--THE MILWAUKEE RIVER EAST-WEST BRANCH WATERSHED RESOURCE MANAGEMENT PLAN.
Wisconsin Dept. of Natural Resources, Milwaukee.
S. L. Gayan, and J. D'Antuono.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 165-172, 1 fig, 5 ref.

Descriptors: *Interagency cooperation, *Milwaukee River, *Nonpoint pollution sources, *Water pollution control, *Water resources management, *Watershed management, Conservation, Environmental policy, Governmental interrelations, Headwaters, Natural resources.

The Milwaukee River Program is an example of how the Wisconsin Department of Natural Resources (WDNR) is responding to meet the challenges of both protecting and managing natural resources in southeastern Wisconsin. This approach uses a complex interdisciplinary and interagency coordination effort to ensure that the conservation, enhancement, management, and use of the natural resources in the Basin are achieved in the most effective manner possible. The East-West Branch is the largest and most complex of the Milwaukee River basin's five major drainage areas. Planning efforts in this watershed demonstrate how nonpoint pollution sources can be controlled more effectively using integrated resource management, and the reduction of pollutants entering the headwaters of the river system will benefit not only those smaller streams directly impacted, but also will result in improved aquatic resources downstream. The integrated resource management concept uses the WDNR Nonpoint Source Pollution Control Program as the foundation for initiating and coordinating the efforts of 11 WDNR program areas, units and agencies of government, agricultural interests, and environmental organizations on a watershed basis. The involvement of these program areas, units and agencies of government, and special interest groups is made possible through advisory, technical, and informational committees and subcommittees. (See also W91-03704) (Author's abstract)
W91-03723

MODELING NONPOINT POLLUTION AT THE WATERSHED LEVEL WITH THE AID OF A GEOGRAPHIC INFORMATION SYSTEM.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
B. M. Evans, and D. A. Miller.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Pro-

ceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 283-291, 3 fig, 1 tab, 5 ref.

Descriptors: *Computer models, *Geographic information systems, *Model studies, *Nonpoint pollution sources, *Path of pollutants, *Water quality management, Agriculture, Cost-benefit analysis, Demonstration programs, Microcomputers, Pennsylvania, Simulation analysis, Water policy, Water pollution control, Water pollution sources, Water resources management, Watershed management.

In a recently completed demonstration project, an integrated approach coupling a computer simulation model with a geographic information system (GIS) was used to assess agricultural nonpoint source (NPS) pollution problems at the watershed level in Pennsylvania. A microcomputer-based GIS was used to create a high-resolution digital geographic database containing data on over a dozen spatially distributed watershed variables. The GIS was also used to compute the average values for each watershed variable (e.g., curve number, slope, soil erodibility) for subareas within the watershed. This data was subsequently digitally reformatted for direct input to the simulation model. The simulation model used was AGNPS (Agricultural Non-Point Source) which is considered by many to be one of the most comprehensive and cost-effective watershed-based NPS models currently available. Based on estimates for conducting AGNPS analyses of watersheds of varying sizes, it was predicted that this particular study would have cost approximately $14,400 using the conventional approach, in contrast with half that amount for the study using the GIS-based approach (including the cost for developing parameter overlay capabilities). This type of cost-benefit ratio would almost surely increase as the size of watersheds being evaluated increases. Future plans for improving the program include providing the capability for assigning values for parameters so that they would not have to be manually entered, and developing new algorithms for more precisely quantifying slope gradient and field slope length automatically. (See also W91-03704) (Fish-PTT)
W91-03734

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

STATUS OF BIOASSESSMENT ACTIVITIES IN THE U.S. FISH AND WILDLIFE SERVICE.
Fish and Wildlife Service, Washington, DC. Div. of Environmental Contaminants.
D. W. Steffeck, and J. A. Blankenship.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 3A-17--3A-29, 1 tab, 14 ref.

Descriptors: *Bioassay, *Bioindicators, *Environmental effects, *Monitoring, *Water management, *Water pollution effects, Bioaccumulation, Ecosystems, Fish, Fish and Wildlife Service, Wildlife.

The US Fish and Wildlife Service (USFWS) is faced with a multitude of contaminant problems that effect fish and wildlife sources throughout the US. In order to identify and mitigate contaminant problems, the USFWS monitors the health of the nation's fish and wildlife resources through a variety of methods. One such method, the National Contaminant Biomonitoring Program (NCBP) is designed to monitor trends in contaminant levels in fish and wildlife species over time and according to geographic region. In addition, various site specific studies are initiated each year to identify and define the extent of contaminant problems and formulate solutions. Bioassessment techniques are rapidly becoming the main focus of many of these studies, replacing the purely chemical basis of contaminant analysis so prevalent in recent years. Past and ongoing laboratory and field research by the USFWS National Research Centers has provided a variety of approaches for identifying and evaluating contaminant problems in fish and wildlife, including on-site and laboratory bioassays, the use of gross biological responses (tumors, spinal deformities, external lesions), physiological and/or biochemical responses, contaminant bioaccumulation, and changes in community composition. New techniques are being developed, as are methods to evaluate adverse impacts of new generation chemicals. (See also W91-03032) (Author's abstract)
W91-03045

HETEROTROPHIC PLATE COUNT BACTERIA IN POTABLE WATER MONITORING METHODS AND APPLICATIONS.
Environmental Protection Agency, Cincinnati, OH. Microbiological Treatment Branch.
For primary bibliographic entry see Field 5F.
W91-03224

40 CFR 265 INTERIM-STATUS GROUNDWATER MONITORING PLAN FOR THE 2101-M POND.
Battelle Pacific Northwest Labs., Richland, WA.
M. A. Chamness, S. P. Luttrell, and S. Dudziak.
Available from the National Technical Information Service, Springfield, Virginia 22161, as DE89-010565. Price codes: A07 in paper copy, A01 in microfiche. Report no. PNL--6851, March 1989. 152 p, 12 fig, 9 tab, 31 ref, 5 append.

Descriptors: *Groundwater pollution, *Hanford, *Monitoring, *Monitoring wells, *Path of pollutants, *Ponds, *Radioactive wastes, *Sampling, Evaluation, Groundwater movement, Hazard assessment, Resource Conservation and Recovery Act, Water analysis.

A groundwater monitoring plan has been developed for the 2101-M pond, located in the southwestern part of the 200-East Area on the Hanford Site in southcentral Washington State. It has been determined that hazardous materials may have been discharged to the pond. Installation of an interim-status groundwater monitoring system is required under the Resource Conservation and Recovery Act to determine if hazardous chemicals are moving out of the pond. Phase I of the plan is an indicator evaluation groundwater monitoring program, which involves hydrogeologic characterization, a schedule of characterization and well installation, sampling and analysis of indicator evaluation monitoring data, and the associated reports. Phase II is the initiation of an assessment-level monitoring program, encompassing initiation criteria, an assessment-level monitoring program (nature and extent of contamination, rate of movement, additional well installations, additional field and laboratory testing, and modeling), and a plan for continued analysis and evaluation (review of methods and procedures, review of sampling parameters and frequency, and notification and reports). Four new wells are planned, one upgradient and three downgradient. (Fish-PTT)
W91-03238

RCRA GROUND-WATER MONITORING PROJECTS FOR HANFORD FACILITIES: ANNUAL PROGRESS REPORT FOR 1988.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5G.
W91-03242

STEAM DISTILLATION WITH RESIN EXTRACTION FOR ISOLATION AND CONCENTRATION OF ORGANIC COMPOUNDS FROM AQUEOUS SAMPLES.
Ames Lab., IA.
For primary bibliographic entry see Field 2K.
W91-03290

SOLID-PHASE EXTRACTION FOR TOXICITY REDUCTION EVALUATIONS OF INDUSTRIAL WASTEWATER EFFLUENTS.
West Point-Pepperell Research Center, Valley, AL.
For primary bibliographic entry see Field 5D.
W91-03291

SOLID-PHASE EXTRACTION OF HERBICIDES FROM WELL WATER FOR DETERMINATION BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY.
Monsanto Agricultural Products Co., St. Louis, MO.
S. A. Schuette, R. G. Smith, L. R. Holden, and J. A. Graham.
Analytica Chimica Acta ACACAM, Vol. 236, No. 1, p 141-144, September 1990. 1 fig, 1 tab, 4 ref.

Descriptors: *Gas chromatography, *Groundwater pollution, *Mass spectrometry, *Pollutant identification, *Separation techniques, *Triazine herbicides, *Water analysis, Alachlor, Atrazine, Cyanazine, Metolachlor, Simazine.

A simple, rapid method for isolating herbicides from well water was developed using disposable octadecyl (C18) solid-phase extraction columns. Deuterium-labeled internal standards were used to compensate for any losses that may occur during sample preparation owing to matrix effects. Detection by capillary gas chromatography-mass spectrometry in the selected ion monitoring mode minimized the frequency of false-positive results. The accuracy of the method was + or -5% at concentrations >0.20 micrograms/L for four of the five herbicides studied (alachlor, metolachlor, atrazine, and simazine). Cyanazine exhibited slightly poorer accuracy and substantially greater variability, particularly at the lower concentrations, probably due to its poor chromatographic properties and detector response. (Author's abstract)
W91-03292

DETERMINATION OF URANIUM IN AN ANALYTICAL CHEMISTRY LABORATORY.
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 7B.
W91-03376

SETTING UP A LABORATORY FOR RADON IN WATER MEASUREMENTS.
Maine Univ. at Orono. Dept. of Physics and Astronomy.
C. T. Hess, and S. M. Beasley.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 193-202. 2 fig, 1 tab, 6 ref.

Descriptors: *Analytical techniques, *Laboratory equipment, *Pollutant identification, *Radioisotopes, *Radon, *Water analysis, Air pollution, Quantitative analysis, Radiation, Research facilities, Water quality control.

The steps required to measure radon in water using liquid scintillation counting are presented. The steps, which are explained in detail, are: sampling, scintillation counter operation, analysis of the counts, calculation of the concentration, and the preparation of standards. The process of testing water for radon concentrations can be summarized into three steps: (1) preparation of water sample vials; (2) counting the activity of the vials using a liquid scintillation counter; and (3) converting the counts per minute into picocuries per liter. The operation of the liquid scintillation counter involves several steps, which include: calibrating the gain, setting up the discrimination windows, adjusting the time of counting, loading a set of samples and standards, and calculating and reporting the results. It is concluded that the process of testing water for radon gas is an effective means of determining if the water poses a significant source of indoor air radon and a significant health threat. A thorough understanding of radon gas, its progenies' health hazards, and methods of infiltration facilitate a more accurate analysis of individual homes. (See also W91-03366) (Agostine-PTT)
W91-03378

ANALYTICAL METHODOLOGY FOR RADIUM IN FOOD AND WATER.
Food and Drug Administration, Winchester, MA. Winchester Engineering and Analytical Center.
E. J. Baratta.

IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 203-212. 3 tab, 42 ref.

Descriptors: *Analytical methods, *Analytical techniques, *Chemical analysis, *Drinking water, *Foods, *Pollutant identification, *Radiochemical analysis, *Radium, *Water analysis, Laboratory methods, Quality control, Radioisotopes, Water quality standards.

The hazards associated with radium-226 and radium-228 have been well studied and documented. Analysis at the levels set by the Environmental Protection Agency (EPA) for these two isotopes in drinking water should present no analytical problems. The methods for radium-226 by total radium and emanation have been collaboratively studied and published in the ALPHA Standard Methods. The method of Krieger for radium-228, although it has not been collaboratively tested, has the tentative approval of the American Public Health Association (ALPHA) Standard Methods and was recommended by the National Institute for Science and Technology (formerly the National Bureau of Standards). In this method the radium is precipitated using barium and lead carriers, then purified and the actinium-228 allowed to ingrow. It is separated using a yttrium carrier and the actinium-228 is beta counted. Other methods could also be used. It should be noted that the EPA's Quality Assurance Program should be used to document that the methods being used are performing adequately. (See also W91-03366) (Agostine-PTT)
W91-03379

PRECONCENTRATION OF IRON BY COMPLEXATION AND ULTRAFILTRATION.
Turin Univ. (Italy). Dipt. di Chimica Analitica.
For primary bibliographic entry see Field 7B.
W91-03411

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC APPROACH FOR MONITORING ETHOFUMESATE IN PLANT, SOIL AND WATER.
Jordan Univ., Amman. Analytical Chemistry Labs.
M. A. Alawi.
Analytical Letters ANALBP, Vol. 23, No. 9, p 1695-1709, September 1990. 3 fig, 3 tab, 5 ref.

Descriptors: *Agricultural chemicals, *Chemical analysis, *Herbicides, *High performance liquid chromatography, *Pollutant identification, *Water analysis, Beets, Detection limits, Groundwater pollution, Soil contamination.

Ethofumesate is a selective herbicide used for beet and grass crops. A simple quantitative high performance liquid chromatography (HPLC) ultraviolet (uv) method for the analysis of ethofumesate in fodder beet, soil, and water samples has been developed. This method is based on a simple extraction step, gel-chromatographic and/or mini-silica gel column cleanup step and a separation step on a reversed phase column with uv-detection. The method is sensitive down to 0.01 mg/kg in water and 0.05 mg/kg in plants and soil. This approach shows recoveries between 90% and 110% in almost all matrices. The advantages of this approach are the simple extraction step and the clean extraction residue after the gel-chromatographic and/or silica gel cleanup steps. These advantages combined with the specific detection at 280 nm render this method suitable for routine analysis of ethofumesate. Preliminary tests show that this method is also applicable for the analysis of ethofumesate in other plant materials. (Author's abstract)
W91-03412

MEMBRANE/GAS CHROMATOGRAPHIC SYSTEM FOR AUTOMATED EXTRACTION AND DETERMINATION OF TRACE ORGANICS IN AQUEOUS SAMPLES.
Dow Chemical Co., Midland, MI. Analytical Labs.
R. G. Melcher, and P. L. Morabito.
Analytical Chemistry ANCHAM, Vol. 62, No. 20, p 2183-2188, October 15, 1990. 7 fig, 4 tab, 14 ref.

Descriptors: *Analytical methods, *Chemical analysis, *Gas chromatography, *Membranes, *Organic compounds, *Pollutant identification, *Water analysis, Chlorinated hydrocarbons, Chromatography, Concentration factors, Detection limits, Organic solvents, Pesticides, Sample matrix, Standards.

A new automated extraction analysis system, which combines membrane cell technology with a pneumatically operated pressurized rotary gas chromatographic injection valve, was developed and tested. The system was evaluated by using chlorinated aromatic compounds and pesticides as test sample mixtures. These compounds were successfully extracted and determined in water and organic/water type matrices in part-per-trillion to part-per-billion range. Two modes of membrane operation were demonstrated: the continuous-flow mode, which produces concentration factors of approximately 3 to 5; and the stop-flow mode, which produces concentration factors in the 50-200 range. The effects of adding common organic solvents to the samples were unexpected increases in extraction efficiency. To reduce sample matrix effects, an internal standard procedure was evaluated. The internal standard, which was added to the sample, was extracted with the analytes of interest to help compensate for matrix effects. The accuracy and precision were significantly improved over the use of an external standard analysis; however, the internal standard analysis was unable to completely compensate when high percent levels of organic solvents were added to the sample. Membrane cell technology with a pneumatically operated pressurized rotary gas chromatographic injection valve has potential both for use in sophisticated laboratory systems for automated extraction and analysis and also for simplified, dedicated systems for on-line analyzers. (Author's abstract)
W91-03436

SOIL-GAS SURVEYING FOR SUBSURFACE GASOLINE CONTAMINATION USING TOTAL ORGANIC VAPOR DETECTION INSTRUMENTS: PART II. FIELD EXPERIMENTATION.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
G. A. Robbins, B. G. Deyo, M. R. Temple, J. D. Stuart, and M. J. Lacy.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 4, p 110-117, Fall 1990. 8 figs, 4 tab, 6 ref. Environmental Monitoring Systems Laboratory and U.S. EPA Cooperative Agreement Grant CR-814542-01.

Descriptors: *Analytical methods, *Gasoline, *Groundwater pollution, *Hydrocarbons, *Measuring instruments, *Pollutant identification, *Soil contamination, Field tests, Instrumentation, Organic pollutants, Soil gases, Total organic vapor detection.

Field studies were performed at a service station to illustrate the responses of total organic vapor detection instruments in soil-gas surveying under field conditions and to demonstrate the use of the serial dilution technique. Field measurements confirmed that instrument responses were influenced by the relative humidity, low oxygen content, high carbon dioxide level, and relative abundance of detectable constituents of the soil gas. The distribution of organic vapors as determined by sampling soil-gas probes directly or undiluted Tedlar bags did not delineate the area of known contamination. Also, poor correlation was obtained between field instrument readings and laboratory measurements. Application of the serial dilution technique resulted in improved correlation between field and laboratory soil-gas measurements as well as the delineation of the area of known gasoline leakage. Response factor calculations, performed using field data and theoretical and laboratory relations, closely approximated observed instrument responses. The results of the field study demonstrated that the casual use of total organic vapor detection instruments in soil-gas surveying can result in misleading information on the presence, location, and extent of subsurface contamination. The application of these instruments can be significantly improved through performing serial dilutions. (See also W91-00368) (Author's abstract)
W91-03448

PRELIMINARY DELINEATION OF CONTAMINATED WATER-BEARING FRACTURES INTERSECTED BY OPEN-HOLE BEDROCK WELLS.
Geological Survey, Albany, NY.
For primary bibliographic entry see Field 5B.
W91-03449

DETERMINATION OF TOTAL PHOSPHORUS IN WATERS WITH AMPEROMETRIC DETECTION BY COUPLING OF FLOW-INJECTION ANALYSIS WITH CONTINUOUS MICROWAVE OVEN DIGESTION.
Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Anorganisch-Chemisches Inst.
S. Hinkamp, and G. Schwedt.
Analytica Chimica Acta ACACAM, Vol. 236, No. 2, p 345-350, September 17, 1990. 3 fig, 3 tab, 14 ref.

Descriptors: *Analytical methods, *Chemical analysis, *Laboratory methods, *Microwaves, *Phosphorus, *Pollutant identification, *Water analysis, Analytical techniques, Digestion, Hydrogen ion concentration, Microwave digestion, Orthophosphates.

Phosphorus appears in ground, surface and waste waters in various concentrations either in dissolved or undissolved forms, or as organically bound compounds. For the continuous determination of total phosphorus, a combination of a decomposition unit and flow-injection analysis are necessary. Microwave sample digestion has been used for the rapid determination of numerous elements in biological and geological matrices. A continuous microwave oven decomposition with subsequent amperometric detection of orthophosphate was used to determine total phosphorus in water. The percentage digestion was examined for two different decomposition reagents and by varying the pH of the carrier and the length and diameter of the digestion coil. With potassium peroxodisulfate decomposition, the recoveries of phosphorus varied from 91-100% for organic phosphorus compounds. With perchloric acid decomposition, the recoveries varied from 60-70% for inorganic polyphosphates. Calibration graphs were linear for up to 30 mg P/L, the determination limit was 0.1 mg P/L and the precision of the method was 3% (relative standard deviation) (n = 5) at 5 mg P/L. The sampling rate was 20 samples/hour. Good recoveries of phosphorus after addition to domestic waste were obtained. (Mertz-PTT)
W91-03458

FIELD METHOD FOR DETERMINATION OF TRACES OF THIOLS IN NATURAL WATERS.
Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Marine and Atmospheric Chemistry.
A. Vairavamurthy, and K. Mopper.
Analytica Chimica Acta ACACAM, Vol. 236, No. 2, p 363-370, September 17, 1990. 5 fig, 31 ref. Office of Naval Research grant 0014-84-K-0733 and National Science Foundation grants OCE 8516020 and OCE 8613940.

Descriptors: *Analytical methods, *Chemical analysis, *Field tests, *Pollutant identification, *Pore water, *Thiols, *Water analysis, Analytical techniques, Biscayne Bay, Black Sea, Liquid chromatography, Organic compounds, Sample preparation.

Derivatization with 2,2'-dithiobis(5-nitropyridine) (DTNP) was used to stabilize thiols in field samples and to determine these compounds by liquid chromatography with ultraviolet detection. Alternatively, the thiols can be regenerated from DTNP derivatives using tributylphosphine and derivatized with 0-phthalaldehyde. The DTNP derivatives were stable at pH 5 and 6 for more than 2 weeks in the reaction mixture, but the stability was considerably lower at pH values > 8. Derivatization at pH 6 was routinely done and the reaction was complete within 5 minutes. The derivatives can be extracted quantitatively on commercial C18 cartridges, which allows several-fold sample enrichment. The cartridge-adsorbed derivatives are

stable at 0-5 C for long periods and, therefore, can be stored for liquid chromatography separation at a later date. DTNP derivatives of 10 low-molecular-weight thiols were separated on a C18 microbore column using gradient elution and a flow-rate of 200 microliters/minute. The relative standard deviation based on repeated analyses of standards is about 5% in the range 0.5-2 micromoles. Without C18 cartridge enrichment, the detection limits of the studied thiols are in the range 50-100 nanomoles. These limits are further reduced by about 100-fold by using the 0-phthalaldehyde method after regeneration of thiols from the DTNP derivatives using tributylphosphine. The method was applied to coastal sediment pore water and anoxic Black Sea water. Organic-rich sediment pore water samples from Biscayne Bay, FL, had 3-mercaptopropionic acid present as the dominant thiol in almost all samples. Thiols detected in Black Sea water included glutathione and 2-mercaptoethanol. (Mertz-PTT)
W91-03459

CRITICAL COMPARISON OF TWO STANDARD DIGESTION PROCEDURES FOR THE DETERMINATION OF TOTAL MERCURY IN NATURAL WATER SAMPLES BY COLD VAPOUR ATOMIC ABSORPTION SPECTROMETRY.
Umea Univ. (Sweden). Dept. of Analytical Chemistry.
D. C. Baxter, and W. Frech.
Analytica Chimica Acta ACACAM, Vol. 236, No. 2, p 377-384, September 17, 1990. 2 fig, 5 tab, 26 ref.

Descriptors: *Analytical methods, *Atomic absorption spectrophotometry, *Chemical analysis, *Laboratory methods, *Mercury, *Pollutant identification, *Water analysis, Digestion, Ion exchange, Marshes, Standards, Swedish Standard method, West German Standard method.

Two pretreatment procedures for total mercury determinations in natural water samples were compared. The first, the Swedish Standard method, involves digestion of water in the presence of concentrated nitric acid at 120 C and under pressure for 30 minutes. In the West German Standard method, small volumes of nitric and sulfuric acids, permanganate and peroxodisulfate are added to the sample, and digestion proceeds at 50 C in an ultrasonic bath. Mercury was determined after both digestion procedures using a modified cold vapor atomic absorption spectrometric method, in which mercury generated after the addition of a reducing agent is collected and atomized in a platinum-lined graphite furnace. The efficacy of the two digestion procedures was tested using various standard organic mercury compounds, and it was found that only the West German Standard method provided quantitative recoveries. Purification of the reagents required by the West German Standard method was achieved using a mercury-selective ion-exchange resin, Chelite S, resulting in blank levels below 21.5 nanograms Hg/L. Both methods were applied to the determination of total mercury in an unpolluted marsh water sample, giving 2.0 nanogram Hg/L with the Swedish Standard method and 2.7 nanogram Hg/L with the West German Standard method. The West German Standard digestion procedure is recommended for the determination of total mercury in natural water samples. (Author's abstract)
W91-03460

PRECONCENTRATION OF LEAD, CADMIUM, COPPER AND ZINC IN WATER AT THE G/G LEVEL BY NON-BOILING EVAPORATION.
Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France).
U. Gorlach, and C. F. Boutron.
Analytica Chimica Acta ACACAM, Vol. 236, No. 2, p 391-398, September 17, 1990. 2 fig, 5 tab, 24 ref.

Descriptors: *Analytical techniques, *Cadmium, *Chemical analysis, *Copper, *Evaporation, *Lead, *Pollutant identification, *Snow, *Water analysis, *Zinc, Analytical methods, Antarctica, Atomic absorption spectrophotometry, Greenland, Heavy metals, Teflon.

Various improvements have been made for the preconcentration of Pb, Cd, Cu, and Zn to allow efficient control of contamination problems at these extremely low, non-boiling evaporation technique concentrations. They include the choice of FEP Teflon for the evaporation containers and the use of sophisticated cleaning, aging and pre-conditioning procedures. Detailed calibration graphs were obtained down to the sub-picagram/g level by processing ultra-low concentration standards. This technique was then applied to the determination of Pb, Cd, Cu, and Zn in snow samples collected in Greenland and Antarctica. Surface Greenland snow samples allowed a check of whether the different chemical forms could lead to different behaviors during the evaporation process. The concentrations of heavy metals were measured in three typical surface Greenland snow samples by direct graphite furnace atomic absorption spectrometry and by graphite furnace atomic absorption spectrometry after preconcentration. The results confirmed the reliability of the evaporation preconcentration procedure for real samples in which the chemical forms of the metals were more complex than in synthetic standards. In three typical Antarctic snow samples concentrations ranged from 2.5-9.5 picagrams/g for Pb, from < 0.2-0.7 picagram/g for Cd, from 2.3-4.7 picagram/g for Cu and from 2.4-8.3 picagram/g for Zn. The precision was found to range from about 25% for the lowest concentrations to less than about 10% for the highest concentrations. (Mertz-PTT)
W91-03461

DETERMINATION OF VANADIUM IN WATER BY ATOMIC ABSORPTION SPECTROMETRY WITH ELECTROTHERMAL ATOMIZATION AND USING HOT INJECTION AND PRECONCENTRATION ON THE GRAPHITE TUBE.
Santiago Univ. (Spain). Faculty of Chemistry.
P. Bermejo-Barrera, E. Beciero-Gonzalez, and A. Bermejo-Barrera.
Analytica Chimica Acta ACACAM, Vol. 236, No. 2, p 475-477, September 17, 1990. 1 tab, 16 ref.

Descriptors: *Analytical techniques, *Atomic absorption spectrophotometry, *Chemical analysis, *Pollutant identification, *Vanadium, *Water analysis, Analytical methods, Laboratory methods.

To determine vanadium in freshwater, the atomic absorption spectrometry with electrothermal atomization has been used, but owing to the low levels present, preconcentration is necessary. This is accomplished using hot injection and preconcentration on a graphite tube. The water sample (200 microliters) is added to a heated graphite tube in four portions over 200 seconds, with magnesium nitrate used as a matrix modifier. The relative standard deviation of ten replicate analyses of one sample during the same run was 5.43%. The within-batch precision of the method, obtained from ten replicate analyses of water samples with 1 microgram vanadium/L was 10.8%; 1 microgram/L was 7.4%; 3 microgram/L, 3.4%; and 5 microgram/L, 3.7%. To study the accuracy of the method, standard reference material water from the International Atomic Energy Agency, with a vanadium content of 5.8 microgram/L and a confidence interval of 4.9-10 microgram/L was used. The vanadium content in this reference material obtained using the proposed method was 6.23 +/- 0.86 microgram/L. The method allows vanadium down to 0.27 microgram/L to be detected. (Mertz-PTT)
W91-03462

DETERMINATION OF TRACE CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUND WATER USING CLOSED-LOOP STRIPPING, EDWARDS AQUIFER, TEXAS.
Geological Survey, Austin, TX.
P. M. Buszka, S. D. Zaugg, and M. G. Werner.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 4, p 507-515, October 1990. 1 fig, 2 tab, 17 ref.

Descriptors: *Edwards Aquifer, *Groundwater quality, *Path of pollutants, *Pollutant identification, *Water analysis, *Water pollution sources, Biodegradation, Chemical analysis, Groundwater chemistry, Groundwater pollution, Organic compounds, Tetrachloroethene, Texas, Toluene, Water quality, Xylenes.

The Edwards Aquifer in the Cretaceous Edwards Limestone in southcentral Texas is the sole source of drinking water for San Antonio, and is the major source of water for much of the region. Areas considered most susceptible to contamination from surface sources are the aquifer outcrop and the part of the aquifer downdip from the outcrop that is unconfined, collectively known as the recharge area. Volatile and semivolatile organic compounds were examined to see if they occurred at less than microgram/L concentrations, and to assess the potential use of such compounds for regional tracers of groundwater quality. Water samples were collected from four wells in the recharge area and at Comal Springs, a major discharge site from the confined zone. Closed-loop stripping was used to extract, and gas chromatography/mass spectrometry to separate, identify, and quantify organic compounds in water. Several compounds classified as priority pollutants by the U.S. EPA were detected in the water samples. Tetrachloroethene was detected in all samples collected from Comal Springs and from two recharge-area wells in areas with septic sewers. Methyl benzene (toluene) and a dimethyl benzene (xylene) isomer were inconsistently detected among replicate samples. This inconsistency, in combination with losses of surrogate compounds indicated biodegradation as a probable cause of the losses. Trichloroethene was detected in one sample from Comal Springs. The compound 2,6-bis-di-tert-butyl-p-butyl-p-benzoquinone, an indicator of pollution of water by sewage, was detected in well samples. Two of the compounds detected, tetrachloroethene and 2,6-bis-di-tert-butyl-p-benzoquinone, are potentially viable tracers of human-induced effects on groundwater quality. Results indicate a tentative relation between the presence of these compounds and patterns of domestic waste disposal. (Mertz-PTT)
W91-03465

ORDINATION ANALYSIS AND BIOINDICES BASED ON ZOOBENTHOS COMMUNITIES USED TO ASSESS POLLUTION OF A LAKE IN SOUTHERN FINLAND.
Ristola (Paavo) Consulting Engineers Ltd., Hollola (Finland).
P. H. Kansanen, L. Paasivirti, and T. Vayrynen.
Hydrobiologia HYDRB8, Vol. 202, No. 3, p 153-170, August 31, 1990. 6 fig, 6 tab, 33 ref, 2 append.

Descriptors: *Benthic fauna, *Bioindicators, *Eutrophic lakes, *Finland, *Limnology, *Multivariate analysis, *Pollutant identification, *Pollution index, *Water pollution effects, Benthic environment, Ecosystems, Midges, Oligochaetes, Oligotrophic lakes, Sampling, Species diversity, Statistical analysis, Water depth, Water pollution, Water quality, Wood wastes.

When the state of a polluted watercourse is evaluated on the basis of zoobenthic data, it is necessary to reduce the large number of measured parameters. The suitability of an ordination method, detrended correspondence analysis (DCA), was tested in assessing the degree of pollution of a large lake on the basis of the zoobenthos communities. Lake Etela-Saimaa, in southern Finland, was originally oligotrophic but is now heavily loaded by effluents from the wood-processing industry. Comparison between areas was complicated by variation in the water depths of the lake sub-basins. A horizontal pollution gradient could, however, easily be detected by means of the DCA in both the profundal and sublittoral zones. The benthic quality index (BQI) based on the composition of the profundal chironomid fauna failed at some stations because the indicator species were lacking, despite enlargement of the indicator species pool. The BQI based on the oligochaetes could be calculated at almost all the stations. This index was modified by altering the empirical constants for two species. Diversity indices and the occurrences of a single species had a limited value in the water

quality assessment. The study concluded that DCA ordination is a powerful tool in evaluation of pollution. The method gives the best results when the sampling network is carefully planned and the material represents all sections of the underlying environmental gradients, e.g. a gradient from oligotrophy to eutrophy or heavy pollution. (Author's abstract)
W91-03490

ULVA LACTUCA AS BIOINDICATOR OF METAL CONTAMINATION IN INTERTIDAL WATERS IN HONG KONG.
Hong Kong Univ. Dept. of Botany.
Y. B. Ho.
Hydrobiologia HYDRB8, Vol. 203, No. 1/2, p 73-81, September 14, 1990. 3 fig, 5 tab, 17 ref.

Descriptors: *Algae, *Bioindicators, *Heavy metals, *Hong Kong, *Intertidal areas, *Marine pollution, *Metals, *Pollutant identification, *Water pollution, *Water pollution effects, Cadmium, Chlorophyta, Copper, Industrial wastewater, Iron, Lead, Manganese, Nickel, Pollution index, Rural areas, Sea lettuce, Urban areas, Zinc.

The cosmopolitan green alga Ulva lactuca L. is widespread along the shores of Hong Kong. It grows well in intertidal waters, and accumulates high nutrient levels in urban areas contaminated by domestic sewage. The use of Ulva as an indicator of metal contamination was assessed by analyzing the levels of Mn, Fe, Ni, Cu, Zn, Cd, and Pb in the alga collected from 24 intertidal sites around the Island of Hong Kong. Twelve of the sites are in the rural southern parts of the Island where the coastal waters are relatively clean. The remaining 12 sites are located in the north and within Victoria Harbour which receives, apart from industrial effluents, untreated domestic sewage from a population of some 3.5 million. The mean levels of Mn, Fe, Ni, Cu, Zn, and Pb in Ulva from the urban sites were respectively 4.0, 4.6, 1.8, 2.3, 2.4, and 4.6 fold greater than those from the rural sites. However, similar levels of Cd were found in the alga among all the sites. Locations of high levels of metal contamination, particularly toward the eastern end of the Harbour, have been identified. Preliminary results indicate that Ulva is a good indicator of Mn, Fe, Cu, Zn, and Pb contamination. (Author's abstract)
W91-03498

METHODS DEVELOPMENT AND IMPLEMENTATION FOR THE NATIONAL PESTICIDE SURVEY.
Environmental Protection Agency, Cincinnati, OH.
D. J. Munch, R. L. Graves, R. A. Maxey, and T. M. Engel.
Environmental Science and Technology ESTHAG, Vol. 24, No. 10, p 1446-1451, October 1990. 1 fig, 7 tab, 1 ref.

Descriptors: *Data acquisition, *National Pesticide Survey, *Network design, *Pesticides, *Pollutant identification, *Surveys, Baseline studies, Domestic water, Drinking water, Environmental Protection Agency, Municipal water, Path of pollutants, Water sampling, Wells.

In 1984, a joint project between EPA's Office of Drinking Water and the Office of Pesticide Programs was initiated to conduct a statistically based survey of pesticide contamination of drinking water wells. The National Pesticide Survey had two objectives: to provide statistically valid data that can be extrapolated to represent both rural domestic and community drinking-water wells nationally and to evaluate possible associations between pesticide contamination of drinking water wells and pesticide use and hydrogeological vulnerability. Pesticides selected for study had to meet several criteria: use of at least 1,000,000 pounds in 1982, water solubility greater than 30 mg/L and hydrolysis half-life longer than 25 weeks. By October 1986, a total of 100 pesticides and their degradation products were identified as priority analytes. Steps for research into the analyses of these compounds included methods development research, methods consolidations, research into confirmation techniques, sample preservation studies and ruggedness testing and validation of final methods. A pilot study was conducted in March and April 1987. In April 1988, sampling began for the full survey. Sampling of community water systems was completed in December 1989, and of the domestic systems in February 1990. 600 community systems and 800 domestic wells were sampled. (Mertz-PTT)
W91-03507

HISTORICAL PERSPECTIVE ON THE ENVIRONMENTAL BIOAVAILABILITY OF DDT AND ITS DERIVATIVES TO GULF OF MEXICO OYSTERS.
Texas A and M Univ., College Station. Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W91-03509

ASSESSING TOXICITY OF DRINKING WATER CONTAMINANTS: AN OVERVIEW.
Vanderbilt Univ., Nashville, TN. Dept. of Biochemistry.
R. A. Neal.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 10, p 44-47, October 1990. 13 ref.

Descriptors: *Drinking water, *Risk assessment, *Toxicity, *Toxicology, *Water analysis, *Water treatment, Carcinogenicity, Chemical analysis, Contaminants, Epidemiology, Mathematical studies, Testing procedures, Water quality.

Chemical contaminants in drinking water can cause a variety of adverse health effects in humans, and a number of means are available to assess the toxicity of these chemicals. The most important means are epidemiology and animal tests. Epidemiology provides the most direct and least ambiguous information in that it assesses the actual occurrence of toxic effects in human populations exposed to chemical contaminants. Unfortunately, these are limitations to the use of epidemiology. Currently, experimental testing of animals is the most important means available to determine the toxicity of chemicals. A major limitation of these tests is the uncertainty about their applicability to humans. This uncertainty extends not only to differences in the qualitative responses of animals and humans to chemicals but more particularly to differences in the degree of response to various exposure levels. The usual practice for assessing a chemical's noncarcinogenic toxic effects in humans is to determine, based on epidemiology studies or rodent tests, the dose at which a toxic effect seen at higher doses is no longer observed, called the no-observed-effect level. In rodents exposed to a drinking water contaminant get cancer, or if cancer has been detected in an epidemiological study, then the current practice of the US EPA is to use a mathematical model to estimate the cancer incidence in humans that could result from the low levels of exposure associated with consuming contaminated drinking water. These mathematical models use the dose-response data in rodents and data from available epidemiological studies along with the estimated levels of human exposure to the chemical of interest. The major strength of mathematical modeling of human cancer risk ar that it is relatively easy to do and it provides an opportunity for regulatory agencies to base their decisions on an estimate of the degree of risk. The validity of the predictions of cancer risk in humans calculated using these mathematical models has, however, never been verified experimentally. (Mertz-PTT)
W91-03527

ASSESSMENT OF AQUATIC ORGANISMS AS BIOINDICATORS OF HISTORICAL RADIONUCLIDE RELEASE TO THE COLUMBIA RIVER.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W91-03564

TOXICITY BIOASSAYS: WATER POLLUTION EFFECTS ON AQUATIC ANIMALS AND PLANTS (JUN 86-FEB 90). CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W91-03569

METHODS FOR THE DETERMINATION OF ORGANIC COMPOUNDS IN DRINKING WATER.
Environmental Monitoring Systems Lab., Cincinnati, OH.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-220461/AS. Price codes: A17 in paper copy, A01 in microfiche. Report No. EPA/600/4-88/039. December 1988. 392p, 35 fig, 63 tab, 96 ref.

Descriptors: *Chemical analysis, *Drinking water, *Laboratory methods, *Organic compounds, *Pollutant identification, *Water analysis, Disinfection, Extraction techniques, Gas chromatography, Liquid chromatography, Mass spectrometry.

Thirteen analytical methods for the identification and measurement of organic compounds in drinking water are described in detail. Six of the methods are for volatile organic compounds (VOCs) and certain disinfection by-products. These methods were cited in the Federal Register of July 8, 1987, under the National Primary Drinking Water Regulations. The other seven methods are designed for the determination of a variety of synthetic organic compounds and pesticides, and these methods were cited in proposed drinking water regulations in the Federal Register of May 22, 1989. Five of the methods utilize the inert gas purge-and-trap extraction procedure for VOCs, six methods employ a classical liquid-liquid extraction, one method uses a new liquid-solid extraction technique, and one method is for direct aqueous analysis. Of the 13 methods, 12 use either packed or capillary gas chromatography column separations followed by detection with mass spectrometry or a selective gas chromatography detector. One method is based on a high performance liquid chromatography separation. (Author's abstract)
W91-03580

EVALUATION OF TREND DETECTION TECHNIQUES FOR USE IN WATER QUALITY MONITORING PROGRAMS.
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 7B.
W91-03584

NUTRIENTS FOR BACTERIAL GROWTH IN DRINKING WATER: BIOASSAY EVALUATION.
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
For primary bibliographic entry see Field 5F.
W91-03590

HEALTH ASSESSMENT FOR ALSCO ANACONDA NATIONAL PRIORITIES LIST (NPL) SITE, GNADENHUTTEN, OHIO.
Agency for Toxic Substances and Disease Registry, Atlanta, GA.
For primary bibliographic entry see Field 5B.
W91-03593

SEDIMENT QUALITY VALUES REFINEMENT: VOLUME 1 - DATA APPENDICES, 1988 UPDATE AND EVALUATION OF PUGET SOUND AET.
PTI Environmental Services, Bellevue, WA.
R. Barrick, S. Becker, L. Brown, H. Beller, and R. Pastorok.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-200406. Price codes: A13 in paper copy, A01 in microfiche. Final Report No. EPA/910/9-88/246B, September 1988. 296p, 26 tab.

Descriptors: *Data collections, *Pollutant identification, *Puget Sound, *Sediment contamination, *Washington, *Water pollution effects, Apparent Effects Threshold, Benthic fauna, Bioassay, Microtox, Oysters.

This report contains a detailed evaluation of the Apparent Effects Threshold (AET) approach. The AET approach can be used to develop chemical specific sediment quality values. As part of this effort, AET values were generated for Puget Sound, Washington, and applied in a predictive manner to approximately 300 stations. The objective of this investigation was to test the reliability of AET, and potential sediment quality standards based on AET, in predicting adverse biological effects associated with sediment contamination. Of the 201 benthic infauna stations and 287 amphipod bioassay stations evaluated, approximately 75% were in accordance with AET predictions. Approximately 96% of the 50 stations at which oyster larvae and microtox bioassays were performed were in accordance with AET predictions. Based on AET for the four biological indicators, Puget Sound maps were produced showing the location of predicted impacts in the estuary. This effort involved the generation and evaluation of AET for 58 metal and organic chemicals. (Author's abstract)
W91-03599

MUSSELS (MYTILUS EDULIS L.) IN COASTAL WATER QUALITY CONTROL (DIE MIESMUSCHEL (MYTILUS EDULIS L.) ALS INDIKATOR VON UMWELTBELASTUNGEN).
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
H. Fischer.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-794682. Price codes: A04 in paper copy, A01 in microfiche. Report UBA-FB--86-069, May 1986. 54p, 9 fig, 5 tab, 84 ref. English summary.

Descriptors: *Bioindicators, *Cadmium, *Mussels, *Path of pollutants, *Pollutant identification, *Salinity, *Water pollution effects, Growth, Heavy metals, Lead, Shell weight, Tissue analysis, Zinc.

Low salinity was supposed to be a natural reason of higher Cd concentration in mussels from the Baltic Sea. Research on this topic evolved to a reformed 'mussel watch' concept. Shell weight as an independent variable in relation to Cd content of molluscs. Analysis of field samples: Reference of body burden to shell weight (Cd/shell-wt index) eliminates variability due to fluctuation of tissue-wt of Cd concentration. Influence of temperature, salinity, and oxygen on Cd balance of mussels. Experimental studies: Verification of Cd/shell-wt index as a reliable indicator. Low salinity produces high Cd levels in mussels. Essential in related research: growth. Cd, Zn, Pb, and Cu in mussels: (1) Field samples: Reference of Pb and Zn to shell-wt.; reference of Cu to soft-tissue wt.; and (2) Experiments: effects of metals on growth; metal levels in mussels. Bionindication of Zn is complicated by regulated uptake. Growth in the environment and reference of non-regulated, cumulative contaminants to shell weight are elements of a future 'mussel watch' routine. (Author's abstract)
W91-03605

PROCEEDINGS OF THE SIXTH CORPS CHEMISTS MEETING, 16-17 MAY 1989.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Available from the National Technical Information Service, Springfield, VA 22161. Miscellaneous Paper EL-90-14, September 1990. Final Report. Compiled by A. B. Strong and A. B. Morrow. 33p.

Descriptors: *Chemical analysis, *Conferences, *Path of pollutants, *Pollutant identification, *Sediment analysis, *Water analysis, *Water chemistry, Groundwater pollution, Hydrocarbons, Organic compounds, Polychlorinated biphenyls, Soil analysis, Soil contamination, Underground storage tanks.

Presentations and discussions given are centered around analytical methods used by the Army Corps of Engineers, the expanding Corps mission in hazardous and toxic waste (HTW) work, the continuing importance of water quality programs, quality assurance for Corps projects, and communications between field and laboratory personnel. Topics presented include: polychlorinated biphenyl (PCB) congener toxicity; influence of groundwater well casings on organic and inorganic analytes; influence of soil sampling and soil history in investigating soil-mediated processes; sediment analysis case studies; petroleum hydrocarbon methods; and, chemistry work involved with underground storage tank removal. (Lantz-PTT)
W91-03659

SPECTROPHOTOMETRIC DETERMINATION OF ANIONIC SURFACTANTS IN TAP AND RIVER WATERS WITH 1-(10-BROMODECYL)-4-(4-AMINONAPHTHYLAZO)-PYRIMIDINIUM BROMIDE.
Okayama Univ. (Japan). School of Health Sciences.
Y. Shimoishi, and H. Miyata.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 338, No. 1, p 46-49, September 1990. 4 fig, 2 tab, 8 ref.

Descriptors: *Chemical analysis, *Pollutant identification, *Spectrophotometry, *Surfactants, *Water analysis, Laboratory methods, Sodium dodecylbenzenesulfonate, Sodium dodecylsulfate, Stoichiometry.

A new cationic dye, 1-(10-bromodecyl)-4-(4-aminonaphthylazo)-pyrimidinium bromide, was synthesized and evaluated as a new reagent for the determination of anionic surfactants. The reagent reacts with anionic surfactants, such as sodium dodecylsulfate and sodium dodecylbenzenesulfonate, to produce an ion associate in an aqueous medium. The color change occurs simultaneously, and the color development is very stable. This makes it possible to determine anionic surfactants directly by spectrophotometry without solvent extraction. The stoichiometric ratio of the ion associate was found to be 1:1 by the mole ratio method. The calibration graph was linear up to 2.5 micromoles/L. The apparent molar absorptivity of the ion associate was 53000 L/mole/cm (at 595 nm). The relative standard deviation (n = 10) for 1.2 micromoles/L sodium dodecylsulfate was 4.9%. The proposed method was applied to the determination of anionic surfactants in tap and river waters, with results comparable to those obtained by other methods. (Author's abstract)
W91-03839

GAS CHROMATOGRAPHIC DETERMINATION OF SYSTEMIC FUNGICIDE TRICYCLAZOLE IN SOIL AND WATER.
Zhejiang Agricultural Univ., Hangzhou (China). Dept. of Plant Protection.
Y. Xiao, D. Fan, and H. Chen.
Journal - Association of Official Analytical Chemists JANCA2, Vol. 73, No. 5, p 761-763, September/October 1990. 2 fig, 2 tab, 7 ref.

Descriptors: *Fungicides, *Laboratory methods, *Pollutant identification, *Soil analysis, *Tricyclazole, *Water analysis, Chemical analysis, Flame photometry, Gas chromatography, Organic compounds, Soil contamination.

Tricyclazole, 5-methyl-1,2,4-triazolo(3,4-b)benzothiazole, is a systemic fungicide for control of rice blast disease. Tricyclazole can be extracted from soil by refluxing with ethyl acetate-acetone (80 + 20 v/v) and from water by partitioning into dichloromethane. The soil extract is purified by coagulation. The compound is detected and measured by gas chromatography using a flame photometer operated in the sulfur mode. Detection limits are 8 ppb for soil and 0.8 ppb for water. Recoveries for control samples fortified with tricyclazole at 0.1-5.0 ppm averaged 97.1% for soil and 108.1% for water. (Author's abstract)
W91-03846

ALTERATIONS IN THE ENERGY METABOLISM OF AN ESTUARINE MYSID (MYSIDOPSIS BAHIA) AS INDICATORS OF STRESS FROM CHRONIC PESTICIDE EXPOSURE.
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W91-03883

CHARACTERIZATION AND ASSAY CONDITIONS FOR USE OF ACHE ACTIVITY FROM SEVERAL MARINE SPECIES IN POLLUTION MONITORING.
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes. Lab. Effets Biologiques des Nuisances.
G. Bocquene, F. Galgani, and P. Truquet.
Marine Environmental Research MERSDW, Vol. 30, No. 2, p 75-89, 1990. 6 fig, 4 tab, 24 ref.

Descriptors: *Acetylcholinesterase, *Bioassay, *Bioindicators, *Laboratory methods, *Marine environment, *Monitoring, *Pollutant identification, *Water pollution effects, *Water quality, Biochemistry, Path of pollutants.

The use of biochemical change as an indicator of pollution has many advantages over chemical analysis, which can be difficult to perform and interpret. Moreover, among biological effects of pollutants, biochemical changes occur more quickly than physiological response, thus providing earlier warning of a potential pollution effect. Acetylcholinesterase (AChE) activity was investigated in eight marine species of potential value for monitoring pesticides. AChE, butyrylcholinesterase (BUChE) and propionylcholinesterase (PChE) activities were compared, and optimal conditions of extraction, storage and measurement were determined. TRIS extract buffer 0.1 M, pH 8, was found to provide good specific production. AChE activity was not altered by freezer storage at -20 C. Optimal measurement temperatures ranged from 20 to 34 C, and pH was optimal between 6.5 and 8.5. Because marine sediments are recognized as a suitable environment for chemical contaminants, benthic or demersal species have been selected for monitoring investigations. Plaice (Pleuronectes platessa) and common prawn (Palaemon serratus) were found to have the highest AChE levels are thus recommended for monitoring the effects of anticholinesterase compounds. (Lantz-PTT)
W91-03885

HEAVY METAL ACCUMULATION BY BARNACLES AND ITS IMPLICATIONS FOR THEIR USE AS BIOLOGICAL MONITORS.
Victoria Univ. of Manchester (England). Dept. of Environmental Biology.
M. I. Powell, and K. N. White.
Marine Environmental Research MERSDW, Vol. 30, No. 2, p 91-118, 1990. 1 fig, 5 tab, 81 ref.

Descriptors: *Barnacles, *Bioaccumulation, *Bioindicators, *Heavy metals, *Monitoring, *Path of pollutants, Bioassay, Biological studies, Cadmium, Copper, Lead, Marine environment, Salinity, Water quality, Zinc.

As part of an investigation into the suitability of barnacles as biological monitors, the effect of metal exposure and a number of intrinsic and extrinsic factors on Cd, Cu, Pb and Zn levels in Semibalanus balanoides bodies was examined, with limited comparative studies on Balanus crenatus. No regulation was apparent over exposure periods of up to 100 days at added concentrations of 5-60, 20-90, 50-200 and 20-80 microgm/L of Cd, Cu, Zn and Pb. Accumulation rates of metals in bodies and egg masses were proportional to added metal concentrations although rates in egg masses increased with brood time. A single collection at 50 days post-exposure gave a similar indication of ambient metal levels and would be preferable for a routine monitoring program. Metal levels were negatively correlated with body weight, necessitating weight-normalization of data. Decreases in body metal levels following transfer to an uncontaminated environment were due to dilution by body weight increase rather than excretion. Cadmium accumulation was most influenced by salinity and some other metals (Cu increased uptake although Zn had no effect). These experiments suggest that barna-

cles may be suitable monitors of Cu, Zn and possibly Pb. Intermetallic effects argue against their use to assess Cd contamination. (Author's abstract)
W91-03886

DETERMINATION OF RADON IN WATER BY ARGON PURGING AND ALPHA COUNTING WITH A PROPORTIONAL COUNTER.
Ecole Polytechnique, Montreal (Quebec).
For primary bibliographic entry see Field 7B.
W91-03888

5B. Sources Of Pollution

TRAVELTIME AND REAERATION COEFFICIENTS FOR THE NORTH PLATTE RIVER, CASPER TO ORIN, WYOMING.
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-02959

HYDROGEOLOGIC AND CHEMICAL DATA FOR THE O-FIELD AREA, ABERDEEN PROVING GROUND, MARYLAND.
Geological Survey, Towson, MD. Water Resources Div.
P. R. Nemoff, and D. A. Vroblesky.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-238, 1989. 70p, 18 fig, 24 tab, 3 ref.

Descriptors: *Aberdeen Proving Ground, *Aquifers, *Bottom sediments, *Groundwater, *Groundwater pollution, *Hydrologic data, *Landfills, *Maryland, *Organic compounds, *Organic solvents, *Surface water, *Water pollution sources, Chemical analysis, Confining beds, Contamination, Detection limits, Field tests, Herbicides, Hydrographs, Hydrology, Inorganic compounds, Lithologic logs, Migration, Radiation, Sampling, Volatility, Waste disposal, Water level.

O-Field, located at the Edgewood area of Aberdeen Proving Ground, Maryland, was periodically used for disposal of munitions, waste chemicals, and chemical-warfare agents from World War II through the 1950's. This report includes various physical, geologic, chemical, and hydrologic data obtained from well-core, groundwater, surface water, and bottom-sediment sampling sites at and near the O-Field disposal area. The data are presented in tables and hydrographs. Three site-location maps are also included. Well-core data include lithologic logs for 11 well-cluster sites, grain-size distributions, various chemical characteristics, and confining unit characteristics. Groundwater data include groundwater chemistry, method blanks for volatile organic carbon, available data on volatile and base/neutral organics, and compilation of corresponding method blanks, chemical-warfare agents, explosive-related products, radionuclides, herbicides, and groundwater levels. Surface-water data include field-measured characteristics; concentrations of various inorganic constituents including arsenic; selected organic constituents with method blanks; detection limits of organics; and a compilation of information on corresponding acids, volatiles, and semivolatiles. Bottom-sediment data include inorganic properties and constituents; organic chemistry; detection limits for organic chemicals; a compilation of information on acids, volatiles, and semivolatiles; and method blanks corresponding to acids, volatiles, and semivolatiles. A set of 15 water-level hydrographs for the period March 1986 through September 1987 also is included in the report. (USGS)
W91-02964

TIME OF TRAVEL OF SOLUTES IN THE TRINITY RIVER FROM DALLAS TO TRINIDAD, TEXAS, MAY AND AUGUST 1987.
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-02969

HYDROLOGY, AQUATIC MACROPHYTES, AND WATER QUALITY OF BLACK EARTH CREEK AND ITS TRIBUTARIES, DANE COUNTY, WISCONSIN, 1985-86.
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2H.
W91-02974

INTER-AGENCY RESEARCH AND TECHNICAL INTEGRATION.
For primary bibliographic entry see Field 5G.
W91-02987

FATE AND TRANSPORT OF AIRBORNE PESTICIDES: AN OVERVIEW OF ATMOSPHERIC MODELLING REQUIREMENTS.
Agricultural Research Service, Beltsville, MD. Environmental Chemistry Lab.
For primary bibliographic entry see Field 5G.
W91-02992

CONSIDERATIONS FOR DATA COLLECTION TO SUPPORT SIMULATION ANALYSES IN THE SATURATED ZONE.
For primary bibliographic entry see Field 7A.
W91-02994

PESTICIDES IN STREAMS OF THE UPPER MIDWESTERN UNITED STATES.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5G.
W91-03002

STATUS UPDATE--NATIONAL PESTICIDE SURVEY.
For primary bibliographic entry see Field 5G.
W91-03004

GEOLOGIC MAPPING FOR PROTECTION OF GROUNDWATER RESOURCES.
For primary bibliographic entry see Field 7C.
W91-03005

ACID DEPOSITION IN MARYLAND: SUMMARY OF RESULTS THROUGH 1988.
Maryland Dept. of Natural Resources, Annapolis. Chesapeake Bay Research and Monitoring Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-182729. Price codes: A08 in paper copy, A01 in microfiche. Report No. AD-89-1, January 1989. 150p, 28 fig, 23 tab, 163 ref, append.

Descriptors: *Acid rain, *Acid rain effects, *Maryland, *Path of pollutants, *Research, *Water pollution sources, Air pollution, Environmental effects, Legislation, National Acid Precipitation Assessment Program, Water pollution control.

The report builds on the information contained in the previous annual reports (PPRP, 1987; 1988) and provides a summary of the scientific principles upon which acid deposition research has been based. The findings of recent research conducted in Maryland are documented along with the results of other research projects which facilitate a better understanding of acid deposition issues in Maryland. Chapter II summarizes the findings reported in the 1987 Interim Assessment produced by the National Acid Precipitation Assessment Program (NAPAP). Chapter III discusses the emission of acid deposition precursors and the resulting transformation, transport and deposition of these materials. Chapter IV evaluates the potential effects of acid deposition on aquatic and terrestrial ecosystems, as well as on human health and physical materials. Chapter V presents recent information on control technologies and other means of reducing the emission of acid deposition precursors. Chapter VI presents a summary of recent federal legislative initiatives to control acid deposition. Chapter VII was drafted with direct contributions from the Acid Deposition Advisory Committee (ADAC), identifying areas of uncertainty that remain in the assessment of the potential impacts of acid deposition in Maryland. (Lantz-PTT)

Sources Of Pollution—Group 5B

W91-03025

RADIOLOGICAL SURVEY OF SAN DIEGO BAY.
Eastern Environmental Radiation Facility, Montgomery, AL.
M. O. Semler, and R. L. Blanchard.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-210645. Price codes: A03 in paper copy, A01 in microfiche. EPA Report EPA 520/5-88-019, June 1989. 20p, 4 fig, 4 tab, 3 ref, append.

Descriptors: *Naval operations, *Nuclear reactors, *Path of pollutants, *Radioactive wastes, *Radioactivity, *San Diego Bay, *Water pollution sources, California, Cesium radioisotopes, Cobalt radioisotopes, Ecological effects, Sediment contamination, Tritium.

The Office of Radiation Programs of the US EPA identifies and evaluates environmental public health impacts of both natural and man-made radiation sources. Results of a survey conducted by the Eastern Environmental Radiation Facility personnel to assess the levels of environmental radioactivity resulting from maintenance and operation of nuclear powered warships in Dan Diego Bay, California are presented. A radiological survey of three sites in San Diego Bay provided the basis for the following conclusions: (1) Small quantities of 60-Co (0.02-0.05 pCi/g) are present in the bottom sediments in some areas of the harbor at the Submarine Base. Most, if not at all, of the 60-Co contamination present probably originated prior to the earlier 1967 survey that reported 60-Co as much as 300 times larger than those observed in this study. The highest 60-Co concentration measured is now less than 1% of the normal background radioactivity in harbor sediment samples. (2) No tritium or gamma ray detectors, other than trace amounts of those occurring naturally, were detected in surface water from the dock areas or in nearby drinking water supplies. (3) Only radionuclides of natural origin and trace amounts of 137-Cs from fallout of previous nuclear weapons tests were detected in samples of kelp, algae, and fish taken from the harbor at the Submarine Base. (4) Gamma-ray surveys of the harbors near the docking areas and along shorelines and beaches near the shipyards failed to detect any exposure rates above background. (5) Based on this survey, operations related to nuclear-powered warship activities have contributed no increase in radioactivity to the harbors in San Diego Bay that would result in significant population exposure or contamination of the environment. Thus, under present conditions, Naval operations within San Diego Bay pose no radiological health problems to the public. (Lantz-PTT)
W91-03026

WATER-QUALITY VARIABILITY IN A CENTRAL FLORIDA WETLAND RECEIVING HIGHWAY RUNOFF.
Geological Survey, Altamonte Springs, FL.
D. M. Schiffer.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 7A-1--7A-11, 3 fig, 3 tab, 5 ref.

Descriptors: *Detention reservoirs, *Florida, *Highways, *Storm wastewater, *Urban runoff, *Water management, *Water pollution sources, *Water quality, *Wetlands treatment, Ammonia, Heavy metals, Lead, Orlando, Path of pollutants, Phosphorous, Sedimentation, Wetlands, Zinc.

Constituent concentrations were measured at the stormwater inlet and outlet, and at 9 other sites within a wetland receiving highway runoff, located north of Orlando, Florida. Most of the reduction in constituent concentrations in water observed in the wetland occurred within 100 feet of the stormwater inlet. Constituent concentrations measured in the wetland bed sediments indicate that the primary removal mechanism may be sedimentation. The 9 sampling sites within the wetland, in groups of three, were about 30, 100, and 250 ft from the stormwater inlet. Statistical analysis

of the data collected at the sampling sites indicate that for 26 of the 40 water quality variables, the mean values differ significantly (alpha equal to 0.05) with distance from the inlet. These differences were most frequently detected between the sites that are within 30 ft and 100 ft from the inlet. Constituents that generally decreased in concentration with distance from the inlet include total phosphorous, ammonia, lead and zinc. The median total phosphorous concentration at the inlet was 0.23 mg/l at 100 ft, and decreased to 0.04 mg/l at 100 ft. Total ammonia was 0.23 mg/l at the inlet, decreasing to 0.01 mg/l 100 ft away. Median concentrations decreased from 18 micrograms/l at the inlet to 4 micrograms/l at a distance of 100 ft, and median zinc concentrations decreased from 75 micrograms/l to 20 micrograms/l over the same distance. (Author's abstract)
W91-03058

PROCESSES AFFECTING RETENTION OF WATER-QUALITY CONSTITUENTS IN A DETENTION POND-WETLAND SYSTEM.
Geological Survey, Altamonte Springs, FL.
For primary bibliographic entry see Field 5D.
W91-03059

STATISTICAL-BASED METHODOLOGY FOR PRIORITIZING THE VULNERABILITY OF COMMUNITY GROUND-WATER SUPPLIES TO CONTAMINATION.
Illinois State Water Survey Div., Champaign.
K. J. Hlinka, and J. M. Shafer.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 8B-15--8B-23, 4 fig, 1 tab, 3 ref, append.

Descriptors: *Classification, *Geographic information systems, *Groundwater pollution, *Groundwater quality, *Groundwater resources, *Illinois, *Risk assessment, *Water resources management, Data interpretation, Maps, Public health, Water quality control.

Nearly 45% of all groundwater withdrawn in Illinois is used for public water supply. Therefore the susceptibility of community wells to contamination is a reasonable focus for public health concerns regarding groundwater quality. A methodology has been developed for prioritizing counties within Illinois according to the vulnerability of community groundwater supplies to contamination. A basic assumption is that the shallower the well, the more susceptible it is to contamination from surface activities. A geographic information system (GIS) was used to compute county composite vulnerability rankings and to develop computer generated maps showing statewide priority rankings. The GIS was also used to plot the distribution and depth of municipal wells included in the prioritization. Public water supply information from the Illinois EPA was provided by the Public-Industrial Commercial Survey database (PICS) of the Illinois State Water Survey (ISWS). Counties in central Illinois with a relatively large number of municipal wells finished in shallow sand and gravel deposits, were determined to have the greatest vulnerability. The results of this prioritization will be used by planning agencies to initiate groundwater protection efforts in counties with the highest ratings. (See also W91-03032) (Author's abstract)
W91-03071

GROUND WATER MODELING ANALYSIS FOR A CONTAMINATED WATER-SUPPLY WELL FIELD IN INDIANA.
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 2F.
W91-03081

BIOTREATMENT: THE USE OF MICROORGANISMS IN THE TREATMENT OF HAZARDOUS MATERIALS AND HAZARDOUS WASTES.
For primary bibliographic entry see Field 5D.
W91-03097

METABOLIC DIVERSITY OF MICROBIAL BTEX DEGRADATION UNDER AEROBIC OR ANOXIC CONDITIONS.
Michigan Univ., Ann Arbor. Medical Center.
For primary bibliographic entry see Field 5D.
W91-03099

SEDIMENT AND NUTRIENT LOSSES FROM SUBSURFACE DRAINAGE.
Florida Univ., Gainesville. Dept. of Agronomy.
A. Bottcher, E. J. Monke, D. B. Beasley, and L. F. Huggins.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 622-633, 7 fig, 2 tab, 5 ref.

Descriptors: *Agricultural runoff, *Nonpoint pollution sources, *Nutrient loss, *Sediment yield, *Subsurface drainage, *Water pollution sources, Beans, Corn, Fertilizers, Indiana, Monitoring, Nitrogen losses, Performance evaluation, Seasonal distribution, Tillage, Water quality control, Wheat.

Erosion control practices often increase subsurface drainage and related nutrient losses. Since subsurface drainage is becoming more and more common, its water quality impacts need to be understood. A study was conducted with two objectives: to determine the water quality impact of the subsurface drainage system and to relate field management practices to the system's potential to pollute downstream waters. The monitored subsurface tile field (17.4 ha) is 2 mi south of Woodburn, Indiana; it has less than 1% slope and has raised field borders formed by ditching around the field. Ninety-five percent of the field is a Hoytville silty clay. The drainage system outlet was monitored for flow and water quality parameters using automatic sampling and recording equipment from April 1976 to June 1981. Different crops (corn, beans, wheat) were grown during the monitoring period and moldboard plowdown and disking were used. Fertilization was urea, ammonia, or ammonium nitrate. When surface runoff is restricted, subsurface drainage systems can control erosion and losses of sediment-associated nutrients and P in drainage water. However, N losses are only moderately reduced by such a system. Most of the subsurface drainage from the 17-ha field occurred as the result of winter moisture accumulation. Profile storage and increased evapotranspiration reduce summer subsurface drainage flow to nearly zero. More than 70% of the N lost in the drainage water was in the nitrate form. Approx 70% of the P lost was in the form of sediment-bound P. Sediment, sediment-bound P, and pesticides moved through the soil profile, indicating the presence of direct flow channels during periods of a storm. Tillage can moderately increase the leaching of sediment, sediment-associated nutrients, and soluble nutrients for a short period afterward. Heavy rain shortly after fertilization can increases of N and to a lesser degree P through the subsurface drainage system. (See also W91-03117) (Rochester-PTT)
W91-03168

NUMERICAL GROUNDWATER QUALITY MODELLING: THEORETICAL BASIS AND PRACTICAL APPLICATIONS.
Gesamthochschule Kassel (Germany, F.R.).
For primary bibliographic entry see Field 2F.
W91-03192

GROUNDWATER CONTAMINATION: PROCESSES, CHARACTERIZATION, ANALYSIS, AND REMEDIATION.
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5G.
W91-03194

COUPLED MODELLING OF WATER CYCLE AND NITRATE TRANSPORT IN A HYDROLOGICAL SYSTEM.
Q. Z. Geng, G. Girard, and E. Ledoux.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 283-297, 6 fig, 2 tab, 4 ref.

Descriptors: *Groundwater pollution, *Hydrologic models, *Model studies, *Nitrates, *Nonpoint pollution sources, *Path of pollutants, Farm wastes, Flow models, France, Groundwater management, Groundwater movement, Surface-groundwater relations, Water resources development, Water resources management.

On a global scale, the main input of nitrogen in the ground comes from natural fixation of the nitrogen contained in the air; however, the major nitrogen pollution in water is caused by intensive agricultural activities. The nitrogen cycle which is responsible for the transfer of pollutant from the soil to the aquifers is governed by multiple and complex phenomena which must be simplified before attempting its modeling. A conceptual model of nitrate-leaching into the soil, taking into account nitrogen input and agricultural techniques. This model is compatible with a previously-developed spatially-discretized model of both surface and groundwater flow. This model has been validated to a lysimetrical case scale as well as to the scale of a small cultivated watershed in France. A foreseen utilization of such a model is the study of the influence of agricultural applications on the long-range evolution of groundwater quality. (See also W91-03178) (Fish-PTT)
W91-03195

ADIRONDACK WATERSHED DATA BASE: ATTRIBUTE AND MAPPING INFORMATION FOR REGIONAL ACIDIC DEPOSITION STUDIES.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 7C.
W91-03234

EFFECTS OF MISSING DATA ON THE CALCULATION OF PRECIPITATION-WEIGHTED-MEAN CONCENTRATIONS IN WET DEPOSITION.
Atmospheric Environment Service, Downsview (Ontario).
A. Sirois.
Atmospheric Environment Part A: General Topics AEATEN, Vol. 24, No. 9, p 2277-2288, September 1990. 9 fig, 2 tab, 8 ref.

Descriptors: *Acid rain, *Data quality control, *Meteorological data, *Precipitation, *Statistical analysis, *Water pollution sources, Algorithms, Nitrates, Simulation analysis, Sulfates, Uncertainty.

Uncertainties in the calculation of monthly, seasonal and annual precipitation-weighted-mean concentrations due to missing data are addressed. An algorithm is presented to estimate the effects of missing samples through the use of a simulation technique. Quantitative estimates of uncertainty due to missing data are given for monthly, seasonal and annual precipitation-weighted-mean sulfate and nitrate concentrations at six monitoring sites where daily precipitation samples were taken. It is found that the expected value of the precipitation-weighted-mean concentration estimator is biased if the percentage of missing samples (%MN), and the percentage (%MP) of the precipitation amount associated with the missing samples, are different. The absolute value of the bias becomes larger as the difference increases. The standard deviation of the estimator increases with increasing values of %MP. For a given value of %MP, it is a minimum when %MN is equal to %MP, and increases with increasing differences between %MN and %MP. These results indicate that %MN of about 10%, which is not uncommon in precipitation networks data, gives an uncertainty of about 10, 5, and 2% for monthly, seasonal and annual averaging periods, respectively. Of the types of application given, the calculation of confidence intervals for two or more precipitation-weighted-mean concentrations should be the most useful for day-to-day applications. (Author's abstract)
W91-03293

LABORATORY STUDY ON THE SCAVENGING OF SO2 BY SNOW CRYSTALS.
Mainz Univ. (Germany, F.R.). Meteorological Inst.
S. K. Mitra, S. Barth, and H. R. Pruppacher.
Atmospheric Environment Part A: General Topics AEATEN, Vol. 24, No. 9, p 2307-2312, September 1990. 5 fig, 1 tab, 26 ref. Ministry for Research and Technology of the F.R.G Project 325-4007-070458 and German National Science Foundation Project SFB-233.

Descriptors: *Acid rain, *Path of pollutants, *Precipitation scavenging, *Snow, *Sulfur dioxide, Chemistry of precipitation, Cloud chemistry, Crystal growth, Hydrogen peroxide, Ice.

The uptake of sulfur dioxide (SO2) by dendritic snow crystals was studied in two laboratory experimental series. In the first series, the uptake of SO2 was studied during the growth of the snow crystals from water vapor with and without the presence of hydrogen peroxide (H2O2) in the air. In the second series, the uptake of SO2 by snow crystals which had completed their growth was examined. Results showed that under both conditions SO2 became scavenged by snow crystals. The uptake of SO2 was particularly pronounced during the growth of the snow crystals, and at temperatures close to 0 C where a quasi-liquid layer exists at the surface of ice. The SO2 uptake became enhanced in the presence of H2O2. The present results are in qualitative agreement with previous studies involving bulk ice. (Author's abstract)
W91-03296

INTERACTION BETWEEN EQUILIBRATION PROCESSES AND WET OR DRY DEPOSITION.
California Inst. of Tech., Pasadena. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2B.
W91-03297

NUMERICAL SIMULATION OF WET SCAVENGING OF AIR POLLUTANTS: I. MODELING OF SEQUENTIAL PRECIPITATION RATES AT THE GROUND.
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical Engineering.
W. T. Tsai, and E. R. Altwicker.
Atmospheric Environment Part A: General Topics AEATEN, Vol. 24, No. 9, p 2473-2483, September 1990. 11 fig, 1 tab, 25 ref.

Descriptors: *Acid rain, *Air pollution, *Mathematical models, *Path of pollutants, *Precipitation rate, *Precipitation scavenging, Chemistry of precipitation, Cloud physics, Convective precipitation, Numerical analysis, Simulation analysis, Wind velocity.

A one-dimensional Eulerian transport/transformation/removal model is developed to explain and predict existing field data and chemical compositions of precipitation. The PLUVIUS model is used as the framework for the proposed model with significant modifications which take into consideration cloud dynamics, microphysics, and water phase. The equation of motion is solved to generate a vertical wind velocity profile for convective precipitation. The upwind scheme is used to handle the convective, non-linear transport problem. The modeling results of ground precipitation rates for a summer convective shower indicate that the precipitation rate is sensitive to the following precipitation parameters: autoconversion rate, cloud water concentration, relative humidity, entrainment rate, and the heights of cloud base and cloud type. (See also W91-03299) (Author's abstract)
W91-03298

NUMERICAL SIMULATION OF WET SCAVENGING OF AIR POLLUTANTS: II. MODELING OF RAIN COMPOSITION AT THE GROUND.
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical Engineering.
W. T. Tsai, and E. R. Altwicker.
Atmospheric Environment Part A: General Topics AEATEN, Vol. 24, No. 9, p 2485-2498, September 1990. 9 fig, 4 tab, 38 ref.

Descriptors: *Acid rain, *Air pollution, *Chemistry of precipitation, *Mathematical models, *Path of pollutants, *Precipitation scavenging, Ammonia, Convective precipitation, Hydrogen peroxide, Nitrates, Numerical analysis, Ozone, Sulfates, Sulfur.

The modeling of rain composition for a convective shower (Tucson, Arizona, 10 September 1977) and a frontal precipitation event (Den Helder, Holland, 12 December 1978) is performed by including the pollutant species and wet scavenging mechanisms into the mass transport equation of a sequential sampling model. The major scavenging mechanisms for most pollutants in convective showers appear to be similar to those in frontal precipitation. The major scavenging mechanisms for ammonium and nitrate are gas absorption, whereas the absorption of sulfur dioxide by aqueous drops and oxidation of S(IV) by hydrogen peroxide and ozone in the aqueous phase are the major formation and scavenging mechanisms for sulfate. The scavenging by raindrops in the below-cloud region is the dominant removal mechanism for coarse particles, whereas nucleation is the major scavenging mechanism for submicrometer particles. Hydrogen peroxide is the most important oxidant responsible for the oxidation of S(IV) and the formation of sulfate in precipitation. The contributions of both sulfur dioxide plus hydrogen peroxide and sulfur dioxide plus ozone reactions to sulfate concentration in precipitation are larger for convective precipitation than for frontal precipitation. (See also W91-03298) (Author's abstract)
W91-03299

METALS IN ULVA LACTUCA IN HONG KONG INTERTIDAL WATERS.
Hong Kong Univ. Dept. of Botany.
Y. B. Ho.
Bulletin of Marine Science BMRSAW, Vol. 47, No. 1, p 79-85, July 1990. 3 fig, 3 tab, 11 ref.

Descriptors: *Algae, *Bioaccumulation, *Bioindicators, *Heavy metals, *Hong Kong, *Intertidal areas, Cadmium, Copper, Iron, Lead, Manganese, Nickel, Zinc.

The levels of Mn, Fe, Ni, Cu, Zn, Cd, and Pb in Ulva lactuca collected from 24 intertidal sites around the Island of Hong Kong were determined by flame atomic absorption spectrophotometry. Twelve of the sites are in the rural southern parts of the island where the coastal waters are relatively clean. The remaining 12 sites are located in the north and within Victoria Harbor which receives, apart from industrial effluents, untreated domestic sewage from a population of some 3.5 million. The mean levels of Mn, Fe, Ni, Cu, Zn and Pb in Ulva from the urban sites were respectively 4.0, 4.6, 1.8, 2.3, 2.4, and 4.6 times those from the rural sites. However, somewhat similar levels of Cd were found in the alga amongst all the sites. Some locations of high levels of metal contamination have been identified in Victoria Harbor. Preliminary findings indicated that Ulva is a good indicator of Mn, Fe, Cu, Zn and Pb contamination due to its cosmopolitan distribution, simple morphology leading to ease of growth assessment, and its graded tolerance and response to pollutants. (Author's abstract)
W91-03301

IMPACT OF INTENSIVE IRRIGATION ON GROUNDWATER REGIMEN IN PARTS OF OSMANSAGAR AREA, R. R. DISTRICT, A. P., INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
For primary bibliographic entry see Field 5G.
W91-03334

GROUNDWATER QUALITY OF AN ALLUVIAL AQUIFER.
Centre for Water Resources, Madras (India).
L. Elango, S. Manickam, M. V. Somasundaram, and J. H. Tellam.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 715-732, 8 fig, 1 tab, 11 ref.

Descriptors: *Alluvial aquifers, *Groundwater quality, *India, *Irrigation effects, *Nonpoint pollution sources, *Path of pollutants, *Water pollution sources, Confined aquifers, Evaporation, Groundwater management, Hydrologic budget, Mathematical models, Saline water, Seasonal variation, Water demand, Water supply.

A preliminary study was conducted of long-term water quality in the heavily exploited Arani-Korttalai alluvial aquifer in southern India. The aquifer consists of a low-permeability unconfined part that acts as a semi-confining layer to the lower high-permeability portion. The system is heavily pumped for water supply and local irrigation. Flow modeling suggests that much of the pumped water in deep wells is supplied by vertical leakage from the upper layer. Water quality is very variable spatially and appears to reflect the importance of vertical flow; some correlation with land use is observed. Water quality varies seasonally, with some wells showing and increase in salinity as water levels rise in response to the monsoon. This appears to be due to flushing of evaporation-concentrated salt in the unsaturated zone. Long-term data suggest that the system is generally stable chemically, possibly because of the volume of rainfall recharge. In some locations, however, water quality is changing. Preliminary salt balance calculations suggest that the system could be sensitive to changes in chemical inputs (especially fertilizers) under certain circumstances. (See also W91-03311) (Author's abstract)
W91-03335

ANALYSIS OF BREAKTHROUGH CURVES FOR ASSESSING MOVEMENT OF CONTAMINANTS.
Central Soil Salinity Research Inst., Karnal (India).
S. K. Gupta.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 769-777, 4 fig, 3 tab, 13 ref.

Descriptors: *Groundwater movement, *Groundwater pollution, *Mathematical models, *Model studies, *Path of pollutants, *Solute transport, Breakthrough curves, Groundwater quality, Mathematical equations, Monitoring, Porous media.

Transport of chemicals in porous media has received much attention as well-documented studies on pollution of groundwater resources from agricultural non-point sources have appeared. Movement of chemical in groundwater pollution problems has been studied mostly with breakthrough curves. A refinement to this approach has been developed based on the analysis of breakthrough curves for linearly absorbing ions. The theory has been developed to present dimensionless leached fractions and parameter identification equations. Whereas the solute concentration curves for adsorbing and non-adsorbing solutes merge at some pore volume, the leached fraction curves remain separate at all pore volumes. This is because part of the solute is adsorbed on the solid matrix. At higher pore volumes, the solutes in the solution phase, for both the interacting and non-interacting ions, are similar in concentration. At higher pore volumes the leached fraction becomes independent of the Peclet number and is a function of pore volume and the adsorption parameter (k) only. This fact provides the basis for deriving parameter identification equations. An equation is derived that is a variation of the solution of the dispersion convection model used as the basis for groundwater quality models. In the new form, the equation permits the direct evaluation of the threats to groundwater by giving the fraction of the total

solute that will contribute to groundwater loading. The method work wells when an comprehensive data base is lacking, allows the estimation of more than one pore volume parameter simultaneously without the need for additional tests for estimation of the adsorption coefficient, and eliminates the need for a breakthrough curve in field studies for parameter identification. The proposed changes do not force a major change in the existing framework of field management models applied to groundwater quality and monitoring programs. (See also W91-03311) (Rochester-PTT)
W91-03340

DISPERSION OF POLLUTANTS IN POROUS MEDIA FLOW ONE-DIMENSIONAL APPROACH.
College of Engineering, Poona (India).
D. G. Paygude, B. Vasudeva Rao, and S. G. Joshi.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 779-790, 7 fig, 12 ref.

Descriptors: *Computer models, *Finite element method, *Groundwater movement, *Groundwater pollution, *Mathematical equations, *Model studies, *Path of pollutants, *Solute transport, Cost analysis, Courant number, Peclet number, Porous media, Sparse matrix.

A numerical solution was developed for the one-dimensional form of the convective-dispersion equation for the case of saturated homogeneous isotropic flow in porous media using Galerkin's finite element formulation. The results obtained with the numerical solution were compared with those of the available analytical solution and the stability of the numerical result was studied in terms of the Courant number and Peclet number. The finite element method (FEM) results were in close agreement with those of the analytical solution. One-dimensional FEM results were stable for wider ranges of Courant number and Peclet number than had been previously stated. There was about a 70-80% saving in memory core of the computer when a compact storage scheme to store the Sparse matrix was employed. There was a considerable saving in central processing unit time when an element matrix was formed by using direct integration instead of numerical integration. (See also W91-03311) (Rochester-PTT)
W91-03341

NUMERICAL MODELLING OF MASS TRANSPORT EQUATION.
Banaras Hindu Univ., Varanasi (India). Dept. of Geophysics.
M. Banerjee.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 791-802, 2 fig, 14 ref.

Descriptors: *Groundwater movement, *Mathematical models, *Model studies, *Numerical analysis, *Path of pollutants, *Saline water intrusion, *Solute transport, Convection, Diffusion, Dispersion, Finite difference methods, Groundwater pollution, Hydrodynamics, Hysteresis, Infiltration, Soil water.

The general vertical mass transport equation for a porous medium involves convection, molecular diffusion, and hydrodynamic dispersion. This is a cumbersome hydrodynamic problem that must be solved only by a numerical technique. A numerical finite difference model was developed for solving the convective-diffusive-dispersion equation for mass transport through a rigid isotropic and homogeneous medium. Computer experiments were conducted for salt disposition within a profile of porous material. The results for mass concentration within a profile during infiltration and distribution processes are presented here for a soil column 3.5 m in length. They exhibit a lag in salinity front and salt peak. The dispersion effect was more pronounced during a redistribution event, thus indicating the importance of a numerical model, which accounts for hysteresis. Studies of salt movement under intermittent conditions indicate that most of the salt is being transported by convection, but dispersion is more significant during each cycle of intermittency. The shape of the concentration profiles is altered due to increasing dispersion. Models such as the present one may provide guidelines for setting the control between the surface supply of salt with water and the changes in the quality of soil water and groundwater during irrigation. (See also W91-03311) (Rochester-PTT)
W91-03342

SINGLE-PHASE/TWO-PHASES NUMERICAL MODEL USING NESTED SQUARE MESHES.
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 2F.
W91-03343

SEMI-ANALYTIC SOLUTION OF ONE-DIMENSIONAL DISPERSION CONVECTION EQUATION.
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
S. Ram Singh, A. Kumar Saini, and S. K. Kamra.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 867-878, 2 fig, 13 ref.

Descriptors: *Convection, *Dispersion, *Groundwater movement, *Model studies, *Path of pollutants, *Solute transport, Differential equations, Finite element method, Mathematical equations, Mathematical models, Peclet number, Performance evaluation, Porous media, Semi-analytic solutions, Soil water.

The dispersion convection equation adequately describes the transport of a solute in porous media. The spatial discretization of the one-dimensional equation by Galerkin's finite element method yields a system of time-dependent, inhomogeneous ordinary differential equations. The solution of such an inhomogeneous matrix-vector differential equation is obtained with the help of the matrix exponential in exactly the same way as would be used with a scalar equation. The eigenvalue-eigenvector method of Euler is employed for computing the matrix exponential. The resulting solution is continuous in time. Results from this new model were compared with an analytic solution of the dispersion equation for describing the distribution of solutes flowing into a soil column of finite length. At low Peclet numbers the deviation in the semi-analytic solution compared to the analytic one is negligible. The error decreases with increased time at all Peclet numbers. At low Peclet numbers the trend is uniformly decreasing, whereas at high Peclet numbers it decreases with oscillation. (See also W91-03311) (Rochester-PTT)
W91-03348

NITRATE POLLUTION OF GROUNDWATER IN LUCKNOW AREA, U. P.
Central Ground Water Board, Lucknow (India).
V. K. Sahgal, R. K. Sahgal, and Y. P. Kakar.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 879-891, 2 fig, 4 tab, 12 ref.

Descriptors: *Groundwater pollution, *India, *Nitrates, *Path of pollutants, *Water pollution control, *Water pollution sources, Animal wastes, Fertilizers, Land disposal, Leaching, Lucknow, Public health, Septic tanks, Wastewater pollution.

With the establishment of a direct relationship between nitrate concentrations in drinking water and the incidence of methemoglobinemia, which can be fatal to infants, the study of nitrate in water supplies has assumed great importance. Studies were undertaken in the Lucknow area, India, demonstrating that nitrate levels several times higher than the prescribed limit of 45 mg/L were present. Nitrate concentrations in groundwater exceed 100 mg/L at several places and concentrations as high as 650 mg/L have been observed in shallow groundwater. Pollutants have adversely affected the groundwater quality in the depth range 100-135 m, with nitrate concentrations of 145, 168, and 590 mg/L in some of the tubewells. Preliminary investigations have identified the sources of nitrate pollution as leachates from soak pits, septic tanks, unlined sewage drains, and abandoned wells used for dumping wastes. Regular surveillance of nitrate is necessary. Measures that would help control this type of groundwater pollution include: (1) lining of drains carrying sewage to the river; (2) grouting of septic tanks found to be leaky; (3) treatment of raw sewage before it is discharged on land; (4) closing of abandoned wells to prevent their use for dumping of wastes; (5) use of fertilizers at optimal levels to prevent leaching to the groundwater; and (6) better management of wastes from dairy animals to prevent leaching to the groundwater. (See also W91-03311) (Rochester-PTT)
W91-03349

STUDY OF GROUNDWATER POLLUTION AT TIRUMALA, TIRUPATI, INDIA.
National Geophysical Research Inst., Hyderabad (India).
B. S. Sukhija, D. V. Reddy, and V. K. Saxena.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 893-897, 4 fig, 1 ref.

Descriptors: *Groundwater pollution, *India, *Water pollution sources, Groundwater chemistry, Nitrates, Path of pollutants, Sewers, Urban areas, Water chemistry, Water level.

The Tirumala temple at Tirupati, India, is one of the biggest pilgrim centers in India. North of the temple is a large water reservoir called Pushkarni in which thousands of devotees bathe before entering the temple. Dense residential complexes surround the temple. The sewers are both lined and unlined, and run along the four streets of the temple. An investigation was undertaken to determine the nature and extent of groundwater pollution in the area of the temple and to identify possible sources of pollution. Special emphasis was placed on four wells (Bangaur Bavi, Viraja Nadi, Pottu Bavi, and Poola Bavi). Including these four important wells, around 60 wells were monitored for water levels and water chemistry. Water level data collected so far indicate the presence of groundwater mounds around the temple area, with the movement of the Pushkarni water toward the well in the temple area. Groundwater chemistry indicates excess nitrates and suspended solids in most of the wells. The nitrate contents of the Pushkarni are close to those of two nearby wells supporting the influent condition of the Pushkarni. High contents of suspended solids, fat, and food material were detected in one of the wells. A simple tracer experiment established that a large kitchen was an important source of pollution. (See also W91-03311) (Rochester-PTT)
W91-03350

DISTRIBUTION OF FLUORIDE IN SHALLOW AQUIFERS IN AND AROUND DISTRICT ROHTAK, HARYANA STATE.
Panjab Univ., Chandigarh (India). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W91-03354

NITRATE POLLUTION IN THE GROUNDWATER OF SANGAREDDY AREA, ANDHRA PRADESH, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
G. Shankar Naryana, V. Sudarshan, and C. Narsimulu.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 917-920, 1 fig, 4 ref.

Descriptors: *Groundwater pollution, *India, *Nitrates, *Water pollution sources, Drinking water, Manjira River, Sangareddy area, Surveys, Wells.

The hydrogeochemical investigations of the groundwater from parts of the Manjira River basin (India) revealed two main zones of nitrate facies. Forty-two representative samples were obtained from dug wells, dug-cum-borewells, borewells, and filter points and analyzed with an Orion EATM expandable ion analyzer. The nitrate concentrations in the northern region of the river are below 45 ppm, which is the safe limit prescribed by the World Health Organization for potability of water. On the southern region of the river near Sangareddy township concentrations varied from 45 to 165 ppm. Although nitrogen fertilizers are often the cause of excessive nitrates in groundwater, no N fertilizer use or related industries exist in the study area. It is concluded that some other, unknown, anthropogenic cause accounts for the observed high nitrate levels. (See also W91-03311) (Rochester-PTT)
W91-03355

RADON, RADIUM AND URANIUM IN DRINKING WATER.
For primary bibliographic entry see Field 5F.
W91-03366

RADON TRANSFERRED FROM DRINKING WATER INTO HOUSE AIR.
Maine Univ. at Orono. Dept. of Physics and Astronomy.
C. T. Hess, M. A. Vietti, E. B. Lachapelle, and J. F. Guillemette.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 51-67. 5 fig, 6 tab, 20 ref. U.S. EPA Cooperative Agreement CR813554-01-2.

Descriptors: *Air pollution, *Drinking water, *Path of pollutants, *Radioisotopes, *Radon, Analytical methods, Maine, Pollutant identification, Population exposure, Water use.

A study was conducted to locate homes with high values of Rn-222 in the state of Maine. Forty Maine houses were selected with alleged Rn-222 in water concentrations higher than 5000 pCi/L. Rn-222 measurements were performed during two periods in each residence from Oct. 1986 to June 1987. During one period of approximately two hours duration, measurements were made while a series of simulated water use activities were conducted. Radon monitoring was performed over a second period of 24 hours, during which the residents used water according to their normal daily routine. Radon in water ranged up to 193,000 pCi/L. Water bursts ranged from 160-928 L. House volumes ranged from 190,000 to 2.2 million L. Air exchange was measured by both SF6 tracer diffusion and Rn-222 loss. The decay constant for SF6 ranged from 0.188 to 1.65 per hour, and the decay constant for Rn-222 ranged from 0.142 to 1.33 per hour. Emissivity ranged from 0.00 to 5.10, and Rn-222 transfer coefficients ranged from 0.00116 to 0.0000000301. The average value of the 24-hour transfer coefficient is 0.0000267 and is lower than the previous average of 0.00010. (See also W91-03366) (Agostine-PTT)
W91-03371

RELATIONSHIP OF RADIUM AND RADON WITH GEOLOGICAL FORMATIONS.
Research Planning Inst., Inc., Columbia, SC.
J. Michel.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 83-95. 3 fig, 2 tab, 19 ref.

Descriptors: *Geochemistry, *Geologic formations, *Radioisotopes, *Radium, *Radon, *Water pollution sources, Aquifers, Groundwater transport, Lithology, Radioactive half-life, Reviews, Water quality management, Wells.

A review is given of the available information for the isotopes Ra-228, Ra-226 and Rn-222 in groundwater, with emphasis on aquifers used as public water supplies. Ra-226 and Ra-228 are very different in several important ways. First, they are from different decay series. Ra-226 is the fifth member of the uranium-238 series and decays by alpha emission. Because U forms soluble complexes under oxidizing conditions it can be transported by groundwater over long distances. Ra-228 is the second member of the thorium-232 series and decays by beta emission. Th is extremely insoluble and is not subject to mobilization by groundwater. A second difference affecting the groundwater distribution of the Ra isotopes is their half-lives, 5.7 years for Ra-228 versus 1622 years for Ra-226. The Environmental Protection Agency sponsored two studies to determine the feasibility of using aquifer type and water-quality characteristics to predict the occurrence of Ra-228 in groundwater. An aquifer classification scheme was developed and the results were used to generate a map of the U.S. showing the distribution of areas with high, medium, and low probability of having elevated Ra-228. A similar, although more detailed, map was generated for Ra-226. Much more data were available for Ra-226 due to monitoring requirements and the fact that it is easier to measure. Radon is a gas with no chemical affinities and a half-life of 3.8 days. It is not transported any significant distance in groundwater and its concentration in a well is directly controlled by the lithology of the aquifer solids adjacent to the well. Numerous studies of radon in groundwater have shown that small public water supplies and private wells have the highest levels of Rn. This is apparently due to the relationship between system size and aquifer composition or rock type. (See also W91-03366) (Agostine-PTT)
W91-03372

OCCURRENCE OF RADIONUCLIDES IN DRINKING WATER, A NATIONAL STUDY.
Environmental Protection Agency, Cincinnati, OH. Office of Administration and Resources Management.
J. Longtin.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 97-139. 8 fig, 11 tab, 8 ref.

Descriptors: *Data collections, *Distribution patterns, *Drinking water, *Geochemistry, *Radioisotopes, *Surveys, *Water pollution sources, Baseline studies, Geography, Groundwater, Political aspects, Water quality control, Water quality standards.

The results of the National Inorganics and Radionuclides Survey (NIRS) are reviewed to develop some perspective on the national occurrence of radon in drinking water originating from groundwater sources. The study, which was conducted by the Environmental Protection Agency (EPA), is compared to previous experience. Included in the discussion are radium, radon, and uranium. The geographical scope of the survey included the United States, its territories and possessions. The universe of community groundwater supplies is inventoried in the EPA Federal Reporting Data System (FRDS) database. A random sample of 1000 sites, stratified into four population categories, was selected from this inventory. The actual sampling was done between July 1, 1984, and October 331, 1986. Samples and site data were collected by state personnel regularly employed in sampling for monitoring drinking water quality. The physical samples were supplemented by collecting a variety of site information which included the following: (1) NIRS sample number, (2) FRDS public water supply identification number, (3) Location information, (4) Site information and (5) Well information (for individual wells in system). Despite the fact that a comprehensive study of the data has not yet been done, sufficient appraisal has been concluded to demonstrate that general agreement exists between NIRS and previous data. Extensive site and quality control information augmenting the results will permit the NIRS results to be used for a variety of purposes. The survey has yielded an important database that will complement existing information and assist understanding of the occurrence of radionuclides in the United States. (See also W91-03366) (Agostine-PTT)
W91-03373

GASTROINTESTINAL ABSORPTION OF SOLUBLE URANIUM FROM DRINKING WATER BY HUMANS.
Utah Univ., Salt Lake City. Environmental Radiation Lab.
M. E. Wrenn, N. P. Singh, H. Ruth, M. L. Rallison, and D. P. Burleigh.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 159-163. 2 fig, 1 tab, 8 ref. U.S. EPA Contract CR-812681-01-03.

Descriptors: *Absorption, *Drinking water, *Gastrointestinal absorption, *Human physiology, *Path of pollutants, *Uranium, Alpha spectrometry, Analytical methods, Radioisotopes, Synergistic effects.

An experiment was conducted to determine the gastrointestinal (GI) absorption of soluble uranium from drinking water by humans. The GI absorption of U in humans may be affected by the concurrent consumption of food. The gastrointestinal absorption of uranium has been measured in ten normal healthy adult volunteers of both sexes by feeding them 1 L of water containing 200-300 microgram of uranium per liter. The water was consumed during normal daytime activities while food was also ingested at its normal rate. Complete collections of urine and feces were made and composited on a daily basis over a period of two weeks, one week being prior to the consumption of the uranium containing water. Uranium was measured by radiochemical separation followed by alpha spectrometry. Both U-234 and U-238 were determined. The results on these people showed that the uptake of uranium under these conditions averaged 0.6%, well below the 5% fraction of U absorbed recommended by the International Commission on Radiological Protection. (See also W91-03366) (Agostine-PTT)
W91-03375

PUBLIC HEALTH AND SLUDGE UTILIZATION: PART II.
Agricultural Research Service, Beltsville, MD. Soil-Microbial System Lab.
R. L. Chaney.
Biocycle BCYCDK, Vol. 31, No. 10, p 68-73, October 1990. 16 ref.

Descriptors: *Cadmium, *Land disposal, *Path of pollutants, *Public health, *Sludge utilization, Agriculture, Bioaccumulation, Heavy metals, Sludge disposal, Waste disposal.

Crops differ in relative cadmium uptake even though all approach a plateau with increasing sludge application rate. Lettuce and spinach have a high response, while beans, rice, and many other crops take up little cadmium even when soil levels are high. Cadmium slowly accumulates in the human kidney throughout life. In the U.S., the public reaches (by age 50) an average kidney cadmium level about one-tenth of that required to cause the first symptoms of cadmium poisoning in most sensitive part of the population. In estimating the effect of sludge utilization on cadmium intake from garden vegetables, the ability of different food groups to accumulate soil cadmium must be considered. The crop in each food group with the highest cadmium uptake was used to estimate the increased cadmium uptake for the whole food group. By using the actual amounts in high cadmi-

um uptake crops such as lettuce and spinach, and the uptake slopes for this subset of leafy vegetables, it was found that estimated increased dietary cadmium from garden leafy vegetables was only about half the apparent risk estimated by the Environmental Protection Agency. Another factor which must be considered in assessing risk from sludge-applied cadmium is bioavailability. Just because increased cadmium is eaten in foods doesn't mean that the cadmium will be absorbed by the intestine at the same level as when cadmium salts are added to the diet. Data from a study in which swiss chard was grown (using three different sludges and a control) shows that cadmium in the chard in one treatment was five times higher than that in the control crop. However, when this chard was fed for a long period to guinea pigs, there was no change in cadmium levels in the kidney or the liver of these animals. Careful estimation of the potential increase in dietary cadmium garden vegetables grown on sludge-fertilized soils shows that the risk may have been overstated. Individuals who actually eat model amounts of garden vegetables have a very good diet and are not going to be the nutrient-deficient people who are at the highest risk from dietary cadmium. A peer review of the EPA 503 draft regulations for sludge management has noted defects in the regulation. The most important flaws were caused by misuse or miscollection of data for crop uptake of metals, crop tolerance of metals, livestock accumulation, and other transfer paths. The proposed regulation also does not presently have a pH-control requirement even though pH is the most important single factor affecting metal transfer and toxicity. (Lantz-PTT)
W91-03384

IMPACT OF ANIMAL WASTE LAGOONS ON GROUND-WATER QUALITY.
Delaware Agriculture Experiment Station, Newark.
W. F. Ritter, and A. E. M. Chirnside.
Biological Wastes BIWAED, Vol. 34, No. 1, p 39-54, 1990. 8 fig, 6 tab, 8 ref.

Descriptors: *Animal wastes, *Farm wastes, *Groundwater pollution, *Lagoons, *Path of pollutants, *Waste disposal, *Wastewater treatment, *Water pollution sources, Ammonium, Chlorides, Delmarva Peninsula, Dissolved solids, Drainage, Loam, Monitoring wells, Nitrates, Nitrogen compounds, Sand, Soil properties, Water table.

Groundwater quality was monitored for three years at two sites around clay-lined animal waste lagoons on the Delmarva Peninsula. A swine waste lagoon located in an Evesboro loamy sand soil (excessively well-drained) was having a severe impact on groundwater quality. Ammonium nitrogen concentrations above 1000 mg/L N have been measured in shallow monitoring wells around the lagoon. Chloride and total dissolved solids concentrations were also high. At the second site which has three lagoons and a settling pond in poorly drained soils, some seepage was occurring. Ammonium nitrogen, nitrate nitrogen, chloride and total dissolved solids were above background concentrations in some of the monitoring wells. There was a strong correlation between nitrate nitrogen and chloride concentrations in the monitoring wells. The results indicated that clay-lined animal waste lagoons located in sandy loam or loamy sand soils with high water tables may lead to the degradation of groundwater quality. (Author's abstract)
W91-03386

POLYCHLORINATED BIPHENYLS IN LAKE MICHIGAN TRIBUTARIES.
Wisconsin Univ.-Madison. Water Chemistry Program.
E. A. Marti, and D. E. Armstrong.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 396-405, 1990. 5 fig, 2 tab, 43 ref. EPA Cooperative Agreement 807836010. NOAA Federal Grant NA800-AA-D-00086.

Descriptors: *Aroclors, *Lake Michigan, *Path of pollutants, *Polychlorinated biphenyls, *Tributaries, *Water pollution sources, Bottom sediments, Fluvial sediments, Gas chromatography, Particulate matter, Pollutant identification, Suspended solids.

Polychlorinated biphenyl (PCB) concentrations were measured by gas chromatography in 14 major tributaries to Lake Michigan in samples collected in 1980-1983. Mean total PCB concentrations ranged from 7 to 103 ng/L and were related to evidence of river or sediment contamination. Aroclor 1242/1248-like mixtures were dominant. Association of PCBs with suspended particulate matter averaged 53 to 83% and was influenced by suspended particulate matter concentration and PCB mixture composition. Enhanced association of highly chlorinated PCBs with particulate matter may retard transport. Resuspension of contaminated bottom sediments contributed to the PCB loading transport by rivers. However, high suspended sediment concentrations increased the proportion of the PCBs associated with suspended particulate matter which should enhance retention of PCBs by deposition in near-shore sedimentation zones in lakes. (Author's abstract)
W91-03404

COMPARISON OF MEASURED AND SIMULATED FLOWS DURING THE 15 DECEMBER 1987 DETROIT RIVER FLOW REVERSAL.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2E.
W91-03406

TOXICITY OF SEDIMENTS FROM WESTERN LAKE ERIE AND THE MAUMEE RIVER AT TOLEDO, OHIO, 1987: IMPLICATIONS FOR CURRENT DREDGED MATERIAL DISPOSAL PRACTICES.
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W91-03409

MONITORING RIVER PLUME TRANSPORT AND MESOSCALE CIRCULATION IN GREEN BAY, LAKE MICHIGAN, THROUGH SATELLITE REMOTE SENSING.
Wisconsin Univ.-Madison. Environmental Remote Sensing Center.
R. G. Lathrop, J. R. Vande Castel, and T. M. Lillesand.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 471-484, 1990. 10 fig, 2 tab, 21 ref.

Descriptors: *Eutrophication, *Green Bay, *Lake Michigan, *Limnology, *Path of pollutants, *Plumes, Remote sensing, Satellite technology, Suspended solids, Transparency.

The transport and fate of the Fox River plume and the general circulation patterns within Lake Michigan's Green Bay were investigated using satellite remote sensing imagery (Landsat TM and NOAA AVHRR). The calibrated satellite water color and thermal imagery showed the extreme lower portion of the bay as a distinct water mass (due to the influx of the Fox River) with a steep gradient in water transparency and surface temperature within the first 10 km from the river mouth. Fox River water and its heavy load of suspended and adsorbed material is advectively transported up along the bay's eastern shore in the form of a plume. Significant mixing of Fox River water is not restricted to the extreme lower portion of the bay but also occurs in the middle portions of the bay. Similar water transparency but a distinct difference in thermal structure at the frontal zone between the Green Bay and Lake Michigan water masses indicated that materials entering from the Fox River are largely retained within the bay rather than transported to the open waters of Lake Michigan. (Author's abstract)
W91-03410

INVESTIGATION OF NONPOINT SOURCE POLLUTION ASSOCIATED WITH KARST AQUIFER SYSTEMS.
Western Kentucky Univ., Bowling Green. Dept. of Health and Safety.
W. D. Green, L. P. Elliott, and N. C. Crawford.
Transactions of the Kentucky Academy of Science TKASAT, Vol. 51, No. 3/4, p 177-181, 1990. 1 fig, 2 tab, 21 ref.

Descriptors: *Groundwater pollution, *Karst, *Kentucky, *Nonpoint pollution sources, *Path of pollutants, Animal wastes, Bioindicators, Biological studies, Colonization, Escherichia coli, Fecal coliforms, Fecal streptococci, Groundwater movement, Membrane filters, Septic wastewater, Wastewater pollution.

Karst terrains are very susceptible to pollution from many sources due to rapid recharge into and fast flow rates within conduit systems. Most of Bowling Green, Kentucky, is located within the Lost River Karst Groundwater Basin where conduit flow is the predominant form of underground water transport. Therefore, this area is an ideal location for an investigation of nonpoint source problems associated with karst aquifer systems. Fecal coliforms (FC) and fecal streptococci (FS) from groundwater in the Lost River system were isolated on membrane filters (MF) and subsequently identified by means of API systems appropriate for FC and FS. All typical streptococcal colonies were identified as FS by the 20S system. However, only 92.1% of the FC colonies were identified as Escherichia coli by the 20E system, with the prevalent biovars being implicated as pathogens. Colonies producing falsely positive FC reactions on MF were identified by the 20E system as members of the genera Acinetobacter, Citrobacter, Enterobacter, and Klebsiella. There were many FC/FS ratios > 4.0 and fewer but frequent FC/FS ratios of 0.4, indicating contamination from, respectively, septic tanks and animals. Clostridium perfringens was also present. These data indicate fecal contamination of the Lost River system and present the first verification of the isolation on MF of FS from a karstic aquifer. (Author's abstract)
W91-03435

USING SOIL AND METEOROLOGIC DATA BASES IN UNSATURATED ZONE MODELING OF PESTICIDES.
Environmental Research Lab., Athens, GA.
R. F. Carsel, and R. L. Jones.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 4, p 96-101, Fall 1990. 2 tab, 43 ref.

Descriptors: *Aeration zone, *Databases, *Mathematical models, *Model studies, *Path of pollutants, *Pesticides, *Soil contamination, Data collections, Data requirements, Meteorological data collection, Pesticide transport, Root zone, Soil texture, Soil water.

Soil and meteorologic data bases have been used in the mathematical modeling of pesticide transport and transformation in the unsaturated zone. The Pesticide Root Zone Model (PRZM) was used to demonstrate the use of existing data bases and estimation techniques in developing parameter sets for modeling. Input data required by PRZM include meteorologic, soil, pesticide, crop, and hydrologic information. Pesticide concentration profiles typically are available from monitoring studies; however, soil-water retention or meteorologic data are usually lacking. Meteorologic information collected by the National Oceanic and Atmospheric Administration from stations located throughout the United States can be used in PRZM. PRZM requires data on four major soil characteristics: field capacity, wilting point, organic matter, and bulk density. In the absence of site-specific data, approximations may be obtained utilizing Soil Conservation Service county soil surveys, a Soils Information Retrieval System, or generalized values based on textural classification of soils. PRZM and most other unsaturated zone models describe pesticide transport with a simple retardation equation using the soil partition coefficient. PRZM has been used with soil and meteorological data bases in a variety of simulation techniques including site-specific, soil-specific, regional, stochastic, and saturated/unsaturated zone simulations. (MacKeen-PTT)
W91-03446

GROUND WATER MONITORING AT WELLHEAD PROTECTION AREAS.

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-03447

SOIL-GAS SURVEYING FOR SUBSURFACE GASOLINE CONTAMINATION USING TOTAL ORGANIC VAPOR DETECTION INSTRUMENTS: PART II. FIELD EXPERIMENTATION.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5A.
W91-03448

PRELIMINARY DELINEATION OF CONTAMINATED WATER-BEARING FRACTURES INTERSECTED BY OPEN-HOLE BEDROCK WELLS.
Geological Survey, Albany, NY.
J. H. Williams, and R. W. Conger.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 4, p 118-126, Fall 1990. 8 fig, 19 ref.

Descriptors: *Aquifer testing, *Geophysical surveys, *Groundwater pollution, *Path of pollutants, Bedrock, Geologic fractures, Groundwater movement, Logging (Recording), Mahopac, New York, On-site investigations, Open wells, Spring Valley, Volatile organic compounds, Water sampling, Wells.

Contaminated water-bearing fractures intersected by open-hole bedrock wells were preliminarily delineated through a combination of geophysical logging, vertical-flow measurements, and downhole water sampling as part of remedial site investigations at two sites in southeastern New York. The wells investigated range from 100 to 450 ft in depth, have only shallow surface casing, and intersect multiple water-bearing zones. The distribution of water-bearing zones that intersect the wells was determined from single-point resistance, caliper, fluid-resistivity, temperature, and acoustic-televiewer logs. Measurable flow in the wells was downward from upper producing zones to lower receiving zones that are poorly connected in the aquifer and that differ in hydraulic head as a result of nearby pumping. A downhole sampler was used to collect discrete and composite water samples for analysis of volatile organic compounds from producing zones that are self-purging as a result of flow from the wells. At the Spring Valley wellfield, a supply well completed in Mesozoic sandstone and conglomerate intersects water-bearing zones at depths of 204 to 245 ft that produced contaminated water that was received by a zone at 278 ft. Most of the water-bearing zones are bedding-plane separations that probably provide pathways for contaminant transport in the bedrock aquifer for significant distances. In the Mahopac business district site, a deep test well completed in Precambrian gneiss intersected shallow water-bearing zones at 50 to 79 ft that produced contaminated water that was received by deep zones at 260 and 328 ft. The water-bearing zones consist of single or closely spaced multiple fractures with dips of 5 to 50 degrees. The methods presented can be applied in existing open-hole wells for preliminary investigation of groundwater flow and contamination in fractured bedrock-aquifers. (Author's abstract)
W91-03449

TEMPORAL VARIATIONS OF CHLORINATED SOLVENTS IN ABSTRACTION WELLS.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
M. O. Rivett, D. N. Lerner, and J. W. Lloyd.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 4, p 127-133, Fall 1990. 9 fig, 1 tab, 13 ref.

Descriptors: *Chlorinated hydrocarbons, *Groundwater pollution, *Path of pollutants, Pump wells, *Water quality monitoring, Aquifer testing, Birmingham, England, Organic solvents, Temporal distribution, Water quality trends.

Data obtained during an organic water quality survey of abstraction (pumping) wells in the Triassic Sandstone Aquifer of Birmingham, England indicated that there were important variations of chlorinated solvent concentrations with time. Short-term observation of solvent concentrations with elapsed pumping time indicated widely differing well responses; such observations are important in establishing good sampling protocols. Long-term monitoring indicated that solvent concentrations, particularly trichloroethene, were often stable with time. When large variations did occur, these were shown to be due to the variation in the abstraction history of the well or to significant migration of solvent plumes during the monitoring period. Solvent plume migration was particularly exemplified by rising trends in 1,1,1-trichloroethane concentrations. The changes observed in solvent concentrations during long-term monitoring of the Birmingham Aquifer were slow to occur, but often large. The data indicate that abstraction wells may be used to provide valuable information on the degree and trend of groundwater pollution by chlorinated organic solvents. (Author's abstract)
W91-03450

HYDROGEOLOGY OF THE BRUNSWICK (PASSAIC) FORMATION AND IMPLICATIONS FOR GROUND WATER MONITORING PRACTICE.
Deutsche Veterinaermedizinische Gesellschaft e.V., Giessen (Germany, F.R.).
For primary bibliographic entry see Field 2F.
W91-03451

SOME ECOLOGICAL FACTORS IN THE DEGRADATION OF 2,4-DICHLOROPHENOL IN WATERS FROM AQUATIC ENVIRONMENTS.
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Environmental Science and Conservation.
S. Nakano, and M. Seto.
Japanese Journal of Limnology RIZAAU, Vol. 51, No. 3, p 155-161, 1990. 5 fig, 3 tab, 15 ref.

Descriptors: *Aquatic bacteria, *Biodegradation, *Chlorinated hydrocarbons, *Dichlorophenols, *Fate of pollutants, Microbiological studies, Most probable number test, Nutrient requirements, Population density, Water sampling.

The relationship between the degradation of 2,4-dichlorophenol (DCP) and changes in the density of DCP-degrading microorganisms was examined in water samples from aquatic environments. Water samples were collected from a pond, swamp, lake, and spring, spiked with DCP, and analyzed by high performance liquid chromatography for DCP level. The density of DCP-degraders was determined by a most probable number method. In most of the water samples, the rapid degradation of 0.1 or 1.0 microg DCP-C/ml was observed, after a lag period lasting more than a week, when DCP-degraders had increased to 1000-10,000 or 10,000-100,000 cells/ml, respectively. However, in the water sample from the spring degradation of 0.1 microg DCP-C/ml was not observed in a 42-day incubation, although DCP-degraders had increased to 10,000 cells/ml at day 35 of incubation. When both nitrogen and phosphorous were added to the spring water sample, rapid degradation of DCP was observed. The results suggested that sufficient increase in the density of DCP-degraders was a prerequisite condition for the degradation of DCP, but ecological factors such as mineral nutrient concentrations might limit the activity of DCP-degraders even when their densities were high. (Author's abstract)
W91-03454

EFFECT OF AIR POLLUTION CHEMICAL COMPONENTS ON THE ACIDITY OF RAIN WATER IN JAPAN.
Kobe Women's Coll. of Pharmacy (Japan).
A. Adachi, Y. Asaka, M. Ozasa, N. Sawai, and T. Kobayashi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 4, p 495-499, October 1990. 2 fig, 1 tab, 6 ref.

Descriptors: *Acid rain, *Anions, *Cations, *Chemistry of precipitation, *Hydrogen ion concentration, *Japan, *Neutralization, *Path of pollutants, *Water pollution sources, Acidity, Air pollution, Air pollution effects, Ammonium, Calcium, Conductivity, Magnesium, Nitrates, Sodium, Sulfates.

Acid rain has recently become a serious environmental problem in Japan. To determine the effects of various kinds of air polluted chemical components on the acidity of rain water (pH), electric conductivity and cationic and anionic ions in rain water collected from an industrial and a residential area in the southern part of Hyogo prefecture in Japan, was compared. In almost all cases, the pH value of the rain water collected from the industrial area was higher than those from the residential area, with the mean pH in rain water of the industrial area 6.3; the residential area had a mean pH of 5.8. This was a discrepancy, because air pollution in industrial areas is generally heavier than in residential areas. In order to clarify this discrepancy, the ions in the rain water were assayed. The results showed that the concentrations of cations--NH4(+), Ca(2+), Na(+), and Mg(2+)--in industrial area rain were significantly higher than those in residential area rain. Total cation levels in the rain water collected from the industrial areas were about 2 times higher than those from the residential area, suggesting that these cations neutralized the acidic anions--SO4(2-) and NO3(-). (Mertz-PTT)
W91-03464

DETERMINATION OF TRACE CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUND WATER USING CLOSED-LOOP STRIPPING, EDWARDS AQUIFER, TEXAS.
Geological Survey, Austin, TX.
For primary bibliographic entry see Field 5A.
W91-03465

MUTAGEN FORMATION AND NITRATION BY EXPOSURE OF PHENYLPHENOLS TO SUNLIGHT IN WATER CONTAINING NITRATE OR NITRITE ION.
Science Univ. of Tokyo (Japan). Faculty of Pharmaceutical Sciences.
J. Suzuki, T. Sato, A. Ito, and S. Suzuki.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 4, p 516-522, October 1990. 4 tab, 15 ref.

Descriptors: *Mutagens, *Path of pollutants, *Phenols, *Photochemistry, *Photolysis, *Water pollution sources, Aromatic compounds, Chemical reactions, Degradation, Nitrates, Nitrites, Solar radiation, Ultraviolet radiation, Water pollution.

Mutagens in aquatic environments are considered to be attributable not only to the inflow of industrial effluent and domestic sewage containing mutagens, but also chemical to the and biological transformation of organic pollutants to mutagens. Photochemical reactions of aromatics with nitrate or nitrite ions may be an important cause of the mutagens in aquatic environments. However, it is uncertain whether photochemical mutagen formation is caused by sunlight, because earlier studies were undertaken by irradiating ultraviolet light derived from a high-pressure mercury lamp. To clarify this uncertainty, phenylphenols, which are used for the storage of citrus fruits as a fungicide, were exposed to sunlight for 2-8 weeks during the summer in neutral aqueous nitrate and nitrite solutions. Phenylphenols were nitrated and converted to a mutagen by exposure to sunlight in water containing nitrite ions. The mutagen formed was direct-acting as shown by the fact that the mutagenicities of the ether extracts were depressed with metabolic enzymes in rat liver. Photochemical mutagen formations by exposure to sunlight did not occur in aqueous nitrate solutions and the nitration of phenylphenols in aqueous nitrate solution was slow compared with that in an aqueous nitrite solution. The degradation of phenylphenols were observed to the same degree in either nitrate or nitrite solution, indicating that the photolysis of phenylphenols was independent of the photolysis of nitrate and nitrite ions. This implies that the

nitration and the mutagen formation are governed only by photolysis of nitrate and nitrite ions and independent of the photo-degradation of phenylphenols. Consequently, the most important factor for photochemical mutagen formation in the aquatic environment is the concentration level of nitrite ion. (Mertz-PTT)
W91-03466

TRACE METALS IN TROPICAL COASTAL LAGOON BIVALVES, CRASSOSTREA CORTEZIENSIS.
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ciencias del Mar y Limnologia.
F. Paez-Osuna, and C. Marmolejo-Rivas.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 4, p 538-544, October 1990. 3 fig, 1 tab, 15 ref. Consejo Nacional de Ciencias y Tecnologia de Mexico Project PCCBBNA 021995.

Descriptors: *Heavy metals, *Oysters, *Path of pollutants, *Trace metals, Bioaccumulation, Cadmium, Chromium, Cobalt, Copper, Iron, Lagoons, Lead, Manganese, Mollusks, Nickel, Seasonal variation, Water pollution, Zinc.

The Mangrove oyster Crassostrea corteziensis is a brackish species that is geographically distributed from the Gulf of California to the North of Peru. Along the Pacific coast of Mexico, this mollusk is widely utilized for human consumption. The accumulation of nine trace metals (Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn) from lagoonal water by the oyster C. corteziensis during a 12-month period from the Port of Mazatlan, Mexico was examined. The levels of Fe, Mn, Cd and Cr were relatively constant, while levels of Ni, Co and Pb simultaneously showed an enrichment in the autumn-winter months, when temperatures of seawater decreased from 30-32 C to 22-24 C. The relationships between some metals in C. corteziensis were significant. For Zn and Cu, the linear correlation coefficient was 0.85; for Mn-Fe, the linear coefficient was 0.61; for Co-Cr, 0.80; Cd-Ni, 0.71, Co-Ni, 0.92; and Ni-Pb, the linear coefficient was 0.70. Seasonal fluctuations with highest values in the autumn-winter months have been found in other species of bivalves. These results show that the relationships found are valuable because it is possible to estimate the concentration factor and the concentration of metals in water that is likely to cause the elements to accumulate in bivalves to undesirable concentrations. (Mertz-PTT)
W91-03467

TRACE METALS IN TROPICAL COASTAL LAGOON BIVALVES, MYTELLA STRIGATA.
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ciencias del Mar y Limnologia.
C. Marmolejo-Rivas, and F. Paez-Osuna.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 4, p 545-551, October 1990. 3 fig, 1 tab, 15 ref. Consejo Nacional de Ciencia y Tecnologia de Mexico Project PCCBBNA-0210995.

Descriptors: *Heavy metals, *Manganese, *Mussels, *Path of pollutants, *Trace metals, Bioaccumulation, Cadmium, Chromium, Cobalt, Copper, Iron, Lagoons, Mollusks, Nickel, Productivity, Seasonal variation, Water pollution, Water temperature, Zinc.

The tropical mussel Mytella strigata is a lagoonal species that is geographically distributed from the Gulf of California to the south of Salvador and the Galapagos islands in the Pacific, and from Venezuela to Argentina in the Atlantic Ocean. The accumulation of nine trace metals (Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn) from lagoonal water by the mussel M. strigata during a nine-month period from the Port of Mazatlan, Mexico was examined. Co, Ni and Zn in June, and Pb and Fe in April showed the maximum concentration in the soft tissue of the mussel. Cr, Cu, and Mn had an enrichment in the winter months. It was possible that some of the observed fluctuations of Mn and Cr values were not significant, however, large differences between some months were most likely valid. Cd was relatively constant during the months sampled. The relationships between some metals in the mussel M. strigata were significant. For Cr and Cu, the linear correlation coefficient was 0.73; whereas Mn fluctuated in an inverse manner with Cd with a linear correlation coefficient of -0.63. Seasonal variations, with the highest values in autumn or winter months, have been found in other species of mussels. Seasonal changes in trace metal concentrations have been related to factors such as: food supply associated with an increase of productivity resulting from higher temperatures and longer days during spring and summer; changes in runoff of particulate metal to the sea due to high precipitations; or simply to seasonal size changes in metal content during the year. In M. strigata, no correlations was made with the levels of dissolved metals observed in the lagoonal water, nor with the level of metals in the particulate fraction corresponding to the same collection time. However, a significant relationship was found for the levels of trace elements in the mussel with the particulate fraction of the month immediately preceding for 3 of the 9 metals analyzed. (Mertz-PTT)
W91-03468

DISTRIBUTION OF POLYCHLOROBIPHENYLS AND HEXACHLOROBENZENE IN DIFFERENT TISSUES OF THE DAB (LIMANADA LIMANADA L.) IN RELATION TO LIPID POLARITY.
Hamburg Univ. (Germany, F.R.). Inst. fuer Biochemie und Lebensmittelschemie.
U. Kammann, R. Knickmeyer, and H. Steinhart.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 4, p 552-559, October 1990. 3 fig, 1 tab, 14 ref. Bundesminister fuer forschung und Technologie Project MFU 05765.

Descriptors: *Chlorinated hydrocarbons, *Flatfish, *Lipids, *Path of pollutants, *Polychlorinated biphenyls, Bioaccumulation, Fish physiology, Hexachlorobenzene, Tissue analysis, Water pollution effects.

Cyclic organochlorines are environmentally persistent and widely distributed in marine ecosystems. Fish can accumulate these substances from water and food. The patterns of 26 individual PCB (polychlorobiphenyl) congeners and HCB (hexachlorobenzene) in different organs of female dabs (Limanda limanda L.) were investigated. The influence of total lipid content as well as polar lipid fractions and neutral lipid fraction on the distribution of PCB congeners in the tissues was also studied. All tissues under investigation exhibited a distinct PCB pattern, independent of sampling station and season. PCB patterns of kidney and gallbladders showed large contributions of trichlorobiphenyls and tetrachlorobiphenyls. High amounts of polar lipids in kidneys and gallbladders correlated to increased contributions of more polar trichlorobiphenyls and tetrachlorobiphenyls. Patterns of liver, ovaries, gills and stomach, however, were dominated by pentachlorobiphenyls and hexachlorobiphenyls, PCB 153 and PCB 138. In these tissues large amounts of pentachlorobiphenyls and hexachlorobiphenyls correlated with high amounts of neutral lipids. PCB patterns of the stomach reflect the actual food composition of the dab. The PCB patterns of ovaries were directly influenced by the transfer of liver lipids with a preferred transfer of PCB 138 and 128 from livers to ovaries. At the beginning of the spawning period in February, PCB congeners and hexachlorobenzene contamination of livers exhibited their lowest levels; however, the concentrations of these compounds in the ovaries increased. Maximal PCB-congener and hexachlorobenzene burden in ovaries coincides with a minimum of neutral lipids in female livers. These findings may be explained by a transfer of organochlorines from livers to ovaries during periods of unfavorable food conditions. (Mertz-PTT)
W91-03469

UPTAKE AND RELEASE OF CADMIUM IN VARIOUS ORGANS OF THE COMMON MUSSEL, MYTILUS EDULIS (L).
Nederlands Inst. voor Onderzoek der Zee, Texel.
J. M. Everaarts.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 4, p 560-567, October 1990. 2 fig, 3 tab, 16 ref.

Descriptors: *Bioaccumulation, *Cadmium, *Mussels, *Path of pollutants, Heavy metals, Mollusks, Tissue analysis, Toxicity, Water pollution, Water temperature.

Numerous data on the internal distribution of trace metals in Mytilus edulis have been published. The highest concentration and main body burden of cadmium are reported for the mid-gut gland and the kidney. During 40 days of exposure to 50 microgram cadmium/L at 15 C, cadmium accumulated linearly in mussel kidney to 300 microgram/g dry weight, in the gills to 130 microgram/g dry weight, and in the hepatopancreas to 170 microgram/g dry weight. Cadmium concentrations in the foot, adductor muscle and mantle were relatively low. After 40 days exposure at 20 C, cadmium accumulation in the kidney, gill, mantle and adductor muscle was a factor of 2.2 to 2.7 higher than at 15 C. The depuration of cadmium was measured at 20 C. Concentrations decreased according to a first order reaction: a rapid release during the first four days of exposure to clean seawater and a more gradual loss thereafter until a level of equilibrium was reached. Release of cadmium did not continue until the original control level was reached. This was possibly due to cadmium binding to metal binding proteins, hampering the excretion of the metal-rich residual bodies. After exposure for 9 days to an estimated dose of 180 microgram Cd/L, and a subsequent recovery period of 28 days in clean seawater, the amount of Cd bound to thioneine in the digestive gland of Mytilus galloprovincialis at the end of the recovery period had increased by approximately 250%. These data demonstrate the importance of methallothionein induction in the reduction of the cytotoxic effects exerted by high levels of Cd accumulation. (Mertz-PTT)
W91-03470

TRANSFER OF TOXIC CONCENTRATIONS OF SELENIUM FROM PARENT TO PROGENY IN THE FATHEAD MINNOW (PIMEPHALES PROMELAS).
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
For primary bibliographic entry see Field 5C.
W91-03471

DETOXIFICATION OF COPPER BY NITZSCHIA OBTUSA WN. SM., A PENNATE DIATOM.
Madras Univ. (India). Centre of Advanced Study in Botany.
K. P. Gowrinathan, and V. N. R. Rao.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 4, p 612-618, October 1990. 3 fig, 2 tab, 17 ref.

Descriptors: *Biochemistry, *Detoxification, *Heavy metals, *Path of pollutants, *Phytoplankton, *Toxicology, Algae, Biological wastewater treatment, Diatoms, Fate of pollutants, Wastewater treatment.

Phytoplankton have the ability to detoxify metals to survive in water laden with high concentrations of heavy metals. Adaptations of algae to an unfavorable metal environment include the exclusion of heavy metals by binding metals outside the cell with extracellular materials such as polypeptides, polysaccharides and hydroxamates that have metal binding sites. Possible detoxification mechanisms in Nitzschia obtusa Wm.Sm. to copper were determined by analyzing whole cells without EDTA washing (showing 0.13 microgram of Cu/1,000,000 cells). Approximately 30% of the Cu that disappeared from the medium was adsorbed on the surface of the cells. A reduction in the amount of metal in the cytosolic fraction of the cells may be due to a binding of Cu to the membranes of intracellular inclusions. Two mechanisms for tolerance were encountered: (1) adsorption of cations

on the cell surface, and (2) formation of methallothionein-like protein complex in the cytoplasm of cells. More studies on the detoxification mechanisms exhibited by diatoms in response to various metals may help to evolve a biological treatment system for industrial effluents containing high amounts of heavy metals. (Mertz-PTT)
W91-03474

SANITARY AND BACTERIAL ANALYSIS OF WATER AND BOTTOM SEDIMENTS OF A HEAVILY POLLUTED, HYPERTROPHIC LAKE.
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Dept. of Ecology and Freshwater Biology.
S. Niewolak.
Ekologia Polska ELPLBS, Vol. 37, No. 1/2, p 3-30, 1989. 8 fig, 9 tab, 55 ref.

Descriptors: *Lake Beskie, *Lake sediments, *Poland, *Water pollution sources, *Water quality, Agricultural runoff, Algal blooms, Bacteria, Bioindicators, Coliforms, Farm wastes, Fecal coliforms, Fecal streptococci, Seasonal variation, Wastewater farming, Water pollution, Water temperature.

The development of cattle and pig fattening farms constitutes a serious threat to the cleanliness of lakes. Particularly dangerous are the slurry wastes if applied in excess to crop-fields, meadows and pastures. Sanitary and bacteriological studies of a hypertrophic Lake Beskie, in the Masurian Lakeland, Poland, were carried out during 1982-1984. Values for total number of bacteria, total number of coliforms, number of fecal coliforms and number of fecal streptococci were determined for four different sites, at different depths and at temperatures between 20 and 37 C. The degree of pollution of water and bottom sediments varied between the sampling sites, study years, and over a yearly cycle. Bacterial pollution in the water and bottom sediments was higher near sewage discharge sites. Bacterial pollution was also higher in 1982, when livestock numbers in the catchment area were twice as high, compared with 1983 and 1984. Consequently, slurry wastes, with which crop-fields, meadows and pastures were treated, was greatly increased during 1982. Over a yearly cycle, indicator bacteria were higher in spring, summer and autumn, compared with winter. Bacteria numbers were also higher following a storm or long-lasting rainfalls. Lower bacteria numbers were recorded during algal blooms and death. (Mertz-PTT)
W91-03476

AIR QUALITY OF BRAMA MORAWSKA REGION AND TRANSBOUNDARY TRANSPORT OF SULPHUR DIOXIDE.
Instytut Ksztaltowania Srodowiska, Katowice (Poland).
S. Hlawiczka, P. Hallala, and H. Polewko.
Ekologia Polska ELPLBS, Vol. 37, No. 1/2, p 83-95, 1989. 3 fig, 2 tab, 10 ref.

Descriptors: *Acid rain, *Air pollution, *Air pollution sources, *Czechoslovakia, *Path of pollutants, *Poland, *Sulfur dioxide, Cadmium, Dry deposition, Heavy metals, Hydrogen ion concentration, Iron, Lead, Manganese, Nitrates, Pollution load, Sulfates, Zinc.

Air quality was investigated along the southern part of Poland from the Babia Gora in an eastward direction to the western part of the Karkonosze range in the west. The Brama Morawska region was investigated separately because is represents the one broad depression in the mountain range along the border between Poland, Czechoslovakia and Moravia. It is the only possible space (30 km) where an undisturbed transport of polluted air is possible. Over two years of investigations included measurements of daily dust concentrations and analysis for SO2(2-), NO3(-), Zn, Pb, Cd, Mn, and Fe. Measurements of SO2 concentrations in dust fall, rainfall and pH were also performed. An excess of permissible concentrations of suspended dust and Pb was found. The share of SO4(2-) in dust was about 16% and of NO3(-) about 5.5%. The average pH value of rain ranged from 4.8 to 5.2. The annual average dust fall ranged between 50 and 180 ton/square km/year. The rough estimation of loads of some pollutants reaching the soil with dust fall and rainfall was about 10.6 m/square for sulfates and 3.2 g/square m for nitrates. The annual load of SO2 was about 86,500 ton. About 50,000 ton, or 58% of the SO2 load was transported from Czechoslovakia to Poland and about 36,500 ton, or 42%, of the SO2 load was sent back from Poland. (Mertz-PTT)
W91-03480

NITRATE DEPLETION IN THE RIPARIAN ZONE AND STREAM CHANNEL OF A SMALL HEADWATER CATCHMENT.
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
A. B. Cooper.
Hydrobiologia HYDRB8, Vol. 202, No. 1/2, p 13-26, August 29, 1990. 3 fig, 4 tab, 46 ref.

Descriptors: *Agricultural runoff, *Denitrification, *Fate of pollutants, *Headwaters, *Riparian land, *Streams, *Surface-groundwater relations, Anoxic conditions, Carbon, Enzymes, Groundwater movement, Hydrological regime, Mass balance, New Zealand, Nitrogen cycle, Organic soils, Plant populations, Soil chemistry, Wetlands.

Processes within riparian wetlands and within stream channels themselves are capable of removing nitrate from agricultural drainage, although the significance of these processes in regulating nitrate flux varies widely. A mass balance procedure was used to determine rates of nitrate depletion in the riparian zone and stream channel of a small New Zealand headwater stream. In all 12 surveys the majority of nitrate loss (56-100%) occurred in riparian organic soils, despite these soils occupying only 12% of the stream's border. This disproportionate role of the organic soils in depleting nitrate was due to two factors: (1) they were located at the base of hollows and consequently a disproportionately high percentage (37-81%) of the groundwater flowed through them in its passage to the stream; and (2) they were anoxic and high in both denitrifying enzyme concentration and available carbon. Direct estimates of in situ denitrification rate for organic soils near the upslope edge were much higher than average values estimated for the organic soils as a whole and suggested that areas of these soils were limited in their denitrification activity by the supply of nitrate. The capacity of these soils to regulate nitrate flux was therefore under-utilized. The majority of stream channel nitrate depletion was apparently due to plant uptake, with estimates of the in situ denitrification rate of stream sediments being less than 15% of the stream channel nitrate depletion rate estimated by mass balance. This study reinforces the view that those seeking to understand the functioning of these ecosystems need to consider hydrological phenomena. (Author's abstract)
W91-03483

GULL CONTRIBUTIONS OF PHOSPHORUS AND NITROGEN TO A CAPE COD KETTLE POND.
Cape Cod National Seashore, South Wellfleet, MA.
J. W. Portnoy.
Hydrobiologia HYDRB8, Vol. 202, No. 1/2, p 61-69, August 29, 1990. 2 fig, 5 tab, 24 ref.

Descriptors: *Animal wastes, *Eutrophic lakes, *Eutrophication, *Gulls, *Limnology, *Massachusetts, *Nitrogen, *Phosphorus, *Ponds, Aquatic productivity, Cape Cod, Excretion, Migration, Nutrients, Water pollution sources.

Phosphorus (P) and nitrogen (N) and their sources have received widespread study because of their key roles in algal and macrophyte nutrition. The estimation of P loading rates has become an accepted approach for predicting lake productivity as well as a management tool for controlling cultural eutrophication in disturbed watersheds. Nutrient excretion rates and the annual contribution of P from the feces of the gulls Larus argentatus and L. marinas (and of N from L. argentatus) to the nutrient budget of Gull Pond (Wellfleet, Massachusetts), a soft water seepage lake, have been estimated. Intensive year-round gull counts by species were combined with determinations of defecation rate and the nutrient content of feces to quantitatively assess the P loading rates associated with regular gull use of this coastal pond on a seasonal and annual basis. Total P loading from gulls was estimated to be 52 kg/yr, with 17 kg from L. argentatus and 35 kg from L. marinus, resulting from about 5,000,000 h/yr and 1,700,000 h/yr of pond use. This compares with P loading estimates of 67 kg/yr from upgradient septic systems, 2 kg/yr from precipitation and 3 kg/yr from unpolluted groundwater. Fifty-six percent of annual gull P loading was associated with migratory activity in late fall. Estimated annual N loading by L. argentatus was 14 kg total kieldahl 206 g NO3-N, and 1.85 g NH3-N. (Author's abstract)
W91-03484

HEAVY METAL AND PCB CONTAMINATION OF BRYOZOAN COLONIES IN THE RIVER MEUSE (BELGIUM).
Liege Univ. (Belgium). Lab. of Animal Morphology.
V. Henry, J. C. Bussers, J. M. Bouquegneau, and J. P. Thome.
Hydrobiologia HYDRB8, Vol. 202, No. 3, p 147-152, August 31, 1990. 2 fig, 1 tab, 19 ref.

Descriptors: *Belgium, *Bioaccumulation, *Biomass, *Bryozoans, *Ecosystems, *Heavy metals, *Path of pollutants, *Polychlorinated biphenyls, *Sediment contamination, Animal populations, Aquatic animals, Cadmium, Chromium, Colonization, Copper, Environmental impact, Industrial wastewater, Lead, Meuse River, Nuclear powerplants, Pollution load, River sediments, Water pollution effects, Zinc.

In the Meuse River (Liege area, Belgium), large amounts of three species of Bryozoans, Fredericella sultana (BLUM.), Plumatella emarginata ALL., and Plumatella fungosa (PALL.) occur. They cover 3 to 40% of the bank walls and their biomass ranges from 12 to 293 g/sq-m (dry weight). In the heated waters of a nuclear power plant and of industries lined up along the river, colony development occurs 3 to 4 weeks earlier than at an upstream station. The heavy metal content of living colonies ranges from 4 to 21 mg/kg cadmium, 45 to 182 mg/kg copper, 803 to 2232 mg/kg zinc, 150 to 483 mg/kg lead, and 21 to 138 mg/kg chromium dry weight. The mean concentration of polychlorinated biphenyls (PCBs) was 925 micrograms/kg dry weight. Heavy metal and PCB concentrations in the sediments were close to those of the colonies, suggesting that most of the pollutants found in the Bryozoans is in fact in the sediment trapped by the colonies. (Author's abstract)
W91-03489

HISTORICAL PERSPECTIVE ON THE ENVIRONMENTAL BIOAVAILABILITY OF DDT AND ITS DERIVATIVES TO GULF OF MEXICO OYSTERS.
Texas A and M Univ., College Station. Dept. of Oceanography.
J. L. Sericano, T. L. Wade, E. L. Atlas, and J. M. Brooks.
Environmental Science and Technology ESTHAG, Vol. 24, No. 10, p 1541-1548, October 1990. 6 fig, 3 tab, 41 ref. National Oceanic and Atmospheric Administration, Contract 50-DGNC-5-00262.

Descriptors: *DDD, *DDE, *DDT, *Fate of pollutants, *Gulf of Mexico, *Oysters, *Pesticide residues, *Pesticides, Mollusks, National Status and Trends Survey, Pollutant identification, Surveys.

DDT and its metabolites, DDD and DDE were analyzed in 479 oyster samples from the Gulf of Mexico between 1986 and 1988 as part of the National Status and Trends Mussel Watch Program. DDT and/or its derivatives were found in every sample analyzed in concentrations ranging over 2 orders of magnitude. DDT accounted for 3-6% of the total DDT burden in oysters. The

remaining percentage was approximately equally distributed between DDD and DDE. After the first 3 years of the National Status and Trends Program, the geographical distribution of total DDT along the northern coast of the Gulf of Mexico has been well defined. Based on 3 years of data, there were only a few sites that had statistically significant monotonic changes in concentrations with time. However, when the present data set is compared to historical data for the Gulf of Mexico, a general decrease is observed. The rate of DDT disappearance, as monitored by Gulf of Mexico oysters, is comparable with its decline in other marine environments. (Author's abstract)
W91-03509

DYNAMIC PARTITIONING OF ORGANIC CHEMICALS IN REGIONAL ENVIRONMENTS: A MULTIMEDIA SCREENING-LEVEL MODELING APPROACH.
California Univ., Los Angeles. Dept. of Chemical Engineering.
Y. Cohen, W. Tsai, S. L. Chetty, and G. J. Mayer.
Environmental Science and Technology ESTHAG, Vol. 24, No. 10, p 1549-1558, October 1990. 3 fig, 5 tab, 68 ref. EPA agreement CR-812271-03.

Descriptors: *Chlorinated hydrocarbons, *Fate of pollutants, *Model studies, *Path of pollutants, California, Dry deposition, Rainfall, Runoff, Vadose zone, Water pollution.

A screening-level spatial-multimedia-compartmental approach to modeling the fate and transport of volatile organic pollutants in regional environments was developed. The screening-level spatial-multimedia-compartmental approach, which makes use of both uniform (for example, well-mixed) and nonuniform (one-dimensional) compartments, incorporates a variety of transport phenomena associated with pollutant transport such as dry deposition, rain scavenging, runoff, infiltration, soil drying, and pollutant diffusion and convection in the vadose zone. The multimedia distributions of trichloroethylene, tetrachloroethylene, and 1,1,1-trichloroethane in the Los Angeles area, and tetrachloroethylene in the San Diego area, were explored by using the screening-level spatial-multimedia-compartmental model. The predicted concentrations were found to be in reasonable agreement with the available field data. The study suggests that the screening-level spatial-multimedia-compartmental approach is useful and efficient for rapid screening-level analysis of the steady-state or dynamic multimedia distribution of chemical pollutants. (Author's abstract)
W91-03510

PHOTOCATALYTIC DEGRADATION OF ATRAZINE AND OTHER S-TRIAZINE HERBICIDES.
Parma Univ. (Italy). Ist. di Chimica Fisica Applicata.
For primary bibliographic entry see Field 5F.
W91-03511

EFFECTS OF TERRESTRIAL EFFLUENTS ON THE INCIDENCE OF AEROMONAS SPP. IN COASTAL WATERS.
Barcelona Univ. (Spain). Dept. of Microbiology.
R. M. Araujo, R. Pares, and R. Lucena.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 3, p 439-444, 1990. 6 fig, 2 tab, 15 ref.

Descriptors: *Coastal waters, *Fecal streptococci, *Path of pollutants, *Pathogenic bacteria, *Spain, *Water pollution effects, *Water pollution sources, Bacteria, Bacterial analysis, Fecal coliforms, Pollutant identification, Rivers, Water analysis, Water pollution.

Strains of the Aeromonas hydrophila group are known pathogens of animals, especially fish, frogs and reptiles. They are also considered to be opportunistic pathogens for humans in whom they cause gastroenteritis, bacteremia and external skin and wound infections. The numbers of Aeromonas species were monitored for one year on the Barcelona, Spain coast. Nine stations, 1 m in depth on the Barcelona coast and two stations situated in the Besos and Llobregat river about 3 km from the mouth were sampled monthly for one year. In summer, a further nine stations were also sampled. Their concentrations exceeded those of fecal coliforms and fecal streptococci in all samples, both on the shoreline and at 500 m from the coast. The mean values of the three bacterial counts reflected the proximity of the terrestrial effluents. There was a positive correlation between aeromonads and fecal indicators on the shoreline but not at 500 m offshore. This reflected their common origin and different survival rates in seawater. When sterile sea water was inoculated with A. hydrophila ATCC 7966, the numbers decreased initially by three orders of magnitude before they began to multiply. The final count was related to the concentration of organic matter in the water. (Mertz-PTT)
W91-03521

FATE OF CHLOROTHALONIL IN GROUND WATER 1N COMMERCIAL CRANBERRY CULTURE IN THE NEW JERSEY PINE BARRENS.
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
G. Winnett, P. Marucci, S. Reduker, and C. G. Uchrin.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 6, p 587-595, August 1990. 2 fig, 2 tab, 6 ref.

Descriptors: *Agricultural chemicals, *Chlorothalonil, *Cranberries, *Groundwater quality, *New Jersey, *New Jersey Pine Barrens, *Path of pollutants, *Pesticides, Bogs, Cohansey aquifer, Monitoring wells, Pesticide residues, Surface water, Water quality monitoring.

The fate of the agricultural pesticide chlorothalonil in groundwater was studied in an experimental cranberry bog in the Pine Barrens, New Jersey. Clusters of monitoring wells were sunk at depths of 0.5, 1.0, and 1.5 m. Chlorothalonil was applied to the experimental bog 3-4 times per growing season at 5-16 pints per acre for 1985-1987. Groundwater and surface waters were sampled weekly or biweekly for two years and samples were analyzed for chlorothalonil residues by gas chromatography. In general, the chlorothalonil treatments to the experimental bog, which followed the recommendation of the New Jersey Agricultural Station to the state's cranberry growers, showed no discernible vertical movement of the pesticide from the surface to the groundwater. In the few cases where there was a groundwater residue, levels were so small and inconsistent that they may have been the result of channeling along the well casing. Instances of chlorothalonil residues in surface waters may be explained by occurrence of a spill and drift of the pesticide during application. Where residues of chlorothalonil were found in the soil, they were limited to the top 1-2 inches. It is concluded that chlorothalonil application to cranberry bogs in the Pine Barrens poses little risk of contaminating the underlying Cohansey aquifer system. (MacKeen-PTT)
W91-03533

ENVIRONMENTAL STUDY ON CHEMICAL POLLUTION OF THE LAKE KORONIA IN NORTHERN GREECE.
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
G. A. Vasilikiotis, J. A. Stratis, A. N. Voulgaropoulos, G. A. Zachariadis, and B. Michalopoulou.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 6, p 611-620, August 1990. 1 tab, 12 fig, 10 ref.

Descriptors: *Greece, *Heavy metals, *Lake Koronia, *Lakes, *Path of pollutants, *Water pollution sources, Chemical analysis, Conductivity, Eutrophic lakes, Hydrogen ion concentration, Lake sediments, Nutrient concentrations, Surface water.

The chemical pollution of Lake Koronia in the district of Thessaloniki, Greece was surveyed. Surface water and sediment samples were collected over a nine-month period from six sampling stations and tested for chemical and physicochemical parameters including pH, conductivity, temperature, and concentrations of nutrients and heavy metals. Temperatures were similar at all sampling stations, and lake water was slightly alkaline. The ratio of nitrate-N to phosphate-P was significantly elevated and as a result an extended eutrophication was observed. At stations near the site of discharge of untreated wastewater, the concentrations of Hg and Pb were higher than at the other stations; however, levels of these metals in the corresponding sediments were low. An analysis of cold-extractable versus total metals in sediments indicated that all of the Cu and Hg present in sediments was attributable to pollution, whereas most of the Fe originated in the sediment. An investigation into the sources of heavy metal pollution of the lake is recommended. (MacKeen-PTT)
W91-03534

PARAMETER IDENTIFICATION OF SOLUTE TRANSPORT MODELS FOR UNSATURATED SOILS.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
R. Abeliuk, and H. S. Wheater.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 199-224, September 1990. 11 fig, 8 tab, 35 ref.

Descriptors: *Flow models, *Model studies, *Parameterization, *Path of pollutants, *Soil water, *Solute transport, *Unsaturated flow, Conductivity, Dispersion, Sandy soils, Soil moisture, Soil profiles.

In models of unsaturated flow and solute transport, parametric relationships may be used to define material properties, namely the soil moisture characteristic, unsaturated conductivity function and the hydrodynamic dispersion relationship. The application of optimization methods to identify parameter values from experimental data of time-varying vertical profiles of moisture content and solute concentration is investigated for a sandy soil. Multiple local optima are identified for both flow and solute transport relationships, but these alternative parameter sets are shown to be generally more robust in prediction within he range of observed system states, which suggests utility for this approach to parameter identification. Other possible forms of dispersion relationship are investigated, and several different formulations produce identical performance. This indicates that the dispersion relationship is ambiguous and hence the interpretation of analytical form from this type of experimental data may not be possible. (Author's abstract)
W91-03549

MOBILITY TESTS OF PESTICIDES IN AGRICULTURAL SOILS (ESSAIS DE MOBILITE DES PESTICIDES DANS LES SOLS AGRICOLES).
Faculte des Sciences Agronomiques de l'Etat, Gembloux (Belgium).Lab. d'Hyraulique.
S. Dautrebande, M. Polarski, and J. Dewalsche.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 301-321, September 1990. 18 fig, 4 tab, 9 ref. English summary.

Descriptors: *Agricultural chemicals, *Laboratory methods, *Path of pollutants, *Percolation tests, *Pesticides, *Soil columns, Degradation products, Mathematical models, Model studies, Soils, Solute transport.

A laboratory soil column experiment was performed to determine the percolation potential of several pesticides and/or their degradation products in agricultural soils. A convenient model was developed for the systematic analysis of the potential of pesticides in the following processes: (1) degradation on the surface; (2) accumulation in the soil; (3) mobility, both of the original chemical and its degradation products; (4) absorption/desorption; and (5) dispersion. It was possible to relate characteristic parameters for pesticide transfers to a classification of potential risks of their accumulation in groundwater under conditions of medium

infiltration. These differences can be determined in the laboratory for different types of soil and under different conditions of infiltration. It is concluded that experimentation on soil columns in the laboratory may contribute to the development of a systematic methodology for the prediction of the extent of pesticide mobility in soils, either in their initial form or degraded. It would be possible, therefore, to compare the pesticides among themselves and come to a rational selection, especially with regard to the risk of pollution of the groundwater. (Peters-PTT)
W91-03554

VIRAL AND BACTERIAL CONTAMINATION OF MUSSELS (MYTILUS EDULIS) EXPOSED IN AN UNPOLLUTED MARINE ENVIRONMENT.
Institut National de la Sante et de la Recherche Medicale, Nice (France). Unite 303 Mer et Sante.
C. Jehl-Pietri, B. Hugues, and R. Deloince.
Letters in Applied Microbiology LAMIE7, Vol. 11, No. 3, p 126-129, September 1990. 1 tab, 15 ref.

Descriptors: *Coliforms, *Enteroviruses, *Marine pollution, *Path of pollutants, *Shellfish, *Viruses, Coastal waters, Fecal coliforms, Fecal streptococci, Marine environment, Mediterranean Sea, Shellfish contamination.

The contamination of mussels (Mytilus edulis) by fecal bacteria, cell-culturable enteroviruses and hepatitis A virus (HAV) was studied in mussels exposed in an unpolluted marine environment. Mussels were immersed at a depth of 15 m at a site 180 m south of the coastal point known as 'Cap Roux', Alpes-Maritimes, France. Samples were removed every 15 d for 7 mo. Of the 16 mussel samples examined, none contained cell-culturable enteroviruses, four showed a low-level contamination by HAV, and two did not conform to current bacteriological norms. No connection was observed between the viral and bacterial contamination. No viral contamination was detected in the sea water samples, but two gave bacterial counts above current norms. (MacKeen-PTT)
W91-03558

SUPERFUND RECORD OF DECISION: MONTGOMERY TOWNSHIP HOUSING DEVELOPMENT, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-03561

SUPERFUND RECORD OF DECISION: EWAN PROPERTY, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-03562

SUPERFUND RECORD OF DECISION: DORNEY ROAD, PA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-03563

ASSESSMENT OF AQUATIC ORGANISMS AS BIOINDICATORS OF HISTORICAL RADIONUCLIDE RELEASE TO THE COLUMBIA RIVER.
Battelle Pacific Northwest Labs., Richland, WA.
D. D. Dauble, T. M. Poston, and R. L. Newell.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-005941. Price codes: AO3 in paper copy, AO1 in microfiche. December 1988. 30p, 1 fig, 4 tab, 48 ref. DOE Contract DE-AC06-76RLO 1830.

Descriptors: *Bioaccumulation, *Bioindicators, *Columbia River, *Radionuclides, *Strontium, Mussels, Whitefish.

The potential for using several aquatic organisms as biological indicators of historic levels of radionuclides released to the Hanford Reach of the Columbia River was examined. The purpose of the study was to determine the types of environmental samples that could be collected to further the understanding of previous releases of radionuclides at Hanford. Information was initially collected to determine the relative abundance and persistence of radionuclides historically released at Hanford. The potential for long-lived radionuclides to bioaccumulate in aquatic organisms was then assessed. The life history of several common aquatic organisms was examined to evaluate their use as potential bioindicators of radionuclides released to the Columbia River. Considerations for analyzing strontium (90Sr) in biological sampes were determined. Based on this review of radionuclides released to the environment and their potential for bioaccumulation in aquatic organisms, strontium appears to be the only radionuclide suitable for further study. White sturgeon (Acipenser transmontanus) and the common mussel (Margaritifera margaritifera) are suitable condidates for developing dose reconstruction scenarios. Considerations for tissue analysis of radionuclide concentration in these species include potential for biological turnover and tissue mass. (Author's abstract)
W91-03564

SUPERFUND RECORD OF DECISION: G.E. WIRING, PR.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-03565

SUPERFUND RECORD OF DECISION: NL/TARACORP/GOLDEN AUTO, MN.
For primary bibliographic entry see Field 5G.
W91-03566

SUPERFUND RECORD OF DECISION: BROWN WOOD PRESERVING, FL.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-03567

TYPES AND EFFECTS OF MICROBIAL CONTAMINATION OF GROUNDWATER.
Environmental Protection Agency, Research Triangle Park, NC. Office of Research and Development.
G. F. Craun.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-222699/AS. Price codes: AO3 in paper copy, AO1 in microfiche. Report No. EPA/600/D-89/067. 1989. 32p, 5 fig, 6 tab, 4 ref.

Descriptors: *Groundwater pollution, *Path of pollutants, *Public health, *Water pollution sources, Disinfection, Drinking water, Groundwater quality, Pathogens.

Water may become a vehicle for the transmission of illness as well as a reservoir for the development of organisms that harbor or transmit illness. The incidence of water-related illnesses in the United States and other developed countries is low compared with most of the rest of the world. Nevertheless, there is a residual occurrence of waterborne disease which can and should be eliminated. A significant number of outbreaks and cases of illness occur because of groundwater contamination. Almost half of the waterborne outbreaks and cases of illness reported in the United States during 1971-85 were caused by the use of contaminated, untreated or inadequately treated groundwater. An analysis of 48 waterborne outbreaks and 54,935 cases of illness caused by source and treatment deficiencies in community water systems during 1946-70 showed that the use of untreated groundwater resulted in a high waterborne illness rate, 84.53 illnesses per million people served per year, or about six times the overall waterborne illness rate of all water systems. This indicates that either the quality of groundwater in many cases is questionable, the source is inadequately protected, the well is inadequately developed, or that the proper treatment is not being provided. If the disinfection of all community groundwater supplies were required and practiced, it is anticipated that the waterborne illness rate in groundwater supplies could be lowered to 22.6 illnesses per million people per year. Placing more emphasis on the operation and maintenance of continuous disinfection should result in an even lower rate, comparable to that observed for treated surface water supplies (4.6 illnesses per million people served per year). (Author's abstract)
W91-03577

VULNERABILITY OF KARST AQUIFERS TO CHEMICAL CONTAMINATION.
Environmental Protection Agency, Washington, DC. Office of Health and Environmental Assessment.
M. S. Field.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-218820/AS. Price codes: AO3 in paper copy, AO1 in microfiche. Report No. EPA/600/D-89/008. November 1988. 16p, 1 fig, 28 ref.

Descriptors: *Groundwater movement, *Groundwater pollution, *Groundwater quality, *Karst, *Path of pollutants, *Water pollution sources, Aquifers, Caves, Dolines, Ecological effects, Flood effects, Springs, Water table, Wells.

Groundwater flow in Karst aquifers is very different from flow in granular or fractured aquifers. Karst groundwater flow is often turbulent within discrete conduits that are convergent in the upper reaches and divergent in the lower, simulating the flow pattern of surface water streams that are dendritic or trellised but with discharge to one or more springs. Significant precipitation tends to flood karst aquifers quickly, causing a rapid rise in the water table that may flood higher levels with discharge to different springs. The epikarstic zone stores and directs infiltrating water down discrete percolation points. The vulnerability of karst aquifers to chemical contamination is a result of these characteristics. Chemical contamination may be fed directly to a karst aquifer via overland flow to a doline with little or no attenuation that may contaminate downgradient wells, springs, and dolines within a few hours to a few days. Contaminants may also become temporarily stored in the epikarstic zone for eventual release to the aquifer. Flood pulses may flush the contaminants causing transiently higher levels of contamination in the aquifer and discharge points. The convergent nature of flow in karst aquifers may result in contamination becoming concentrated in conduits. These contaminants can affect delicate plant and animal life that exists in caves as well as contaminate drinking water supplies too rapidly for adequate warning. (Author's abstract)
W91-03578

CHROMIUM DISTRIBUTION AND TRANSPORT BENEATH A CONTAMINATED SITE.
Sandia National Labs., Albuquerque, NM.
C. L. Stein, and D. F. McTigue.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-009696/AS. Price codes: AO4 in paper copy, AO1 in microfiche. February 1989. 50p, 16 fig, 7 tab, 12 ref, append. DOE Contract DE-AC04-76DP00789.

Descriptors: *Chromium, *Groundwater pollution, *Model studies, *New Mexico, *Path of pollutants, *Soil contamination, *Waste dumps, Geology, Pollutant transport.

For an undetermined period of years during the 1970s, liquid waste containing unspecified but significant quantities of chromium was dumped into an unlined disposal pit in surficial alluvium in the Sandia National Laboratories (New Mexico) chemical disposal site in Technical Area III. The alluvial sediments are variable in particle size and contain lenses of gravel and/or cobbles and clay/silt layers. Mineralogy consists of quartz, illite and kaolinite, calcite, gypsum, and feldspar (mainly microcline). Depth to the water table beneath this site is approximately 145 m. A single borehole was

drilled and sampled at the site in 1981. In 1983, previous workers sampled and analyzed soil from four 23-m deep holes drilled along an east-west profile across the pit. Cr was detected at that time to a depth of 15 m beneath the pit, and at a depth between 3 and 8 m at a distance 5.5 m west of the western end of the pit. Cr was detected in samples collected in 1987 at concentrations of about 150 micrograms/g at a depth of 15 m directly below the pit, and about 60 micrograms/g at a depth of 14 m below a point 5.5 m west of the west end of the pit. The 1987 sampling showed Cr to be present at a depth of 23 m in three of the holes. Superposition of the 1983 and 1987 data shows downward migration and dispersion of Cr. A model for Cr transport prior to 1981 was based on assumptions about the dumping history. One-dimensional simulations, in conjunction with a parameter-estimation code, yielded estimates of the average convection velocity (53 nm/s) and dispersivity (3.0 sq nm/s). Subsequent simulations, using the measured 1983 profile as the initial condition and the 1987 profile as a final state, yielded reasonably consistent values for the velocity (30 nm/s) and dispersivity (17 sq nm/s). This exercise illustrates a number of issues likely to be encountered in any attempt to couple site-specific data with even simple model calculations. Significant factors include sampling distribution and methodology; effects of smoothing, interpolation, and extrapolation of data; assumptions regarding boundary conditions where unknown; effects of two-dimensional and three-dimensional transport; sediment inhomogeneity; biological and geochemical transformation effects; and definition of appropriate 'goodness of fit' measures. (Author's abstract)
W91-03579

ADVANCED UTILITY SIMULATION MODEL, ANALYTICAL DOCUMENTATION, STATE LEVEL MODEL (VERSION 1.0).
Illinois Univ. at Urbana-Champaign. Coll. of Engineering.
For primary bibliographic entry see Field 7C.
W91-03581

SUPERFUND RECORD OF DECISION: WILDCAT LANDFILL, DE.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-03587

HEALTH ASSESSMENT FOR ALSCO ANACONDA NATIONAL PRIORITIES LIST (NPL) SITE, GNADENHUTTEN, OHIO.
Agency for Toxic Substances and Disease Registry, Atlanta, GA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-100330. Price codes: A02 in paper copy, A01 in microfiche. January 1989. 9p.

Descriptors: *Alsco Anaconda National Priority Site, *Groundwater pollution, *Ohio, *Path of pollutants, *Pollutant identification, *Soil contamination, *Water pollution sources, Aroclors, Cyanide, Fluorides, Gnadenhutten, Heavy metals, Manganese, Nitrates, Polychlorinated biphenyls, Public health, Selenium.

The Alsco Anaconda plant in Gnadenhutten, Ohio, is listed on the National Priorities List, was sampled for soil, sludge, groundwater, and sediment contamination. On-site soils were found to be contaminated with manganese at levels of public health concern, 480-7,200 parts per million (ppm). Swamp sediments were found to be contaminated with polychlorinated biphenyls (PCBs) (Aroclor 1242, 1248, and 1254) at levels of public health concern, < 0.16-3,000 ppm. Groundwater samples show that cyanide (total) (< 0.02-0.47 ppm), fluoride (< 0.1-8.7 ppm), nitrate (< 0.1-21 ppm), and selenium (< 0.001-0.015 ppm) were all at levels of public health concern. The site is considered to be of potential public health concern because of the risk to human health caused by the possibility of exposure to hazardous substances via the ingestion of contaminated biota found in the swamp, and of river water after the site has been flooded. (Author's abstract)
W91-03593

HEALTH ASSESSMENT FOR WINDOM DUMP, MINNESOTA.
Minnesota Dept. of Health, Minneapolis.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-100322. Price codes: A03 in paper copy, A01 in microfiche. June 1989. 26p, 1 tab, 16 ref, append.

Descriptors: *Groundwater pollution, *Minnesota, *Path of pollutants, *Public health, *Volatile organic compounds, *Waste dumps, Drinking water, Municipal water supply, Wells, Windom Dump Site.

The Windom Dump Site, Windom, Minnesota is listed on the National Priorities List. Thirty-one volatile organic compounds (VOCs) have been detected in groundwater beneath the site and at its perimeter. Eight of these VOCs were detected at concentrations greater than Recommended Allowable Limits (RALs) for drinking water. A Windom city well has also been contaminated. The city well has contained a maximum 2 micro g/L cis-1,2-dichloroethylene (1,2-DCE) and 4 micro g/L vinyl chloride. The RALs for 1,2-DCE and vinyl chloride are 70 micro g/L and 0.15 micro g/L, respectively. 1,2-DCE was detected in the distribution system at a concentration of 1.2 micro g/L; vinyl chloride was not detected. Use of the contaminated city well has continued on a limited basis since the 1,2-DCE detection in the distribution system. Potential for human exposure of public health concern to site contaminants exists if the VOC concentrations in the contaminated city well increase, or if the only city wells become contaminated. However, if frequent monitoring of the Windom city wells is continued, early detection of contaminants and prompt response actions will make substantial exposure to contaminants via the municipal water supply unlikely. (Author's abstract)
W91-03596

HEALTH ASSESSMENT FOR WASTE DISPOSAL ENGINEERING, INC. SANITARY LANDFILL SITE, ANDOVER, MINNESOTA.
Agency for Toxic Substances and Disease Registry, Atlanta, GA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-100306. Price codes: A03 in paper copy, A01 in microfiche. April 1988. 12p, 4 tab, 8 ref.

Descriptors: *Air pollution, *Groundwater pollution, *Minnesota, *Path of pollutants, *Public health, *Sanitary landfills, *Volatile organic compounds, Drinking water, Dusts, Lime sludge, Sediment contamination, Vapors.

Waste Disposal Engineering Inc. Sanitary Landfill, is an NPL site located in the City of Andover. The 173-acre site was used to landfill municipal refuse and industrial wastes. Volatile organic compounds and lime sludge are the predominant contaminants present at the landfill. Exposure pathways for the site are the following: ingestion of surface water, groundwater, sediment, and lime sludge; inhalation of dusts and vapors generated on-site; and dermal exposure to surface water, sediment, lime sludge, groundwater, and exposed water. The remedial action proposed will address major health concerns for the site. There is public health concern regarding inhalation and dermal absorption of lime sludge (particularly to the fugitive dust generated) and vapors, as well as ingestion exposure to the lime sludge. (Author's abstract)
W91-03597

SUPERFUND RECORD OF DECISION: CROYDEN TCE SPILL, PA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-03601

CYCLE IN THE SYSTEM SOIL-PLANT-ANIMAL ON LOCATIONS WITH EXTREMELY HIGH SOIL CONTAMINATION BY CADMIUM AND NICKEL CAUSED BY SEWAGE-SLUDGE (KREISLAUF IM SYSTEM BODEN-PFLANZE-NUTZTIER AUF STANDORTEN MIT EXTREM HOHER CADMIUM-UND NICKELBELASTUNG DURCH KLARSCHLAM-MAUFBRINGUNG).
Landwirtschaftliche Untersuchungs- und Forschungsanstalt, Speyer (Germany, F.R.).
G. Crossmann.
Available from the National Technical Information Service, Springfield, VA 22161 as T1B/B88-82380. Price codes: E11 in paper copy, X00 in microfiche. Report No. UBA-FB 86-106, December 1986. 95p, 3 fig, 52 tab, 47 ref. English summary.

Descriptors: *Bioaccumulation, *Cadmium, *Crops, *Heavy metals, *Nickel, *Soil contamination, Food chains, Leaching, Nitrates, Soil properties, Vegetable crops.

In 3-year field experiments the uptake and accumulation of cadmium and nickel in vegetable and arable plants was studied. The soils were characterized by high sorption conditions (clay, organic matter, pH, Fe-oxides and Mn-oxides). The availability of Cd and Ni therefore was relatively low. The aqua regia soluble contents were on the average 157 mg Cd and 558 mg Ni/kg soil, with large variations. The high nitrate concentrations over all the years were remarkable. The Cd-content in vegetables decreased in the following order: leaves-roots-kale-onion-fruits-potatoes-legumes. A low Cd-content was also found in grains of barley and maize. Leafy-vegetables and legumes showed higher Ni-contents than other vegetables. Limits and practicalities of plant cultivation on highly contaminated soils were discussed in regard to contaminant transfer into plants and leaching. The large nitrogen supply and its mobility needs permanent plant cultivation (e.g. industrial plants, plantations). The degradation of sorptive soil conditions increases the risk of higher Cd-availability and Ni-availability and leaching processes, with unfavorable effects on food chains and on the ecosystem. (Author's abstract)
W91-03602

GROUND WATER POLLUTION TRANSPORT: MODEL STUDIES (JAN 75-MAR 89).
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W91-03604

UPWARD MIGRATION OF UNDERGROUND INJECTION WASTES THROUGH HYDROLOGIC CONDUITS AROUND THE WELLBORE.
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 5E.
W91-03606

ROLE OF CROPPING SYSTEMS IN ENVIRONMENTAL QUALITY: GROUNDWATER NITROGEN.
Agricultural Research Service, Lincoln, NE.
For primary bibliographic entry see Field 3F.
W91-03643

NUTRIENT LOADING STATUS OF THE CONESTOGA RIVER BASIN, 1985-1989.
Susquehanna River Basin Commission, Harrisburg, PA. Resource Quality Management and Protection Div.
A. N. Ott.
Susquehanna River Basin Commission, Harrisburg, PA. Publication No. 133, September 1990. 11p. 4 fig, 3 tab.

Descriptors: *Conestoga River, *Nonpoint pollution sources, *Nutrient concentrations, *Water pollution sources, *Water quality, Monitoring, Nitrates, Nitrogen, Phosphorus, Pollution load, Wastewater treatment.

The Conestoga River at Conestoga, PA, is one of 14 sites that has been monitored for its nutrient

content during a five year period from 1985-1989. A primary purpose of this monitoring program is to establish a sound database which can be used to plan, implement, and evaluate immediate and long-range reduction efforts. The Conestoga River data presents a prime example of how this information can be used. Nutrient monitoring of the Conestoga River has indicated no change in the nitrogen loading for the period 11985-1989, but shows a slight decrease in the phosphorus load for 1988 and a significant decrease for 1989. Records from the Lancaster sewage treatment plant (STP) show a decreased phosphorus concentration in their effluent midway through 1988 and an even lower concentration throughout 1989. While they have significantly decreased their ammonia concentration during the same period, the nitrate concentration has concurrently increased. Subtraction of the point source STP nutrient load from the measured basin load provides an estimate of the nonpoint source nutrient load. Evaluation of this phosphorus load with water discharge shows no change in loading from 1985-1988, but shows a definite load decrease in 1989. This decrease in 1989 phosphorus nonpoint source load is shown to be coincidental with the lower than normal suspended sediment load in 1989. This report indicates that long-term monitoring data can be used to detect changes in small tributary watersheds. However, interpretation of the data must be coupled with a knowledge of the changing conditions within the watershed. (Lantz-PTT)
W91-03647

INTRODUCTION TO MODELING OF TRANSPORT PHENOMENA IN POROUS MEDIA.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-03654

PROCEEDINGS OF THE SIXTH CORPS CHEMISTS MEETING, 16-17 MAY 1989.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5A.
W91-03659

MANAGEMENT OF LAKE ONTARIO RESOURCES: A HOLISTIC PERSPECTIVE.
State Univ. of New York at Buffalo.
For primary bibliographic entry see Field 2H.
W91-03678

ASSESSMENT OF AGRICULTURAL NONPOINT SOURCE POLLUTION POTENTIALS IN THE CANADIAN GREAT LAKES BASIN.
Guelph Univ. (Ontario). Dept. of Land Resource Science.
G. J. Wall, E. A. Pringle, and W. T. Dickinson.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 179-188, 1 fig, 3 tab, 19 ref.

Descriptors: *Fertilizers, *Great Lakes, *Nonpoint pollution sources, *Path of pollutants, *Pesticides, *Triazine herbicides, *Water pollution sources, Agricultural chemicals, Alachlor, Atrazine, Cadmium, Farm wastes, Lake management, Land management, Phosphorus, Pollution load, Surface-groundwater relations, Water quality management, Water quality standards, Water resources management.

Existing agricultural land data bases plus stream water and sediment quality in intensively farmed areas of the Canadian Great Lakes basin (Ontario) were examined to assess the magnitude and potential sources of agricultural nonpoint pollution. The analysis revealed high fertilizer and pesticide use with phosphorus applications occurring at up to three times the recommended rate in some regions. Soil hydrologic conditions in the study area indicated high potential to transfer pollutants to surface water and groundwater. Soil and water conservation practices have been used minimally. The combination of fertilizer and pesticide use along with soil potentials for pollutant transfer indicated that Kent and Elgin counties possessed the highest relative potentials within the study area to contribute to agricultural nonpoint source pollution. Tributary water quality data indicated the presence of all 8 contaminants analyzed (PCBs, HCBs, OCS, P, Cd, Cl, Pb, and NO3). Phosphorus and cadmium consistently exceeded water quality standards in all tributaries, and agricultural pesticides such as atrazine and alachlor were found in 93% and 15% of all Thames River samples respectively. Several computational methods were used to calculate annual loading rates for P, Cd, Cl, NO3, Pb, atrazine, alachlor, metolachlor, and cyanazine for some of the tributaries. High tributary pollutant concentrations and the resulting loads in the predominantly agricultural nonpoint source pollution has been contributing to impaired water quality in the study area. Comprehensive land management must be promoted at the farm level, and water quality monitoring and standards must be improved. (See also W91-03672) (Author's abstract)
W91-03692

NIAGARA'S PROGRAM FOR REDUCTION OF PRIORITY POLLUTANTS TO THE NIAGARA RIVER.
Niagara Regional Municipality, Thorold (Ontario).
C. H. Eidt.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 189-200, 2 fig.

Descriptors: *Great Lakes, *Lake management, *Niagara River, *Priority pollutants, *Water pollution control, *Water quality management, *Water resources management, Canada, Pollution load, Sewer systems, Wastewater disposal, Wastewater facilities, Wastewater treatment, Water pollution sources.

The Niagara River Toxics Committee Report of October 1984 identified eight significant discharges of priority and special pollutants reaching the Niagara River from the Canadian side; four from industrial sources and four from municipal sources. Three are water pollution control plants operated by Niagara and the fourth, a combined sewer in Welland. The Niagara Falls 12 MIGD primary plant was given highest priority. A process study was initiated including a pilot plant to determine methods of handling normal flow plus loading from canning and winery industries. The recommended solution was installation of rotating biological contactors. Operating problems were encountered, resolved, and pollutant discharges significantly reduced. Similar studies were carried out for Anger Avenue 5.4 MIGD pollution control plant in Fort Erie and Welland 10.0 MIGD pollution control plant in Welland, which discharges indirectly into the Niagara River. In both cases, studies recommended continuation of activated air process with two lines of sewage treatment, one for normal sewage and a second for weak sewage during wet weather periods. Both plants are under construction and the Welland plant includes sand filtration to reduce ammonia. The fourth source, a combined sewer, will be connected to the Welland plant and treated. (See also W91-03672) (Author's abstract)
W91-03693

PHOSPHORUS LEVELS IN ONTARIO STREAMS TRIBUTARY TO THE GREAT LAKES A DECADE AFTER PLUARG.
Ontario Ministry of the Environment, Toronto.
B. Bodo.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 211-220, 4 fig, 1 tab, 14 ref.

Descriptors: *Great Lakes, *Phosphorus, *Water pollution control, *Water quality management, *Water quality standards, Agricultural runoff, Eutrophication, Farm wastes, Lake Erie, Lake Ontario, Lake management, Land use, Ontario, Water quality trends, Water resources management.

Broad scale spatial analysis of recent total phosphorus (P) levels in 116 Ontario streams tributary to the Great Lakes reveals that in the majority of tributaries across southern Ontario P exceeds a criterion of 30 micrograms/L intended for protection against in-stream eutrophication. Tributary P inputs remain of concern, particularly to Lake Erie where levels at all sites exceed 30 micrograms/L and at 16 of 21 sites exceed 90 micrograms/L; and to a lesser degree, Lake Ontario where a majority of 45 streams exceeds the 30 micrograms/L criterion. With the exception of Lake Huron, drainage from Ontario's agricultural southwest, upper lakes tributaries generally exhibit low P. Trend screening of recent (1985-87) records against 1975-77 Pollution from Land Use Activities Reference Group (PLUARG) era records at 109 sites shows significant P declines in Lake Ontario tributaries, but little net change elsewhere. Continuing surveillance is warranted on the lower lakes tributaries as both urban and agricultural land uses continue to intensify. Past and future changes in measurement protocols must be documented to assure reliable interpretation of long-term trends. (See also W91-03672) (Author's abstract)
W91-03695

WATER QUALITY IN A THIN WATER-TABLE AQUIFER ADJACENT TO LAKE MICHIGAN, WITHIN A HIGHLY INDUSTRIALIZED REGION OF INDIANA.
Geological Survey, Indianapolis, IN.
K. J. Banaszak, and J. M. Fenelon.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 247-258, 2 fig, 5 tab, 8 ref.

Descriptors: *Great Lakes, *Groundwater pollution, *Hazardous wastes, *Water pollution sources, Alkalinity, Calumet aquifer, Groundwater quality, Hydrogen ion concentration, Lake Michigan, Lake management, Oil industry, Specific conductivity, Steel industry, Unconfined aquifers, Water quality management, Water resources management, Water temperature.

Many sources of hazardous material directly overlie the thin, water-table, low-hydraulic-gradient Calumet aquifer, whose water ultimately reaches Lake Michigan. Thirty-five stainless steel wells, including six pairs of nested wells, were sampled in a 50-square-mile area. Field characteristics measured were temperature, pH, specific conductance, dissolved oxygen, and alkalinity. Additional analytes were three nutrients; three common anions; bromide; boron; silica; four common cations; 11 heavy metals; and 88 organic chemicals, including some organic chemical groups, such as phenol. Median pH was 7.3, but samples from three wells screened in slag had pH values above 11. Median alkalinity was 290 mg/L as CaCO3, but concentrations in three samples exceeded 900 mg/L. Median specific conductance was 1,200 microseimens/cm, but six values exceeded 2,380 microseimens/cm. Of these six samples, three were from fresh slag and the other three were contaminated by petroleum products. Sixty-seven of the organic chemicals analyzed, including trichloroethylene, were not detected. Phenol, however, was found in samples collected from wells in or near steel or petrochemical plants were significantly different (at the 95% confidence level) from medians in samples from all other wells. (See also W91-03672) (Author's abstract)
W91-03699

NONPOINT POLLUTION: 1988-POLICY, ECONOMY, MANAGEMENT, AND APPROPRIATE TECHNOLOGY.
For primary bibliographic entry see Field 5G.
W91-03704

EFFECTS ON U.S. WATER RESOURCES OF AGRICULTURAL CHEMICALS AND RUNOFF: MAGNITUDE, EXTENT, AND ECONOMIC CONSEQUENCES.
Economic Research Service, Washington, DC.
For primary bibliographic entry see Field 6G.
W91-03709

RESULTS OF FIFTEEN YEARS OF CONTINUOUS MONITORING OF WATER QUALITY IN THE RUHR RIVER HEAVILY AFFECTED BY RESIDUAL POINT AND NONPOINT POLLUTION.
Ruhrverband, Essen (Germany, F.R.).
D. R. Albrecht.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 271-281, 14 fig, 10 ref.

Descriptors: *Aeration, *Germany, *Monitoring, *Nonpoint pollution sources, *Ruhr River, *Stream pollution, *Water pollution control, *Water pollution sources, Algal growth, Dissolved oxygen, Eutrophication, Instream aeration, Runoff, Storm water management, Urban runoff, Wastewater management, Wastewater treatment, Water quality trends, Water resources management.

A large fish kill in the impoundment Lake Baldeney on the Ruhr River in 1963 was an incentive to create a system for instream aeration in the lower Ruhr River. The river presently receives treated secondary sewage and urban and rural runoff from heavily populated areas of Germany. Industrial wastewater contribution in the Ruhr basin amounts to 47% of the total wastewater flow. Instream aeration has been used for mitigation of the remaining pollution and problems of eutrophication. Operation of the aeration devices requires continuous dissolved oxygen (DO) monitoring at selected key cross-sections of the river. Statistical evaluation of the results provides detailed information on water quality and eutrophication trends of the river. The results showed that in the period from 1972 to 1987 the winter averages of dissolved oxygen in the river were increased form 62 to 95% of saturation. During summer half-years frequently oversaturation due to algal photosynthesis occurs. It has been found that secondary pollution due to algal productivity is becoming a major factor in the DO-regime. As phosphorus concentrations have been diminished in the Ruhr after 1976, mass algal developments are now reduced. New targets for the Ruhr water quality and recent legal requirements demand further reduction of phosphorus and ammonia in wastewater treatment plants. Future strategies are further focused on the reduction of organic halogens which can be adsorbed by activated carbon and on nonpoint pollution abatement by improved storm water treatment in combined sewage systems. (See also W91-03704) (Author's abstract)
W91-03733

MODELING NONPOINT POLLUTION AT THE WATERSHED LEVEL WITH THE AID OF A GEOGRAPHIC INFORMATION SYSTEM.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
For primary bibliographic entry see Field 4D.
W91-03734

IRRIGATION-INDUCED WATER QUALITY PROBLEMS: POLICY IMPLICATIONS OF DOI RECONNAISSANCE STUDY RESULTS.
National Irrigation Water Quality Program, Washington, DC.
J. P. Deason.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 293-302, 4 tab, 9 ref.

Descriptors: *Environmental policy, *Irrigation effects, *Nonpoint pollution sources, *Surveys, *Water pollution sources, *Water quality, *Water resources management, Climatic effects, DDE, Drainage effects, Environmental impact, Geologic control, Irrigation water, Pesticides, Selenium, Trace elements, Water policy, Water pollution control, Watersheds, Wetlands.

In 1986, the U.S. Department of the Interior embarked on a series of reconnaissance level investigations throughout the western states to identify and assess potential irrigation-induced water quality problems. A series of water, sediment, and biological samples are being analyzed for selenium and 16 other trace elements, as well as a number of pesticides. Nine investigations in seven states have been completed and ten additional investigations are underway. A number of generic observations can be made, based upon the results of the first nine investigations: (1) knowledge of geologic sources of trace elements is very important in determining where problems with irrigation-induced contamination are likely to exist; (2) meteorological characteristics of an area can be very meaningful regarding potential for problems; (3) closed watersheds were found to be an important physical characteristic of locations that may tend to exhibit symptoms of irrigation-induced contamination; (4) at the study areas where selenium was found to be at levels that could adversely affect wildlife reproduction and growth, extensive irrigation and drainage activities occur; (5) selenium is the constituent of concern commonly found at elevated concentrations in wetland ecological systems receiving irrigation drainage water; (6) concentrations of analytes were found to vary widely on a spatial basis in all media sampled; (7) yearly variations in precipitation and streamflow make accurate assessments of conditions in a given area difficult without a long period of analysis; and (8) organochlorine pesticides (principally DDE) generally were detected only in areas where applications have been large, and concentrations were low in water, sediment, and biota. (See also W91-03704) (Fish-PTT)
W91-03735

DIFFUSED GROUNDWATER CONTAMINATION BY HERBICIDES IN AN AGRICULTURAL AREA IN NORTHERN ITALY.
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
A. G. Capodaglio, M. Baldi, P. Valentini, and G. Bellinzona.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 303-312, 2 fig 5 tab, 8 ref.

Descriptors: *Agricultural chemicals, *Groundwater pollution, *Herbicides, *Italy, *Nonpoint pollution sources, *Water pollution control, *Water pollution sources, *Water resources management, Atrazine, Drinking water, Environmental impact, Molinate, Po River, Public health, Regulations, Social aspects, Water policy, Water quality standards.

Residues of herbicides were detected in 1986 in public and private water supply wells throughout the Po River Valley in northern Italy. Atrazine and molinate were the two compounds most frequently identified. Although the concentrations of herbicides were relatively low compared to U.S. standards, their occurrence was considered an index of environmental stress in the area, thus raising concern in scientists and the general public. Moreover, drinking water standards derived from the European Community's directives set the allowable limits for the detected compounds below their actual concentrations in aquifers, causing an emergency-type situation for the population relying on the 'contaminated' aquifer for their water supply. The contamination of groundwater detected in the study area does not have immediate adverse health effects for the resident population, although long-term consequences of human exposure to the herbicides found have not yet been thoroughly studied. The emotional response of the public to the occurrence is exacerbated by the contradictions and continuous changes in the regulations which also promote lack of credibility in the official organizations entrusted with the safeguard of public health. The long-term monitoring of the aquifer underlying agricultural areas which are the source of the contamination is expected to give useful information on the spread of the contamination and on the natural processes occurring within the soil in the affected areas, regardless of the magnitude of the real hazards at the present time, and may be usefully employed to promote more environmentally sound cultivation practices, as well as to guide the implementation of fair regulatory measures. (See also W91-03704) (Fish-PTT)
W91-03736

TRANSPORT IN HETEROGENEOUS POROUS FORMATIONS: 1. TIME-DEPENDENT CONVECTIVE DISPERSION.
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
For primary bibliographic entry see Field 7C.
W91-03755

TRANSPORT IN HETEROGENEOUS POROUS FORMATIONS: 2. TIME-DEPENDENT DOUBLE DISPERSION.
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
For primary bibliographic entry see Field 7C.
W91-03756

ESTIMATION OF DIFFUSE INPUTS TO A COASTAL SEA: SOLUTION TO AN INVERSE MODELLING PROBLEM.
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 2L.
W91-03817

TRACE METAL CHEMISTRY OF A DUTCH RESERVOIR, THE TJEUKEMEER.
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 2H.
W91-03827

FACTORS AFFECTING SULFUR INCORPORATION INTO LAKE SEDIMENTS: PALEOECOLOGICAL IMPLICATIONS.
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 2H.
W91-03828

STABLE ISOTOPIC COMPOSITIONS OF SULFUR IN PIRLA SEDIMENT CORES.
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2H.
W91-03829

PALAEOECOLOGICAL TEST OF THE LAND-USE HYPOTHESIS FOR RECENT LAKE ACIDIFICATION IN SOUTH-WEST NORWAY USING HILL-TOP LAKES.
Bergen Univ. (Norway). Botanical Inst.
For primary bibliographic entry see Field 2H.
W91-03830

REVIEW OF IMMISCIBLE FLUIDS IN THE SUBSURFACE: PROPERTIES, MODELS, CHARACTERIZATION AND REMEDIATION.
GeoTrans, Inc., Herndon, VA.
J. W. Mercer, and R. M. Cohen.
Journal of Contaminant Hydrology JCOHE6, Vol. 6, No. 2, p 107-163, September 1990. 5 fig, 5 tab, 236 ref, 2 append.

Descriptors: *Cleanup, *Groundwater pollution, *Hydrocarbons, *Literature review, *Path of pollutants, *Remediation, *Site remediation, *Water pollution treatment, Chemical properties, Groundwater transport, Mass transfer, Solubility, Solute transport, Vadose zone, Vaporization.

Nonaqueous phase liquids (NAPLs) are immiscible fluids that result from a variety of industrial processes and are found at numerous contaminated sites. NAPLs behave differently than dissolved solutes in the subsurface. Their behavior depends on fluid properties such as interfacial tension, viscosity and density. Density determines if the immiscible fluid is lighter than water (LNAPL) or heavier than water (DNAPL). In addition, mass transfer produces vapor transport in the vadose

zone and solute transport in groundwater. Mass transfer depends on properties associated with volatilization and aqueous solubility. LNAPLs are often associated with petroleum hydrocarbons. Because of work performed in the petroleum industry, considerable information has been developed on properties associated with petroleum products. In addition, because LNAPL is at or near the water table, characterization and remediation are generally more successful than at DNAPL sites. Remediation of NAPL contamination often involves a combination of techniques to form a treatment train. Mobile NAPL should be recovered using a pump-and-treat technology. This will leave behind a residual saturation that might be remediated by another technique such as vacuum extraction or EOR methods. Residual NAPL recovery, especially for DNAPL, is difficult with no routine proven technology available. At some sites, hydraulic containment may be the only practical contaminant management option. Considerable research is necessary before NAPL problems are well understood. (Hoskin-PTT)
W91-03847

SORPTION AND DEGRADATION OF CHLOROPHENOLS, NITROPHENOLS AND ORGANOPHOSPHORUS PESTICIDES IN THE SUBSOIL UNDER LANDFILLS--LABORATORY STUDIES.
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
P. Kjeldsen, J. Kjolholt, B. Schultz, T. H. Christensen, and J. C. Tjell.
Journal of Contaminant Hydrology JCOHE6, Vol. 6, No. 2, p 165-184, September 1990. 6 fig, 7 tab, 21 ref.

Descriptors: *Chemical degradation, *Landfills, *Nitrophenols, *Organophosphorus pesticides, *Path of pollutants, *Pesticides, *Sorption, Anaerobic conditions, Denmark, Dimethoate, Fate of pollutants, Groundwater movement, Groundwater pollution, Leachates, Malathion, Phenols, Sand, Soil columns, Sulfotep.

To study the fate of co-disposed chemicals in the subsoil of landfills, anaerobic soil columns loaded with anaerobic leachate from a municipal landfill were set up. The leachate was spiked with eleven compounds representing three groups of chemicals: chlorophenols, nitrophenols and organophosphates. Two subsoils, a coarse sand and a sandy loam, were used in the study. The columns were maintained at Danish groundwater temperature (8-10 degrees) and were run for a period of 10 months. Analysis of the influent leachate concentrations of the spiked compounds showed that the concentrations were constant during the entire experimental period. Many of the compounds showed delayed breakthrough (compared to chloride breakthrough) in both soils, followed by a constant effluent concentration ratio of less than unity indicating that degradation was occurring. The velocities for the chlorophenols and nitrophenols were in the range of 10-100% of the water velocity in the two subsoils. The distribution coefficient for the specific phenol, the acidity and the pH of the soil apparently governed the retardation of the phenolic compounds. Degradation of most of the phenols was observed with half-life values of 30-150 days. The four organophosphorus pesticides, Dimethoate, Malathion, Sulfotep and Fenitrothion, showed relative velocities from $<10\%$ to ca. 100%. Malathion and Sulfotep were degraded with half-life values of 10-20 days, while Dimethoate was not significantly degraded in the two soil columns. Fenitrothion did not appear in the effluent from the columns, probably due to high retardation. (Author's abstract)
W91-03848

SEPARATION OF RADIONUCLIDE MIGRATION BY SOLUTION AND PARTICLE TRANSPORT IN SOIL.
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
J. Torok, L. P. Buckley, and B. I. L. Woods.
Journal of Contaminant Hydrology JCOHE6, Vol. 6, No. 2, p 185-203, September 1990. 11 fig, 3 tab, 12 ref, append.

Descriptors: *Groundwater pollution, *Ion transport, *Path of pollutants, *Radioisotopes, *Solute transport, Adsorption, Cesium radioisotopes, Cobalt radioisotopes, Colloids, Diffusion coefficient, Laboratory methods, Lysimeters.

Laboratory-scale lysimeter experiments were performed with simulated waste forms placed in candidate buffer materials which have been chosen for a low-level radioactive waste repository. Radionuclide releases into the effluent water and capture by the buffer material were determined. The results could not be explained by traditional solute transport mechanisms, and particle transport was suspected as the dominant mechanism for radionuclide release from the lysimeters. To elucidate the relative contribution of particle and solute transport, lysimeter wastes were replaced by a wafer of neutron-activated buffer soaked with selected soluble isotopes. Particle transport was determined by the movement of gamma-emitting neutron-activation products. Solute transport was quantified by comparing the migration of soluble radionuclides relative to the transport of neutron-activation products. Distribution coefficients and rate constants of radionuclide desorption were calculated directly from buffer cores, and rate constants for radionuclide adsorption were then approximated. The results of this experiment and modelling of the solution transport process were used to determine the radionuclide transport mechanism in experiments with simulated waste forms in the lysimeters. The mechanisms are as follows: 137Cs particle transport; 60Co was incorporated as particles within the waste form and released as colloids. The new approach presented here for monitoring radionuclide migration in soil facilitates the determination of most of the fundamental coefficients required to model the transport process. (Author's abstract)
W91-03849

FATE OF NITROGEN AND PHOSPHORUS ENTERING A GULF COAST FRESHWATER LAKE: A CASE STUDY.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. D. DeLaune, C. W. Lindau, R. S. Knox, and C. J. Smith.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 621-631, August 1990. 9 fig, 3 tab, 41 ref. NSF Grant BSR8414006.

Descriptors: *Eutrophication, *Fate of pollutants, *Limnology, *Nonpoint pollution sources, *Nutrients, *Path of pollutants, *Phosphorus, *Water pollution sources, Adsorption, Ammonium, Case studies, Cycling nutrients, Denitrification, Lake Verret, Lake sediments, Louisiana, Nitrates, Nitrification, Nitrogen, Nutrient concentrations, Nutrient removal, Orthophosphates, Sedimentation, Water chemistry.

Nitrogen and P fluxes, transformations and water quality functions of Lake Verret (a coastal Louisiana freshwater lake), were quantified. Ortho-P, total-P, NH4(+)-N, NO3-N and Total Kjeldahl nitrogen (TKN) in surface water collected from streams feeding Lake Verret averaged 104, 340, 59, 185 and 1060 mg/L, respectively. Lake Verret surface water concentrations of ortho-P, total-P, NH4+-N, NO3-N and TKN averaged 66, 191, 36, 66 and 1292 micrograms/L. The higher N and P concentrations were located in areas of the lake receiving drainage. Nitrification and denitrification processes were significant in removing appreciable inorganic N from the system. In situ denitrification rates determined from acetylene inhibition techniques show the lake removes 560 mg N/sq m/yr. Laboratory investigations using sediment receiving 450 micrograms NH4(+)-N (15-N labeled) showed that the lake has the potential to remove up to 12.8 g N/sq m/yr. Equilibrium studies of P exchanges between the sediment and water column established the potential or adsorption capacity of bottom sediment in removing P from the overlying water. Lake Verret sediment was found to adsorb P from the water column at concentrations above 50 micrograms P/L and the adsorption rates were as great as 300 micrograms P/sq cm/day. Using the 137Cs dating techniques, approximately 18 g N/sq m/yr and 1.2 g P/sq m/yr were removed from the system via sedimentation. Presently elevated nutrient levels are found only in the upper reaches of the lake receiving nutrient input from runoff from streams draining adjacent agricultural areas. Nitrification, denitrification and adsorption processes at the sediment-water interface over a relatively short distance reduces the N and P levels in the water column. However, if the lake receives additional nutrient loading, elevated levels will likely cover a larger portion of the lake, further reducing water quality in the lake. (Author's abstract)
W91-03857

OPTIMAL BATHYMETRY OF TYRRHENIAN SEA BY STOCHASTIC INTERPOLATORS.
Padua Univ. (Italy). Dipt. di Metodi e Modelli Matematici per le Scienze Applicate.
G. Gambolati, and G. Galeati.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 677-685, August 1990. 6 fig, 3 tab, 25 ref.

Descriptors: *Bathymetry, *Data analysis, *Data interpretation, *Geomorphology, *Mathematical analysis, *Mediterranean Sea, *Path of pollutants, *Stochastic models, *Thermal pollution, Italy, Kriging, Marine environment, Mathematical equations.

The analysis of the sea depth in the vicinity of a thermal power plant is important in view of the heat dispersion and transport of the cooling water discharged from the energy production processes. The bathymetry of the Tyrrhenian Sea in the area facing the thermoelectric plant being built at Montalto di Castro, Italy, is reconstructed with the aid of the kriging technique. The large number of measurements (2038) precludes the use of a global interpolation model. At the same time, the steepness of the variogram suggests that the stochastic process is likely non-stationary. The latter problem is managed by detrending the observed records with a fourth-order polynomial drift determined with the least squares method. The global approach is replaced with local models with an influence radius of 70 m and a minimal number of interpolation records equal to 10. The detrended residuals appear to be second-order stationary having an isotropic variogram that is fitted equally well by a linear or a spherical function. The average size of the local interpolation models is 28, which ensures a high computational efficiency. The bathymetry of the sea area of interest is then reconstructed over a regular grid with a total of 3570 nodes. The estimation standard deviation maps show that the accuracy of the prediction is even greater than the prescribed tolerance ($= 0.2$ m) and indicate that future data collection campaigns require a less dense and therefore, less expensive recording network. The redundant measurement profiles are identified. Their elimination still allows for bathymetry estimates affected by interpolation errors that fall within the project specifications. (Author's abstract)
W91-03862

MOVEMENT OF CRUDE OIL IN AN EXPERIMENTAL SPILL ON THE SEEDS SIMULATED PIPELINE RIGHT-OF-WAY, FORT NORMAN, N.W.T.
Alberta Univ., Edmonton. Dept. of Geography.
G. P. Kershaw.
Arctic ATICAB, Vol. 43, No. 2, p 176-183, June 1990. 5 fig, 2 tab, 21 ref.

Descriptors: *Northwest Territories, *Oil spills, *Path of pollutants, *Permafrost, *Pipelines, *Simulation analysis, *Subarctic zone, Absorption, Canada, Oil pollution, Soil contamination, Vegetation.

The Studies of the Environmental Effects of Disturbances in the Subarctic (SEEDS) experimental spill was conducted on a simulated pipeline right-of-way and trench. A total of 3273 L of Norman Wells crude oil was released over a 24 h period at a depth of 100 cm in a simulation of a rupture from a subsurface pipeline. Absorptive qualities of the surface vegetation and organic soil layers in an undisturbed forest, produce rates of flow and area

of contamination values much lower than the SEEDS experiment. Similarities exist between the SEEDS spill and previously conducted surface, point-origin, experimental crude oil spills. The areal extent of the oil was controlled by: (1) low volume but continually flowing water in a shallow channel; (2) topographically depressed areas and their degree of interconnectedness; and (3) low absorptive ability of the surfaces in contact with the oil (including moisture content of the substrate). The SEEDS crude oil spill deviated from the other experimental spills in that: (1) the oil front moved rapidly over saturated mineral soil-dominated surfaces, conditions expected over a buried pipeline; (2) average concentration values were low, while area-to-volume ratios were high; and (3) the areal extent of the spill continued to increase until some time after freeze-up, but certainly much longer time periods were required to achieve stability compared with forest area spills. (Lantz-PTT)
W91-03866

BACTERIAL CONTAMINATION AND REMEDIATION MEASURES AT MARINA DEL REY, CALIFORNIA, U.S.A.
Los Angeles County Dept. of Beaches and Harbors, CA.
L. Charness, and D. G. Smith.
Environmental Auditor ENVAE8, Vol. 2, No. 1, p 35-40, 1990. 2 fig, 1 tab, 5 ref.

Descriptors: *Bacteria, *Beach contamination, *Marina del Rey, *Site remediation, *Water pollution prevention, *Water pollution sources, California, Fecal coliforms, Monitoring, Water birds, Water quality control.

Bacterial contamination of the swim beach at Marina del Rey, California, was identified in October 1987 and the area closed to swimmers. Weekly water sampling continued to reveal unacceptable levels of total and fecal coliform and enterococcus bacteria. An environmental audit of potential sources of the high bacterial levels identified shorebird defecation as the most probable cause. Following the installation of overhead monofilament fishing lines, shorebird populations generally abandoned the site, bacterial counts declined significantly, and the beach was reopened in February 1989. Today, bacterial counts remain low. (Author's abstract)
W91-03872

BINATIONAL MANAGEMENT OF HAZARDOUS WASTE: THE MAQUILADORA INDUSTRY AT THE US-MEXICO BORDER.
California Univ., Los Angeles. School of Public Health.
For primary bibliographic entry see Field 5G.
W91-03875

QUANTIFICATION OF HYDROCHLORIC ACID AND PARTICULATE DEPOSITION RESULTING FROM SPACE SHUTTLE LAUNCHES AT JOHN F. KENNEDY SPACE CENTER, FLORIDA, USA.
Bionetics Corp., Cocoa Beach, FL.
T. W. Dreschel, and C. R. Hall.
Environmental Management EMNGDC, Vol. 14, No. 4, p 501-507, 1990. 8 fig, 2 tab, 19 ref. NASA Contract No. NAS10-10285.

Descriptors: *Environmental effects, *Hydrochloric acid, *Kennedy Space Center, *Particulate matter, *Rocket launches, *Space shuttle, *Water pollution sources, Aluminum oxide, Ecological effects, Fishkill, Hydrogen ion concentration, Path of pollutants, Water pollution effects, Wet deposition.

Observations of damage to vegetation, acute reductions in surface water pH, and kills of small fish prompted the Biomedical Operations and Research Office at the JFK Space Center to initiate intensive environmental evaluations of possible acute and long-term chronic impacts that may be produced by repeated launches of the space shuttle. An important step in this evaluation was the identification of deposition patterns and the quantification of ecosystem loading rates of exhaust constituents from the solid rocket motors (SRMs) in the area of the launch pad. These constituents are primarily aluminum oxide (Al2O3) and hydrochloric acid (HCl). During three launches of the space transportation system (STS-11, 13, 14) up to 100 bulk deposition collectors, 83 mm in diameter containing 100 ml of deionized water, were employed in a grid pattern covering 12.6 ha north of launch pad 39-A. Estimates of HCl and particulate deposition levels were made based on laboratory measurements of items entrained in the collectors. Captured particles consisted of a variety of items including Al2O3, sand grains, sea shell fragments, paint chips and other debris ablated from the launch pad surface by the initial thrust of the SRMs. Estimated ranges of HCl and particulate deposition in the study area were 0-127 g/sq m and 0-246 g/sq m. Deposition patterns were highly influenced by wind speed and direction. These measurements indicate that, under certain meteorological conditions, up to 7,100 kg of particulates and 3,400 kg of HCl can be deposited to the near-field environment beyond the launch pad perimeter fence. (Author's abstract)
W91-03878

USE OF FIELD-FLOW FRACTIONATION TO STUDY POLLUTANT-COLLOID INTERACTIONS.
Monash Univ., Clayton (Australia). Water Studies Centre.
R. Beckett, D. M. Hotchin, and B. T. Hart.
Journal of Chromatography JOCRAM, Vol. 517, p 435-447, September 26, 1990. 3 fig, 37 ref.

Descriptors: *Adsorption, *Analytical techniques, *Data acquisition, *Fate of pollutants, *Path of pollutants, Analytical methods, Atrazine, Australia, Chemical interactions, Colloids, Fluid-flow fractionation, Glyphosate, Orthophosphate pesticides, Particle size, Particulate matter, Radioactive tracers, River sediments, Sediments, Soils.

The association of pollutants and other trace elements and compounds with particle surfaces plays a dominant role in determining their transport, fate, biogeochemistry, bioavailability, and toxicity in natural waters, sediments, and soils. The adsorption of pollutants to sediments depends on the specific surface area and the nature of the particle surfaces. It is believed that the ubiquitous coatings of Fe and Mn oxides and organic matter, which is invariably present on the surface of natural particles, may well be the dominant factor in determining the surface adsorption density. A new approach has been developed utilizing fluid-flow fractionation (FFF) methods to determine adsorption density distributions across the size spectrum of a particulate sample. The sedimentation FFF separation technique was used to study the interaction of the nutrient orthophosphate (32P labelled) and the herbicides glyphosate and atrazine (both 14C labelled) with suspended particulate matter obtained from the Darling, Murray, and Yarra rivers in Australia. Results of the investigation indicate that significant amounts of phosphate and glyphosate adsorbed to the particles, but very little of the less polar herbicide, atrazine, was adsorbed. In addition, it was determined that the smaller particles contained the highest pollutant content. This has important implications for pollutant transport in aquatic systems, since these particles will usually remain in suspension until an aggregation process occurs to induce settling and deposition. (Korn-PTT)
W91-03879

MERCURY CONTAMINATION LEVELS AND DISTRIBUTION IN TISSUES AND ORGANS OF DELPHINIDS (STENELLA ATTENUATA) FROM EASTERN TROPICAL PACIFIC, IN RELATION TO BIOLOGICAL AND ECOLOGICAL FACTORS.
Bordeaux-1 Univ., Talence (France). Lab. d'Ecologie Fondamentale et d'Ecotoxicologie.
J. M. Andre, F. Ribeyre, and A. Boudou.
Marine Environmental Research MERSDW, Vol. 30, No. 1, p 43-72, 1990. 6 fig, 3 tab, 71 ref.

Descriptors: *Bioaccumulation, *Cetoceans, *Mercury, *Path of pollutants, *Tissue analysis, Blood, Distribution patterns, Ecological effects, Food chains.

Based on a sample of 44 dolphins belonging to the Stenella attenuata species and captured in the Eastern tropical zone of the Pacific Ocean, this study was devoted to the analysis of the total mercury accumulation levels and distribution in 18 organs or tissue samples. The average concentration measured varied from 0.36 mg Hg/kg in the blood, to 62 mg Hg/kg in the liver, skeletal muscle and blubber, containing almost 95% of the estimated total burden present in the organs collected. The mercury distribution in the organs is an indication that the trophic contamination route, via the marine alimentary networks, may play a leading role with regard to the uptake of the metal. The different biological and ecological factors taken into account such as age, body weight, sex, or geographical origin, interact with the mercury concentrations and burdens in the collected organs or tissues. This is not confirmed for the date of capture, but the location of the capture area appears to be of prime importance, especially the latitude. The accumulation levels in the organs increase when the capture site is nearer the equator. (Author's abstract)
W91-03884

HEAVY METAL ACCUMULATION BY BARNACLES AND ITS IMPLICATIONS FOR THEIR USE AS BIOLOGICAL MONITORS.
Victoria Univ. of Manchester (England). Dept. of Environmental Biology.
For primary bibliographic entry see Field 5A.
W91-03886

SALINE SEEPAGE AND LAND DEGRADATION--A NEW SOUTH WALES PERSPECTIVE.
Soil Conservation Service of New South Wales, Sydney (Australia).
P. E. V. Charman, and R. S. Junor.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 195-203, 1990. 4 fig, 2 tab, 24 ref.

Descriptors: *Australia, *Environmental impact, *Environmental policy, *Geochemistry, *Saline groundwater, *Saline soils, *Saline water systems, *Water pollution sources, *Water resources management, Geohydrology, Geomorphology, Irrigation effects, Research priorities, Salts, Seepage, Soil conservation, Soil management, Vegetation effects, Water conservation, Water quality control.

Increasing salinization of both land and water in the Murray Basin in southeastern Australia is now widely recognized as contributing significantly to environmental degradation. Dryland salinization is generally a result of saline water discharge associated with non-irrigated land, adversely affecting soils, vegetation and water resources, as well as creating a form of degradation which reduces the economic and aesthetic value of the land which is not easy to correct. The Soil and Conservation Service of New South Wales is oriented primarily to erosion control and the rehabilitation of eroded land, and therefore is involved in treating dryland salinity. Factors which cause saline water discharge include: vegetation, clearing, sources of salt, geology and geomorphology, soil types, climate, and land use. Salinity affects soils, vegetation, erosion and water resources. Dryland salinity requires control and prevention. The three long-term research needs of the seepage salting problem are in the areas of recharge research, water table monitoring, and model development. The Soil Conservation Service is planning a number of major programs to address the salinization problem; the expertise present in many organizations must be used in cooperative programs. Current knowledge can prevent the impending disaster, given the required level of cooperation and commitment. (Fish-PTT)
W91-03893

VEGETATION AND CLIMATE OF THE LATE CAINOZOIC IN THE MURRAY BASIN AND

THEIR BEARING ON THE SALINITY PROBLEM.
New South Wales Univ., Kensington (Australia). School of Biological Sciences.
For primary bibliographic entry see Field 2A.
W91-03903

DEVICE FOR IN SITU DETERMINATION OF GEOCHEMICAL TRANSPORT PARAMETERS: 2. BIOCHEMICAL REACTIONS.
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 7B.
W91-03909

FIELD EVIDENCE FOR THE EFFECT OF ACETATE ON LEACHATE ALKALINITY.
Water and Earth Science Associates Ltd., Kitchener (Ontario).
J. F. Devlin.
Ground Water GRWAAP, Vol. 28, No. 6, p 863-867, November/December 1990. 4 fig, 15 ref.

Descriptors: *Alkalinity, *Field tests, *Groundwater quality, *Leachates, *Water chemistry, *Water quality, Acetates, Alkaline water, Carbonates, Chemical analysis, Fatty acids, Geochemistry, Landfills, Methanogenesis, Organic acids, Plumes, Subsurface mapping, Volatile organic compounds.

Alkalinity measurements are routinely conducted as part of standard water quality determinations. Often, very little interpretation of the values is attempted, and the entire alkalinity is attributed to carbonate or bicarbonate. When landfill leachates are involved, this assumption could be misleading in terms of plume mapping, determining the incrustation potential of the water, or assessing the likelihood of methane generation because substances other than carbonate, for example acetate, can contribute significantly to the sample's alkalinity. A set of landfill leachate samples was collected and analyzed for alkalinity and volatile fatty acids. Acetate was the only organic acid identified. A very strong correlation was observed between acetate and alkalinity. Actual titration curves (volume of acid vs. pH) were compared with curves calculated assuming that acetate and bicarbonate were the two major species contributing the total alkalinity. Excellent agreement was observed between the experimental and theoretical data. Distinct differences in the shapes of the curves for carbonate-dominated and acetate-dominated alkalinities make it possible to distinguish these two classes of water solely on the basis of alkalinity measurements. Water containing acetate titrates with an equivalence point which is less distinct than water containing only carbonate. (Author's abstract)
W91-03910

PARTICLE-TRACKING ANALYSIS OF FLOW PATHS AND TRAVELTIMES FORM HYPOTHETICAL SPILL SITES WITHIN THE CAPTURE AREA OF A WELLFIELD.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
E. S. Bair, R. A. Sheets, and S. M. Eberts.
Ground Water GRWAAP, Vol. 28, No. 6, p 884-892, November/December 1990. 8 fig, 2 tab, 12 ref.

Descriptors: *Flow pattern, *Groundwater movement, *Hydrologic models, *Path of pollutants, *Spills, *Tracking techniques, *Traveltime, Advection, Aquifers, Big Walnut Creek, Flow, Flow velocity, Glacial aquifers, Highways, Ohio, Scioto River, Simulation analysis, Velocity potential, Well pumping.

Velocity fields computed from simulated flows from a steady-state, three-dimensional numerical model of a glacial-drift/carbonate-bedrock aquifer system were used in conjunction with a particle-tracking program to delineate traveltime-related capture areas of a municipal wellfield and to compute flow paths and advective traveltimes from hypothetical spill sites located along interstate highways and heavily-traveled state routes. Results indicate the municipal wells operated by the City of Columbus, Ohio, capture flow from certain highway segments but other discharge points, including quarry-dewatering systems, the Scioto River, and Big Walnut Creek, capture flow from other highway segments. Advective traveltimes from three hypothetical spill sites to municipal wells range from 900 to 5,100 days under normal pumping rates and from 450 to 3,100 days under estimated maximum pumping rates. The 2,000-day capture area of the wellfield is approximately 30% larger (16 square miles) and contains approximately 4.5 more miles of highway under estimated maximum pumping rates compared to normal pumping rates. (Author's abstract)
W91-03913

INFLUENCE OF AQUIFER HETEROGENEITY ON CONTAMINANT TRANSPORT AT THE HANFORD SITE.
Colorado School of Mines, Golden. Dept. of Geology and Geological Engineering.
E. Poeter, and D. R. Gaylord.
Ground Water GRWAAP, Vol. 28, No. 6, p 900-909, November/December 1990. 6 fig, 40 ref. DOE Contract DE-AC06-76RL0 1830; Northwest College and University Association for Science (University of Washington) contract DE-AM06-76-RL02225 with the Department of Energy.

Descriptors: *Aquifer characteristics, *Geohydrology, *Groundwater pollution, *Hanford Site, *Heterogeneity, *Path of pollutants, *Radioactive wastes, Borehole geophysics, Geologic mapping, Hydraulic properties, Lithology, Model studies, Parametric hydrology, Plumes, Tritium, Unconfined aquifers, Washington, Water pollution control.

Aquifer heterogeneities defined by mapping and correlating lithofacies derived from existing geologic and borehole geophysical data at the U.S. Department of Energy's Hanford Site in south-central Washington, were compared to tritium migration trends within the unconfined aquifer. Lithofacies percentage maps proved useful in defining large-scale (on the order of miles) tritium pathways at Hanford but were not sufficiently detailed to serve as unambiguous predictors of these pathways. Results suggest that: (1) incorporation of geologic parameters more closely related to hydraulic properties (e.g., quantified grain size and sorting, degree of cementation, packing arrangement, sedimentary structures, and grain shape); and (2) conscientious integration of all geohydrological data at the Hanford Site (and elsewhere) will allow definition of three-dimensional aquifer elements termed 'hydrofacies' and enhance reliable prediction of contaminant migration pathways. Strict reliance on standard fluvial models in the evaluation of lithofacies at Hanford is not appropriate for predicting plume migration because of the complex depositional and erosional history of the sediments comprising the unconfined aquifer. Use of 'hydrofacies' ultimately may serve as the appropriate conceptual framework for predicting plume migration. (Author's abstract)
W91-03915

5C. Effects Of Pollution

SEDIMENT-TRANSPORT CHARACTERISTICS AND EFFECTS OF SEDIMENT TRANSPORT ON BENTHIC INVERTEBRATES IN THE FOUNTAIN CREEK DRAINAGE BASIN UPSTREAM FROM WIDEFIELD, SOUTHEASTERN COLORADO, 1985-88.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2J.
W91-02963

STATUS OF BIOASSESSMENT ACTIVITIES IN THE U.S. FISH AND WILDLIFE SERVICE.
Fish and Wildlife Service, Washington, DC. Div. of Environmental Contaminants.
For primary bibliographic entry see Field 5A.
W91-03045

USE OF A FORESTED WETLAND IN SOUTH CAROLINA FOR TERTIARY TREATMENT OF MUNICIPAL WASTEWATER.
CH2M Hill, Charleston, SC.
For primary bibliographic entry see Field 5D.
W91-03060

ADIRONDACK WATERSHED DATA BASE: ATTRIBUTE AND MAPPING INFORMATION FOR REGIONAL ACIDIC DEPOSITION STUDIES.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 7C.
W91-03234

ANALYSIS OF THE HEALTH RISK FROM INGESTED RADON.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. J. Crawford-Brown.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 17-26. 2 fig, 4 tab, 16 ref.

Descriptors: *Drinking water, *Radioisotopes, *Radon, *Risk assessment, *Risks, *Water pollution effects, Cancer, Dose-response relationships, Path of pollutants, Water quality.

The solubility coefficient of radon in fat is significantly higher than that for water. It is generally assumed that doses of radon to fatty tissues will be higher than those to other systemic tissues. Any long-term retention of radon in the body may be dominated by the content in fatty tissue. This assumption has not been demonstrated to date. The most detailed organ-specific measurements of radon were performed at Massachusetts General Hospital as part of the Environmental Protection Agency (EPA) effort to regulate radon. From this information a compartmental model for the movement of radon through the human body was developed. These compartments are assumed to be: (1) the stomach, (2) the small intestine, (3) the upper large intestine, (4) the lower large intestine, (5) the portal blood, liver and lung tissue, (6) the general body tissues (including fat), and (7) the air spaces of the lung (including pulmonary and tracheobronchial spaces). Using the EPA data, the concentration of radon in each compartment as a function of time was determined. The system of whole body effective dose equivalent adopted by the International Commission on Radiological Protection was employed to estimate risk. The results indicate that the lifetime risk is dominated by the risk to the stomach when ingestion is considered. The calculations support earlier findings that the risk of lung cancer is dominated by the inhalation pathway of exposure. (See also W91-03366) (Agostine-PTT)
W91-03368

RISK ASSESSMENT AND CONTROL MANAGEMENT OF RADON IN DRINKING WATER.
Oak Ridge Associated Universities, Inc., Washington, DC.
For primary bibliographic entry see Field 5F.
W91-03369

TOXICITY OF SEDIMENTS FROM WESTERN LAKE ERIE AND THE MAUMEE RIVER AT TOLEDO, OHIO, 1987: IMPLICATIONS FOR CURRENT DREDGED MATERIAL DISPOSAL PRACTICES.
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
R. A. Hoke, J. P. Giesy, G. T. Ankley, J. L. Newsted, and J. R. Adams.
Journal of Great Lakes Research JGLRDE, Vol. 16, No. 3, p 457-470, 1990. 1 fig, 6 tab, 25 ref.

Descriptors: *Dredging, *Fluvial sediments, *Lake Erie, *Lake sediments, *Maumee River, *Path of pollutants, *Toxicity, *Water pollution effects, *Water pollution sources, Benthos, Bioaccumulation, Daphnia, Ecological effects, Macroinvertebrates, Microtox assay, Midges.

The toxicity of sediments in the Maumee River, the Maumee River-western Lake Erie federal navi-

gation channel, and selected areas of western Lake Erie was measured using four assays: Photobacterium phosphoreum 15-minute bioluminescence inhibition (Microtox) in sediment pore waters and elutriates; Ceriodaphnia dubia 7-day survival and reproduction; Pimephales promelas 7-day larval survival and growth in sediment elutriates; and Chironomus tentans 10-day growth inhibition in whole sediments. The Microtox assay generally was the most sensitive of the four assays. Sediment elutriates were always equally or more toxic than pore waters from the same location when tested using the Microtox assay. The greatest toxicity in the Microtox and C. tentans assays was observed with pore waters or elutriates and sediments collected near point sources of contaminants to the Maumee River. Very little toxicity was observed in any assay using open-lake navigation channel or disposal site sediments or sediment extracts. Sediments from the Lake Erie portion of the navigation channel were suitable for open-lake disposal based on the lack of observed effects in the four assays. Toxicity of sediment from the open lake disposal site was similar to that of sediments from other locations in the western basin of Lake Erie which have not been impacted by dredged material disposal events. Sediments from near point sources such as industrial discharges, liquid unloading facilities, or sewage treatment plant outfalls on the Maumee River represent potential sources of toxicity for downstream resuspension and distribution. Further studies will be necessary to delineate the exact distribution of contaminated sediments near the point source discharges to the Maumee River. (Author's abstract)
W91-03409

IMPACT OF GLOBAL WARMING AND COOLING ON MIDWESTERN AGRICULTURE.
Iowa State Univ., Ames. Dept. of Agronomy.
L. M. Thompson.
Journal of the Iowa Academy of Science JIASEB, Vol. 97, No. 3, p 88-90, September 1990. 3 fig, 11 ref.

Descriptors: *Agricultural watersheds, *Drought effects, *Global warming, *Greenhouse effect, *Weather patterns, Air temperature, Atmosphere, Climatology, Crop production, Iowa, Meteorology, Temperature effects.

The global warming trend since 1980 has been greater than it was during the warming trend from 1880 to 1940. This has caused concern that the very warm years of 1987 and 1988 might have been associated with greenhouse warming. However, the cooling trend from 1940 to 1980 occurred during a rapid buildup in greenhouse gases in the atmosphere. Although there may have been some greenhouse warming since 1880, the unusual warmth of 1987 and 1988 may have been caused by changes in the temperature of the equatorial Pacific Ocean, and changes in transparency of the atmosphere or other phenomena acting on the atmosphere. There have been changes in weather variability associated with the global warming and cooling. The unusually benign period of weather in the Midwest from 1956 to 1973 occurred at the end of a brief period of global cooling. Since 1973, there has been increased weather variability like that experienced in the 1930s. The most important factor in weather variability in the Midwest has been associated with the El Nino cycle. Crop production appears to be favored in years of El Nino events. All the major droughts in the Midwest since 1891 have occurred between El Nino years. The El Nino event starts about every 3 to 7 years and lasts 1 to 2 years. In the Midwest the year after an El Nino event tends to be warmer and drier than normal and is sometimes a drought year. (Author's abstract)
W91-03429

RELATIONSHIP BETWEEN THE YEARLY CHANGES IN PHYTOPLANKTON OCCURRENCE AND NUTRIENT CONCENTRATION IN BRACKISH LAKE NAKANOUMI, 1974-1986.
Shimane Univ., Matsue (Japan). Environmental Science Lab.
K. Kondo, Y. Seike, and Y. Date.
Japanese Journal of Limnology RIZAAU, Vol. 51, No. 3, p 191-197, 1990. 4 fig, 2 tab, 23 ref.

Descriptors: *Eutrophication, *Japan, *Lake Nakanoumi, *Limnology, *Nutrient concentrations, *Phytoplankton, *Saline lakes, *Water pollution effects, Algal blooms, Brackish water, Lakes, Nitrogen, Phosphorous, Population density, Seasonal variation, Species diversity, Statistical analysis.

Monthly surveys of phytoplankton occurrence were conducted from 1974 to 1986 at six stations in the brackish Lake Nakanoumi. The concentration of total nitrogen (TN) approximately doubled from 1975 to 1979 and, after reaching peaks between 1978 and 1982, TN concentrations remained the same or slowly decreased. The concentration of total phosphorous (TP) sharply increased from 1975 to 1978 at half of the sampling stations, with no general trend observed at the remaining stations. The mean numbers of phytoplankton cells tended to be large during 1975-1979, except for 1977. Red tides occurred frequently during this period. The number of phytoplankton species increased sharply from 1974 to 1978. Thus, both the numbers of phytoplankton cells and species tended to increase during the periods when TN concentrations increased, and decreased when TN concentrations remained at the same level or gradually decreased. However, statistical analysis indicated that the fluctuation of nutrient concentration did not directly affect the number of phytoplankton cells, while nutrient concentrations were related to numbers of species at some of the sampling stations. Among four diversity indices for the phytoplankton community (i.e., Patten, Shannon, Simpson, and Margalef), only the Margalef index showed a highly positive correlation (coefficient >0.7) with the annual change in TP or TN concentration at some stations. (MacKeen-PTT)
W91-03457

TRANSFER OF TOXIC CONCENTRATIONS OF SELENIUM FROM PARENT TO PROGENY IN THE FATHEAD MINNOW (PIMEPHALES PROMELAS).
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
R. Schultz, and R. Hernamutz.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 4, p 568-573, October 1990. 2 tab, 11 ref.

Descriptors: *Bioaccumulation, *Ecotoxicology, *Fathead minnows, *Path of pollutants, *Selenium, *Toxicology, *Water pollution effects, Ecological effects, Fish eggs, Fish physiology, Toxicity, Water pollution.

Selenium may become concentrated in aquatic ecosystems to levels that are toxic to fish. Research has shown occurrences of edema and lordosis in the larvae of fathead minnows (Pimephales promelas) exposed to 10 microgram/L selenium in experimental streams. Selenium levels within fathead minnow embryos in a semi-natural ecosystem were examined to determine whether selenium levels resulted from direct uptake by the embryos following spawning, from female-to-progeny transferral, or from some combination of these two occurrences. Embryos and ovaries from fatheads raised in control and 10 microgram/L selenium streams were collected and analyzed for selenium content. Selenium uptake was analyzed over a 24-hour period by embryos from control streams when placed in 10 microgram/L selenium water, and occurrences of edema and lordosis in larvae were compared. A higher incidence of edema and lordosis was found to occur in fathead minnow larvae from 10 microgram/L streams versus larvae from control streams. The highest incidence was usually noted on day four. A significant difference also existed between the amount of selenium accumulated by embryos spawned in streams containing 10 microgram/L selenium and embryos spawned in control streams. Embryos from fish reared in the dosed streams contained selenium levels 13 times higher than embryos from fish reared in the control streams. The hypothesis that selenium is passed from female to progeny in fathead minnows is supported by the similarity in residues of selenium between embryos and ovaries within the same treatment, and the lack of significant uptake of selenium by control embryos exposed to water containing selenium. In addition, this passage of selenium has been found to result in toxic effects demonstrated by the increased incidence of edema and lordosis. Larvae exhibiting these characteristics are not expected to survive in natural systems. (Mertz-PTT)
W91-03471

EFFECTS OF TRIBUTYLTIN OXIDE ON THE SKELETAL STRUCTURES OF DEVELOPING AND REGENERATING LIMBS OF THE AXOLOTL LARVAE, AMBYSTOMA MEXICANUM.
Guelph Univ. (Ontario). Dept. of Zoology.
S. R. Scadding.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 4, p 574-581, October 1990. 1 fig, 1 tab, 20 ref.

Descriptors: *Antifoulants, *Ecotoxicology, *Organotin compounds, *Salamanders, *Teratogenic effects, *Toxicology, *Water pollution effects, Differentiation, Pesticides, Physiological effects, Regeneration, Toxicity, Water pollution.

Tributyltin is used as an antifouling agent in marine paints because it is a potent biocide and is very effective at preventing marine organisms such as barnacles from settling on the hulls of boats. Tributyltin, however, is clearly toxic to a variety of marine invertebrates. The potential teratogenicity of tributyltin in vertebrates, particularly teratogenic effects on developing or regenerating limbs, was investigated on the axolotl, Ambystoma mexicanum. Axolotl larvae were obtained as eggs or young larvae from the axolotl colony at the University of Ottawa, and treated with tributyltin by adding it to the water in their bowls. Tributyltin was mixed with acetone and serially diluted with tap water to reach final concentrations of 50, 15, 5, 1.5, or 0.5 microgram/L. Tributyltin was clearly toxic at the higher dose levels. All axolotl larvae exposed to 50 microgram/L died within 24 hours and most exposed to 15 microgram/L died within 7 days. The skeletal patterns of the limbs developing in the presence of 0.5 microgram/L tributyltin were indistinguishable from those of the controls. However, the hindlimbs exposed to 1.5 microgram/L tributyltin showed a slightly increased incidence of skeletal deletions. At the 5 microgram/L level, only 3 out of 20 limbs were complete. Surprisingly, tributyltin at concentrations of up to 5 microgram/L did not cause any derangement of the skeletal pattern of the regenerating forelimbs, even though the concentration (5 microgram/L) approached levels that were lethal. The observation that tributlytin was teratogenic during limb development but not during limb regeneration raised the possibility that the two processes are different in some way to allow differential responses to tributyltin. (Mertz-PTT)
W91-03472

ACUTE TOXICITY TO JUVENILE PACIFIC SALMONIDS AND RAINBOW TROUT OF BUTOXYETHYL ESTERS OF 2,4-D, 2,4-DP AND THEIR FORMULATED PRODUCT: WEEDONE CB AND ITS CARRIER.
Environmental Protection Service, West Vancouver (British Columbia). Pacific and Yukon Region.
M. T. Wan, R. G. Watts, and D. J. Moul.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 4, p 604-611, October 1990. 6 tab, 10 ref.

Descriptors: *Ecotoxicology, *Herbicides, *Salmon, *Toxicology, *Trout, *Water pollution effects, Esters, Fuel, Toxicity, Water pollution, Weedone CB.

Butoxyethyl esters of 2,4-dichlorophenoxyacetic acid and 2-(2,4-dichlorophenoxy)propionic acid are base chemicals manufactured for formulating Weedone CB. The use of Weedone CB for forestry conifer release and industrial rights-of-way programs in coastal British Columbia may result in the accidental introduction of butoxyethyl esters into water bodies inhabited by anadromous fish. The acute toxicity of butoxyethyl esters, Weedone CB and its carriers to juvenile salmonids of the Pacific

Northwest was examined. A series of 96-hour static acute toxicity tests was conducted in fresh water using several species of juvenile salmonids. The measured concentrations of 2,4-dichlorophenoxyacetic acid and 2-(2,4-dichlorophenoxy)propionic acid in different water types in the coho test vessels before fish introduction was much less than the corresponding theoretical concentration. The data suggest that losses of these butoxyethyl esters occurred in both the technical and formulated products. Losses for butoxyethyl esters and Weedone were apparently greater in soft, acidic water than in hard, alkaline water. Results showed that the butoxyethyl esters, Weedone, and Weedone combined with carriers was highly toxic to salmonids. They were more toxic to young salmon than the carriers (Carrier A (proprietary formulation) and diesel oil), irrespective of water type. Carrier A was much more toxic to the fish than diesel oil. The acute toxicity to salmonids of 2,4-dichlorophenoxyacetic acid and Weedone with carriers, but not 2-(2,4-dichlorophenoxy)propionic acid and plain Weedone, was affected by the characteristics of water. At the manufacturer's recommended rate of application (50 L product/hectare), the potential to generate concentrations acutely toxic to salmonids is high in streams unintentionally oversprayed. Pink salmon were much more sensitive to the diesel oil carrier when compared to coho salmon and rainbow trout. (Mertz-PTT)
W91-03473

MACROFAUNA OF ELODEIDS OF TWO LAKES OF DIFFERENT TROPHY. I. RELATIONSHIPS BETWEEN PLANTS AND STRUCTURE OF FAUNA COLONIZING THEM.
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
For primary bibliographic entry see Field 2H.
W91-03477

ACCUMULATION OF METALS AND THEIR TOXICITY IN THE MARINE INTERTIDAL INVERTEBRATES CERASTODERMA EDULE, MACOMA BALTHICA, ARENICOLA MARINA EXPOSED TO PULVERISED FUEL ASH IN MESOCOSMS.
Kema N.V., Arnhem (Netherlands). Dept. of Environmental Research.
H. A. Jenner, and T. Bowmer.
Environmental Pollution ENPOEK, Vol. 66, No. , p 139-156, 1990. 4 fig, 3 tab, 24 ref.

Descriptors: *Ash, *Benthic environment, *Bioaccumulation, *Ecological effects, *Heavy metals, Path of pollutants, *Waste disposal, *Water pollution effects, Annelids, Arsenic, Bivalves, Electric power, Environmental effects, Mortality, Zinc.

Coal-fired generating stations produce two types solid waste, bottom boiler ash and pulverized el ash. The pulverized fuel ash is collected on ectrostatic filters from the flue gases. Although western Europe, Japan and the United States, a rge proportion of pulverized fuel ash is utilized in e building industry, substantial amounts remain, eating a sizeable disposal problem. The biologi- l effects from metals accumulating from pulver- ed fuel ash were investigated in three intertidal nthic invertebrates. After the first run of 90 ys, high mortality was found in the lugworm renicola marina. After intermittent exposure to lverized fuel ash, high mortality was also found the cockle Cerastoderma edule. No mortality curred with the baltic tellin Macoma balthica. etal accumulation differed widely among the ecies. A. marina accumulated As to high levels m pulverized fuel ash mixtures, which may be ributed to changes in the redox potential of the iment. It also appeared that Zn levels in M. thica tissue, for both control and exposed ani- ls, were apparently normal but extremely high. posal of pulverized fuel ash in marine coastal ters will radically affect community structure at dumping site. Accumulation of certain ele- nts like As will be favored in the mixing zone at borders of a dump site due to a higher organic tent and consequent higher bioavailability. ertz-PTT)
I-03481

IMPACT OF MILD EXPERIMENTAL ACIDIFICATION ON SHORT TERM INVERTEBRATE DRIFT IN A SENSITIVE BRITISH COLUMBIA STREAM.
British Columbia Univ., Vancouver. Dept. of Zoology.
D. P. Bernard, W. E. Neill, and L. Rowe.
Hydrobiologia HYDRB8, Vol. 203, No. 1/2, p 63-72, September 14, 1990. 1 fig, 2 tab, 38 ref.

Descriptors: *Acid rain, *Acid streams, *Acidification, *Aluminum, *Aquatic drift, *British Columbia, *Invertebrates, *Mountain streams, *Stream ecology, *Water pollution effects, Animal behavior, Caddisflies, Hydrogen ion concentration, Insects, Midges, Population density, Precipitation, Snowmelt.

The deposition of acidic atmospheric pollutants of anthropogenic origin has resulted in recent acidification of surface waters in eastern North America and northern Europe. Streams undergoing acidification often suffer rapid pH depressions during rainstorms and/or snowmelt events, accompanied by increases in dissolved aluminum which is mobilized from sediments and soils in the surrounding catchment. Both H(+) and Al(+3) are toxic to many stream invertebrates and vertebrates. Long term exposures to acidification have been associated with changes in species diversity, composition, and abundance in lakes and streams. Daytime drift behavior of lotic macroinvertebrates was studied following short term (12 h) additions of HCl or HCl plus AlCl3 to a circumneutral soft water (alkalinity ca. 100 microeq/L) mountain stream in British Columbia, Canada. Addition of HCl (pH reduced from 7.0 to 5.9) resulted in an overall tripling of invertebrate drift density with rapid (<1 h) increases in chironomid Diptera and Trichoptera. Small Ephemeroptera also entered the drift at high densities, but were delayed about 6 h. Addition of AlCl3 (0.71 to 0.95 mg/L total Al(+3)) in HCl (stream pH reduced to 5.9) resulted in an overall 6-fold increase in invertebrate drift, with rapid increases by Ephemeroptera and delayed responses by chironomids and Trichoptera. These results suggest that the behavior of several macroinvertebrates from low alkalinity, unacidified streams can be altered by simulations of short-term, mild acidic deposition events. Further, the magnitude and timing of entry into the drift varies among taxonomic groups with the presence or absence of low concentrations of aluminum ions. (Author's abstract)
W91-03497

TOXICITY OF HEAVY METALS TO ASELLUS AQUATICUS (L.) (CRUSTACEA, ISOPODA).
Naples Univ. (Italy). Dipt. Genetica, Biologia Generale e Molecolare.
L. Migliore, and M. de Nicola Giudici.
Hydrobiologia HYDRB8, Vol. 203, No. 3, p 155-164, September 21, 1990. 8 fig, 6 tab, 27 ref.

Descriptors: *Crustaceans, *Heavy metals, *Isopods, *Pollution index, *Toxicity, *Toxicology, *Water pollution effects, Aquatic populations, Cadmium, Chromium, Copper, Ecosystems, Environmental impact, Food chains, Iron, Lead, Mercury, Nickel, Water quality standards, Zinc.

Agricultural and industrial activities cause environmental contamination by heavy metals which are harmful to all components of the community by their extreme toxicity. Crustaceans are among the most important elements of aquatic and marine food webs. Their sensitivity to heavy metals is well-documented. Effects of heavy metals on the isopod Asellus aquaticus were studied by static toxicity tests. Results demonstrate that the species is sensitive to Cd(+2), Cr(+6), Cu(+2), Fe(+3), Hg(+2), Ni(+2), Pb(+2), and Zn(+2), but the toxicity of each metal is different. Differences are also found between adults and juveniles. The comparative analysis of all data on the toxicity has been performed on the concentrations of metal ions and not on metal compound concentrations. To correctly state a threshold for these metals which is compatible with the survival of Asellus aquaticus, it is necessary to examine the effects on all the components of its population. Moreover, toxicity tests should be extended to this and similar species which can be usefully employed to determine suitable standards for the stability of freshwater communities. (Fish-PTT)
W91-03501

IMPACT OF INADEQUATE SANITARY CONDITIONS ON HEALTH IN DEVELOPING COUNTRIES.
London School of Hygiene and Tropical Medicine (England). Maternal and Child Epidemiology Unit.
S. R. A. Huttly.
World Health Statistics Quarterly WHSQDQ, Vol. 43, No. 3, p 118-126, 1990. 1 fig, 1 tab, 57 ref.

Descriptors: *Developing countries, *Impaired water quality, *Public health, *Sanitation, *Water pollution effects, Drinking water, Education, Human diseases, Nematodes, Sanitary engineering.

One of the achievements of the International Drinking Water Supply and Sanitation Decade (1981-1990) is a better understanding of the relationship between poor sanitary conditions and health. A review of current knowledge of the major water-related and excreta-related diseases considers four health indicators: diarrheal diseases, soil-transmitted nematode infections, dracunculiasis (guinea-worm disease), and nutritional status. These constitute some of the major health problems in the developing world. Although there are large variations in morbidity and mortality rates between and within geographical areas, some global estimates have been made. Children under 5 years of age experience a diarrheal mortality rate of 12 per 1,000 (4 million diarrhea-associated deaths per year). Approximately 1 billion people are believed to be infected with Ascaris lumbricoides, 900 million with hookworms, and 500 million with Trichuris trichiura. Dracunculiasis may infect 10 million people each year. The complex issues involved in measuring the health impact of improved sanitary facilities, the differences in sanitary improvements and environmental settings, and the diverse nature of the health indicators all contribute substantial variations in the health impact observed. There is good evidence that sanitary improvements have multiple health benefits, direct and indirect, both in the short and the long term. During recent years, many recommendations have been made, including emphasis on technological issues and on behavior-related factors. An integrated approach has been advocated, involving hardware implementation alongside appropriate education in order to maximize facility usage and hygienic practices and to bring about the desired health benefits. (Fish-PTT)
W91-03505

HEALTH RISKS ASSOCIATED WITH POLLUTION OF COASTAL BATHING WATERS.
World Health Organization, Athens (Greece). Coordinating Unit for the Mediterranean Action Plan.
L. J. Saliba, and R. Helmer.
World Health Statistics Quarterly WHSQDQ, Vol. 43, No. 3, p 177-187, 1990. 1 fig, 4 tab, 22 ref.

Descriptors: *Beach contamination, *Coastal waters, *Human diseases, *Public health, *Risk assessment, *Swimming, *Tourism, *Water pollution effects, Bacteria, Dose-response relationships, Epidemiology, Microbiological studies, Population exposure, Recreation, Sanitation, Viruses, Wastewater pollution.

A number of bacterial, viral, and other diseases can be contracted by man through exposure to sewage-polluted bathing water or beach sand. The increasing use of the sea for recreation has led to major concern regarding health hazards to both local and tourist populations. Epidemiological studies attempting to correlate microbiological water quality with health effects have produced different results, leading to a wide variation in recreational water quality criteria and standards applied, and to considerable controversy regarding their implementation. The Mediterranean provides a good example of a problem region. Coastal pollution by sewage is still a major concern and control measures vary considerably. A number of microbiological/epidemiological studies have been carried out

since 1953 in an attempt to define the levels of risk following exposure to different concentrations of bacteria in bathing waters. Practically all studies showed higher morbidity among bathers as compared to non-bathers, but correlation between specific symptoms and bacterial indicator concentrations varied considerably. On the basis of the 1972-1978 Cabelli Environmental Protection Agency (EPA) study in the U.S., later developed by EPA into a recommended health-effects criterion for marine recreational water, one would expect 25-40 gastrointestinal cases per 1,000 persons exposed to seawater containing 100 enterococci per 100 ml. Much more work is needed, however, before a satisfactory dose-response relationship is obtained, principally because of confounding factors inherent in all studies carried out so far, which still require a solution. (Fish-PTT)
W91-03506

EFFECTS OF TERRESTRIAL EFFLUENTS ON THE INCIDENCE OF AEROMONAS SPP. IN COASTAL WATERS.
Barcelona Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W91-03521

ASSESSING TOXICITY OF DRINKING WATER CONTAMINANTS: AN OVERVIEW.
Vanderbilt Univ., Nashville, TN. Dept. of Biochemistry.
For primary bibliographic entry see Field 5A.
W91-03527

ROLE OF SHORT-TERM TESTS IN EVALUATING HEALTH EFFECTS ASSOCIATED WITH DRINKING WATER.
Environmental Protection Agency, Cincinnati, OH.
J. R. Meier, and F. B. Daniel.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 10, p 48-56, October 1990. 4 tab, 47 ref.

Descriptors: *Ames test, *Carcinogens, *Drinking water, *Mutagens, *Public health, *Risk assessment, *Testing procedures, *Water treatment, Bioassay, Chemical analysis, Health aspects, Water analysis.

Short-term bioassays such as the Ames test are used to assess genotoxicity and potential carcinogenicity of specific drinking water contaminants as well as concentrated samples of drinking water. When these tests are applied to complex mixtures such as drinking water, a number of additional factors complicate the interpretation of test results. These tests are based on the premise that DNA is the common target of mutagens and carcinogens regardless of the cell type of animal species. It is hoped that by using these bioassays, chemicals that pose a significant health hazard can be identified and measures to prevent or reduce human exposure can be implemented. Because of the uncertainties regarding the proper interpretation of test results, it is difficult to make firm recommendations on how best to apply these tests for assessing health risks in drinking water. The positive results that have been obtained using in vitro short-term tests for genotoxicity on chlorinated-drinking water concentrates indicate a certain real probability that the water contains human mutagens, carcinogens, or both. This finding in itself does not suggest that an imminent hazard to human health exists, but neither does it seem prudent to ignore this result. Although uncertainties regarding interpretation limit the application of short-term test for risk assessment, short-term tests provide public health officials with a useful tool for obtaining timely and cost-efficient information about potential health risks associated with drinking water. (Mertz-PTT)
W91-03528

CANCER RISK ASSESSMENT: IMPORTANCE OF IDENTIFYING MECHANISMS OF ACTION.
Washington State Univ., Pullman. Coll. of Pharmacy.
For primary bibliographic entry see Field 7B.
W91-03529

COMPARATIVE SUBCHRONIC TOXICITY STUDIES OF THREE DISINFECTANTS.
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W91-03530

HEPATOPATHOTOXICITY OF THREE PESTICIDES IN A FRESHWATER FISH, PUNTIUS CONCHONIUS HAM.
Jefferson Medical Coll., Philadelphia, PA. Dept. of Anatomy.
T. S. Gill, J. Pande, and H. Tewari.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 6, p 653-663, August 1990. 10 fig, 14 ref.

Descriptors: *Animal pathology, *Fish, *Liver, *Pesticides, *Population exposure, *Toxicology, *Water pollution effects, Carbamate pesticides, Chronic toxicity, Halogenated pesticides, Organophosphorus pesticides, Rosy Barb, Sublethal effects.

Liver pathology was evaluated in a freshwater fish, Puntius conchonius, chronically exposed to sublethal concentrations of pesticides: a carbamate (0.806 ppm aldicarb); an organophosphorus (109.5 ppm phosphamidon); and an organochlorine (6.72 ppb endosulfan). Aldicarb exposure led to extensive necrosis combined with nuclear pycnosis and karyolysis after 1 week and hypertrophy of hepatocytes and massive fatty degeneration of the liver after 4 weeks. Endosulfan poisoning evoked serious structural impairments including hepatocyte regression, vacuolization, and nuclear pycnosis. Hepatic lesions in fish exposed to phosphamidon included hepatocyte hypertrophy and nuclear deterioration. Focal necrotic changes were often noted in the treated fish. The carbamate pesticide proved to be more injurious to the liver as compared to the other two pesticides tested. (MacKeen-PTT)
W91-03536

TOXICITY BIOASSAYS: WATER POLLUTION EFFECTS ON AQUATIC ANIMALS AND PLANTS (JUN 86-FEB 90). CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W91-03569

HEALTH ASSESSMENT FOR WHITTAKER CORPORATION NATIONAL PRIORITIES LIST (NPL) SITE, MINNEAPOLIS, HENNEPIN COUNTY, MINNESOTA, REGION 5, CERCLIS NO. MND006252233.
Agency for Toxic Substances and Disease Registry, Atlanta, GA.
For primary bibliographic entry see Field 5G.
W91-03574

TYPES AND EFFECTS OF MICROBIAL CONTAMINATION OF GROUNDWATER.
Environmental Protection Agency, Research Triangle Park, NC. Office of Research and Development.
For primary bibliographic entry see Field 5B.
W91-03577

SEDIMENT QUALITY VALUES REFINEMENT: VOLUME I. 1988 UPDATE AND EVALUATION OF PUGET SOUND AET (APPARENT EFFECTS THRESHOLD).
PTI Environmental Services, Bellevue, WA.
R. Barrick, S. Becker, L. Brown, H. Beller, and R. Pastorok.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-200398/AS. Price codes: AO9 in paper copy, AO1 in microfiche. Report No. EPA 910/9-88-246a. September 1988. 180p, 47 fig, 19 tab, 4 append. EPA Contract No. 68-01-4341.

Descriptors: *Data processing, *Environmental impact, *Puget Sound, *Sediment contamination, *Washington, *Water pollution effects, Amphipods, Benthic fauna, Bioassay, Metals, Microtox, Organic compounds, Oysters.

The Apparent Effects Threshold (AET) can be used to develop chemical specific sediment quality values. As part of this effort, AET values were generated for Puget Sound, Washington, and applied in a predictive manner to approximately 300 stations. The objective of this investigation was to test the reliability of AET, and potential sediment quality standards based on AET, in predicting adverse biological effects associated with sediment contamination. Of the 201 benthic infauna stations and 287 amphipod bioassay stations evaluated in this study, approximately 75% were in accordance with AET predictions. Approximately 96% of the 50 stations where oyster larvae and microtox bioassays were performed were in accordance with AET predictions. Based on AET for the four biological indicators, Puget Sound maps were produced showing the location of predicted impacts in the estuary. This effort involved the generation and evaluation of AET for 58 metal and organic chemicals. (Author's abstract)
W91-03583

EFFECTS OF HEAVY METALS IN SEDIMENTS ON THE MACROINVERTEBRATE COMMUNITY IN THE SHORT CREEK/EMPIRE LAKE AQUATIC SYSTEM, CHEROKEE COUNTY, KANSAS: A RECOMMENDATION FOR SITE-SPECIFIC CRITERIA.
Environmental Protection Agency, Kansas City, KS. Environmental Services Div.
J. Jobe.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-189773. Price codes: A04 in paper copy, A01 in microfiche. EPA Report No. 600/9-89/018, October 1988. 48p, 11 fig, 6 tab, 13 ref. EPA Grant No. U-913001-01-0.

Descriptors: *Empire Lake, *Heavy metals, *Macroinvertebrates, *Short Creek, *Water pollution effects, Cadmium, Ecological effects, Environmental effects, Kansas, Lead, Manganese, Path of pollutants, Species diversity, Standards, Statistical analysis, Zinc.

Cherokee County, Kansas, was the site of the most intensive mining in the tri-state mining area. Little cleanup of the tailings and waste materials from smelting operations has been done. This study uses statistical analysis techniques to determine the effects of four heavy metals (cadmium, lead, manganese, and zinc) on the macroinvertebrate community using the data collected in the fall 1987. The concentrations of all four metals were found to be greatly elevated throughout Empire Lake and in both the Spring River and Shoal Creek arms of the reservoir. The concentrations of all four metals were found to be greatly elevated throughout Empire Lake and both the Spring River and Shoal Creek arms of the reservoir. The mean concentration of Cd was 21.61 ppm with a range of 4.11 ppm to 131.50 ppm. The mean concentration of Pb was 189.92 ppm with a range of 52.90 ppm to 1607 ppm. The mean concentration of Mn was 648.57 ppm with a range of 248.5 ppm to 1937 ppm. The mean concentration of Zn was 3052.05 ppm with a range of 185.50 ppm to 25008.00 ppm. The mean density of macroinvertebrates in the study was 1,063.6/sq m with a range of 129.2/sq m to 5,382.8/sq m. The mean number of species found per Surber sampler was 5.8 with a range of 1 to 18. The total number of species found in the study was 32. However, 30 of these species were found in one transect. Many were represented by only one individual. There were only 14 species that were represented by 17 or more individuals. It was concluded that density and species richness were greatly reduced. The results of several statistical tests indicate that site specific sediment criteria for the four metals should be as follows: Mn should not exceed the range of 450-600 ppm; Cd should not exceed 10-27 ppm; Zn should not exceed the range of

1354-2190 ppm; and the combined levels of Mn and Pb should not exceed 600 ppm. These concentrations provide upper bounds to the maximum allowable levels. Since all of the information for this study was based on communities in an impacted reservoir, it may be that safe levels are much lower than this study suggests. Also, additional variables not in the current analysis, such as sediment type, amount of organic debris and season, could have a significant affect upon the model. (Lantz-PTT)
W91-03588

SEDIMENT QUALITY VALUES REFINEMENT: VOLUME 1 - DATA APPENDICES, 1988 UPDATE AND EVALUATION OF PUGET SOUND AET.
PTI Environmental Services, Bellevue, WA.
For primary bibliographic entry see Field 5A.
W91-03599

CYCLE IN THE SYSTEM SOIL-PLANT-ANIMAL ON LOCATIONS WITH EXTREMELY HIGH SOIL CONTAMINATION BY CADMIUM AND NICKEL CAUSED BY SEWAGE-SLUDGE (KREISLAUF IM SYSTEM BODEN-PFLANZE-NUTZTIER AUF STANDORTEN MIT EXTREM HOHER CADMIUM-UND NICKELBELASTUNG DURCH KLARSCHLAMMAUFBRINGUNG).
Landwirtschaftliche Untersuchungs- und Forschungsanstalt, Speyer (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-03602

MUSSELS (MYTILUS EDULIS L.) IN COASTAL WATER QUALITY CONTROL (DIE MIESMUSCHEL (MYTILUS EDULIS L.) ALS INDIKATOR VON UMWELTBELASTUNGEN).
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 5A.
W91-03605

WASTEWATER IRRIGATION IN DEVELOPING COUNTRIES: HEALTH EFFECTS AND TECHNICAL SOLUTIONS.
Hebrew Univ. of Jerusalem (Israel). School of Public Health.
For primary bibliographic entry see Field 3F.
W91-03650

ECONOMIC IMPLICATIONS OF GROUNDWATER CONTAMINATION TO COMPANIES AND CITIES.
Freshwater Foundation, Navarre, MN.
Freshwater Foundation, Navarre, Minnesota. 1989. 9p.

Descriptors: *Case studies, *Cleanup operations, Economic aspects, *Groundwater pollution, Groundwater quality, *Minnesota, *Site remediation, *Water pollution control, *Water pollution effects, Costs, Long-term planning, Monitoring, Water quality.

Groundwater contamination poses an important challenge to future economic development in Minnesota, as well as nationwide, threatening property values, tax revenues and business development. In a survey of 21 Minnesota cities and 18 companies, conservatively estimated, groundwater contamination resulted in the following costs: to 17 Minnesota cities, a total of $24,045,500; and to 18 Minnesota companies, a total of $43,026,500. In those few instances, groundwater pollution costs in Minnesota alone were estimated by the participants over $67 million. This figure does not, however, take into account the large number of contaminated sites already identified in the state and currently in some stage of assessment or remediation. Nor does it include an estimated $13 million in jobs that would have come from potential new business in the one city, where prime commercial property has been compromised by pollution. Nor does it include the millions of dollars for cleanup, bottled water supplies, testing, and staff time from the Minnesota Pollution Control Agency, or Superfund monies for construction of new water treatment facilities. As monitoring increases, contamination from current and past practices will uncover additional cases. How equitable and efficiently Minnesota deals with these incidences will have a profound effect on the amount and distribution of economic development throughout the state. The economic impact of groundwater contamination offers an important market incentive to both cities and businesses to minimize the production of waste and more effectively address the long-term pollution and liability issues stemming from its disposal. In Minnesota, businesses have already spent millions of dollars on cleanup of waste sites that have contaminated groundwater or have the potential to contaminate groundwater. If businesses can't meet the growing future costs of cleanup, additional burdens will be passed on to the taxpayer. Cleanup and remediation are not a short-term expense; they are becoming a long-term liability. For the future, instead of monies spent on legal fees, consultants, and testing; good preventive manufacturing practices, sound waste management and minimization, and other preventive strategies will be needed to protect water quality--turning the short-term expense into a long-term investment. The economic issues related to groundwater contamination will serve as a catalyst to developing a more integrated framework for all land and water management. Both groundwater and economic resources will benefit from such new approaches. (Lantz-PTT)
W91-03660

COLONIAL WATERBIRD DEFORMITIES--AN EFFECT OF TOXIC CHEMICAL RESIDUES IN THE GREAT LAKES.
Ecological Research Service, Inc., Bay City, MI.
J. P. Ludwig, and H. Kurita.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 201-209, 33 ref.

Descriptors: *Bioindicators, *Great Lakes, *Teratogenic effects, *Water pollution effects, *Waterfowl, Aquatic life, Biological magnification, Chemical analysis, Dioxins, Ecosystems, Environmental impact, Food chains, Lake management, Polychlorinated biphenyls, Toxins, Water birds, Water quality management, Water resources management.

Colonial waterbirds have been recognized as sensitive monitors of toxic chemical contamination in the Great Lakes. Recent information suggests that, contrary to widely publicized evidence that amounts of total contamination of the Great Lakes biota is decreasing, reassurance is both premature and inaccurate. Furthermore, there are high rates of deformities of specific types of colonial waterbird species found over the last ten years, which can be reproduced in the laboratory by feeding PCB, dioxin, and furan contaminants to avian test species. Reproductive problems of the bird species include egg infertility, altered eggshells, structural embryonic deformities, and deformed young. Waterbird studies are useful in that birds cannot reabsorb abnormal embryos, and birds share a similar homeothermic metabolism with mammals. The multiplicity of toxins present in the foods consumed by both the birds and men that live in shared ecosystems demand a real world approach. The overall effects of toxics have increased in a variety of colonial waterbird species as the reported total PCB levels and other toxic concentration levels are declining. Clearly the birds are integrating their toxic burden differently than the analytical chemists and the policy-makers have predicted. The public would be best served by monitoring reproduction of the sensitive colonial waterbirds or aquatic mammals using standard protocols. In addition, by first looking for real toxic effects in wildlife and then testing those organisms that have bioconcentrated the worst materials to the maximum extent feasible, the analytical chemist should be able to take a step closer to actual fingerprinting of individual contamination plumes. (See also W91-03672) (Fish-PTT)
W91-03694

FADING RECOVERY: THE ROLE OF ROACH (RUTILUS RUTILUS L.) IN MAINTAINING HIGH PHYTOPLANKTON PRODUCTIVITY AND BIOMASS IN LAKE VESIJARVI, SOUTHERN FINLAND.
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
For primary bibliographic entry see Field 5G.
W91-03773

TOXICITY OF A SOLUBLE PEPTIDE FROM MICROCYSTIS SP. TO ZOOPLANKTON AND FISH.
Chile Univ., Santiago. Dept. de Biologia.
R. Penaloza, M. Rojas, I. Vila, and F. Zambrano.
Freshwater Biology FWBLAB, Vol. 42, No. 2, p 233-240, October 1990. 6 fig, 3 tab, 32 ref. FONDECYT Grant 178/88 and Departamento Tecnico de Investigacion, Universidad de Chile, Grant B 2811-8813.

Descriptors: *Algal toxins, *Bioassay, *Chile, *Cyanophyta, *Eutrophic lakes, *Limnology, *Toxicity, *Toxins, Daphnia, Fishkill, Hydrogen ion concentration, Peptides, Rotifers, Temperature, Zooplankton.

In order to determine the cause of fish kills in eutrophic Aculeo Lake (Chile) during blue-green algae blooms, the composition of the phytoplankton and its toxin content were analyzed. In addition, the lethal action of a partially-purified component from natural phytoplankton was investigated on zooplankton and on Gambusia affinis Holbrooki, a common fish in Aculeo Lake. It was found that the soluble fraction extraction was lethal to common native zooplankton, including the rotifers Keratella sp., Trichocerca similis, the copepod Boeckella sp., and the cladoceran Chydorus sphaericus, as well as to G. affinis. The specific toxicity of the soluble fraction from phytoplankton varied four-fold to six-fold with seasonal peaks during periods of warm temperature. The results showed that after cell disruption, the toxicity resides in the soluble fraction, which strongly suggests that the toxin is a natural component of the intracellular content, and not bound to a particulate structure of the cell. It is thought that the toxic peptide released from Microcystis may reach a concentration lethal to fishes, which through dilution produces a short-lived pulse. It is less likely that a chemical degradation process is involved because the toxic component remains unaltered despite large changes to pH and temperature (a temperature close to boiling is needed to deactivate the toxin). However, bacterial degradation of the toxin has not been excluded. (White-Reimer-PTT)
W91-03821

SUCCESSIONAL CHANGES IN THE SOFT-WATER MACROPHYTE VEGETATION OF (SUB)ATLANTIC, SANDY, LOWLAND, REGIONS DURING THIS CENTURY.
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 2H.
W91-03824

MACROFAUNA RECOLONIZATION OF SUBTIDAL SEDIMENTS. EXPERIMENTAL STUDIES ON DEFAUNATED SEDIMENT CONTAMINATED WITH CRUDE OIL IN TWO NORWEGIAN FJORDS WITH UNEQUAL EUTROPHICATION STATUS. I. COMMUNITY RESPONSES.
Norsk Inst. for Vannforskning, Oslo.
J. A. Berge.
Marine Ecology Progress Series MESEDT, Vol. 66, No. 1/2, p 103-115, September 1990. 11 fig, 6 tab, 40 ref. Norwegian Institute of Water Research Grant E-87720.

Descriptors: *Eutrophication, *Macroinvertebrates, *Norway, *Oil pollution, *Recolonization, *Water pollution effects, Colonization, Restoration.

Perturbations of marine sediment may defaunate or disturb patches in soft bottom communities which subsequently are recolonized. Experiments were performed by placing oiled and unoiled defaunated

sediment in boxes (0.2 sq m) on the sea floor in 2 Norwegian fjords, the eutrophicated Oslofjord and the non-eutrophicated Raunefjord. In the Oslofjord no negative effects of the added oil (3920 ppm wet weight sediment) on macrofauna community structure were seen after 3 mo., thus restoration of the community took less than 3 mo during a spring/summer situation in a soft bottom area with a species composition dominated by opportunistic species (Polydora spp.). In the Raunefjord the effect of the added oil (4520 ppm) was shown in reduced species diversity after 4 mo, and altered k-dominance curves, distribution of individuals among species, Hurlbert's rarefaction curves and multidimensional scaling plots. The added oil reduced the mean equilibrium number of species per box from 80 to 55. The time needed to reach 90% of this equilibrium was shorter in the oiled boxes (259 d) than in the control boxes (466 d). Immigration rates were similar (0.27 species/d/box) in both treatments during June to November; however, from November to March the rate was higher in control boxes (0.24) than in oiled boxes (0.17). Mean extinction rates in boxes were; however, larger in the oiled boxes than in the control boxes during both periods. It is concluded that restoration of the benthic macrofauna after oil contamination of sediment takes longer in a non-eutrophicated area than in a eutrophicated area. The reduced density of macrofauna in the oiled boxes in the Raunefjord was caused by toxic response to oil directly, or by secondary effects leading to increased mortality, rather than by reduced settlement. Macrofauna recolonization is easily affected by oil-contamination in a non-eutrophicated area; however, separation of oil-specific responses in benthic communities from responses to other disturbances can hardly be demonstrated without relevant controls. (Author's abstract)
W91-03832

INCREASE OF BENTHIC BIOMASS IN THE SKAGERRAK-KATTEGAT DURING THE 1970S AND 1980S--EFFECTS OF ORGANIC ENRICHMENT.
Groelands Fiskeriundersoegelser, Charlottenlund (Denmark).
A. B. Josefson.
Marine Ecology Progress Series MESEDT, Vol. 66, No. 1/2, p 117-130, September 1990. 6 fig, 4 tab, 35 ref.

Descriptors: *Baltic Sea, *Benthos, *Eutrophication, *Macroinvertebrates, *North Sea, *Skagerrak-Kattegat, *Species diversity, *Water pollution effects, Biomass, Community structure, Echinoderms, Foods, Nutrients, Polychaetes, Salinity.

A benthic data set that illustrates environmental changes over a 16 yr period in a large area of the Skagerrak and northern Kattegat (a transition area between the Baltic Sea and the North Sea) is presented. Biomass and abundance of macrobenthos was monitored from 1972 to 1988 at 14 soft-sediment stations below the halocline in the Skagerrak-Kattegat area. Year-to-year variations in fauna were analyzed. Clear general trends were demonstrated over the study area, which is >170 km long. Total biomasses showed linear increases by a median factor of 1.8, primarily from 1981 to 1988, and biomasses excluding some large species, notably echinoids, increased by a median factor of 1.7 from 1972 to 1988. The changes were primarily due to echinoderms, notably the amphiuroid Amphiura filiformis, and polychaetes. Polychaetes contributed more to the increase at the deepest stations, and the absolute increase of this group was positively related with water depth. The relative increases in biomass without large species as well as biomass of amphiuroids and polychaetes were positively related to water depth. Parallel to the biomass change, land freshwater run-off from western Sweden and to Danish inner waters have increased, and this has influenced the input of nutrients to the sea. Although reliable data on primary production and sedimentation of organic material are largely lacking, the present results are in accordance with hypotheses that soft-sediment infauna in the area is food limited, and that the area is being affected by organic enrichment. (Author's abstract)
W91-03833

DETECTION OF INITIAL EFFECTS OF POLLUTION ON MARINE BENTHOS: AN EXAMPLE FROM THE EKOFISK AND ELDFISK OILFIELDS, NORTH SEA.
Oslo Univ. (Norway). Inst. of Marine Biology.
J. S. Gray, K. R. Clarke, R. M. Warwick, and G. Hobbs.
Marine Ecology Progress Series MESEDT, Vol. 66, No. 3, p 285-299, September 1990. 14 fig, 3 tab, 26 ref.

Descriptors: *Benthic fauna, *Bioindicators, *Norway, *Oil pollution, *Species diversity, *Water pollution effects, Classification, Community structure, Multivariate analysis, Ordination.

The environmental effects of oil fields on marine benthos were studied in the Ekofisk and Eldfisk oil fields in Norway. Exploration of the Ekofisk field began in the late 1960's and the first environmental investigation around the main platform complex was carried out in 1973. Environmental investigations in the adjacent Eldfisk field began in 1984 in conjunction with the fifth survey of the Ekofisk field. This study is based on the results of the sixth environmental survey of the Edofisk field and the second at Eldfisk. Sampling sites were arranged as radii and were approximately logarithmically spaced with 38 sites located at the Edofisk field and 20 at the Eldfisk. Reductions in number of species and diversity and increased dominance of opportunistic species occurred late in the sequence of response to oil as a stress factor (within 500 to 1000 m of discharge sources). However, multivariate analyses, (classification analysis using the Bray-Curtis dissimilarity index) and ordination (multi-dimensional scaling) clearly distinguished site groupings related to oil activities at distances of up to 2 to 3 km from the Ekofisk pollution source and up to 1.5 km from the Eldfisk source. The first recorded changes in benthic communities in response to oil were increased abundance patterns of some species and changes in the presence and absence patterns of rare species, with species being mostly present in one site group and mostly absent in another site group. Only under severe pollution did the opportunistic species, which have often been suggested as universal indicators of pollution, dominate. The major site groupings could still be distinguished after aggregation to higher taxa (families and even phyla) when using multivariate analyses. If these findings prove to be a generally applicable, then great savings in time and effort, with little or no loss of precision, will be possible in environmental monitoring. Although the use of determinations to phyla for monitoring is not yet confirmed, the use of multivariate analyses does appear capable of providing diagnostic monitoring of oil activity effects. (White-Reimer-PTT)
W91-03837

EFFECTS OF CLIMATIC CHANGE ON THE THORNTHWAITE MOISTURE INDEX.
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 2B.
W91-03858

PREDICTION, VALIDATION, MONITORING, AND MITIGATION OF ANTHROPOGENIC EFFECTS UPON NATURAL SYSTEMS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
J. Cairns.
Environmental Auditor ENVAE8, Vol. 2, No. 1, p 19-25, 1990. 27 ref.

Descriptors: *Ecological effects, *Environmental effects, *Habitat restoration, *Monitoring, *Water pollution control, Minimization, Model studies, Recycling, Waste disposal, Waste management, Water pollution effects, Water quality control.

Abundant evidence on a global scale shows that the capacity of ecosystems to endure the stresses put upon them by human activities has been exceeded in a variety of ways, and present practices are not suitable for reaping the long-term benefits of natural ecosystems. A global environmental quality control system must be put into place which includes: range finding or screening tests to determine which activities are likely to result in adverse effects upon ecosystems; the development of prediction models that will determine acceptable levels of such uses, if any; the validation of these models in field enclosures of natural systems or surrogates of natural systems (microcosms and mesocosms); and monitoring systems to ensure that previously established quality control systems based on the predictive and validation activities are being met nd to provide an early warning when they are not. Finally, restoration ecology must be used more vigorously to restore the ecosystems damaged by anthropogenic activities so that the ecosystem's services (such as carbon storage) are again available. Ecosystem restoration will mitigate some of the environmental impacts by transforming deleterious materials into less harmful or even beneficial materials, but the primary effort to make long-term, sustainable, beneficial use of ecosystems possible will depend on waste minimization and recycling. Waste minimization means selection of production methods that produce the least harmful waste products (low toxicity, rapid degradation, and small volume) and methods that allow recycling of materials deleterious to the environment or involving high energy demands in their production. Prescriptive laws and regulations should be avoided to ensure the flexibility needed for generating the large database to make the predictive models more robust. (Lantz-PTT)
W91-03871

QUANTIFICATION OF HYDROCHLORIC ACID AND PARTICULATE DEPOSITION RESULTING FROM SPACE SHUTTLE LAUNCHES AT JOHN F. KENNEDY SPACE CENTER, FLORIDA, USA.
Bionetics Corp., Cocoa Beach, FL.
For primary bibliographic entry see Field 5B.
W91-03878

EFFECTS OF CHLORINE DIOXIDE ON THE DEVELOPING RAT BRAIN.
Health Effects Research Lab., Research Triangle Park, NC. Developmental Toxicology Div.
For primary bibliographic entry see Field 5F.
W91-03880

ENVIRONMENTAL ASPECTS OF CRYPTOSPORIDIUM SPECIES: A REVIEW.
Scottish Parasite Diagnostic Lab., Glasgow. Dept. of Bacteriology.
For primary bibliographic entry see Field 5F.
W91-03881

ALTERATIONS IN THE ENERGY METABOLISM OF AN ESTUARINE MYSID (MYSIDOPSIS BAHIA) AS INDICATORS OF STRESS FROM CHRONIC PESTICIDE EXPOSURE.
Environmental Research Lab., Gulf Breeze, FL.
C. L. McKenney, and E. Matthews.
Marine Environmental Research MERSDW, Vol. 30, No. 1, p 1-19, 1990. 5 fig, 4 tab, 51 ref.

Descriptors: *Animal metabolism, *Bioindicators, *Crustaceans, *Estuaries, *Fenthion, *Pesticides, *Water pollution effects, Nitrogen, Organophosphorus pesticides, Oxygen, Stress, Toxicity, Zooplankton.

Dose-response relationships were developed for several metabolic rate functions (oxygen consumption and ammonia excretion) and physiological indices (K2 values and O/N ratios) at different life stages of an estuarine mysid (Mysidopsis bahia) during a life cycle exposure to fenthion, an organophosphate insecticide. Initial exposure to fenthion resulted in elevated respiration rates of juvenile mysids. As shown by lower net growth efficiency (K2 values), these increased metabolic demands reduced the amount of assimilated energy available for production of new tissue, resulting in retarded juvenile growth rates. O/N ratios indicated that juvenile mysids primarily utilized lipid substrates as an energy source, but during maturation shifted to greater usage by proteinaceous substrates. Higher O/N ratios during maturation of fenthion-exposed mysids suggest greater reliance on the

more energy-rich lipid substrates to support the elevated rates of oxidative metabolism, resulting in less lipid material being available for gamete production. These results, when compared with similar studies with two other pesticide classes, suggest that measurements of alterations in the energy metabolism of contaminated individuals from sensitive zooplankton populations (e.g. mysids) may be used as indicators of reductions in population performance from chronic exposure to toxic organics. (Author's abstract)
W91-03883

CHARACTERIZATION AND ASSAY CONDITIONS FOR USE OF ACHE ACTIVITY FROM SEVERAL MARINE SPECIES IN POLLUTION MONITORING.
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes. Lab. Effets Biologiques des Nuisances.
For primary bibliographic entry see Field 5A.
W91-03885

EFFECTS OF AN OIL SPILL ON THE GASTROPODS OF A TROPICAL INTERTIDAL REEF FLAT.
Smithsonian Tropical Research Inst., Balboa (Panama).
S. D. Garrity, and S. C. Levings.
Marine Environmental Research MERSDW, Vol. 30, No. 2, p 119-153, 1990. 12 fig, 8 tab, 30 ref.

Descriptors: *Gastropods, *Intertidal areas, *Oil spills, *Reefs, *Water pollution effects, Caribbean Sea, Marine environment, Oil pollution, Species diversity, Tropical regions, Water level.

The effects of an oil spill on the mollusks of an intertidal reef flat were examined. At least 8,000,000 L of medium weight crude oil were spilled on 27 April 1986 from the refinery at Isle Payardi on the Caribbean coast of the Republic of Panama. The severity of effects on a nearby reef flat varied with the amount of oil deposited in a green zone of the reef. Immediate mortality of snails occurred in zones with heavy accumulations of oil and abundances further decreased in some zones after the activities of a cleanup crew. Overall density and species number decreased over time. Recruitment appeared reduced in some zones more than two years after the spill. No such patterns were observed at an un-oiled control site until a small spill of diesel fuel in May 1988 similarly reduced mollusk populations. However, this spill had no long-term effects. Effects of oil spills on these types of reef flats depend on the pattern of tidal emersion at the time of the oil spill, because water levels determine the distribution of oiling across the reef flat. (Author's abstract)
W91-03887

ENVIRONMENTAL CONSEQUENCES OF SALINE GROUNDWATER INTRUSION INTO THE WIMMERA RIVER, VICTORIA.
Laiela Fisheries Research Station, Shepparton (Australia). Fisheries Div.
For primary bibliographic entry see Field 2F.
W91-03898

5D. Waste Treatment Processes

PERFORMANCE OF MODIFIED RECIRCULATING SAND FILTERS USING BOTTOM ASH AND BOILER SLAG MEDIA.
West Virginia Univ., Morgantown. Water Research Inst.
J. A. Sack, M. A. Usmen, and S. P. Dix.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-222266/AS. Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report of Project WV87-09, 1989. 49p, 1 fig, 15 tab, 24 ref, 2 append. USGS Contract No. 14-08-0001-G1457. USGS Project No. G1457-09.

Descriptors: *Filtration, *Septic wastewater, *Wastewater treatment, Ash, Biochemical oxygen demand, Boiler slag, Design criteria, Nitrogen removal, Performance evaluation, Sand filters.

This research was conducted to evaluate the performance of a novel recirculating sand filter (RSF2) treating septic tank effluent. The RSF2 consisted of a column containing filter media underlain by gravel. The gravel served both as a storage and treatment zone. Effluent was pumped into the bottom of the gravel and recirculated to the top of the filter. Effluent was removed from a layer which lay between the filter media and the gravel zone. Four different RSF2 columns containing: (1) screened boiler slag or Black Beauty (BB); (2) screened Fort Martin Bottom Ash (FMBA); (3) unscreened Fort Martin Bottom Ash (EFMBA); and (4) screened Mitchell Bottom Ash (MBA). Loading rates based on forward flow (FFO of 5 to 10 FPD/cu ft and recirculation ratios (RR) of 3:1 and 5:1 were studied. It was found that all columns could be successfully operated at a FF of 5GPD/sq ft and a RR of 5:1 for long periods without ponding. It was concluded that bottom ashes screened to WV specifications could be operated at a loading rate of 6 GPD/sq ft. However, unscreened bottom ash filters should be restricted to 5 GPD/sq ft. The gravel storage zone functioned well in replacing the normally used recirculation tank. In addition, it served as a treatment device for removal of BOD-5 and total nitrogen (TN). BOD-5 removal is conservatively estimated to range between 20% to 40%. Total nitrogen removal which takes place mainly in the gravel zone ranged from 34% to 59%. Recirculation ratios of 3:1 and 5:1 were compared at a FF of 10 GPD//sq ft. The lower recirculation ratio improved TN removal somewhat, probably due to a more completely anoxic condition in the gravel zone. However, the lower RR also reduced run length before ponding and allowed odor generation. Variation in hydraulic loading rate from 5 to 10 GPD/sq ft produced an effluent below 10 mg/L BOD-5 and SS as long as the filters were not ponded. This suggests that an RSF2 system operated at a FF of 5 to 6 GPD/sq ft could withstand short-term hydraulic overloads without deterioration in effluent quality. (USGS)
W91-02984

WETLANDS AND WASTEWATER MANAGEMENT: QUESTIONS, ANSWERS, ADVICE, AND GUIDANCE.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5G.
W91-03014

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR WASTES FROM THE PRODUCTION OF DINITROTOLUENE, TOLUENEDIAMINE, AND TOLUENE DIISOCYANATE, K027, K111, K112, K113, K114, K115, K116, U221, AND U223.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5G.
W91-03015

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR WASTES FROM THE PRODUCTION OF CHLORINATED ALIPHATIC HYDROCARBONS F024.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5G.
W91-03016

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR PHTHALATE WASTES.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5G.
W91-03017

FINAL, BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR K011, K013, AND K014.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5G.
W91-03018

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT): BACKGROUND DOCUMENT FOR K009 AND K010.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5G.
W91-03028

WATER USE, REUSE AND ABUSE.
General Development Corp., Miami, FL.
N. Roen, and R. S. Murali.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 5B-13--5B-21, 14 ref.

Descriptors: *Agricultural water, *Florida, *Wastewater renovation, *Water conservation, *Water management, *Water resources management, *Water reuse, *Water use, Cape Coral, Economic aspects, Environmental protection, Political aspects, Water quality control.

The Cape Coral, Florida debate over dual water systems has brought into focus the complex technical, legal, regulatory, political, socio-economic, financial, public health and environmental issues involving the use, reuse and conservation of ground and surface water resources. Serious and irreversible damage can be caused to the resource, economic development and growth management if these factors are not adequately addressed. The paper presents a review of: the current legal and regulatory framework with emphasis on evolving laws with respect to water use and reuse; the impact of political, socioeconomic and public health issues and the technical, environmental and financial constraints on opportunities for wastewater reuse; and specific disincentives in the current approaches to water use and reuse. There is a need to address both conservation and reuse much more rationally and on a broader scale. A broad-based funding mechanism should be established to undertake viable, large-scale conservation and reuse projects which would have a measurable effect on the water resources. In addition, more environmentally acceptable disposal technologies, developing concepts such as 'Casa del Agua' where potable and nonpotable sources are separated, recycled and reused on site, changes in domestic and irrigation practices toward utilizing drought-tolerant species, low-volume irrigation technologies and plumbing residences and commercial and industrial facilities with low-volume fixtures will have significant impact on conservation and reuse. (See also W91-03032) (Lantz-PTT)
W91-03056

WATER-QUALITY VARIABILITY IN A CENTRAL FLORIDA WETLAND RECEIVING HIGHWAY RUNOFF.
Geological Survey, Altamonte Springs, FL.
For primary bibliographic entry see Field 5B.
W91-03058

PROCESSES AFFECTING RETENTION OF WATER-QUALITY CONSTITUENTS IN A DETENTION POND-WETLAND SYSTEM.
Geological Survey, Altamonte Springs, FL.
W. S. Gain, and R. A. Miller.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 7A-13--7A-23, 3 fig, 1 tab, 13 ref.

Descriptors: *Detention reservoirs, *Path of pollutants, *Storm wastewater, *Wastewater treatment, *Water management, *Water quality, *Wetlands treatment, Aluminum oxide, Biodegradation, Chemical precipitation, Florida, Heavy metals, Iron, Monitoring, Orlando, Phosphorus, Sedimentation, Zinc.

A detention pond-wetland stormwater treatment system in Orlando, Florida, was monitored during 11 storms from 1982 to 1984 to evaluate its effect

on stormwater quality. In general, both the pond and the wetland efficiently retain solid phase constituents. However, differences were observed in the efficiencies at which each of the treatment units retain total dissolved solids, lead and zinc. Retention efficiencies for dissolved solids, lead and zinc were low in the pond and high in the wetland. Conversely, retention efficiencies for dissolved phosphorous were low in the wetland and high in the pond. The low retention efficiency for dissolved solids in the pond may reflect a combination of dissolution from bed sediments and limited biological assimilation. The wetland may maintain phosphorous with less efficiency than the pond because the wetland is more biologically active and presumably cycles phosphorous in larger quantities, maintaining higher concentrations between storms than does the pond. The relatively high efficiency at which dissolved phosphorous is retained in the pond may be attributed to one or a combination of the following: net assimilation by plants, adsorption to bottom materials, or precipitation with iron and aluminum oxide. Zinc concentrations in pond sediments may dissolve into pond water between storms, increasing pond water zinc concentrations and decreasing the dissolved zinc retention efficiency of the pond. The greater retention efficiency for zinc in the wetland than the pond may be attributed to lower concentrations of zinc in wetland sediments, greater rates of wetland biological activity that absorb and immobilize zinc, or different oxidation/reduction conditions in wetlands. (See also W91-03032) (Author's abstract)
W91-03059

USE OF A FORESTED WETLAND IN SOUTH CAROLINA FOR TERTIARY TREATMENT OF MUNICIPAL WASTEWATER.
CH2M Hill, Charleston, SC.
D. S. Baughman, R. L. Knight, W. J. Dunn, and L. Schwartz.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 7A-25--7A-37, 5 tab, 14 ref.

Descriptors: *Municipal wastewater, *South Carolina, *Tertiary wastewater treatment, *Wastewater treatment, *Water management, *Water pollution effects, *Wetland wastewater treatment, Biochemical oxygen demand, Groundwater quality, Monitoring, Nitrates, Nitrogen, Phosphorous, Suspended solids, Vegetation, Waccamaw River, Water quality, Wetlands.

The Grand Strand Water and Sewer Authority (GSWSA) began a pilot study in June 1986 with 400,000 gpd of treated wastewater discharged to a forested wetland called Central Slough on the Waccamaw River in Horry County, South Carolina. This pilot study was conducted to test the assimilative capacity of a cypress-gum wetland and to assess the potential biological effects of the wastewater discharge. Two years of operational monitoring of surface and groundwater quality, and biota have been conducted and are summarized in this paper. The effluent discharged to Central Slough had an average biochemical oxygen demand (BOD) of 13 and 19 mg/L in year 1 and year 2, respectively, while ammonia averaged 6.1 and 10.2 mg/L during the same years. As the effluent flowed through the 32-hectare wetland, ultimate oxygen demanding (UOD) constituents were reduced by 90% in year 1 and 84% in year 2. These estimates are equivalent to mass removal rates of 0.15 and 0.20 g/sq m/d in 1986 and 1987. Overall, the wetland provided at least a 70% reduction for BOD, total suspended solids, NH3-N, total nitrogen, and total phosphorous. No changes in water quality in the Waccamaw River downstream of the wetland were observed during this period, and groundwater monitoring indicated no impacts from the discharge of treated wastewater. The vegetation strata were also monitored over the study period with no changes in the canopy, subcanopy, and shrub importance values of the dominant species observed during the two years of treated wastewater discharge. Ground cover changes were limited to an increase in duckweed. (See also W91-03032) (Author's abstract)
W91-03060

NATIONAL EDUCATIONAL PROGRAM IN WASTEWATER TREATMENT FOR SMALL RURAL COMMUNITIES.
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W91-03072

BIOTREATMENT: THE USE OF MICROORGANISMS IN THE TREATMENT OF HAZARDOUS MATERIALS AND HAZARDOUS WASTES.
Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. 150p.

Descriptors: *Biodegradation, *Biological wastewater treatment, *Bioremediation, *Hazardous wastes, *Microbial degradation, *Wastewater treatment, *Water pollution treatment, Chlorinated hydrocarbons, Coal tars, Composting, Groundwater pollution, Heavy metals, Soil contamination.

Strategies for the biological treatment of hazardous materials and wastes were considered at the Proceedings of the Second National Conference on Biotreatment in Washington, D.C., held concurrently with Superfund 1989. In situ treatments were presented for contaminated groundwater, landfills, and soils at the field and bench-scale levels. Combined technologies for soil treatment addressed chlorinated hydrocarbon, pesticide, coal tar, and oil spills. Innovative combined technologies included forced aeration composting, air stripping/bioremediation, and ozonation and biological activated carbon treatment. Public perception and government regulations are analyzed for genetically engineered or adapted microorganisms for bioremediation. Other conference papers examined recombinant DNA technologies in marine biodegradation studies. (See W91-03098 thru W91-03116) (Geiger-PTT)
W91-03097

BIODEGRADATION OF CHLORINATED ALIPHATICS BY A METHANOTROPHIC CONSORTIUM IN A BIOLOGICAL REACTOR.
C.A.A. Bioremediation Systems, Boston, MA.
M. C. Leahy, M. Findlay, and S. Fogel.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 3-9, 8 fig, 22 ref. NSF Award ISI-8703753.

Descriptors: *Biodegradation, *Biofilm reactors, *Biological wastewater treatment, *Chlorinated hydrocarbons, *Methane bacteria, *Wastewater treatment, Groundwater pollution, Microbial degradation, Water pollution treatment.

A biological reactor process employing methane-oxidizing bacteria was used to degrade chlorinated aliphatic hydrocarbons in contaminated water. Trichloroethylene and cis-dichloroethylene were rapidly degraded by a methanotrophic consortium in a reactor in the presence of methane which served as the sole source of carbon for the biofilm. The concentration of methane in the reactor had a profound effect on the rate of degradation of trichloroethylene (TCE). Degradation of TCE occurred much faster at lower concentrations of methane. The effect of methane concentration on cis-dichloroethene degradation was much less. This bioreactor will have potential applications in the pretreatment and treatment of wastewater, polluted groundwater and leachate contaminated soils. (See also W91-03097) (Geiger-PTT)
W91-03098

METABOLIC DIVERSITY OF MICROBIAL BTEX DEGRADATION UNDER AEROBIC OR ANOXIC CONDITIONS.
Michigan Univ., Ann Arbor. Medical Center.
R. H. Olsen, J. J. Kukor, and M. D. Mikesell.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 11-14, 4 tab, 9 ref. NIEHS Superfund Research and Education Grant No. ES-04911. EPA Grant R815750-010.

Descriptors: *Aerobic conditions, *Anoxic conditions, *Aquatic bacteria, *Benzenes, *Biodegradation, *Fate of pollutants, *Pseudomonas, *Wastewater treatment, *Water pollution treatment, DNA, Genetic engineering, Microbial degradation, Toluenes, Xylenes.

Bacterial strains were isolated from aquifers contaminated with petroleum products which exhibited degradation of benzene, toluene, ethylbenzene or xylene (B, T, E, or X) under aerobic or anoxic conditions when nitrate is present. These strains showed diversity with regard to the range of substrates degraded as well as the biochemical mechanisms associated with degradation. From one of these strains, a DNA fragment was cloned which enabled a laboratory strain of Pseudomonas aeruginosa to grow on B or T. This recombinant strain and the DNA-source organism both degraded xylenes, but did not grow on xylene suggesting that the substrate range extends beyond that which will support growth and cellular reproduction. (See also W91-03097) (Author's abstract)
W91-03099

REMOVAL OF HEAVY METAL IONS FROM GROUNDWATERS USING AN ALGAL BIOMASS.
Bio-Recovery Systems, Inc., Las Cruces, NM.
For primary bibliographic entry see Field 5G.
W91-03103

BIOLOGICAL CLEANUP OF EXTENSIVE PESTICIDE CONTAMINATION IN SOIL AND GROUNDWATER.
Societe de Chimie Industrielle, Paris (France).
For primary bibliographic entry see Field 5G.
W91-03105

FIELD DEMONSTRATION OF A FORCED AERATION COMPOSTING TREATMENT FOR COAL TAR.
C.A.A. Bioremediation Systems, Boston, MA.
For primary bibliographic entry see Field 5G.
W91-03106

AIR STRIPPING/BIOREMEDIATION OF CHLORINATED HYDROCARBONS AT AN NPL SITE.
ECOVA Corp., Redmond, WA.
For primary bibliographic entry see Field 5G.
W91-03108

FEDERAL REGULATION OF HAZARDOUS WASTE TREATMENT BY GENETICALLY ENGINEERED OR ADAPTED MICROORGANISMS.
Hogan and Hartson, Washington, DC.
E. L. Korwek.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 83-87, 27 ref.

Descriptors: *Biological treatment, *Bioremediation, *Environmental policy, *Genetic engineering, *Genetic pollution, *Hazardous wastes, *Regulations, *Waste treatment, Biodegradation, Toxicity, Water law.

Substantial reporting requirements under the Toxic Substances Control Act (TSCA) are applicable to hazardous waste treatment by genetically engineered or adapted microorganisms as well as by unmodified organisms. Under the 1986 TSCA regulations, organisms would be classified as new on the basis of taxonomic considerations rather than process. Microorganisms formed to contain genetic

material from different genera are considered new except where only well-characterized, non-coding regulatory regions are transferred. In addition the 1986 TSCA regulations require premanufacture notification (PMN) for new microorganisms. To monitor the environmental applications that have the potential to pose significant environmental risks but that are not intergeneric combinations and thus are not subject to PMN review, the 1986 TSCA regulations proposed promulgating Significant New Use Rules requiring Significant New Use Notification (SNUN). SNUN laws require notification of the agency at least 90 days prior to any new non-agricultural use, including hazardous waste treatment, involving environmental release of engineered pathogens. A significant statutory exemption from PMN and SNUN requirements pertains to chemical substances manufactured or processed in small quantities solely for research and development. A new 1989 draft of the 1986 TSCA regulations has the following key principles: (1) contained, commercial research and development uses of any microorganism are not subject to any reporting requirements; (2) all environmental releases of intergeneric organisms are usually either reportable or reviewable; (3) intergeneric, contained microorganisms that are used for commercial applications are subject to reporting; and (4) reporting is potentially required only for commercial releases of altered or naturally occurring organisms. EPA has not yet announced a policy specifically for genetically engineered organisms under the Resource Conservation and Recovery Act. The Comprehensive Environmental Response, Compensation and Liability Act also includes numerous provisions that play a significant role in determining whether biological treatment methods are applied to Superfund sites. (See also W91-03097) (Geiger-PTT)
W91-03110

TREAT NOT A TREATMENT: THE USE OF ENGINEERED BACTERIA TO TURN WASTE INTO FOOD.
Maryland Univ., College Park. Inst. for Philosophy and Public Policy.
M. Sagoff.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 99-107, 24 ref.

Descriptors: *Bioremediation, *Biotechnology, *Ethics, *Genetic engineering, *Public policy, *Waste treatment, Biodegradation, Public opinion, Risk analysis.

The risks posed by novel microorganisms created by genetic engineering for the purposes of bioremediation of hazardous wastes and other biotechnologies are often no greater than the risks posed by naturally occurring mutants. Microorganism created through genetic engineering may pose less of a risk to man and the environment than naturally occurring mutant strains of bacteria because they are usually tested in the laboratory for their toxicity to man and the environment before they are allowed to be used under field conditions. Regulatory review serves to examine the benefits of new genetically engineered materials and gather public opinion on it before its actual use is permitted. Critics of biotechnology often confound evaluations of its uses by introducing ethical and religious objections into their arguments against it. Historically, the pollution of the environment has been viewed as an activity fostered by big corporations which were seen as opposed to the values and rights of the common working populace. However, the integrity of nature and of the global environment represents an issue that now unites in vast political consensus groups and classes in the United States otherwise opposed in interest and ideology. The use of genetically engineered organisms may be made attractive to the public by advertizing the natural or moral function bacteria perform in transforming wastes back into something natural, i.e., food for plants and animals. Public policy analysts have shown that what the public ultimately demands is that American industry act on moral principles rather than on political or economic expediency, even if the actions industry takes are the same. (See also W91-03097) (Geiger-PTT)
W91-03112

BIODEGRADATION OF XENOBIOTICS BY SPECIFIC BACTERIA: RESEARCH AND APPLICATIONS.
Groningen Rijksuniversiteit (Netherlands). Dept. of Biochemistry.
B. Witholt, D. B. Janssen, and S. Keuning.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 109-117, 5 tab, 52 ref.

Descriptors: *Bacteria, *Biodegradation, *Dehalogenation, *Microbial degradation, *Priority pollutants, *Waste treatment, *Wastewater treatment, Biological wastewater treatment, Chlorinated hydrocarbons, Genetic engineering, Oxidation.

Investigations of the enzymology, genetics, and physiology of the bacterial degradation of xenobiotics should contribute significantly to the development of practical biotreatment. The utilization of a given pollutant by an organism which has the necessary genetic information to express relevant enzymes to degrade the pollutant may be limited by local environmental conditions. Genetic engineering experiments may result in addition bacterial stains capable of degrading priority pollutants. A critical step in the microbial metabolism of chlorinated compounds is dehalogenation. Five dehalogenation mechanisms have been observed in aerobic bacteria. Hydrolytic dehalogenation is well documented for the conversion of 2-halocarboxylic acids by bacteria that utilize chloropropionate or chloroacetate for growth. Some dehalogenases have been isolated and produced in synthetic form. Compounds with vinylic halogens, trihalomethanes, and several other highly chlorinated aliphatics may be degraded by oxidative conversion mediated by monooxygenases produced by methanotrophic bacteria. Pollutants that are not presently biodegradable may be recalcitrant due to lack of necessary bacterial enzymes to utilize the pollutant, or accumulation of toxic intermediates which inhibit degrading microorganisms. An important goal of research on the biodegradation of chlorinated hydrocarbons will be to achieve biological removal of chlorinated hydrocarbons by microorganisms that rely on cometabolic conversion. Anaerobic conversions that cause dechlorination have been described for several highly chlorinated compounds, such as carbon tetrachloride, perchloroethylene, and 1,1,1-trichloroethane. These conversions could become very important for removing chlorinated aliphatics at low redox potential in anaerobic subsurface environments. (See also W91-03097) (Geiger-PTT)
W91-03113

GENETIC ENGINEERING APPROACH TO TREATING ORGANOPHOSPHATE WASTES.
Maryland Univ. Baltimore County, Catonsville. Dept. of Chemical and Biochemical Engineering.
G. F. Payne, S. J. Coppella, N. DelaCruz, M. K. Speedie, and B. M. Pogell.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 129-133, 2 fig, 2 tab, 39 ref.

Descriptors: *Biodegradation, *Enzymes, *Genetic engineering, *Organic wastes, *Organophosphorus pesticides, *Wastewater treatment, Fermentation, Hazardous wastes, Hydrolysis, Parathion.

Under certain conditions, toxic wastes may be appropriately treated using enzyme-based processes. Since enzyme-based treatment strategies do not require the release into the environment of viable organisms but only cell-free preparations, it is possible to consider the use of recombinant technologies for enzyme production. A recombinant Streptomyces which produces and excretes an enzyme capable of hydrolyzing organophosphates was developed by genetic engineering. By optimizing and scaling up the fermentation, large quantities of this parathion hydrolase enzyme have been produced. This enzyme is currently being tested for its ability to hydrolyze organophosphate pesticides under real and simulated waste conditions. Initial laboratory results indicated that a crude enzyme preparation obtained from the fermentations was capable of hydrolyzing coumaphos in actual waste liquid. The use of enzymes to treat soil contaminated with organophosphates is also a potential use. (See also W91-03097) (Author's abstract)
W91-03115

BIODEGRADATION OF AN OILY BILGE WASTE USING ALGAE.
GHR Engineering Associates, Inc., Lakeville, MA.
For primary bibliographic entry see Field 5G.
W91-03116

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR CYANIDE WASTES.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5G.
W91-03219

1988 NEEDS SURVEY REPORT TO CONGRESS: ASSESSMENT OF NEEDED PUBLICLY OWNED WASTEWATER TREATMENT FACILITIES IN THE UNITED STATES.
Environmental Protection Agency, Washington, DC. Office of Municipal Pollution Control.
For primary bibliographic entry see Field 6B.
W91-03232

COST AND TECHNOLOGY DOCUMENT ON DRINKING WATER TREATMENT FOR INORGANIC WASTES--WASTE DISPOSAL.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-192363. Price codes: A11 in paper copy, A01 in microfiche. September 1986. 88 fig, 39 tab, 36 ref, 5 append.

Descriptors: *Administrative regulations, *Drinking water, *Sludge disposal, *Waste disposal, *Waste management, *Wastewater treatment, *Water treatment, Brine disposal, Cost analysis, Inorganic compounds, Waste characteristics, Wastewater management, Water quality standards.

The United States Environmental Protection Agency (EPA) is in the process of revising the National Interim Primary Drinking Water Regulations. EPA has identified a number of inorganic, radionuclide, and corrosion-related contaminants for which allowable maximum contaminant levels (MCL) in drinking water may be established. Waste disposal options and associated costs have been evaluated for water treatment processes removing many of these contaminants. Waste by-products generally are divided into two categories: sludges and brines. The most economical disposal method for sludges was discharge to the sanitary sewer followed closely by drying lagoons/beds with land disposal. Direct land application for lime softening sludges also was a lower cost alternative. The most economical disposal method for brines was either direct discharge or sanitary sewer discharge. Another lower cost alternative was evaporation pond dewatering and land disposal. Total costs increased in proportion to system complexity and the required amount of equipment. For both sludges and brines, large systems have low total costs because of economies of scale while total costs for small systems are very high. The optimum waste treatment and disposal alternative will be affected by regulatory constraints (industrial pretreatment requirements for sanitary sewer discharges; the RECRA requirements for hazardous waste disposal) and site-specific conditions (cli-

mate, availability of sanitary sewers or suitable receiving water, cost of land, location of disposal sites). (Fish-PTT)
W91-03233

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR ORGANOPHOSPHORUS WASTES.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5G.
W91-03236

CONTROL TECHNOLOGY ASSESSMENT REPORT FOR AIR EMISSIONS FROM WASTEWATER TREATMENT OPERATIONS.
Research Triangle Inst., Research Triangle Park, NC.
S. Harkins, and A. S. Damle.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-207922. Price codes: A03 in paper copy, A01 in microfiche. Report no. EPA-450/3-89-008, April 1989. 35 p, 1 fig, 5 tab, 6 ref, append. Contract no. 68-02-4397.

Descriptors: *Air pollution control, *Air pollution sources, *Chlorinated hydrocarbons, *Waste management, *Wastewater treatment, Carbon filters, Cost-benefit analysis, Refrigeration, Ventilation, Volatile organic compounds, West Virginia.

The Occidental Chemical Plant at Belle, West Virginia, produces chlorinated solvents (e.g., methylene chloride, carbon tetrachloride, and chloroform). The wastewater treatment operations at this plant result in substantial air emissions with a high concentration of volatile organic compounds (VOCs). Field information gathered in September 1986 and July 1988 was used to estimate the total annual emissions of the VOCs as well as the maximum rate of emissions due to working losses from the wastewater treatment operations. Condensation of organics in a refrigeration system, carbon adsorption and a combination of both techniques were evaluated as possible air emissions control options. Based upon this study, the following conclusions may be drawn for efficient organics removal from wastewater treatment system vent VOC emissions at the plant: (1) connecting the headspaces of storage feedwater tank and decanter tanks will eliminate the source of VOC emissions at the feedwater tank; (2) for any control system to be effective, a forced drive system such as a fan at the downstream of the control system is essential; (3) it is necessary to prevent any unwarranted vapor emissions; (4) the secondary vent condenser is capable of condensing up to 68% by mass of vapors in the feed stream using refrigerated glycol cooling; and (5) a combination of the refrigerated glycol cooled secondary condenser and a subsequent carbon adsorption system will be able to remove almost all of the organics in the emissions at a lower cost than that for a carbon adsorption system alone. (Fish-PTT)
W91-03237

RECOVERY OF METALS USING ALUMINUM DISPLACEMENT.
Circuit Chemistry Corp., Maple Plain, MN.
S. C. Meyers.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-222590. Price codes: A03 in paper copy, A01 in microfiche. Report, June 1988. 27 p, 9 fig, 2 tab, 3 append.

Descriptors: *Ion exchange, *Metal-finishing wastes, *Metals, *Recycling, *Waste management, *Waste recovery, *Wastewater treatment, Aluminum, Copper, Lead, Nickel, Tin, Waste treatment, Wastewater reactors, Water pollution prevention.

The removal of typical metals (copper, lead, tin, nickel) from printed circuit and metal finishing waste streams was evaluated using displacement with aluminum. The metal is recovered as metal particles, is nonhazardous, and can be recycled by smelting. The results of this project indicate that aluminum exchange systems could become a significant choice of waste treatment technology for printed circuit manufacturers. Copper, lead, and tin were removed at 85 percent and higher efficiencies from the majority of printed circuit waste streams using a single pass through the aluminum exchange reactor. A multiple pass system using either recirculation through a single reactor, or exchange reactors in series, with the proper flow rate should produce compliance with regulated discharge standards in many facilities. The low equipment cost and simplicity of operation are positive attributes. The aluminum exchange equipment system must be properly engineered for each unique facility to assure good results. For efficient use of this technology, the waste streams should be segregated into metal-containing and non-metal-containing streams. The amounts of flow in the metal-containing streams should be minimal by the use of rinses. The resulting low volume waste stream with high metal concentrations up to 200 ppm is very suitable for aluminum exchange. The low volume flow provides the retention time required for efficient displacement. Waste streams containing nitrates were not successful. Nickel-containing waste streams produced no displacement on aluminum. (Fish-PTT)
W91-03239

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR K043.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5G.
W91-03241

WATER RECLAMATION: HERE, NOW...AND HOW.
Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. 132p. Edited by Benton C. Price.

Descriptors: *Conservation, *Reclaimed water, *Wastewater treatment, *Water reuse, *Water treatment, Drought, Public policy, Resources management, Waste disposal, Wastewater utilization, Water supply.

Today, California's water supplies, like many others nationwide, are threatened by drought. Without adequate water, public landscapes, golf courses, parks, nurseries, industry and agriculture will suffer dramatic losses. Water reuse started in California in 1889. Raw sewage was used to irrigate and fertilize the vast sand dunes on the western edge of San Francisco. Since 1928 the California State constitution has prohibited waste or unreasonable use of water, encouraging the reuse of water wherever safe and practical. The nation's first water reclamation treatment plant was built in San Francisco in 1932. Prudent water users, whose interests have been rekindled by the drought, are recognizing the value of water reuse and are moving to secure such supplies. By including water reclamation in the overall water supply and management program, water supplies are extended, wastewater disposal costs are reduced, water quality is improved, energy is saved, and user rates are stabilized. The Association of Water Reclamation Agencies' (AWRA) annual Water Reuse Symposium represents a forum in which to hear and discuss current water reuse issues, share project successes, explore political, regulatory and cost issues, tour exemplary facilities, and meet people who move the industry. (See W91-03274 thru W91-03289) (Agostine-PTT)
W91-03273

CONTRA COSTA WATER RECLAMATION PROJECT.
Central Contra Costa County Sanitary District, Martinez, CA.
R. Dolan.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 5-10.

Descriptors: *California, *Reclaimed water, *Wastewater treatment, *Wastewater utilization, *Water reuse, *Water treatment, Drinking water, Legal aspects, Water policy, Water resources institutes, Water resources management.

The Contra Costa Reclamation Project is a joint effort of the Contra Costa Water District and the Central Contra Costa Sanitary District (Central San). The water district serves 36 million gallons per day to about 185,000 people. Agricultural demand is now down to 4 million gallons per day. The reclamation project conceived by the engineers for the two districts was a 17 to 30 million-gallon-per-day, low-nitrogen, low-phosphorus reclaimed water project which would supply reclaimed water to five industries. The Central San plant simply couldn't meet its design intent when it went into operation. While in the process of repairing and completing the plant, a number of other things happened in the water reclamation field. California's Title 22 health regulations came into effect. Basin plan requirements came into being which affected both Central San and industrial customers. The state implemented laws and regulations promoting maximum use of reclaimed water. In 1986, Central San and the water district started Phase I of a multiphase evaluation of the water reclaim projects. It was concluded that the economic feasibility of the reclamation projects had been improved by virtue of the increased cost of drinking water. Two reuse options were identified as technically and economically feasible: industrial cooling and landscape irrigation on the order of 5 million gallons a day. In order to proceed with the industrial project and be prepared to pump reclaimed water that next year, a demonstration project was developed. The 1-million-gallon-per-day demonstration project currently operating, is meeting Title 22; it is filtering, nitrifying to take out ammonia and softening. The results of the engineering study will be available in the Spring of 1989. At that time the water district, the sanitary district and the industries will meet to evaluate the future of the reclamation projects. (See also W91-03273) (Agostine-PTT)
W91-03274

PLANNING FOR WATER RECLAMATION IN SOUTHERN CALIFORNIA.
Irvine Ranch Water District, CA.
For primary bibliographic entry see Field 3D.
W91-03275

WHAT COMMUNITY LEADERS HAVE TO DO TO MAKE RECLAMATION HAPPEN.
San Diego County Water Authority, CA.
For primary bibliographic entry see Field 6E.
W91-03276

REGULATIONS THAT ENCOURAGE RECLAMATION.
For primary bibliographic entry see Field 6E.
W91-03277

STATE LEGISLATURE'S VIEW OF RECLAMATION.
For primary bibliographic entry see Field 6E.
W91-03278

RISK MANAGEMENT.
Environmental Protection Agency, San Francisco, CA. Region IX.
J. C. Wise.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 41-50.

Descriptors: *Reclaimed water, *Risk assessment, *Wastewater treatment, *Water reuse, *Water treatment, Drinking water, Legislation, Public opinion, Toxic wastes, Water resources management.

An important aspect of water reclamation that engineering and marketing pragmatism may not be able to overcome is the fundamental issue of how to gain public acceptance of reclaimed water and public trust in the way that water supplies are managed. Industry professionals know that reclamation operations can be derived from wastewaters, return flows, process waters, and even contaminated groundwaters. Those in the industry worry about such things as pathogens, nutrients, metals and organics. The general public does not concern itself with such technical details. Simply stated the public perception of reclaimed water is 'toxic substances in drinking water'. There is a need to better understand the public fear of toxic substances. Three fundamental features of this fear phenomenon are considered. The first feature is the significance of the word 'toxins'. Public fear of chemicals is a powerful and compelling presence in California. The second feature of the toxic substances issue is the 'community right-to-know'. This was recently enacted into law by Title 3 of the 1986 Superfund Amendments and Reauthorization Act at the federal level. The new regulations pursuant to Proposition 65 in California require warning notices and disclosures. The third feature of this issue is the reality that toxins are everywhere. The public seems to be demanding a risk-free environment, or at least an environment free of involuntary risks. The approach of environmental risk management has some promise in reconciling these public fears. Risk management is a matter of choices, explicitly made, based upon a full consideration of all the facts and all of the values. Choice is another word for control. By involving people and especially local leaders in the risk assessment/risk management process, we are seeking to mitigate fears and to reestablish some measure of control. When people see how these decisions are made and see that they have some control over them, they know when to be afraid and when to calm down. Control, therefore, fights panic. (See also W91-03273) (Agostine-PTT)
W91-03279

SOME THOUGHTS ON SECONDARY EFFLUENT.
California Univ., Davis. Dept. of Civil Engineering.
G. Tchobanoglous.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 51-53.

Descriptors: *Filters, *Reclaimed water, *Secondary wastewater, *Wastewater treatment, *Water reuse, *Water treatment, Physical properties, Sludge, Suspended solids, Turbidity.

Five filters used in wastewater reclamation were studied to determine the performance characteristics. Title 22 requirements were used to evaluate the various filters. The types of filters studied were: (1) a mono-medium pulsed-bed filter, (2) a dual-medium filter, (3) a mono-medium deep-bed filter, (4) a continuous upflow filter, and (5) a pair of traveling-bridge filters. What differentiates these filters is the method that is used for the temporary storage of solids. In the pulsed-bed filter, pulsing is used to accumulate material in the upper layers of the filter. In the dual medium and mono-medium filters the interstices of the sand and anthracite grains are used for solid storage. In the upflow filter continuous backwash is employed. In the traveling bridge, surface management is used with a continuous backwash. The parameters investigated include turbidity, suspended solids, and particle size. With respect to turbidity and suspended solids, it was found that each unit of turbidity corresponds to approximately 2.3 to 2.4 mg/L of suspended solids. This relationship has also been found at other installations with activated sludge. Thus, turbidity can be used as a surrogate measure of suspended solids. If the effluent turbidity is less than about 10 to 12 nephelometric turbidity units (NTU), all of the filters tested will produce an average effluent turbidity of 2 NTU or less without the addition of chemicals. If the effluent turbidity is greater than 10 to 12 NTU, all of the filters tested will require chemical addition to achieve an effluent turbidity of 2 NTU or less. (See also W91-03273) (Agostine-PTT)
W91-03280

COST OF WASTEWATER RECLAMATION.
HYA Consulting Engineers, Arcadia, CA.
For primary bibliographic entry see Field 6C.
W91-03281

FINANCING RECLAMATION PROJECTS.
South Coast Water District, Laguna Beach, CA.
For primary bibliographic entry see Field 6C.
W91-03282

HOW TO GET THE PUBLIC BEHIND WATER RECLAMATION.
Los Angeles County Sanitation District, CA.
For primary bibliographic entry see Field 6B.
W91-03283

WATER QUALITY REQUIREMENTS FOR WATER REUSE.
California Regional Water Quality Control Board, San Diego. San Diego Region.
L. H. Delaney.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 93-98.

Descriptors: *California, *Reclaimed water, *Wastewater treatment, *Water quality, *Water quality standards, *Water reuse, *Water treatment, Coasts, Coliforms, Legal aspects, Legislation, Ocean dumping, Public opinion, Wastewater facilities, Water quality management.

The California health department has a specific set of health related criteria for every type of water use. There is a trend in Region IX in California of dischargers selecting the very highest health criteria, which is the nonrestricted recreational impoundment standard. Key features of this criteria includes a coliform standard of 2.2 most probable number (mpn) per 100 mL, and treatment that requires oxidation, coagulation, clarification, and filtration. There are three current factors driving the move toward water reuse: (1) 301(h) waivers, (2) coastal treatment plant capacity, and (3) drought. The 301(h) waivers would have allowed for reducing the treatment levels for ocean discharge. The demise of the waivers drives the cost of ocean discharge up to at least secondary treatment levels, and therefore, the cost difference between ocean disposal and reclamation is much less. Many coastal treatment plants are operating at or near capacity. There is strong public opposition to the expansion of coastal treatment plants. Finally there is a real water shortage in southern California which will drive the need for water reuse. (See also W91-03273) (Agostine-PTT)
W91-03284

HEALTH CRITERIA FOR WATER REUSE.
California Dept. of Health Services, San Bernardino. Public Water Supply Branch.
D. L. Barich.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 99-105.

Descriptors: *California, *Public health, *Reclaimed water, *Wastewater treatment, *Water quality, *Water quality standards, *Water reuse, *Water treatment, Bacteria, Coagulation, Effluents, Enteroviruses, Filtration, Giardia, Irrigation, Legal aspects, Legislation, Microorganisms, Oxidation process, Pathogens, Primary wastewater treatment, Salmonella, Secondary wastewater treatment, Tertiary wastewater treatment, Viruses, Wastewater disposal, Water quality management.

In 1968 the California State Department of Health Service (DHS) issued the first set of regulations under the title 'Statewide Standards for the Safe Direct Use of Reclaimed Water for Irrigation and Impoundments'. The criteria, found in Title 22 of the California Code of Regulations, have undergone a number of revisions and are currently being reviewed. The criteria define: (1) the reclaimed water quality required for the degree of public exposure; (2) The required degree of treatment for the degree of exposure; and (3) the reliability features required for the assurance of a safe product. Some of the pathogens that can be found in wastewater are Giardia lamblia, salmonella and the enteroviruses that cause intestinal upsets. These disease-causing microorganisms can survive for very long times in soil, water and on vegetables. The criteria are therefore intentionally restrictive to satisfy that portion of the criteria that requires 'assured positive health protection.' The degrees of sewage treatment defined include: (1) primary treatment consisting of sedimentation; (2) secondary treatment consisting of oxidation and disinfection; and (3) tertiary treatment consisting of oxidation, coagulation, clarification, filtration, and disinfection. There are provisions for the development of alternative treatment trains that, after extensive independent evaluation, have proven to be reliably equivalent. Each alternative must be approved by the DHS. Reliability features include alarms to indicate failure of treatment, such as chlorine residual and turbidity alarms; emergency storage or disposal facilities for inadequately treated effluent; and duplicate treatment facilities to prevent bypass of vital treatment steps during repairs and maintenance. (See also W91-03273) (Agostine-PTT)
W91-03285

WATER REUSE PLANS AND ASSISTANCE PROGRAMS.
San Diego County Water Authority, CA.
For primary bibliographic entry see Field 6B.
W91-03286

IRRIGATING SOD FARMS WITH RECLAIMED WATER.
For primary bibliographic entry see Field 3C.
W91-03287

GOLF COURSE IRRIGATION WITH RECLAIMED WATER.
Moulton Niguel Water District, Laguna Niguel, CA.
For primary bibliographic entry see Field 3C.
W91-03288

FREEWAY LANDSCAPE IRRIGATION IN SAN DIEGO COUNTY.
For primary bibliographic entry see Field 3C.
W91-03289

SOLID-PHASE EXTRACTION FOR TOXICITY REDUCTION EVALUATIONS OF INDUSTRIAL WASTEWATER EFFLUENTS.
West Point-Pepperell Research Center, Valley, AL.
M. J. M. Wells, A. J. Rossano, and E. C. Roberts.
Analytica Chimica Acta ACACAM, Vol. 236, No. 1, p 131-139, September 1990. 1 fig, 1 tab, 45 ref.

Descriptors: *Bioassay, *Industrial wastewater, *Separation techniques, *Toxicity, *Wastewater analysis, *Wastewater treatment, *Water analysis, Daphnia, Effluent limitations, Monitoring, Water pollution effects.

The physical, chemical and biological characteristics of industrial and municipal wastewater effluents in the United States are limited in National Pollutant Discharge Elimination System (NPDES) permits. Toxicity reduction evaluations involving fractionation of wastewater effluents, biomonitoring for aquatic toxicity and determinations of specific chemicals are conducted when adverse effects on water quality are detected during routine biomonitoring as required by the NPDES permit. However, certain fractionation techniques are incompatible with subsequent testing for aquatic toxicity. The effect of various schemes for fractionation of wastewater effluent on biomonitoring with

freshwater Cladocerans (Daphnia magna, Daphnia pulex, Ceriodaphnia dubia or Ceriodaphnia reticulata) is reviewed. In both liquid-liquid or solid-phase extraction, the extract is recovered in an organic solvent that may be toxic to the test organisms. another problem experienced during fractionation by liquid-liquid extraction is that the extraction solvent may dissolve in the aqueous portion (i.e., the wastewater). In most of the fractionation schemes, toxicity testing is performed on reconstituted extract. When the fractionation is conducted by frontal chromatography, suspect toxicants are removed from the solution prior to toxicity testing. Additional treatments such as removal of solids, molecular weight/size fractionations, chelation of cations, oxidant reduction and variation of water hardness are also used in toxicity reduction evaluation. (Geiger-PTT)
W91-03291

KINETIC AND ECONOMIC CONSIDERATIONS OF BIOGAS PRODUCTION SYSTEMS.
Bangladesh Agricultural Univ., Mymensingh. Dept. of Farm Power and Machinery.
B. K. Bala, and M. A. Satter.
Biological Wastes BIWAED, Vol. 34, No. 1, p 21-38, 1990. 9 fig, 2 tab, 14 ref.

Descriptors: *Biogas, *Economic aspects, *Kinetics, *Model studies, *Waste treatment, Bangladesh, Cost-benefit analysis, Developing countries, Energy sources, Fermentation, Mathematical models, Volatile solids.

The kinetics and economics of substrate degradation and biogas production are considered through the mass balance on substrate, with either the Contois or Adams-Eckenfelder model. These models were used to design the mathematical models of volatile solids reduction and biogas fermentation. The predictions of both the models were found to be in close agreement with the observed values reported. A computer model based on a system dynamics approach was used to model the economics of biogas production by anaerobic digestion from cattle slurry available from typical rural families in Bangladesh. This model incorporated the Adams-Eckenfelder model to determine the amount of gas production, and a technique previously described to take into account the effects of price, interest, and inflation. The production of biogas from anaerobic digestion of cattle slurry for cooking is not economic in terms of return when compared with the cost of fuel wood. However, assigning values to the treated slurry as a fertilizer, and to pollution hazards, would improve the economics. The annual cost was minimum for 15 days of retention time with a daily loading of the slurry from 2 or 4 cows. However, the cost was least for a 20 day retention time for 6 or 8 cows, the cost is reduced considerably when the number of cows is increased to > 4. Fuel wood is currently being collected mainly from rural forests in Bangladesh and being used at an extremely high rate. Biogas shows a potential in saving fuel wood and reducing ecological imbalances. However, relatively large reductions in the digester cost factor or increases in the price for fuel are required for biogas production to be economic in terms of returns. (Lantz-PTT)
W91-03385

IMPACT OF ANIMAL WASTE LAGOONS ON GROUND-WATER QUALITY.
Delaware Agriculture Experiment Station, Newark.
For primary bibliographic entry see Field 5B.
W91-03386

EFFECTS OF USING VARIOUS TYPES OF CARBONACEOUS SUBSTRATE ON UASB GRANULES AND ON REACTOR PERFORMANCE.
Birmingham Univ. (England). Dept. of Civil Engineering.
J. W. Morgan, J. A. S. Goodwin, D. A. J. Wase, and C. F. Forster.
Biological Wastes BIWAED, Vol. 34, No. 1, p 55-71, 1990. 10 fig, 6 tab, 17 ref.

Descriptors: *Carbon, *Sludge digestion, *Wastewater reactors, *Wastewater treatment, Acetates, Ammonia, Biomass, Butanol, Casein, Comparison studies, Ice cream, Lipids, Nitrogen, Performance evaluation, Sludge treatment, Sucrose.

A set of 10 upflow anaerobic sludge blanket (UA3B) digesters was examined as five pairs--one control and four test pairs--to assess the way in which selected types of carbonaceous substrate affected the performance of the reactors. The carbon sources were sucrose, acetate, casein, butanol and ice cream. The results show that the change of feed caused a deterioration in the performance of all the test digesters. The casein feed caused the greatest impact, with de-amination of the protein producing inhibitory levels of ammoniacal nitrogen. This suggests that the use of unacclimatized sludges, even granular sludges, to treat proteinaceous wastes might give unsatisfactory results. It is, therefore, not unreasonable to suppose that there might be the same type of behavior with any wastewater that produced metabolic products which could cause stress to the biomass. The feed that was based on ice cream produced a low specific gas yield because of the way in which one of its components (thought possibly to be lipid) accumulated on the biomass. Care should, therefore, be taken in applying UASB technology, using unacclimatized granules, to wastewaters containing significant concentrations of lipids or other refractory compounds. (Lantz-PTT)
W91-03387

CITRIC ACID PRODUCTION IN LIQUID WASTE FROM A LEAF-PROTEIN PRODUCTION PLANT: EFFECTS OF SUGAR AND POTASSIUM FERROCYANIDE.
Indian Statistical Inst., Calcutta. Leaf Protein Research Unit.
For primary bibliographic entry see Field 5E.
W91-03388

REMOVAL OF TRACE LEVELS OF AROMATIC AMINES FROM AQUEOUS SOLUTION BY FOAM FLOTATION.
Trevecca Nazarene Coll., Nashville, TN. Dept. of Science and Mathematics.
G. A. Nyssen, J. S. White, P. Bibring, and D. J. Wilson.
Separation Science and Technology SSTEDS, Vol. 25, No. 7/8, p 809-824, June/July 1990. 16 fig, 1 tab, 10 ref.

Descriptors: *Amines, *Aromatic compounds, *Flotation, *Foam separation, *Wastewater treatment, Aminobiphenyl, Aminonaphthalene, Benzidine, Benzylamine, Chemical treatment, Dyes, Hydrogen ion concentration, Pyridine, Sodium dodecylsulfate, Surfactants, Xylidine.

Aromatic amines, including 4-(t-butyl)pyridine, 4-(n-butyl)aniline, benzylamine, 4-aminobiphenyl, 1-, and 2-aminonaphthalene, and 2,6-xylidine, were effectively removed from water by foam flotation with the anionic surfactant sodium dodecylsulfate (SDS). With initial amine concentrations of 10 mg/L or less, residual amine concentrations of < 0.1 mg/L were generally obtained after 10-30 minutes of flotation. The SDS concentration and flotation time are directly related to the amount of amine removed. Amine removal is most efficient at pH values low enough so that the amine is protonated (usually about 3), and at low ionic strength. Alcohols up to 10% by volume do not appreciably affect amine removal. The mechanism of removal is dominated by ion-ion attraction between the surfactant and the protonated amine; there is also apparently some contribution from ion-dipole attraction. Benzidine is not removed effectively; evidently it is insufficiently hydrophobic. Foam flotation appears to be a promising technique for the removal of aromatic amines and other organic bases from wastewater; it may prove adaptable to the treatment of sludges and soils as well. (Author's abstract)
W91-03389

ESTIMATION OF THE BIOCHEMICAL OXYGEN DEMAND FROM POLLUTION PARAMETERS IN A WASTE DISPOSAL SYSTEM FOR DAIRY PROCESSING WASTES.
Louisiana Agricultural Experiment Station, Baton Rouge.
R. H. Gough, S. C. Baick, R. W. Adkinson, and J. J. Ryan.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 6, p 679-685, August 1990. 2 tab, 5 ref.

Descriptors: *Aerated lagoons, *Biochemical oxygen demand, *Food-processing wastes, *Wastewater analysis, *Wastewater lagoons, *Wastewater treatment, Chemical oxygen demand, Dairy industry, Louisiana, Model studies, Pollution index, Regression analysis, Solids, Suspended solids, Wastewater facilities.

Biochemical oxygen demand (BOD) was estimated from other pollution parameters in a diary plant processing wastewater. The wastewater treatment system, located at a Louisiana dairy processing facility, consisted of three mechanically aerated lagoons with earth embankments and side slopes. Wastewater samples were randomly collected in the first and second lagoons and final effluent was obtained from the third lagoon. Samples were analyzed for BOD, chemical oxygen demand (COD), total suspended solids (TSS), and total solids (TS). Stepwise regression analysis was used to derive a prediction model for BOD based upon TSS, TS, and COD. In a comparison of the actual and predicted BOD values for 18 wastewater samples, only one observation fell outside the 95% confidence interval. It is concluded that BOD values could be reliably predicted using the model. The ability to predict BOD from other pollution parameters would enable daily checking of the wastewater treatment system, rather than waiting 5 days for a result. (MacKeen-PTT)
W91-03538

WASTE TREATMENT BY REVERSE OSMOSIS AND MEMBRANE PROCESSES: INDUSTRIAL (NOV 76-OCT 89). CITATIONS FROM THE COMPENDEX DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W91-03568

WASTEWATER AND WATER TREATMENT: ANION EXCHANGE (JAN 77-MAY 89). CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W91-03570

EFFLUENT TREATMENT IN THE PAINT AND COATING INDUSTRY (JAN 80-MAY 89). CITATIONS FROM THE WORLD SURFACE COATINGS ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W91-03571

EFFLUENT TREATMENT IN THE TEXTILE INDUSTRY: DYES (JAN 83-JUN 89). CITATIONS FROM THE WORLD TEXTILE ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W91-03572

ANIMAL WASTE POLLUTION AND ITS CONTROL (JAN 70-JUN 89). CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W91-03573

TOXICITY REDUCTION EVALUATION FOR MUNICIPAL WASTEWATER TREATMENT PLANTS.
Engineering-Science, Fairfax, VA.
J. A. Botts, J. W. Braswell, J. Zyman, W. L. Goodfellow, and S. B. Moore.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-195218/AS. Price codes: AO5 in paper copy, AO1 in microfiche. Report No. EPA/600/2-88/062. April 1989. 77p, 6 fig, 10 tab, 47 ref, 2 append.

Descriptors: *Municipal wastewater, *Toxicity, *Wastewater facilities, *Wastewater treatment, Effluent toxicity, Protocols, Toxicity reduction evaluations.

A generalized protocol for conducting a Toxicity Reduction Evaluation (TRE) at a municipal wastewater treatment plant (WWTP) is presented. This protocol is designed to provide guidance to municipalities in preparing TRE plans, evaluating the information generated during TREs, and developing a technical basis for the selection and implementation of toxicity control methods. A TRE involves an evaluation of the municipal WWTP performance; an identification of the specific toxicants causing effluent toxicity; a review of the pretreatment and local limits programs; a characterization of the nature, variability and sources of toxicity; and the evaluation, selection and implementation of the toxicity control options. Because of the broad scope of this protocol, it is to be expected that site specific considerations may to some extent warrant modifications and tailoring of the protocol approach for a given facility. The protocol has been developed based on current research and experience. TRE methods and procedures will be updated and refined based on the results of ongoing research and case studies. (Author's abstract)
W91-03582

EFFLUENT FEES: POLICY CONSIDERATIONS ON A SOURCE OF REVENUE FOR INFRASTRUCTURE FINANCING.
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5G.
W91-03592

COMPARISON OF FALLING-FILM AND GLASS-TUBE SOLAR PHOTOCATALYTIC REACTORS FOR DESTROYING TOXIC ORGANIC CHEMICALS IN WATER.
Sandia National Labs., Albuquerque, NM. Solar Thermal Collector Technology Div.
For primary bibliographic entry see Field 5F.
W91-03595

DEVELOPMENT AND EVALUATION OF A RUBBER 'DUCK BILL' TIDE GATE.
Freeman (Peter A.) and Associates, Inc., Berlin, MD.
For primary bibliographic entry see Field 8A.
W91-03603

BENEFITS OF TARP TO THE ILLINOIS RIVER.
Illinois State Water Survey Div., Champaign.
K. P. Singh, T. A. Butts, and A. Durgunoglu.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 69-76, 3 fig, 2 tab, 6 ref.

Descriptors: *Chicago, *Combined sewer overflows, *Flow control, *Illinois, *Wastewater treatment, Evaluation, Flood control, Illinois River, Management planning, Rainfall-runoff relationships, Water quality, Water resources management, Water treatment.

The Chicago Tunnel and Reservoir Plan (TARP) was conceived to eliminate combined sewer overflows to the Metropolitan Water Reclamation District of Greater Chicago waterways, by storing the runoff from rainfall in underground tunnels and reservoirs, and then gradually releasing it through the existing wastewater treatment plants. The benefits of TARP have been considered for the project area, which covers about 375 sq miles; however, the propagation of these benefits to the Illinois Waterway downstream of Lockport to its confluence with the Mississippi River has not yet been investigated. A study is in progress to determine the reduction in peak flow and improvement in water quality with TARP Phase 1 (nearing completion) and Phase 2 (which includes reservoirs), and to investigate the propagation of these effects downstream of Lockport to Meredosia. The reduced peak flows and stages will provide some relief from severe flooding, thus reducing flood damages and posing less danger to the levees along the river. Runoff from the urban Chicago area, about 375 sq miles, will be treated at the wastewater plants before it is released to the waterways. This will lead to significant improvement in water quality in the Illinois River. (See also W91-03608) (Author's abstract)
W91-03617

WASTEWATER IRRIGATION IN DEVELOPING COUNTRIES: HEALTH EFFECTS AND TECHNICAL SOLUTIONS.
Hebrew Univ. of Jerusalem (Israel). School of Public Health.
For primary bibliographic entry see Field 3F.
W91-03650

CONDITIONABILITY, FILTERABILITY, SETTLEABILITY AND SOLIDS CONTENT OF SLUDGES 1984 (A COMPENDIUM OF METHODS AND TESTS): METHODS FOR THE EXAMINATION OF WATERS AND ASSOCIATED MATERIALS.
Available from Her Majesty's Stationery Office, Government Bookshops, London, England. 54p, 11 fig, 2 tab, 15 ref.

Descriptors: *Analytical methods, *Data acquisition, *Laboratory methods, *Sludge solids, *Sludge treatment, *Wastewater treatment, Activated sludge process, Chemical treatment, Sludge cake, Sludge conditioning, Sludge thickening, Suspended solids.

Methods are included for the: determination of the total solids content (dry residue at 105 C) and the loss on ignition of dry residue at 550 C of sewage and waterworks sludges and related solids; determination of the suspended solids content of sewage and waterworks sludge and related solids; determination of the filterability of a sludge using the capillary suction time (CST) method; determination of the conditionability of a sewage and waterworks sludge; initiation selection of chemicals for use as settlement aids in the treatment of wastewaters; determination of the thickening characteristics of sludges using a low-speed centrifuge method; determination of the settleability of activated sludge expressed as the stirred specific volume index (SSVI) or stirred sludge density (SSD); and, measurement of the specific resistance to dewatering of a sludge, and the sludge cake compressibility coefficient. (Lantz-PTT)
W91-03662

EQUITY AND EFFICIENCY ASPECTS OF ALTERNATE STORMWATER MANAGEMENT FINANCING SYSTEMS.
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W91-03714

WETLANDS: A FUTURE NONPOINT POLLUTION CONTROL TECHNOLOGY.
Wetlands Research, Inc., Chicago, IL.
For primary bibliographic entry see Field 5G.
W91-03729

WATER QUALITY PERFORMANCE OF A DETENTION BASIN-WETLAND TREATMENT SYSTEM IN AN URBAN AREA.
Metropolitan Council, St. Paul, MN.
For primary bibliographic entry see Field 5G.
W91-03730

5E. Ultimate Disposal Of Wastes

DISCHARGE WATER QUALITY OF PERMITTED WET DETENTION SYSTEMS.
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 5G.
W91-03061

MANAGEMENT ALTERNATIVES FOR CHANNEL A, A FLOOD BYPASS CANAL.
Brown and Caldwell, Tampa, FL.
K. W. Boyer, and P. A. Clark.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 12A-5--12A-17, 3 fig, 3 Tab, 13 ref.

Descriptors: *Bypass channels, *Flood routing, *Florida, *Wastewater disposal, *Water management, *Wetlands, Estuaries, Field tests, Flood control, Surface water, Water quality, Wetland restoration.

Management alternatives for improving water quality in a man-made bypass canal are presented in light of a local utility's plan to increase point source discharges of highly treated domestic wastewater. In 1987, the Florida legislature enacted the Grizzle-Figg bill which presumes discharges of recovered water meeting advanced wastewater treatment (AWT) standards will have minimal impact on selected bays and tributaries located in southwest Florida. As a preferred alternative to discharging to relatively pristine surface waters, local utilities are planning to discharge recovered water to a flood bypass canal. Current operation of the flood control system does not consider water quality in Channel A. Alternatives to improve water quality in Channel A, by augmenting streamflow both upstream and downstream of its salinity barrier are recommended as part of a surface water management program for the Rocky Creek drainage basin. Implementation is recommended to begin with field testing followed by an engineering evaluation using locally accepted water quality models leading to a preliminary design and cost estimate. Selected alternatives should also compliment habitat restoration work in Upper (Old) Tampa Bay. Using recovered water to supplement dry-weather freshwater inflows to estuarine marshes is recommended to simulate groundwater exfiltration spread uniformly along the upland shoreline. A linear drain field, spray irrigation or recharge wells in areas immediately upland of the marsh would supplement groundwater exfiltration to the marsh. (See also W91-03032) (Lantz-PTT)
W91-03077

WATER RESOURCES MANAGEMENT IN A SMALL CENTRAL FLORIDA COMMUNITY: TAVARES, FLORIDA.
Howard, Needles, Tammen, and Bergendoff, Orlando, FL.
For primary bibliographic entry see Field 5G.
W91-03078

FIELD DEMONSTRATION OF A FORCED AERATION COMPOSTING TREATMENT FOR COAL TAR.
C.A.A. Bioremediation Systems, Boston, MA.
For primary bibliographic entry see Field 5G.
W91-03106

FEDERAL REGULATION OF HAZARDOUS WASTE TREATMENT BY GENETICALLY ENGINEERED OR ADAPTED MICROORGANISMS.
Hogan and Hartson, Washington, DC.
For primary bibliographic entry see Field 5D.
W91-03110

TREAT NOT A TREATMENT: THE USE OF ENGINEERED BACTERIA TO TURN WASTE INTO FOOD.
Maryland Univ., College Park. Inst. for Philosophy and Public Policy.
For primary bibliographic entry see Field 5D.
W91-03112

3-D STOCHASTIC DISCRETE FRACTURE NETWORK MODEL FOR SIMULATING FLOW AND TRANSPORT THROUGH FRACTURED MEDIA.
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 2F.
W91-03190

COST AND TECHNOLOGY DOCUMENT ON DRINKING WATER TREATMENT FOR INORGANIC WASTES--WASTE DISPOSAL.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5D.
W91-03233

WASTE MANAGEMENT SCHEMES OF POTASH MINES IN SASKATCHEWAN.
Manitoba Hydro, Winnipeg.
For primary bibliographic entry see Field 5G.
W91-03304

DISPOSAL OF RADIUM FROM DRINKING WATER TREATMENT.
Wisconsin Dept. of Natural Resources, Madison. Public Water Supply Section.
N. Hahn.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 249-267. 12 tab, 14 ref.

Descriptors: *Drinking water, *Radioactive waste disposal, *Radioactive wastes, *Radioisotopes, *Radium, *Waste disposal, *Wastewater facilities, *Water treatment, *Water treatment wastes, Economic aspects, Political aspects, Public health, Regulations, Risks.

Waste containing radium removed by sodium ion exchange water treatment plants (WTP) and wastewater treatment plants (WWTP) is identified as naturally occurring radioactive material (NORM). The disposal of WTP and WWTP solid and liquid wastes containing concentrated amounts of radium is feasible in most cases. Each system will face unique disposal circumstances requiring a case-by-case review by design engineers and regulatory agencies. Because radium removal treatment concentrates the radium, it is important that disposal methods protect human health and the environment. Radium removal processes that create wastes that can be practically disposed of will likely be selected over processes that create more highly radioactive wastes. The impact on NORM waste disposal from the mandated opening of additional low-level radioactive waste disposal facilities in the 1990's remains unclear at this time. Additional research is needed on the concentrations of radionuclides contained in NORM wastes and the environmental impacts on their disposal. State regulatory agencies and water and wastewater utilities need to evaluate the fate of radium through treatment processes and take steps to properly dispose of NORM waste. (See also W91-03366) (Agostine-PTT)
W91-03382

PUBLIC ACCEPTANCE STRATEGIES FOR SLUDGE UTILIZATION.
Charlotte-Mecklenburg Utility Dept., NC.
T. C. Mendenhall.
Biocycle BCYCDK, Vol. 31, No. 10, p 34-37, October 1990.

Descriptors: *Land disposal, *North Carolina, *Public relations, *Sludge disposal, *Sludge utilization, Agriculture, Charlotte, Marketing, Public participation, Wastewater disposal.

Wastewater treatment and drinking water are provided for 400,000 people in Charlotte (North Carolina), Mecklenburg County, and two other adjoining counties by a single utility, the Charlotte-Mecklenburg Utility Department (CMUD). Among the challenges facing CMUD is sewage sludge--what to do with it, how to handle it, and its ultimate disposal. CMUD generates approximately 38 dry tons (or 186 cu yd) daily of anaerobically digested sludge at five wastewater treatment facilities. Previously, CMUD sold its sludge to the general public for a nominal fee. That practice was prohibited by the State of North Carolina in 1983. Local landfilling was the disposal option until the State Division of Health Services halted this practice for the county in 1984. In 1985, CMUD sought cost effective and environmentally safe disposal options for sludge. Land application was chosen since the program could be put into operation in a reasonably short time without capital expense. CMUD quickly learned that the key to a successful program was public acceptance. Managing the program requires constant selling, reselling, and explaining to outsiders, top management, public officials, elected officials, farmers, the farmers' neighbors, and a number of other such affected parties. The first step taken by CMUD was to withdraw its application for sites in a bordering county. The state permitted a few sites in Mecklenburg County, and the district began a very limited land application program in October 1987. This enabled CMUD to establish the safety of the practice. A field demonstration was arranged for officials of the neighboring county. While the majority of the county commissioners were not ready to approve the proposal, they decided it was time to resolve the issue and scheduled an official public hearing in early 1988. When the hearing was held, there was no opposition, and the political representatives voted to accept the program on a 2-year trial basis. To this day CMUD maintains a very active presence in the neighboring county by participating in activities such as 'Agriculture Appreciation Week'. (Lantz-PTT)
W91-03383

PUBLIC HEALTH AND SLUDGE UTILIZATION: PART II.
Agricultural Research Service, Beltsville, MD. Soil-Microbial System Lab.
For primary bibliographic entry see Field 5B.
W91-03384

CITRIC ACID PRODUCTION IN LIQUID WASTE FROM A LEAF-PROTEIN PRODUCTION PLANT: EFFECTS OF SUGAR AND POTASSIUM FERROCYANIDE.
Indian Statistical Inst., Calcutta. Leaf Protein Research Unit.
S. Chanda, S. Chakrabarti, and S. Matai.
Biological Wastes BIWAED, Vol. 34, No. 1, p 77-81, 1990. 4 tab, 14 ref.

Descriptors: *Culture media, *Fermentation, *Industrial wastewater, *Potassium ferrocyanide, *Sugars, *Waste disposal, *Wastewater treatment, *Wastewater utilization, Biochemical oxygen demand, Chemical oxygen demand, Chemical precipitation, Chemical treatment, Molasses, Turnips, Waste treatment, Whey.

The liquid waste from a leaf-protein plant ('whey') has posed serious problems for disposal due to its high COD and BOD values. Because it contains carbohydrates, amino acids, minerals, vitamins and other growth factors, it may be utilized for growth of industrially important microbes. Citric acid production by Aspergillis niger was studied in whey along with the effects of sugar and potassium ferrocyanide (K4Fe(CN)6) additions to the culture medium; it has been reported that K4Fe(CN)6 reduces the inhibitory effects of some metal ions. A turnip medium was found to be better for citric acid production than beet whey. Therefore, turnip whey was further fortified with molasses, and molasses-turnip whey was further treated with K4Fe(CN)6 at different concentrations. The molasses-turnip whey treated with K4Fe(CN)6 (0.06% w/v) gave increased yields. K4Fe(CN)6 may remove (by precipitation) some elements known to interfere with citric acid production; this precipitation favors the production of citric acid in many molasses-supplemented media. From these results, it is evident that utilizing wheys as a production medium for citric acid may solve the disposal problem of wheys on the one hand while, on the other hand, utilization of two biological wastes (molasses and whey) simultaneously, with a mere addition of K4Fe(CN)6, may bring an economical method to the field of industrial fermentation. (Lantz-PTT)
W91-03388

CONTRACTORS, INJECTION WELLS, AND THE TC RULE.
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 5G.
W91-03391

CASE-CONTROL STUDY OF THE IMPACT OF IMPROVED SANITATION ON DIARRHOEA MORBIDITY IN LESOTHO.
Overseas Development Inst., London (England).
D. L. Daniels, S. N. Cousens, L. N. Makoae, and R. G. Feachem.
Bulletin of the World Health Organization BWHOA6, Vol. 68, No. 4, p 455-463, 1990. 1 fig, 5 tab, 17 ref.

Descriptors: *Diarrhea, *Environmental sanitation, *Lesotho, *Morbidity, *Public health, *Sanitation, Comparison studies, Domestic water, Education, Health aspects, Rural Sanitation Pilot Project, Rural areas.

A health impact evaluation of the Rural Sanitation Pilot Project in Mohale's Hoek district, Lesotho, was conducted from October 1987 to September 1988. A clinic-based case control design was used to investigate the impact of improved sanitation on diarrhea morbidity in young children. The results indicate that under-5-year-olds from households with a latrine may experience 24% fewer episodes of diarrhea than such children from households without a latrine. The impact of latrines on diarrhea was greater in those households that used more water, practiced better personal hygiene, and where the mothers had a higher level of education or worked outside the home. In common with studies conducted in Malawi, Philippines, and Sri Lanka, little evidence was found that the relationship between latrine ownership and diarrhea was confounded by socioeconomic status or environmental variables. For a sample of cases and controls, data on exposure status (presence or absence of a latrine) that were collected by interview at the clinics agreed closely with those obtained by observation during a home visit. (Author's abstract)
W91-03475

ACCUMULATION OF METALS AND THEIR TOXICITY IN THE MARINE INTERTIDAL INVERTEBRATES CERASTODERMA EDULE, MACOMA BALTHICA, ARENICOLA MARINA EXPOSED TO PULVERISED FUEL ASH IN MESOCOSMS.
Kema N.V., Arnhem (Netherlands). Dept. of Environmental Research.
For primary bibliographic entry see Field 5C.
W91-03481

AIR PERMEABILITY MEASUREMENTS OF THE UNSATURATED BANDELIER TUFF NEAR LOS ALAMOS, NEW MEXICO.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 2G.
W91-03550

EVALUATION OF THE HYDROGEOLOGIC SYSTEM IN DISPOSAL OF MIXED WASTES.
Argonne National Lab., IL.
Y. P. Chia, Y. C. Yuan, and C. Yu.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-009824. Report No. CONF-890207--23, 1989 11p, 4 fig, 1 tab, 9 ref. DOE Contract W-31-109-ENG-38.

Descriptors: *Geohydrology, *Site selection, *Soil water, *Waste disposal, Groundwater movement, Hydraulic conductivity, Infiltration, Leachates, Leakage, Path of pollutants.

Geohydrologic settings and processes are considered to have a controlling effect on the long-term performance of a multi-layered mixed-waste disposal cell. A conceptual modeling of disposal cells indicated that the hydraulic conductivity of the final cover, compared to that of the liner, plays an equal or more important role in determining both the leakage rate from the unit and the breakthrough time. A low water saturation for the disposal facility or a periodic dry condition at the surface can significantly impede downward water infiltration. Analysis also revealed that the emplacement of a disposal cell may cause the water table to shift upward and possibly saturate part of the disposal cell. Seasonal fluctuation of the water table may then carry leachate away from the waste to the aquifer. Therefore, effective design, construction, and monitoring of a mixed waste disposal cell relies on a comprehensive understandings of infiltration through the land disposal unit and of local hydrogeologic conditions. (Author's abstract)
W91-03594

UPWARD MIGRATION OF UNDERGROUND INJECTION WASTES THROUGH HYDROLOGIC CONDUITS AROUND THE WELLBORE.
Argonne National Lab., IL. Energy and Environmental Systems Div.
Y. Chia, and J. Chiu.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-005839. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-8806169--2, 1988. 23p, 6 fig, 1 tab, 9 ref. DOE Contract W-31-109-ENG-38.

Descriptors: *Groundwater pollution, *Hazardous wastes, *Injection wells, *Path of pollutants, *Waste disposal, *Waste disposal wells, Drilling, Fractures, Human health, Hydrologic conduits, Upward migration.

Underground injection, compared to other waste disposal methods, is believed to have the advantage of isolating wastes in a confined brine aquifer well below the horizon of human activity and underground sources of drinking water (USDWs). Recent estimates indicate that of all hazardous waste disposed, more than 60% was injected underground. While most of injected wastes move laterally in the injection zone, posing a long-term concern to human health and the environment, a small amount can migrate upward to the upper aquifers, causing a greater threat to the quality of USDWs. Vertical migration of injected wastes through improperly abandoned wells and fractures in the confining formations is a well-known cause of contamination in shallow USDWs. In addition, wastes can migrate upward through vertical hydrologic conduits around the well. These conduits include microannuli and channels in the cement sheath resulting from poor well completion practices and the deterioration of cement, and fractures in the disturbed zone due to drilling. Both dual porosity and single porosity models were used to investigate the migration of injected wastes through these hydrologic conduits. The results indicate that regional upward migration through an extensive confining formation is a slow process. Nevertheless, injected wastes can move upward rapidly through microannuli and channels in the cement sheath and spread over a distance in the upper aquifer. The wastes can also migrate rapidly through fractures in the disturbed cement and disturbed zone can be significantly diluted if one or more permeable strata exist between the injection zone and USDWs. It was concluded that a critical assessment of upward contaminant migration through hydrologic conduits around the wellbore is essential to ensure the feasibility of underground injection operations. (Author's abstract)
W91-03606

WATER AND THE ENVIRONMENT: THE IMPLEMENTATION OF EUROPEAN COMMUNITY DIRECTIVES ON POLLUTION CAUSED BY CERTAIN DANGEROUS SUBSTANCES DISCHARGED INTO THE AQUATIC ENVIRONMENT.
Department of the Environment, Cardiff (Wales). Welsh Office.
For primary bibliographic entry see Field 5G.
W91-03661

5F. Water Treatment and Quality Alteration

INFORMATION COLLECTION REQUEST FOR: PROPOSED NATIONAL PRIMARY DRINKING WATER REGULATIONS FOR SYNTHETIC ORGANIC CHEMICALS.
Miller (Wade) Associates, Inc., Arlington, VA.
For primary bibliographic entry see Field 5G.
W91-03019

REGULATORY IMPACT ANALYSIS OF PROPOSED NATIONAL PRIMARY DRINKING WATER FOR SYNTHETIC ORGANIC CHEMICALS.
Miller (Wade) Associates, Inc., Arlington, VA.
For primary bibliographic entry see Field 5G.
W91-03020

REGULATORY IMPACT ANALYSIS: BENEFITS AND COSTS OF PROPOSED NATIONAL PRIMARY DRINKING WATER REGULATIONS FOR INORGANIC CHEMICALS.
Miller (Wade) Associates, Inc., Arlington, VA.
For primary bibliographic entry see Field 5G.
W91-03021

TECHNOLOGIES AND COSTS FOR THE REMOVAL OF SYNTHETIC ORGANIC CHEMICALS FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192504. Price codes: A16 in paper copy, A01 in microfiche. March 1989. 356p, 28 fig, 48 tab, 7 append.

Descriptors: *Potable water, *Synthetic organic compounds, *Water treatment, Activated carbon, Economic aspects, Organic compounds, Water pollution treatment, Water quality.

EPA is establishing maximum contaminant levels (MCLs) for a number of synthetic organic chemicals (SOCs) which might occur in contaminated water supplies. The purpose of the document is to assist EPA in defining 'best available technology' BAT technology for removing SOCs from water supplies. The treatment and compliance methods available to a community searching for the most economical and effective means to comply with the proposed SOC MCLs include: modification of existing treatment systems, installation of new systems, and the use of nontreatment alternatives such as regionalization or alternate raw water sources. The major factors that must be considered in selecting a compliance method include: (1) quality and type of water source; (2) degree of SOC contamination; (3) specific compound(s) present in water source; (4) economies of scale and the economic stability of the community being served; and (5) treatment and waste disposal requirements. This document provides an evaluation of the various treatment methods in use today for the removal of different concentrations of SOCs, and their relative costs. These methods include: activated carbon, aeration, reverse osmosis, oxidation, coagulation, sedimentation, and filtration. The various studies reviewed indicate that all 29 studied SOCs (with the exception of epichlorohydrin) to be regulated under Phase II can be removed by GAC. The economy of the process is dependent on the carbon usage rate. Certain volatile organics and chlorinated aromatics have relatively poor adsorbabilities, which result in higher carbon usage rates. (Lantz-PTT)
W91-03029

INTERBASIN WATER TRANSFERS: A MANAGEMENT APPROACH FOR PHOENIX'S WATER FUTURE.
Montgomery (James M.) Consulting Engineers, Inc., Pasadena, CA.
For primary bibliographic entry see Field 6A.
W91-03085

AIR STRIPPING/BIOREMEDIATION OF CHLORINATED HYDROCARBONS AT AN NPL SITE.
ECOVA Corp., Redmond, WA.
For primary bibliographic entry see Field 5G.
W91-03108

APPLICATION OF OZONE AND BAC TO CONTAMINATED GROUNDWATER.
Missouri Univ.-Rolla. Dept. of Civil Engineering.
L. G. Cocquyt, and P. K. TerKonda.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 75-81, 9 fig, 2 tab, 8 ref.

Descriptors: *Activated carbon, *Biodegradation, *Ozonation, *Phenols, *Water treatment, Bioremediation, Cleanup procedures, Groundwater pollution, Microbial degradation.

Biological activated carbon (BAC) is a viable way to remove organics from contaminated groundwater. The feasibility of applying BAC to groundwaters with phenol was examined using granular activated carbon and BAC with or without preozonation. Without ozonation BAC was found to treat 17 times more numbers of pore volumes (PV) than GAC in the complete removal of phenol from a contaminated groundwater until breakthrough occurred at 12 PV with GAC. BAC with preozonation was shown to process the contaminated groundwater five times longer than GAC with preozonation to effect 100% removal of phenol until breakthrough occurred at 42 PV with GAC. (See also W91-03097) (Author's abstract)
W91-03109

COST AND TECHNOLOGY DOCUMENT ON DRINKING WATER TREATMENT FOR LOW RANGE COSTS: ESTIMATED LOW RANGE COSTS FOR THE REMOVAL OF INORGANICS, RADIONUCLIDES, AND CORROSION RELATED CONTAMINANTS FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-192355. Price codes: A03 in paper copy, A01 in microfiche. January 1987. 46 p, 6 fig, 6 tab.

Descriptors: *Drinking water, *Economic evaluation, *Water quality, *Water treatment, *Water treatment facilities, Computer models, Corrosion, Cost-benefit analysis, Estimated costs, Inorganic compounds, Radioisotopes, Water supply.

Low-range costs were estimated for the removal of inorganics, radionuclides, and corrosion-related contaminants from potable water supplies. Capital and operating costs for all technologies were developed for ground and surface waters, for 12 system size categories ranging in population from 25 to >1,000,000, depending on which water source the contaminant is generally found. For the purpose of developing these costs, small water systems are defined as those with design flow requirements less than 1.0 mgd. Small systems often have large ratios of system design capacity to average daily flow. At the same time, however, they generally satisfy that demand through a combination of treatment capacity and storage capacity. For the large systems (those greater than 1.0 mgd) capital costs are based on plant design capacities, and for all system sizes operating costs are based on average plant flows. For each contaminant, the influent/effluent combinations which were utilized to develop estimated costs are used

to categorize each group of cost tables for each contaminant, along with the percent removal associated with each combination and the removal efficiency of each process. The capital and operating costs for the technologies developed were determined using an updated computer model written for the U.S. Environmental Protection Agency. For all the technologies considered, designs and unit costs should be viewed as preliminary. More complete and detailed designs and cost estimates should be developed based upon pilot-plant testing and site-specific considerations. (Fish-PTT)
W91-03221

DEVELOPING A STATE WELLHEAD PROTECTION PROGRAM: A USER'S GUIDE TO ASSIST STATE AGENCIES UNDER THE SAFE DRINKING WATER ACT.
Environmental Protection Agency, Washington, DC. Office of Ground-Water Protection.
P. Bailey, J. Bendall, V. Pye, A. Barnsdale, and T. Mierzwa.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-173751. Price codes: A03 in paper copy, A01 in microfiche. Report no. EPA 440/6-88-003, July 1988. 44 p, append.

Descriptors: *Drinking water, *Groundwater management, *Legal aspects, *Regulations, *Safe Drinking Water Act, *Water pollution prevention, *Water quality control, *Water supply, Environmental protection, Groundwater pollution, State jurisdiction, Water pollution control.

The 1986 Amendments to the Safe Drinking Water Act (SDWA) established a new Wellhead Protection (WHP) Program to protect groundwaters that supply wells and wellfields that contribute drinking water to public water supply systems. Each state must prepare a WHP program and submit it to EPA by June 19, 1989. A Technical Assistance Document (TAD) has been prepared by EPA to assist states in developing their WHP programs. At a minimum, each state's WHP program must: specify roles and duties of government agencies, delineate the wellhead protection area (WHPA) for each wellhead, identify sources of contaminants within each WHPA, develop management approaches, develop contingency plans, site new wells properly, and ensure public participation. The TAD also provides graphic illustrations that show a range of optional approaches a state might consider in developing the program element; and case study examples that illustrate how a state might address the element in its WHP program. (Fish-PTT)
W91-03222

HETEROTROPHIC PLATE COUNT BACTERIA IN POTABLE WATER MONITORING METHODS AND APPLICATIONS.
Environmental Protection Agency, Cincinnati, OH. Microbiological Treatment Branch.
D. J. Reasoner.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-223697. Price codes: A04 in paper copy, A01 in microfiche. Report no. EPA/600/D-89/072, 1989. 61 p, 1 fig, 3 tab, 73 ref.

Descriptors: *Bacterial analysis, *Drinking water, *Heterotrophic bacteria, *Laboratory methods, *Potable water, *Water analysis, *Water quality, Biofilms, Culturing techniques, Public health, Water treatment.

Measurements of bacterial populations in water have been used since the beginning of sanitary bacteriology, and interest in the interpretation of the results has occupied many researchers over the intervening years. The heterotrophic plate count (HPC), formerly known as the standard plate count, is a useful tool for enumerating bacteria in potable water. Methodology considerations in the selection of the HPC procedure to be used include medium (high or low nutrient), incubation time, incubation temperature, and method (pour plate, spread plate, or membrane filter). Applications of HPC monitoring include evaluation of treatment processes, storage and distribution water quality changes, biofilm development, growth of bacteria on construction materials and microbial corrosion. The application of methods to detect viable but nonculturable organisms in drinking water and the assessment of the importance of these organisms to human health are areas which need to be investigated. (Fish-PTT)
W91-03224

DRINKING WATER HEALTH DOCUMENT ON STYRENE.
Environmental Protection Agency, Cincinnati, OH. Office of Drinking Water.
For primary bibliographic entry see Field 5G.
W91-03230

ECONOMIC IMPACT STUDY OF PROPOSED AMENDMENTS TO ILLINOIS ADMINISTRATIVE CODE 604.203 AND 605.104 OF SUBTITLE F PUBLIC WATER SUPPLIES (TRIHALOMETHANES) R84-12.
Blaser, Zeni and Co., Springfield, IL.
For primary bibliographic entry see Field 6E.
W91-03231

COST AND TECHNOLOGY DOCUMENT ON DRINKING WATER TREATMENT FOR INORGANIC WASTES--WASTE DISPOSAL.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5D.
W91-03233

REGULATORY IMPACT ANALYSIS: BENEFITS AND COSTS OF FINAL SURFACE WATER TREATMENT RULE.
Miller (Wade) Associates, Inc., Arlington, VA.
B. Rourke, and C. Kessler.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-207872. Price codes: A04 in paper copy, A01 in microfiche. 17 February 1989. 71 p, 5 fig, 14 tab. Contract no. 68-03-3514.

Descriptors: *Administrative regulations, *Biological pollution, *Cost-benefit analysis, *Surface water, *Water treatment, Disinfection, Monitoring, Performance evaluation, Potable water, Public health, Turbidity.

The costs and benefits of controlling microbiological contaminants in public water systems using surface water sources have been analyzed using the criteria specified in the final Surface Water Treatment Rule (SWTR). The total national cost of the proposed SWTR consists of six components, as follows: (1) treatment requirements for unfiltered systems; (2) turbidity performance requirements for filtered systems; (3) disinfection performance requirements for filtered systems; (4) treatment requirements for surface-influenced groundwater systems; (5) monitoring requirements; and (6) state regulatory program implementation costs. The incremental cost computed for the final rule ranges from $3.2 to $5.0 billion in capital cost with the annualized cost for capital and O&M equalling $499 to $709 million per year, amortized at a social discount rate of 3 percent. When the 'total' cost of the final rule is computed, the annualized cost is projected to range from $518 to $728 million per year. Microbial contaminants of surface waters are responsible for a number of forms of waterborne disease. When these microorganisms are able to survive the treatment process, waterborne disease may be manifest in two forms: outbreak events and endemic incidence. An important benefit that will accrue from the SWTR requirements is the elimination of waterborne disease outbreaks in surface water systems, and their associated social costs. (Fish-PTT)
W91-03235

WATER RECLAMATION: HERE, NOW...AND HOW.
For primary bibliographic entry see Field 5D.
W91-03273

CONTRA COSTA WATER RECLAMATION PROJECT.
Central Contra Costa County Sanitary District, Martinez, CA.
For primary bibliographic entry see Field 5D.
W91-03274

PLANNING FOR WATER RECLAMATION IN SOUTHERN CALIFORNIA.
Irvine Ranch Water District, CA.
For primary bibliographic entry see Field 3D.
W91-03275

WHAT COMMUNITY LEADERS HAVE TO DO TO MAKE RECLAMATION HAPPEN.
San Diego County Water Authority, CA.
For primary bibliographic entry see Field 6E.
W91-03276

REGULATIONS THAT ENCOURAGE RECLAMATION.
For primary bibliographic entry see Field 6E.
W91-03277

STATE LEGISLATURE'S VIEW OF RECLAMATION.
For primary bibliographic entry see Field 6E.
W91-03278

RISK MANAGEMENT.
Environmental Protection Agency, San Francisco, CA. Region IX.
For primary bibliographic entry see Field 5D.
W91-03279

SOME THOUGHTS ON SECONDARY EFFLUENT.
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-03280

COST OF WASTEWATER RECLAMATION.
HYA Consulting Engineers, Arcadia, CA.
For primary bibliographic entry see Field 6C.
W91-03281

FINANCING RECLAMATION PROJECTS.
South Coast Water District, Laguna Beach, CA.
For primary bibliographic entry see Field 6C.
W91-03282

HOW TO GET THE PUBLIC BEHIND WATER RECLAMATION.
Los Angeles County Sanitation District, CA.
For primary bibliographic entry see Field 6B.
W91-03283

WATER QUALITY REQUIREMENTS FOR WATER REUSE.
California Regional Water Quality Control Board, San Diego. San Diego Region.
For primary bibliographic entry see Field 5D.
W91-03284

HEALTH CRITERIA FOR WATER REUSE.
California Dept. of Health Services, San Bernardino. Public Water Supply Branch.
For primary bibliographic entry see Field 5D.
W91-03285

WATER REUSE PLANS AND ASSISTANCE PROGRAMS.
San Diego County Water Authority, CA.
For primary bibliographic entry see Field 6B.
W91-03286

NUMERICAL MODELING OF PRESSURE-REDUCING VALVES IN WATER DISTRIBUTION NETWORK SYSTEMS.
Lakehead Univ., Thunder Bay (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W91-03305

WATER TREATMENT TECHNOLOGY FOR REMOVAL OF EXCESS FLUORIDE.
National Environmental Engineering Research Inst., Nagpur (India).
W. G. Nawlakhe, and K. R. Bulusu.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 815-828, 4 fig, 3 tab, 3 ref.

Descriptors: *Developing countries, *Drinking water, *Fluoride removal, *Water treatment, Defluoridation, India, Nalgonda Technique, Performance evaluation, Rural areas, Social aspects, Village water supply.

Removal of excess fluoride from drinking water is necessary to prevent fluorosis in those consuming the water. The National Environment Engineering Research Institute (Nagpur, India) has developed an inexpensive and simple technique for defluoridation called the Nalgonda Technique. The technique is easily adapted by villagers and can be used at the domestic or community levels. The defluoridation operations are performed on a fill-and-draw basis or on a continuous operation basis. Domestic defluoridation can be performed in a bucket. A small hand-operated fill-and-draw unit of 200 L capacity for domestic use has been designed that can be easily operated and maintained by villagers. A similar unit has been designed for a population of 200 villagers. A plant for a small community comprises a hopper-bottom cylindrical tank with a depth of 2 m equipped with a hand-operated or power driven stirring mechanism. Notable features include: (1) completion of defluoridation within 2-3 hr; (2) few needed accessories; (3) no need to shelter either the plant or the motor; and (4) semi-skilled labor can perform the operation without supervision. It has been estimated that to scale up this type of system for a population 2000 (water supply need of 80 cu m/day), the annual per capita cost for running the defluoridation system would 27.17 rupees. (See also W91-03311) (Rochester-PTT)
W91-03344

RADON, RADIUM AND URANIUM IN DRINKING WATER.
Lewis Publishers, Inc., Chelsea, Michigan. 1990. 286p. Edited by C. Richard Cothern, and Paul A. Rebers.

Descriptors: *Drinking water, *Radioisotopes, *Radium, *Radon, *Uranium, *Water quality management, *Water treatment, Public health, Risk assessment, Water quality standards.

This volume covers all aspects concerning radionuclides in drinking water. The primary focus is on the naturally occurring radionuclides, primarily radon, radium, and uranium. The specific topic areas covered include occurrence, mechanisms resulting in human exposure, analytical chemistry, health effects, quantitative risk assessment, treatment technology for the removal of radionuclides, waste disposal, economics, policy and some aspects of enforcement. It is written for the regional, state, and local health officials who need to understand the background information involved in complying with the regulations for radionuclides in drinking water. Those involved in all levels of providing public drinking water will find details concerning exposure to radionuclides, the resulting estimated health effects, treatment options, and discussions of the economics and policy consequences of compliance. (See W91-03367 thru W91-03382) (Agostine-PTT)
W91-03366

SCIENTIFIC BACKGROUND FOR THE DEVELOPMENT OF REGULATIONS FOR RADIONUCLIDES IN DRINKING WATER.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5G.
W91-03367

ANALYSIS OF THE HEALTH RISK FROM INGESTED RADON.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5C.
W91-03368

RISK ASSESSMENT AND CONTROL MANAGEMENT OF RADON IN DRINKING WATER.
Oak Ridge Associated Universities, Inc., Washington, DC.
W. A. Mills.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 27-37. 4 tab, 12 ref.

Descriptors: *Drinking water, *Legal aspects, *Radioisotopes, *Radon, *Risk assessment, *Risks, *Water quality management, Cancer, Dose-response relationships, Legislation, Path of pollutants, Political aspects, Probable deaths, Regulations, Safe Drinking Water Act, Water quality standards, Wells.

The role of risk assessment and risk management of radon in drinking water was reviewed. It is noted that risk assessments for the public health consequences of radon in drinking water require information on radon concentration in water, exposure pathways, and dose-response relationships. On the other hand, risk management involves assumptions of risk acceptance and the establishment of governmental policies in accord with society's acceptance of these assumptions. Although risk assessment for radon exposures can be reasonably qualitative, risk management is clearly judgmental. The following conclusions/recommendations were made. (1) The presence of radon in drinking water is estimated to have its greatest health impact on the 18% of the U.S. population served by private wells. (2) Although no direct evidence exists associating radon in water with health problems, the diseases that are associated with radon in drinking water are stomach cancer from ingestion and lung cancer from inhalation of radon decay products released during household use of water. (3) Using a number of questionable assumptions, the total number of cancer deaths per year attributable to radon in water is estimated to be about 5000 as a maximum value, with essentially all cases occurring in the population served by private wells. (4) Promulgating federal regulations to control radon levels in water under the Safe Drinking Water Act seems unwarranted, since private wells would not likely be regulated. (5) Government control programs should be limited to emphasizing an awareness of possible substantially higher than average levels of radon in water in certain geological areas. (See also W91-03366) (Agostine-PTT)
W91-03369

TREATMENT TECHNOLOGY FOR REMOVING RADON FROM DRINKING WATER SUPPLIES.
New Hampshire Univ., Durham. Environmental Research Group.
N. E. Kinner, P. A. Quern, G. S. Schell, C. E. Lessard, and J. A. Clement.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 39-50. 5 fig, 1 tab, 12 ref. U.S. EPA Water Engineering Research Laboratory, New Hampshire Department of Environmental Services, and University of New Hampshire Environmental Research Group Cooperative Agreement CR812602.

Descriptors: *Drinking water, *Radioisotopes, *Radon, *Water treatment, *Water treatment facilities, Aeration, Economic aspects, Field tests, Groundwater, Maximum contaminant levels, Water quality standards.

Radon contamination of drinking water primarily affects individual homeowners and small communities using groundwater supplies. Treatment alternatives must be included as part of the maximum contaminant level (MCL) regulation for radon in drinking water, which is expected to be published by the U.S. EPA in 1991. As a result, hundreds of small communities will need treatment systems operating at greater than 90% removal efficiency. Three types of treatment processes have been used to remove radon from drinking water supplies: granular activated carbon (GAC) adsorption, diffused bubble aeration, and packed tower aeration. The U.S. EPA has sponsored field evaluations of GAC, diffused bubble aeration, and packed tower aeration, as well as several modifications to existing water storage tanks. A synopsis of the results of these field evaluations is presented. It was found that the selection of an appropriate treatment system to remove radon from drinking water depends primarily upon: (1) percent removal, (2) capital and operating and maintenance costs, (3) safety, (4) raw water quality with respect to parameters such as Fe, Mn, bacteria, and organics. The radon removal efficiency of the diffused bubble and packed tower aeration exceeded 99% at A:W ratios of 15:1 and 5:1, respectively; the GAC system averaged 81 plus or minus 7.7%. Capital and operating and maintenance costs for GAC treatment are favorable for point-of-entry and very small community water supplies; aeration systems are favorable for larger community supplies. In small communities where storage tanks exist and a moderate level of radon removal is required, low cost/low technology modifications may be an acceptable treatment alternative. (See also W91-03366) (Agostine-PTT)
W91-03370

RAID ON SANITY: POLICY AND ECONOMIC ANALYSIS OF RADIONUCLIDE REMOVAL FROM DRINKING WATER.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
D. W. Schnare.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 141-157. 1 fig, 7 tab, 3 ref.

Descriptors: *Drinking water, *Economic aspects, *Policy making, *Public relations, *Radon, *Risk assessment, *Water quality standards, *Water treatment, Administrative decisions, Analytical methods, Data interpretation, Marketing, Political aspects, Precision, Public opinion, Public policy, Uncertainty.

An overview of the presentation of summary risk-management data is given. This is the kind of data presented to decision makers when setting drinking-water standards; it is also the basis for public statements, press releases, and news stories. Although risk-management data can be explained, none of it can be confirmed as true. The basic techniques by which the analyst manipulates the data, the decision maker, and, therefore, reality are presented. Advice is given on either exposing the manipulators, thence gaining greater radon sanity, or on improving one's manipulative skills, thus increasing chances of success in one's own 'raid on sanity'. A few rules are given that can be used to distort or focus available data. These rules also underlie analysis of data and the selection of analytical methods. These rules are split into two groups: those dealing with the news media and those dealing directly with data presentation. To get a story onto the evening news or the front page of the newspaper empirically-derived press rules apply. The story should include as many of the following as possible: (1) harm, pain, suffering, or death; (2) big names, (3) big money; (4) sex; and (5) controversy. The second set of rules applies to the frame of reference used in analysis of risk and cost. The common approaches followed are (1) the 'Bounding Box Problem'--the problem of the appropriateness of the boundaries within which risk and cost analysis is done or presented; (2) data comparisons--summary data are generally meaningless unless they are compared with other data familiar to the intended audience; (3) theoretical integrity--there are limits, both practical and logi-

cal, to the use of theoretical constructs since they can be twisted or misused; and (4) accuracy and precision--characterizing uncertainty seems to be a forgotten concept (It is done through precision and accuracy; both are necessary). (See also W91-03366) (Agostine-PTT)
W91-03374

REMOVAL OF URANIUM FROM DRINKING WATER BY CONVENTIONAL TREATMENT METHODS.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
T. J. Sorg.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 173-191. 11 fig, 7 tab, 17 ref.

Descriptors: *Drinking water, *Radioisotopes, *Uranium, *Water quality standards, *Water treatment, Analytical methods, Coagulation, Field tests, Filtration, Groundwater, Ion exchange chromatography, Maximum contaminant levels, Water softening.

The Environmental Protection Agency's (EPA) drinking water regulations currently do not contain a maximum contaminant level (MCL) for uranium. Because uranium has not been regulated, treatment methods have not been extensively investigated nor has full-scale treatment been widely applied to water supplies. With the anticipation that a MCL would likely be established in the future, EPA has sponsored several uranium removal studies during the past 4-5 years. Since uranium can occur in both surface and groundwaters, treatment technologies have been evaluated to handle both types of waters. Conventional treatment technologies have been evaluated on either a laboratory of field-scale level, and a summary of their effectiveness is given. The results indicate that coagulation/filtration, lime softening, anion exchange, and reverse osmosis are capable of removing uranium down to the 1-5 microgram/L range. Although laboratory and pilot plant studies have been conducted to evaluate a variety of treatment methods, few full-scale systems have been built to remove uranium primarily because an uranium regulation has not been formally established. Data from full-scale conventional coagulation/filtration have shown uranium to be effectively removed, but the data are very limited and influent concentrations are generally very low. Several small anion exchange systems have been installed at schools, and these systems are performing very effectively. (See also W91-03366) (Agostine-PTT)
W91-03377

PRICE OF CONFIDENCE: THE RATIONALITY OF RADIUM REMOVAL FROM DRINKING WATER.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. J. Crawford-Brown.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 213-223. 2 fig, 1 tab, 16 ref.

Descriptors: *Drinking water, *Policy making, *Public health, *Radium, *Regulations, *Risk assessment, *Water quality standards, *Water treatment, Confidence limits, Economic aspects, Mathematical studies, Political aspects, Probabilistic process, Probable deaths, Radioisotopes, Rational formula.

An approach to assessing the rationality behind any decision to set a regulatory limit on radium removal is examined. It is assumed that the goal of the Environmental Protection Agency (EPA) is to limit the concentration of radium in water supplies and, therefore limit the average probability of death, P, from the radium to a prescribed limit. The central concept addressed is the regulatory limit which would lower the concentration of radium in a water supply to a level at which the EPA is 90% confident that the actual probability will be P or less. The contention is that any EPA action would fail to be rational (although it may be justified by other means) if some designated confidence was not reached prior to setting a limit. Two competing concepts of rationality are presented. They agree that being rational implies developing a line of reasoning showing why the final action may be expected to bring about the stated goals and they differ only in what is to be meant by the term 'expected'. In the formalist camp of rationality, an action is arrived at rationally if the underlying line of reasoning uses the best available tools. The second camp derives from a tradition of craftsmanship and adequacy of solution. Here it is necessary to show that there is a reasonable belief that an action will bring about the goals. Some idea of sufficiency of evidence must be introduced. Also some measure of confidence must be developed if the action is said to be rational. The approach given for measuring confidence requires that all values of P from zero to unity be examined. In this manner, it is ensured that the sum of all confidences be equal to unity. Little confidence may be placed on any statement asserting that the value of P associated with a regulatory limit X is a single value. Increased confidence is gained when regulatory limits are justified only by statements about intervals. (See also W91-03366) (Agostine-PTT)
W91-03380

REMOVAL OF RADIUM FROM DRINKING WATER.
Houston Univ., TX. Dept. of Civil and Environmental Engineering.
D. A. Clifford.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 225-247. 7 fig, 2 tab, 34 ref.

Descriptors: *Drinking water, *Radioisotopes, *Radium, *Water quality control, *Water treatment, Adsorption, Brackish water, Economic aspects, Filtration, Ion exchange, Radioactive waste disposal, Radioactive wastes, Reverse osmosis, Sludge, Waste disposal, Wastewater, Water quality management, Water softening.

The traditional, proven process for radium removal are sodium ion exchange softening (>95% removal before hardness breakthrough), lime softening (75%-95% removal), and reverse osmosis (>96% removal). The newer, radium-specific column processes include adsorption onto the Dow RSC and BaSO4-impregnated alumina. The most promising new radium-specific treatment process for large-scale use is adsorption onto preformed manganese dioxide followed by multimedia or diatomaceous earth filtration. The disposal of radium-contaminated wastewaters and sludges from processes under consideration will be a major factor in process selection. The processes of choice for municipal water supply treatment to remove radium are sodium ion exchange softening, lime softening, manganese dioxide adsorption-filtration, and selective adsorption onto the Dow RSC or BaSO4-impregnated alumina. Where the water is brackish, reverse osmosis hyperfiltration should also be considered. The radium removal process of choice for whole-house or point-of-entry treatment is sodium ion exchange softening. For point-of-use radium removal, a standard reverse osmosis system including cartridge filtration, activated carbon adsorption, and reverse osmosis hyperfiltration is recommended. Although no cost estimates have been made, the relative costs (excluding waste disposal), from most expensive to least expensive, for radium removal in small community water supplies are reverse osmosis, sodium ion exchange softening, lime soda softening, manganese dioxide adsorption-filtration, and the radium-selective adsorbents. (See also W91-03366) (Agostine-PTT)
W91-03381

DISPOSAL OF RADIUM FROM DRINKING WATER TREATMENT.
Wisconsin Dept. of Natural Resources, Madison. Public Water Supply Section.
For primary bibliographic entry see Field 5E.
W91-03382

INGESTION OF CHLORINATED WATER HAS NO EFFECT UPON INDICATORS OF CARDIOVASCULAR DISEASE IN PIGEONS.
New York Univ. Medical Center, NY. Inst. of Environmental Medicine.
A. Penn, M. Lu, and J. L. Parkes.
Toxicology TXCYAC, Vol. 63, No. 3, p 301-313, September 1990. 1 fig, 3 tab, 34 ref. NIEHS Center Grant 00260; U.S. Environmental Protection Agency Cooperative Agreement CR813465.

Descriptors: *Birds, *Chlorination, *Drinking water, *Human diseases, *Public health, *Toxicology, *Water pollution effects, Animal diseases, Calcium, Diets, Feeds, Lipids, Population exposure, Water quality.

Cardiovascular disease (CVD) accounts for nearly half the deaths, yearly, in the United States. The arterio(athero)sclerotic plaque is the principal lesion of CVD. The White Carneau (WC) pigeon is an animal model that has been employed extensively for studying CVD. Cholesterol (CHOL) feeding aggravates atherosclerosis in WC pigeons >2 years old. In 1986, two reports appeared from a single laboratory claiming a direct effect of drinking chlorinated (Cl) water upon lipid levels and plaque development in young (<1 year) WC pigeons. These are the only reports of such direct effects, to date. Three month's exposure to 2 ppm or 15 ppm Cl in the drinking water resulted in increased circulating CHOL levels in young male WC pigeons fed a normocholesterolemic (NC) diet in which Ca(+2) levels were reduced. In addition, at both Cl concentrations there was a significant increase in plaque size, compared to controls. Pigeons in the 2 ppm group also exhibited elevated low density lipoprotein (LDL) levels after 3 months on the NC diet. These findings, if extrapolated to man, could have considerable public health consequences, since nearly 200 million people in the U.S. drink Cl water. A similar set of studies has been carried out with strikingly different results. The same pigeon suppliers and feed were used as in the 1986 reports, and the same approach was followed. Six-month-old WC pigeons drank water with 2 ppm or 15 ppm Cl (pH 8.5) and ate a NC diet with Ca(+2) reduced to 80% of normal. At both 1 and 3 months, body weight, CHOL, triglyceride, and LDL levels were unaffected by drinking Cl water. There was also no effect of Cl water on plaque size after 3 months. Thus, no evidence was found that drinking chlorinated water has any effect upon circulating lipid levels or upon the development of arteriosclerotic plaques, in this animal model. (Author's abstract)
W91-03502

IMPACT OF INADEQUATE SANITARY CONDITIONS ON HEALTH IN DEVELOPING COUNTRIES.
London School of Hygiene and Tropical Medicine (England). Maternal and Child Epidemiology Unit.
For primary bibliographic entry see Field 5C.
W91-03505

CAN CONTAMINATED AQUIFERS AT SUPERFUND SITES BE REMEDIATED.
Oak Ridge National Lab., TN. Office of Risk Analysis.
C. C. Travis, and C. B. Doty.
Environmental Science and Technology ESTHAG, Vol. 24, No. 10, p 1464-1466, October 1990. 12 ref.

Descriptors: *Aquifer management, *Aquifers, *Groundwater pollution, *Site remediation, *Superfund, Environmental policy, Groundwater, Groundwater management, Groundwater quality, Water policy, Water pollution control.

The prevailing view among environmentalists and Superfund site managers is that aquifers at Superfund sites can be restored through groundwater pumping. In fact, approximately 68% of Superfund Records of Decision select groundwater pumping and treating as the final remedy to achieve aquifer restoration. The fact is, however, that contaminated aquifers cannot be restored through pumping and treating. Leading groundwater scientists have predicted that continuous pumping for as long as 100-200 years may be needed in order to lower concentrations by a factor of 100. In spite of this

observation, aquifer restoration is the remedial objective at approximately 93% of the sites known to involve nonaqueous-phase liquids. Experience shows that pumping and treating for aquifer restoration does not work. Typically, an initial drop in concentrations by a factor of 2-10 is seen, followed by a leveling with no further decline. To meet the challenge of aquifer restoration, policy makers must acknowledge that aquifer restoration is currently technically impossible. A more appropriate groundwater classification system must be developed. Discontinuation of the Applicable or Relevant and Appropriate Requirements as cleanup goals for aquifer restoration, which is unrealistic and misleading, is recommended. Plume containment and contaminant mass reduction should become primary goals and it should be recognized that restoring aquifers to a pristine condition is not always necessary. Efforts should be made to prevent future contamination and to assign a high priority to waste minimization efforts. (Mertz-PTT)
W91-03508

PHOTOCATALYTIC DEGRADATION OF ATRAZINE AND OTHER S-TRIAZINE HERBICIDES.
Parma Univ. (Italy). Ist. di Chimica Fisica Applicata.
W. Pelizzetti, V. Maurino, C. Minero, V. Carlin, and E. Pramauro.
Environmental Science and Technology ESTHAG, Vol. 24, No. 10, p 1559-1565, October 1990. 11 fig, 1 tab, 59 ref. CNR, MPI, Eniricerche, Regione Piemonte, E.S.O. contract DAJA 45-85-C-0023 and EV4V-0068-C(CD).

Descriptors: *Fate of pollutants, *Herbicides, *Photolysis, *Triazine herbicides, *Water treatment, Atrazine, Chromatography, Cyanuric acid, Degradation, Prometon, Prometryn, Simazine, Trietazine, Water purification.

The photocatalytic degradation of s-triazine herbicides (atrazine, simazine, trietazine, prometon, and prometryn) has been investigated by using particulate TiO2 as photocatalyst under simulated solar light. The herbicides are rapidly degraded. Traces of atrazine (at ppb level) are decomposed in very short times to less than 0.1 ppb but full mineralization of the herbicides is not observed. Degradation products have been monitored through liquid, gas, and ion chromatography, and the overall degradation process has been monitored through dissolved and particulate organic carbon measurements. Several intermediates have been identified, and cyanuric acid has been recognized as the final product of the degradation process for all the investigated herbicides. The process has been shown to lead to the formation of 2,4,6-trihydroxy-1,3,5-triazine (cyanuric acid) rather than to the complete mineralization often observed for other classes of substrates. Photocatalytic process have been recently proposed as a viable method for water purification. From the substrates examined the final formation of cyanuric acid, a compound reported to have low toxicity, and the complete mineralization for other classes of substrates are promising. (Mertz-PTT)
W91-03511

TOXICOLOGY AND DRINKING WATER REGULATIONS.
For primary bibliographic entry see Field 5G.
W91-03526

ASSESSING TOXICITY OF DRINKING WATER CONTAMINANTS: AN OVERVIEW.
Vanderbilt Univ., Nashville, TN. Dept. of Biochemistry.
For primary bibliographic entry see Field 5A.
W91-03527

ROLE OF SHORT-TERM TESTS IN EVALUATING HEALTH EFFECTS ASSOCIATED WITH DRINKING WATER.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W91-03528

CANCER RISK ASSESSMENT: IMPORTANCE OF IDENTIFYING MECHANISMS OF ACTION.
Washington State Univ., Pullman. Coll. of Pharmacy.
For primary bibliographic entry see Field 7B.
W91-03529

COMPARATIVE SUBCHRONIC TOXICITY STUDIES OF THREE DISINFECTANTS.
Health Effects Research Lab., Cincinnati, OH.
F. B. Daniel, L. W. Condie, M. Robinson, J. A. Stober, and R. G. York.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 10, p 61-69, October 1990. 7 tab, 39 ref.

Descriptors: *Chlorination, *Chlorine, *Disinfection, *Public health, *Toxicity, *Toxicology, Chlorine dioxide, Drinking water, Halogens, Health effects, Monochloramine.

The principal goal of disinfecting water supplies is the elimination of pathogens that are responsible for waterborne diseases. Chlorination is a successful method for achieving this goal and has been the predominant method of drinking water disinfection in the United States for more than 70 years. There has been concern in recent years about the health effects of trihalomethanes and other by-products formed during chlorination when chlorine reacts with organic material contained in surface water. In separate subchronic toxicity studies, male and female sprague-Dawley rats received various dosages of chlorine, monochloramine, or chlorine dioxide in their drinking water for 90 consecutive days. None of the disinfectants caused premature death at any of the concentrations used. The highest dose of chlorine tested (250 mg/L) was concluded to be a no observable adverse effect level. At 200 mg/L (the lowest observable adverse effect level), monochloramine produced decreased body and organ weights in both sexes and a small decrease in red blood cell count and serum calcium in males. Chlorine dioxide produced dosage-related decreases in body organ weight at concentrations as low as 25 mg/L, but it most significant toxic effects was the induction, at all concentrations, of nasal lesions. These studies establish that the subchronic toxicity of the three disinfectants in rats is chlorine dioxide >> monochloramine > chlorine, when administered in drinking water. (Mertz-PTT)
W91-03530

REMOVING AQUATIC ORGANIC SUBSTANCES BY ANION EXCHANGE RESINS.
CH2M Hill, Santa Ana, CA.
P. L. K. Fu, and J. M. Symons.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 10, p 70-77, October 1990. 12 fig, 7 tab, 13 ref. US EPA, Office of Research and Development grant R-812155-01-0.

Descriptors: *Anion exchange, *Dehalogenation, *Drinking water, *Water treatment, Adsorption, Ion exchange, Organic matter, Resins.

The removal of organic substances from drinking water supplies has become a major concern since trihalomethanes were found in chlorinated drinking water in 1974. The US EPA recommended that water utilities should lower the organic content of their water as much as possible prior to the use of any oxidant as a disinfectant. The anion exchange process is an attractive method for removing aquatic organic substances because the majority of them are acidic (ionic). The mechanisms of removal of aquatic organic substances by anion exchange resins, influence of resin properties and clarification processes on removal, and chromatographic behavior of organic substances in anion exchange columns were verified. Depending on the type of resin and the nature of the organic matter, anion exchange resins removed up to 80% of the dissolved organic matter in natural waters. Except for some nonionic organic matter that passes directly through the ion exchange column, the resin removed organic material in preference to some common anions in natural water. Ion exchange was the dominant resin removal mechanism for all organic fractions. Surface adsorption, however, also contributed to the removal of some organic matter. Resin skeleton and pore structure were interrelated; their impact on the removal of each organic fraction depended on the characteristics of the fraction. Overall, however, resin skeleton, which affects degree of swelling of the resins, was more important than pore structure. Highly swelled resins with acrylic skeletons removed more aquatic organic substances than resins with rigid polystyrenic skeletons. (Mertz-PTT)
W91-03531

ASSESSING OZONATION RESEARCH NEEDS IN WATER TREATMENT.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
P. C. Singer.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 10, p 78-88, October 1990. 120 ref.

Descriptors: *Drinking water, *Ozonation, *Water treatment, Amines, Aromatic compounds, Biocides, Coagulation, Disinfectants, Iron, Manganese, Olefins, Sulfides.

Ozone has been used for drinking water treatment on a municipal scale since 1906. Today, more than 1000 drinking water treatment facilities in Europe employ ozonation as part of their overall treatment train. Interest in ozonation in the United States has increased. Ozone can react with organic contaminants in natural water via two principal pathways. It can react directly, as molecular ozone, through reactions that are highly selective. In general, under the conditions employed in drinking water treatment, activated aromatic compounds, olefins and simple amines would be expected to react quickly with molecular ozone. Alternatively, ozone can react with contaminants via an indirect pathway whereby the free radical species arising from ozone decomposition serve as the oxidizing species. Ozone is an effective oxidant for reduced inorganic species, such as ferrous iron, manganous manganese, and sulfide. It is also a very effective biocide. Its principal limitation as a disinfectant is its instability in water. For this reason, ozone cannot be used as a final disinfectant in the distribution system. There are numerous mechanisms by which ozone can facilitate coagulation. Many raw water quality characteristics and treatment parameters may intervene in the ozonation-coagulation process. The practical oxidation of organic impurities in water by ozone produces material that tends to be more biodegradable than the parent species. Using ozone as a final disinfectant can lead to extensive biological regrowth in the distribution system, an obvious disadvantage of terminal ozonation. However, if ozone is applied to the water prior to its contact with a bed or porous media, biodegradation can take place within the bed, producing a water that is biologically stable. The most serious issue related to the widespread use of ozone for drinking water treatment is the question of by-product formation and health effects. Major research is needed to develop analytical methods to identify by-products of ozonation and to conduct health effects bioassays. (Mertz-PTT)
W91-03532

FATE OF CHLOROTHALONIL IN GROUND WATER IN COMMERCIAL CRANBERRY CULTURE IN THE NEW JERSEY PINE BARRENS.
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W91-03533

USE OF FLYASH AS AN ION EXCHANGER IN WATER FILTRATION STUDIES FOR THE REMOVAL OF HEAVY METALS.
Industrial Toxicology Research Centre, Lucknow (India).
R. K. Sharma, S. Kumar, A. K. De, and P. K. Ray.
Journal of Environmental Science and Health (A)

JESEDU, Vol. 25, No. 6, p 637-651, August 1990. 6 fig, 4 tab, 25 ref.

Descriptors: *Adsorbents, *Drinking water, *Fly ash, *Heavy metals, *Ion exchange, *Water treatment, Adsorption, Chromium, Iron, Lead, Manganese, Sand filters.

Fly ash as an adsorbent was found to be effective for the removal of heavy metals after generation with 2.3% HCl at about pH 6. Iron, lead, manganese and chromium ions were studied for their adsorption efficiency. In the experiments in which metals were tested separately, lead showed a maximum of 93% adsorption. In a mixture iron showed maximum adsorption and for lead adsorption was reduced to 28%. Chromium showed the minimum adsorption of 6.3% when tested individually and 13.03% in a mixture. On the basis of these data, testing of fly ash at the pilot plant level versus the slow sand filtration method for the purification of drinking water is recommended. (Author's abstract)
W91-03535

REMOVAL OF IRON FROM WATER BY COAL FLY ASH.
Industrial Toxicology Research Centre, Lucknow (India).
A. K. De, and M. M. Lal.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 6, p 665-677, August 1990. 3 fig, 4 tab, 10 ref.

Descriptors: *Adsorbents, *Drinking water, *Fly ash, *Iron, *Water treatment, Adsorption, Chromium, Copper, Hydrogen ion concentration, Lead, Manganese, Metals, Natural waters.

The use of coal fly ash, an industrial solid waste, for removal of iron from water was investigated. At concentrations of iron below 3.5 mg/L, 100% of iron was removed with a 6 cm bed depth at pH 3.5. Increasing iron concentrations resulted in decreasing adsorption efficiency of coal fly ash. The optimal pH for iron removal was 4.1, and the adsorption was found to conform to Freundlich's adsorption isotherm. The process was applied to natural water from five sites. More than 80% of the iron was removed in all cases. The treatment also removed Mn, Cu, Cr, and Pb but resulted in increased levels of Mg and Ca. The removal of anions, chemical oxygen demand, and dissolved solids was not significant. It is concluded that coal fly ash is effective for decreasing the concentrations of toxic metals to levels permissible for drinking water. The method is recommended as an economical means of iron removal from polluted water. (MacKeen-PTT)
W91-03537

WASTEWATER AND WATER TREATMENT: ANION EXCHANGE (JAN 77-MAY 89). CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W91-03570

METHODS FOR THE DETERMINATION OF ORGANIC COMPOUNDS IN DRINKING WATER.
Environmental Monitoring Systems Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W91-03580

NUTRIENTS FOR BACTERIAL GROWTH IN DRINKING WATER: BIOASSAY EVALUATION.
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
L. A. Kaplan, and T. L. Bott.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-213995. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/2-89/030, July 1989. 51p, 2 fig, 18 tab, 44 ref. EPA Contract No. CR813135-01-0.

Descriptors: *Bacterial growth, *Bioassay, *Drinking water, *Nutrients, *Pollutant identification, Bacteria, Dissolved organic carbon, Distribution systems, Microbiological studies, Organic carbon, Water quality.

The regrowth of bacteria in drinking water distribution systems can lead to the deterioration of water quality. Pathogenic bacteria are heterotrophs, and heterotrophs are probably the dominant bacteria associated with the regrowth phenomenon. Only a portion of the total organic carbon in drinking water is biologically labile to heterotrophic bacteria, and a bioassay developed to quantify this assimilable organic carbon (AOC) has been proposed as an index of the regrowth potential of drinking water. Both biological and chemical assays have been evaluated for determining AOC as related to regrowth of bacteria in drinking water from surface water and groundwater sources. Pseudomonas fluorescens strain P-17 was used in bioassays for AOC. Dissolved organic carbon (DOC), UV-labile DOC, DOC < 10,000 daltons, monosaccharides, and primary amines were the chemical assays used to predict concentrations of AOC. Growth of P-17 was enumerated as viable and total cells with spread plates and direct epifluorescence microscopy. AOC concentrations in surface waters ranged from 48 to 607 microgm/L and in groundwater supply from 40 to 146 microgm/L. AOC remained relatively constant or declined in distribution systems with distance from the treatment plant. Incubation vessel surface to volume ratio influenced the AOC value by enhancing wall growth of reversibly attached cells. The bioassay assumes that: (1) organic carbon limits growth of the bioassay organism; (2) the yield of the bioassay organism on naturally occurring AOC is constant and equal to yield on model organic compounds; and (3) the bioassay organism is an appropriate surrogate for the native microflora of distribution systems in utilizing AOC. It was found that phosphorus additions to some test waters were required to generate carbon limitation and that yield of P-17 on naturally occurring AOC approximates the yield on acetate. Correlations of the bioassay AOC with chemical determinations were poor, but with improvements that were made in the handling of the test water, glassware, and P-17, it was suggested that the bioassay holds promise for a simple, routine measure of drinking water regrowth potential. (Author's abstract)
W91-03590

COMPARISON OF FALLING-FILM AND GLASS-TUBE SOLAR PHOTOCATALYTIC REACTORS FOR DESTROYING TOXIC ORGANIC CHEMICALS IN WATER.
Sandia National Labs., Albuquerque, NM. Solar Thermal Collector Technology Div.
J. E. Pacheco, and J. T. Holmes.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-010688. Price codes: A03 in paper copy, A01 in microfiche. Report No. SAND--88-2726C, (1989). 13p, 8 fig, 16 ref. DOE Contract DE-AC04-76DP00789.

Descriptors: *Laboratory methods, *Organic compounds, *Photochemistry, *Photolysis, *Wastewater treatment, *Water treatment, Chemical reactions, Comparison studies, Ultraviolet radiation.

Photocatalytic destruction of a model compound has been demonstrated with bench scale and with two engineering scale experiments. For the engineering scale experiments, two solar concentrating hardware systems were used: glass-tube rough system and a falling-film/heliostat. The ultraviolet (UV) power on the reactors of the bench scale, glass-tube/trough and falling film/heliostat systems were 0.15, 1600 and 5200 watts of UV. In the bench scale experiments, the use of hydrogen peroxide as an oxidant with a titanium dioxide catalyst under ultraviolet illumination yielded reaction rates an order of magnitude greater than without the oxidant. The thermal performances of both solar systems are favorable for photocatalytic processes, since mineralization of the contaminant can take place before boiling occurs. The trough/glass tube system was evaluated in clear and partly cloudy weather, and the amount of time to attain the same level of destruction was proportional to the total incident solar energy. With the heliostat falling-film system, experiments were performed at two power levels. The concentration of the model compound was reduced below detectable limits in less than 30 seconds of exposure. Preliminary data indicate initial reaction rates are linear with ultraviolet intensity, though further experimental studies will need to be performed to verify this relation. (Author's abstract)
W91-03595

EFFECTS OF CHLORINE DIOXIDE ON THE DEVELOPING RAT BRAIN.
Health Effects Research Lab., Research Triangle Park, NC. Developmental Toxicology Div.
G. P. Toth, R. E. Long, T. S. Mills, and M. K. Smith.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 31, No. 1, p 29-44, September 1990. 24 ref.

Descriptors: *Chlorine dioxide, *Disinfection, *Toxicology, *Water pollution effects, *Water treatment, Animal physiology, Biochemistry, Laboratory animals.

Chlorine dioxide (ClO_2) is being considered as a drinking water disinfectant since it does not result in the formation of trihalomethanes and does not react with phenol to produce the unpleasant taste of water associated with chlorine treatment. Due to its possible impact on public health, the potential toxicity of ClO_2 and its reduction products, chlorite and chlorate, has been investigated. A study was conducted to characterize the developmental neurotoxic potential of direct ClO_2 exposure and to explore the involvement of the thyroid hormone system in any developmental abnormality. Male and female Long-Evans rat pups, exposed to an oral dose of 14 mg ClO_2/kg/d (postnatal d 1-20), were examined for effects on brain development and for changes in thyroid activity. Body weight reductions were observed on postnatal (pn) d 11, 21, and 35. Forebrain weight and protein content were decreased on pn d 21 and 35, as were the DNA content on d 35 and the number of dendritic spines on cerebral cortical pyramidal cells, a marker for synapse formation. Otherwise, cell proliferation in the forebrain, cerebellum and olfactory bulbs was normal, as were migration and aggregation of neuronal cells in three areas of the cerebral cortex. Histopathology of the forebrain, cerebellum and brainstem showed no gross lesions. (Author's abstract)
W91-03880

ENVIRONMENTAL ASPECTS OF CRYPTOSPORIDIUM SPECIES: A REVIEW.
Scottish Parasite Diagnostic Lab., Glasgow. Dept. of Bacteriology.
H. V. Smith.
Journal of the Royal Society of Medicine JRSMD9, Vol. 83, No. 10, p 629-631, October 1990. 1 tab, 16 ref.

Descriptors: *Drinking water, *Human diseases, *Infection, *Literature review, *Path of pollutants, *Potable water, *Protozoa, *Water pollution effects, Public health, Species composition, Water quality.

In the last decade, Cryptosporidium has been recognized as one of the most common causes of acute self-limiting gastroenteritis caused by a protozoan parasite in immunocompetent people. Infection in the immunocompetent has been described in 26 countries, with a reported prevalence of 0.6-20% in western countries and 4-20% in developing countries. In the last 10 years, the importance of waterborne transmission of cryptosporidiosis has been accepted worldwide. Five outbreaks of waterborne cryptosporidiosis have been documented, and in one an estimated 13,000 persons were affected, indicating the large numbers of consumers at risk of contracting disease from contaminated potable water. In two of the outbreaks, post-treatment

contamination was assumed to be the cause, but two outbreaks have occurred when water treatment works produced final water which met the accepted standards of water quality for that country. Oocysts can gain access into potable water systems by a variety of routes; up to 16,000 mg/L of free chlorine is necessary to reduce the in vitro excystation of human-derived oocysts to zero. Oocysts have been detected in wastewater (range 3.3-20,000/L), surface water receiving agricultural or wastewater discharges (range 0.006-2.5/L), pristine surface water (0.02-0.08/L), drinking water (0.006-4.8/L) and recreational water (0.66-500/L). Detecting oocysts in potable water does not necessarily mean that the consumer is at risk as neither the species nor the viability of such oocysts is known. In order to assess the impact of waterborne oocysts on human cryptosporidiosis, further nationwide studies on their occurrence in raw waters for abstraction and potable waters are being undertaken. In the absence of methods for differentiating between living and dead sporozoites contained within the oocyst, currently each oocyst detected in water is regarded as being viable, and hence potentially infective to man. Therefore, an assay for differentiating a viable from a non-viable oocyst will be of great advantage to the water industry, when assessing the risk of contracting waterborne cryptosporidiosis. (Lantz-PTT)
W91-03881

DETERMINATION OF RADON IN WATER BY ARGON PURGING AND ALPHA COUNTING WITH A PROPORTIONAL COUNTER.
Ecole Polytechnique, Montreal (Quebec).
For primary bibliographic entry see Field 7B.
W91-03888

5G. Water Quality Control

HYDROGEOLOGY AND WATER RESOURCES OF THE LOS OSOS VALLEY GROUNDWATER BASIN, SAN LUIS OBISPO COUNTY.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02971

INFORMATION EXCHANGE ON MODELS AND DATA NEEDS RELATING TO THE IMPACT OF AGRICULTURAL PRACTICES ON WATER QUALITY: WORKSHOP PROCEEDINGS.
Proceedings of the Workshop held February 5-8, 1990, Reston, Virginia. U.S. Geological Survey, Reston, Virginia. 1990. 217p. Cosponsored by: U.S. Geological Survey, Agricultural Research Service, and Soil Conservation Service.

Descriptors: *Agriculture, *Information exchange, *Model studies, *Nonpoint pollution sources, *Water pollution control, *Water resources management, *Workshops, Agricultural chemicals, Databases, Environmental quality, Farming, Geographic information systems, Governmental interrelations, Interagency cooperation, Research priorities, Water quality.

This report documents workshop proceedings, opening with a discussion of the background and objectives of the workshop and recommendations from the steering committee on future continuance of the information exchange. Part I of the report contains summaries of all the presentations made at the workshop, and is divided into several sections. The first includes introductory remarks, an overview of the Water Quality Initiative in the U.S. Department of Agriculture, the Office of Management and Budget's perspective on the Initiative, and perspectives on the impact of agricultural practices on water quality from representatives of the environmental community, the agribusiness sector, a regulatory agency, and the States. The second section includes reports on current interagency research and technical assistance activities. The third section contains a series of presentations on relevant models and the fourth contains a series of presentations on databases, all made for the purpose of promoting their mutual accessibility and appropriate use. Part II includes the results of a pre-workshop solicitation of information on the content and availability of models and databases pertinent to water quality. The workshop was cosponsored by the U.S. Geological Survey, the Agricultural Research Service, and the Soil Conservation Service, and focused on current interagency efforts to conduct research and design technical assistance programs related to the prevention or mitigation of water quality problems in agricultural areas. (See W91-02986 thru W91-03008) (Fish-PTT)
W91-02985

WATER QUALITY INITIATIVE OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.
C. R. Amerman.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 5-8.

Descriptors: *Agricultural chemicals, *Agriculture, *Government supports, *Governmental interrelations, *Nonpoint pollution sources, *Water pollution control, *Water quality control, Databases, Education, Fertilizers, Groundwater pollution, Nitrates, Nitrites, Pesticides, Research priorities.

American agriculture has achieved unprecedented levels of efficiency, due in part to the use of fertilizers and various pesticides. Some of these applied materials have been found to move from their application sites to become contaminants of off-site soils, water, and air. At or above certain concentrations in water, nitrate and nitrite resulting from the use of nitrogen fertilizer and several pesticides and their breakdown products are known or suspected to be harmful to human health. In recognition of the special problems and priorities associated with minimizing contamination of groundwater, the Congress in 1988 directed federal-wide development of an implementation strategy to significantly reduce the risk of agricultural chemical contamination. In response to the Congress' instructions and with an urgency appropriate to declaration of a presidential initiative, the U.S. Department of Agriculture (USDA) developed an implementation strategy in consultation with the Environmental Protection Agency and the National Oceanic and Atmospheric Administration and in close coordination with the U.S. Geological Survey. The central goal of the strategy is prevention of groundwater contamination by agricultural chemicals, and is comprised of three major national thrusts: (1) to deliver the best available knowledge to the farmer and the rancher through education and technical assistance; (2) to conduct an aggressive, high-priority research and development program for developing new crop production technology; and (3) to develop and maintain an agricultural chemical use database for assessing chemical-use trends and determining problems and geographical areas in need of increased program attention and for evaluation of the overall success of the program. Although the immediate emphasis is on groundwater, the program will assure that surface water quality will also be enhanced. (See also W91-02985) (Fish-PTT)
W91-02986

INTER-AGENCY RESEARCH AND TECHNICAL INTEGRATION.
M. R. Burkart.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 11-12.

Descriptors: *Agriculture, *Governmental interrelations, *Interagency cooperation, *Nonpoint pollution sources, *Research priorities, *Water pollution control, *Water pollution sources, *Water quality control, Fate of pollutants, Groundwater pollution, Management planning, Path of pollutants.

During the last few years the U.S. Geological Survey (USGS) has been examining the impact of non-point sources of water contamination, particularly agricultural chemicals. The mid-continental United States was selected as a region where research questions and methods can be examined at several scales. Results will be transferred to other parts of the nation once methods are developed and some fundamental questions regarding fate and transport of agrichemicals are answered. In February 1989 representatives of the USGS, U.S. Department of Agriculture (USDA), Environmental Protection Agency (EPA), and State agricultural and natural resource agencies and institutions met in Iowa City to discuss the integration and coordination of activities to meet both agronomic and hydrologic needs. The products of the meeting included: (1) establishment of a 'technical integration group' (TIG) as a forum to discuss technical needs and plans and coordinate programs and management plans; (2) consensus for a priority of research categories; and (3) nomination of scientists to form research strategy teams to identify specific research priorities. (See also W91-02985) (Fish-PTT)
W91-02987

PROCESS RESEARCH STRATEGY TEAMS.
Geological Survey, Denver, CO. Water Resources Div.
R. W. Healy.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 13-14.

Descriptors: *Agricultural chemicals, *Agriculture, *Herbicides, *Nonpoint pollution sources, *Research priorities, *Water pollution control, Aeration zone, Biodegradation, Environmental effects, Flow models, Path of pollutants, Solute transport, Sorption.

Three process-research strategy teams were formed as part of the Mid-Continent and Midwest Herbicide Initiatives. The goal of each team was to summarize the current state of knowledge in its respective topic area and to identify areas for further research. The teams were comprised of scientists from federal and state agencies, universities, and private industry. The Subsurface Transport Strategy Team identified preferential flowpaths within the unsaturated zone as the most important aspect of subsurface transport. Specific recommendations of this team were to improve methods for identifying and characterizing preferential flowpaths and to improve models of preferential flow and transport. Future research should extend what is known at the small scale up to field and regional scales. The Sorption/Storage Strategy Team identified four subareas into which previous and recommended research could be grouped: environmental assessment, characterization of chemicals, description of sorption and desorption processes, and geologic and environmental characterization of media. The team stressed the importance of studying metabolites, not only in terms of chemical and physical properties, but also in terms of the sorption and desorption processes. The Biodegradation and Transformation Strategy Team noted that little previous work has been performed in this area. Of primary importance was the identification of the mobile and persistent degradation products of agricultural chemicals and the rates of formation of these products. Other important areas which require further research include the effects of transformation, agricultural practices, crops, climate, and other external factors on sorption. (See also W91-02985) (Fish-PTT)
W91-02988

FATE AND TRANSPORT OF AIRBORNE PESTICIDES: AN OVERVIEW OF ATMOSPHERIC MODELLING REQUIREMENTS.
Agricultural Research Service, Beltsville, MD. Environmental Chemistry Lab.
M. S. Majewski.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Prac-

tices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 33-35, 5 ref.

Descriptors: *Agriculture, *Fate of pollutants, *Model studies, *Nonpoint pollution sources, *Path of pollutants, *Pesticides, *Water pollution control, Agricultural chemicals, Air pollution, Analytical techniques, Computer models, Environmental quality, Numerical analysis, Water pollution sources.

The atmosphere has long been recognized as an important repository for pollutants. Predicting a chemical's behavior in the environment through the use of mathematical models offers a more rapid, less expensive alternative to field measurements. However, an understanding of the environmental, as well as chemical, processes is needed for an educated interpretation of these results. Pesticides enter the atmosphere mainly through the agricultural application process. Post-application volatilization from the field also represents a significant input to the lower atmosphere, but over a much longer time period. Transport and distribution of airborne pesticides is dependent upon the planetary boundary layer, which forms over the surface of the earth, into which it is released. There are two basic types of models that can be used to estimate the environmental fate of pesticides: (1) analytical (those that simulate behavior for typical generic situations and generally require less computer time, less data input, and involve mathematical simplifications), and (2) numerical (those that require more site-specific inputs, and can be run on desktop personal computers). One program which integrates a variety of models which assess a pollutant's fate in air, surface water, groundwater, and soil is the Graphical Exposure Modelling System (GEMS) developed by the Environmental Protection Agency. Using these models to predict airborne movement and deposition of organic compounds is only one step in fully understanding the total environmental behavior of these compounds. They will continue to be modified and improved as understanding of the complex environment increases. (See also W91-02985) (Fish-PTT)
W91-02992

SURFACE WATER QUALITY MODELS.
F. O. Thuerer.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 37-38.

Descriptors: *Computer models, *Hydrologic models, *Model studies, *Nonpoint pollution sources, *Surface water data, *Water pollution control, *Water quality management, Computer programs, Data processing, Databases.

Serious computer modeling in the water resources area began in this decade with hydrologic watershed computer models. The single biggest obstacle interfering with interdisciplinary and inter-institutional water quality model and database development is a standard, systematic management approach to modeling. However, information needs to be gathered to collectively formalize model and database development, such as: (1) determination of the difference between verification and validation and an acceptable level of each; (2) whether there is a need for standard validation methods; (3) types of documentation; (4) determination of the difference between models, numerical approximations, and computer programs; (5) whether using structured systems analysis and design with its resulting 'corporate data dictionary' would 'help coordinate model and database efforts'; (6) whether using the business communities software management methods would help interagency model and database development projects; and (7) if there is an advantage to separating computer models into assessment, evaluating and design/construction/maintenance categories. (See also W91-02985) (Fish-PTT)
W91-02993

POLICY ANALYSIS, AGRICULTURE, AND WATER QUALITY.
J. Miranowski.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 45.

Descriptors: *Agriculture, *Economic evaluation, *Farm management, *Nonpoint pollution sources, *Water pollution control, *Water quality control, *Water resources management, Biological studies, Economic aspects, Environmental quality, Farm income, Farms, Model studies.

There has long existed a gap between aggregate policy analysis (particularly socioeconomic analysis) and location-specific physical and biological science research. The former of necessity stresses broad, aggregate issues, such as price and income effects of changes in agricultural policies, regional shifts in production and income, and the consequences of environmental and resource policies. On the other hand, most physical and biological studies are relevant only at a much narrower, micro level. Economists operate on some fairly basic assumptions: farmers are driven by economic information, as revealed by the relative prices of inputs (agricultural chemicals, labor, capital) and outputs. There are four key relationships that need to be understood in order to integrate scientific knowledge on environmental problems of agricultural production with socioeconomic analysis: (1) input/output substitution: how production changes as the level and intensity of input use changes; (2) input/input substitution: the ability of farmers to substitute one input for another in response to changing market conditions or in response to regulatory decisions; (3) output/output substitution: how farmer's choices of which crops to produce are affected by relative prices and the influence of agricultural commodity programs; and (4) input/environmental quality substitution: how changes in input use affect environmental quality. The eventual goal is to build a general response model, which shows how the agricultural sector responds to environmental programs and policies, seeking to understand how water quality is affected by farm policies, and the changes in production they induce from farmers. (See also W91-02985) (Fish-PTT)
W91-02995

ROLE OF ENVIRONMENTAL MODELING IN THE DECISION-MAKING PROCESS.
G. R. Oliver.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 47-50.

Descriptors: *Agricultural chemicals, *Agriculture, *Decision making, *Environmental impact, *Model studies, *Nonpoint pollution sources, *Water pollution control, Conservation, Probability distribution, Risk assessment, Water quality management, Water resources management.

Many regulators, managers, and scientists now utilize environmental models on a regular basis to help make decisions concerning the environmental safety of agricultural chemicals. Their success in employing these models, however, is often limited or sporadic. Accurate and realistic background information is needed to make decisions on the acceptability of a specific use of a particular agricultural chemical. The models currently used can be divided into two broad categories: screening (typically very simplistic, and relying on few inputs) and assessment (requiring more input data, but providing a more situation-specific answer). When performing a modeling assessment or the associated field studies, the amount of effort required to conduct a full assessment is often minimized and instead focuses on only worst-case conditions. The real key to making modeling assessments a truly effective part of the decision-making process will be the incorporation of the probability component. Decision-makers must begin to go beyond initial answers and use models to explore the possibilities for reducing any unacceptable losses through management and conservation practices. Modeling assessments are typically biased towards reporting environmental risk only, and fail to provide the decision-maker with all the information needed. Model developers need to include scientists from other fields such as crop production, entomology, and economics to broaden these models so the decision-makers can view the entire picture. (See also W91-02985) (Fish-PTT)
W91-02996

EPA'S CEEPES PROJECT: DESCRIPTION AND DATA NEEDS.
A. Manale.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 53-55.

Descriptors: *Agricultural chemicals, *Agriculture, *Economic evaluation, *Environmental impact, *Model studies, *Nonpoint pollution sources, *Pesticides, *Water pollution control, Alternative planning, Corn belt, Path of pollutants.

The Office of Policy, Planning, and Evaluation of the Environmental Protection Agency is conducting a research effort to link quantitative economic models with biogeophysical process models. The modeling system, called the Comprehensive Environmental Economic Evaluations System (CEEPES) is designed to predict the multimedia impacts of pesticide (and eventually also nitrogen fertilizer) use and the associated economic benefits. It is to be used to provide broad assessments of policy options relating to agricultural uses of chemicals at a local, regional, and national scale. The configuration of the model system allows damages to occur through multiple media, with the possibility of interregional and intraregional transport from one medium to another. Because according to the medium through which the damage occurs, the system allows for temporal and spatial aggregation. This in turn is linked to the economic benefits derived from agricultural practices in response to alternative policies. The scope of the modeling analysis is the Midwestern Corn Belt. (See also W91-02985) (Fish-PTT)
W91-02997

SOCIO-ECONOMIC DATA RELATING TO THE WATER QUALITY INITIATIVE.
Economic Research Service, Washington, DC. Resources and Technology Div.
S. R. Crutchfield.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 63-65.

Descriptors: *Agriculture, *Data collections, *Databases, *Economic evaluation, *Nonpoint pollution sources, *Water pollution control, *Water quality management, Data storage and retrieval, Farm management, Model studies.

The U.S. Department of Agriculture has access to several types of socioeconomic data that can be used to study the Water Quality Initiative. General data types are primary source data (derived from surveys), secondary source data (derived from external sources), and analytic models which yield useful data for water quality research (primary or secondary source data filtered through Economic Research Service (ERS) modeling or analytic capabilities). Specific types of data available include: financial data, such as prices received as well as farm costs and returns; cropping practices and land use; input use, including pesticides, fertilizers, machinery, and labor; sociological and demographic data; and international and trade data. These data are made available through the internal ERS database (ARIES); publicly available datasets for distribution via electronic media; periodic ERS reports which include statistical or data tables; and ERS reports. The data or surveys specifically relating to water quality that ERS maintains include: Farm Costs and Returns Survey, Objective Yield

Survey, Water Quality Survey, and an agrichemical leaching loss algorithm and associated database. Approximately $1.0 million has been made for the database component of the Water Quality Initiative and currently a pilot cotton survey is underway. Data or analytic capabilities needed by economists include: linkages to geophysical and hydrogeologic databases; filling in the 'Black Box' (fate, transport, and impact of agricultural chemicals); and better understanding of alternatives to traditional agriculture. (See also W91-02985) (Fish-PTT)
W91-02999

DEVELOPMENT OF THE NATIONAL RESOURCES INVENTORY.
Soil Conservation Service, Washington, DC.
For primary bibliographic entry see Field 7C.
W91-03000

SOLID-EARTH SCIENCE DATA BASES.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W91-03001

PESTICIDES IN STREAMS OF THE UPPER MIDWESTERN UNITED STATES.
Geological Survey, Denver, CO.
D. A. Goolsby, and E. M. Thurman.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 89-90, 1 tab, 1 ref.

Descriptors: *Agricultural chemicals, *Herbicides, *Nonpoint pollution sources, *Path of pollutants, *Pollutant identification, *Stream pollution, *Triazine herbicides, *Water pollution control, Distribution, Fate of pollutants, Immunoassay, Midwestern United States.

In 1989, a reconnaissance study was conducted to determine the distribution and concentrations of herbicides in streams in the corn-producing region of the upper midwestern United States. Two specific objectives of this study were to determine the geographic and seasonal distribution of herbicides in streams and to determine the usefulness and limitations of a low-cost, enzyme-based immunoassay analysis for determining triazine-herbicide concentrations on a regional scale. The approach consisted of allocating 150 sampling sites among the 10 states in the study area based on the quantity of corn produced. Each site was sampled three times: (1) prior to application of herbicides (March-April), during the first storm runoff following application of herbicides (May-June), and (3) during the fall (October-November). Several herbicides (atrazine, 90%; desethylatrazine, 51%; metolachlor, 34%; and simazine, 13%) were detected in small concentrations in samples collected prior to application. For samples collected during periods of runoff immediately following application, at least one herbicide was detected in almost every sample (most frequently and in order of occurrence: atrazine-98%, alachlor-86%, desethylatrazine, 86%; metolachlor, 83%; cyanazine, 63%; and simazine, 60%). Immunoassay results from the preapplication and postapplication periods show a good correlation with atrazine results obtained by GC/MS. Results from the third round of sampling are not available at this time. (See also W91-02985) (Fish-PTT)
W91-03002

STATUS UPDATE--NATIONAL PESTICIDE SURVEY.
J. Boland.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 95-97.

Descriptors: *Agricultural chemicals, *Drinking water, *Groundwater pollution, *Nonpoint pollution sources, *Pesticides, *Surveys, *Water pollution control, Analytical techniques, Communication, Public health, Risk assessment.

The National Pesticide Survey (NPS) is a jointly sponsored project of the Environmental Protection Agency's Office of Drinking Water and the Office of Pesticide Programs. After completing a successful pilot study in preparation for the implementation of full survey, sampling began in April 1988. Sampling is scheduled to conclude in February 1990. It is convenient and useful to discuss the NPS by its component parts: design, analytical methods, health advisories, and communications. The design component can be viewed as being composed of two separate surveys in one: community water system wells and domestic well systems were sampled. Five new multi-residue analytic methods and a new analytic method for ethylene thiourea were used. Health advisories contain information on health risks and treatment technologies, and specify levels of chemical concentrations in water that are acceptable for drinking. Effective communications has played a major role in the success of the NPS. As the NPS involved numerous individuals and organizations in the implementation process, so too are many of the same involved in the final report process, scheduled for the first quarter of calendar year 1991. (See also W91-02985) (Fish-PTT)
W91-03004

STATE DATA BASE CAPABILITIES, WISCONSIN.
Wisconsin Univ.-Madison. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W91-03006

STATE OF MINNESOTA DATA BASE CAPABILITIES.
Minnesota Dept. of Agriculture, St. Paul.
For primary bibliographic entry see Field 7C.
W91-03007

STATE DATABASE CAPABILITIES: THE MICHIGAN EXPERIENCE.
Michigan State Univ., East Lansing. Dept. of Resource Development.
For primary bibliographic entry see Field 7C.
W91-03008

WETLANDS AND WASTEWATER MANAGEMENT: QUESTIONS, ANSWERS, ADVICE, AND GUIDANCE.
Environmental Protection Agency, Chicago, IL. Region V.
K. Wernstedt.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-190409. Price codes: A09 in paper copy, A01 in microfiche. February 1988. 173p, 91 ref, 2 append.

Descriptors: *Decision making, *Project planning, *Wastewater management, *Wastewater treatment, *Wetland waste treatment, *Wetlands treatment, Artificial wetlands, Community development, Management planning, Social aspects, Waste disposal, Wastewater disposal.

Focus is placed on the treatment or disposal of wastewater in natural or constructed wetlands both of which may be able to meet some of a community's wastewater disposal and/or treatment needs. The final determination of the appropriateness of a specific discharge to a specific wetland rests on an individual, detailed site assessment. In this document, a number of factors relevant to the assessment are addressed, which include: (1) the initial background assessment of whether wetlands may be appropriate for meeting a community's wastewater management needs; (2) a summary of the regulations which relate to wastewater discharge to wetlands; (3) an assessment of the quality and quantity of wastewater; (4) an analysis of the wetland values in a community and an evaluation of the wetland's ability to tolerate or treat inflows of wastewater; (5) an outline of the possibilities that constructed wetlands may offer; (6) a presentation on the economics of using constructed or natural wetlands to meet treatment or disposal needs; and (7) a discussion of community wastewater management strategies. (Lantz-PTT)
W91-03014

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR WASTES FROM THE PRODUCTION OF DINITROTOLUENE, TOLUENEDIAMINE, AND TOLUENE DIISOCYANATE, K027, K111, K112, K113, K114, K115, K116, U221, AND U223.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
J. E. Labiosa.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-221527. Price codes: A06 in paper copy, A01 in microfiche. Final Report EPA/530-SW-89-0480, May 1989. 92p, 2 fig, 12 tab, 29 ref, 3 append.

Descriptors: *Best demonstrated available technology, *Industrial wastewater, *Toluenes, *Waste treatment, *Wastewater treatment, Dinitrotoluene, Industrial wastes, Organic compounds, Regulations, Standards, Toluenediamine.

The EPA's treatment standards for toluene constituents are provided in this document, although the EPA is not proposing treatment standards for the newly listed related wastes K111 and K112 at this time. This background document presents waste specific information, the number and locations of facilities affected by the land disposal restrictions for K027, K113-K116, U221 and U223 wastes, the waste generating process, characterization data, and the technologies used to treat the waste or similar wastes. Also explained is the determination of the best demonstrated available technology (BDAT), the selection of constituents to be regulated, and the method used to calculate treatment standards. (Lantz-PTT)
W91-03015

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR WASTES FROM THE PRODUCTION OF CHLORINATED ALIPHATIC HYDROCARBONS F024.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
J. R. Berlow, and J. Vorbach.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-221501. Price codes: A03 in paper copy, A01 in microfiche. Final Report EPA/530-SW-89-048M, May 1989. 122p, 1 fig, 20 tab, 37 ref, 3 append.

Descriptors: *Aliphatic hydrocarbons, *Best demonstrated available technology, *Chlorinated hydrocarbons, *Industrial wastewater, *Wastewater treatment, Dioxins, Furans, Industrial wastes, Metals, Organic carbon, Organic compounds, Standards, Suspended solids.

The EPA is regulating 9 organic constituents and 5 dioxins and furans in F024 nonwastewaters and 9 organic constituents, 2 metal constituents, and 5 dioxins and furans in F024 wastewaters. Treatment standards are being reserved for metal constituents in F024 nonwastewaters. Wastewaters for F024 are defined as wastes containing less than 1% (weight basis) total suspended solids and less than 1% total organic carbon (TOC). Wastes not meeting this definition are classified as nonwastewaters and must comply with nonwastewater treatment standards. Recently, analysis of toxicity characteristic leaching procedure (TCLP) extracts obtained from the stabilization of F024 incinerator ash residues were completed, showing a substantial reduction of metals in TCLP extracts following stabilization. The BDAT treatment standards for dioxin and furan constituents in both F024 nonwastewater and wastewater are set at the analytical detection limit that can be routinely achieved for these constituents, consistent with the dioxins rule promulgated by the EPA. Tables included list specific BDAT treatment standards for F024 and total concentration of organic and metal constituents in F024 wastewaters. (Lantz-PTT)
W91-03016

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR PHTHALATE WASTES.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
R. April, and L. Rosengrant.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-221451. Price codes: A04 in paper copy, A01 in microfiche. EPA Report EPA/530-SW-89-048H, June 1989. 51 p, 2 fig, 11 tab, 13 ref.

Descriptors: *Best demonstrated available technology, *Industrial wastes, *Industrial wastewater, *Pthalates, *Standards, *Wastewater treatment, Organic compounds, Regulations.

This background document provides the US EPA's technical support for selecting and developing treatment standards for the constituents to be regulated in phthalate wastes. Sections 2 through 7 present waste-specific information for the K023, K093, and K094 wastes. Section two presents the number and location of facilities affected by the land disposal restrictions, the waste generating process, and the waste characterization data. Section three presents the technologies used to treat the wastes (or similar wastes). Section 4 presents the available performance data, including data on which the treatment standards are based. Section 5 explains EPA's determination of BDAT, while section 6 discusses the selection of constituents to be regulated. Treatment standards are determined in section 7. Section 8 presents a discussion of the development of treatment standards for those phthalate wastes designated as U wastes (U028, U069, U088, U102, U107, and U190). Six facilities produce phthalic anhydride. The EPA is proposing to regulate one organic constituent in both nonwastewater and wastewater forms of K023, K093, and K094 wastes. (Lantz-PTT)
W91-03017

FINAL, BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR K011, K013, AND K014.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
R. April, and M. Chatman-McEaddy.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-221477. Price codes: A06 in paper copy, A01 in microfiche. Final Report EPA/530-SW-89-048J, June 1989. 104p, 1 fig, 13 tab, 20 ref, 3 append.

Descriptors: *Acrylonitriles, *Best demonstrated available technology, *Industrial wastewater, *Standards, *Wastewater treatment, Cyanide, Incineration, Industrial wastes, Organic compounds, Regulations.

This background document presents the US EPA's technical support for selecting and developing the treatment standards for the constituents to be regulated in acrylonitrile wastewaters. Information is included that is relevant to acrylonitrile wastewaters. Section 2 presents waste-specific information: the number and location of facilities affected by the land disposal restrictions, the waste generating process, and waste characterization data. The technologies used to treat the waste (or similar wastes) are discussed in Section 3. All available performance data, including data on which the treatment standards are based, are presented in Section 4. Section 5 explains EPA's determinations of best demonstrated available technology (BDAT), and Section 6 discusses the selection of constituents to be regulated. The treatment standards are determined in Section 7. The EPA would like to emphasize that it has evaluated all available data in developing the BDAT treatment standards for K011/K013/K014 nonwastewaters. The agency has information indicating that generators of the K013, and K014 listed wastes currently mix them together before treatment and disposal. Consequently, The EPA has developed treatment standards for these wastes as K011/K013/K014 mixed nonwastewaters. The acrylonitrile wastes contain cyanide and BDAT list organic constituents. Rotary kiln incineration was determined to be the BDAT for both the organics and cyanides in the K011/K013/K014 nonwastewaters. Four organic constituents and cyanide in nonwastewater forms of the acrylonitrile wastes are regulated. For BDAT list organics and cyanide, the treatment standards reflect total waste concentration. Testing procedures for all sample analyses performed for the regulated constituents are specifically identified in the appendix. (Lantz-PTT)
W91-03018

INFORMATION COLLECTION REQUEST FOR: PROPOSED NATIONAL PRIMARY DRINKING WATER REGULATIONS FOR SYNTHETIC ORGANIC CHEMICALS.
Miller (Wade) Associates, Inc., Arlington, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192421. Price codes: A03 in paper copy, A01 in microfiche. April 1989. 28p, 4 exhibits.

Descriptors: *Drinking water, *Regulations, *Synthetic organic compounds, *Water quality, Herbicides, Lindane, Methoxychlor, Monitoring, Organic compounds, Pesticides, Silvex, Toxaphenes.

Synthetic organic chemicals (SOC) are used in the manufacture of a wide variety of industrial and agricultural products. Concern for the industrial use of solvents is focused primarily on the contamination of groundwater from improper disposal. Currently, National Interim Primary Drinking Water Regulations (NIPDWRs) are in effect for five of the SOCs: lindane, methoxychlor, 2,4-D, 2,4,5-TO (silvex), and toxaphene. Compliance monitoring requirements are proposed by EPA for 30 organic compounds, including 10 solvents, 17 pesticides or herbicides, and 3 miscellaneous chemicals: acrylamide, epichlorohydrin, and polychlorinated biphenyls (PCBs). In developing the proposed information collection requirements, the EPA divided the SOCs into two categories: (1) industrial solvents, and (2) pesticides, herbicides and miscellaneous compounds. The EPA is proposing monitoring requirements, but not standards, for other organic chemical contaminants under this rulemaking which would require the collection of information by public water systems, states and the EPA. Information collection requirements include monitoring, reporting and record keeping activities which are presented in this document. (Lantz-PTT)
W91-03019

REGULATORY IMPACT ANALYSIS OF PROPOSED NATIONAL PRIMARY DRINKING WATER FOR SYNTHETIC ORGANIC CHEMICALS.
Miller (Wade) Associates, Inc., Arlington, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192405. Price codes: A06 in paper copy, A01 in microfiche. April 1989. 108p, 28 exhibits.

Descriptors: *Cost-benefit analysis, *Drinking water, *Regulations, *Synthetic organic compounds, *Water quality, Economic aspects, National Primary Drinking Water Regulations.

National Primary Drinking Water Regulations are proposed for 30 synthetic organic chemicals, termed SOCs. This document presents an analysis of the projected national costs and benefits associated with the proposed regulations in compliance with Executive Order 12291. It also includes an analysis of cost impacts on small water systems in compliance with the Regulatory Flexibility Act. An analysis of occurrence indicates that 30 synthetic organic chemicals (SOCs) fall into three groups or levels which correspond to low, medium, and high 'potential' for groundwater contamination. For a group of 3 miscellaneous contaminants (acrylamide, epichlorohydrin, and PCBs), it was not possible to estimate occurrence due to a lack of data. Total national costs and benefits for all 3 are not anticipated to be very significant. (Author's abstract)
W91-03020

REGULATORY IMPACT ANALYSIS: BENEFITS AND COSTS OF PROPOSED NATIONAL PRIMARY DRINKING WATER REGULATIONS FOR INORGANIC CHEMICALS.
Miller (Wade) Associates, Inc., Arlington, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-192397. Price codes: A06 in paper copy, A01 in microfiche. March 1989. 122p, 34 exhibits.

Descriptors: *Cost-benefit analysis, *Drinking water, *Inorganic compounds, *Regulations, *Water quality, Costs, Economic aspects, Maximum contaminant level, Potable water.

The costs and benefits of controlling inorganic chemical contaminants (IOCs) in drinking water through the promulgation of regulations for maximum contaminant level goals (MCLGs) and maximum contaminant levels (MCLs) were analyzed. A regulatory impact analysis (RIA) was prepared in accordance with Executive Order 12291 which requires that the costs and benefits of all major rules be examined and compared. The major topical areas covered in this RIA are as follows: problem definition; market imperfections, the need for federal regulation, and consideration of regulatory alternatives; assessment of total costs; assessment of benefits; regulatory flexibility and paperwork reduction analyses; and summary of costs and benefits. (Author's abstract)
W91-03021

ECONOMIC ANALYSIS OF PROPOSED AMENDMENTS TO WATER POLLUTION REGULATIONS PHOSPHORUS DISCHARGES R87-6.
Blaser, Zeni and Co., Springfield, IL.
W. L. Blaser, W. R. Rickert, J. L. Carlson, and D. B. Huggins.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-152698. Price codes: A09 in paper copy, A01 in microfiche. Report No. ILENR/RE-EA-8/03, January 1989. 192p, 13 tab, 52 ref. Illinois Department of Energy and Natural Resources Contract EA 59.

Descriptors: *Economic aspects, *Phosphorus, *Regulations, *Water pollution control, Cost-benefit analysis, Costs, Crab Orchard Lake, Illinois, Lake Carlyle, Lake Charleston, Lake Decatur, Lake Shelbyville, Pistakee Lake, Standards, State jurisdiction, Water quality, Water quality control.

An analysis of proposed Illinois statewide regulations to exempt 21 point sources from the requirement to limit total phosphorus in their effluent to 1.0 mg/L is provided. The proposed regulations would provide exemptions to point sources which are more than 25 miles from an impoundment which may have a population equivalent of more than 1500 and less than 2500 or which are tributary to Lake Decatur. Phosphorus is considered to be the limiting nutrient which usually determines the amount of algae, phytoplankton, and macrophytes that grow in bodies of water. Six lakes with treatment plants which would be affected by the proposed regulation are: Crab Orchard Lake, Lake Decatur, Pistakee Lake, Lake Charleston, Lake Shelbyville and Lake Carlyle. Adoption of the proposed exemption would result in increased loadings of phosphorus at each of these lakes. The percentage increases range from 0.4% to 19.4%. The study concludes that the increase in phosphorus loadings at all but Lake Shelbyville would have no measurable effect on aquatic biology. A decline in recreational activity at Lake Shelbyville may have an adverse effect on the local economy. Indications are: (1) that adoption of the proposed regulation would result in benefits exceeding costs for five of the six affected lakes; and (2) that the costs of adoption may be expected to outweigh the benefits for the sixth, Lake Shelbyville. (Lantz-PTT)
W91-03022

ECONOMIC ANALYSIS OF PROPOSED SITE SPECIFIC CHANGES TO WATER QUALITY REGULATIONS AFFECTING BORDEN CHEMICAL COMPANY.
Booker Associates, Inc., St. Louis, MO.
R. B. Pershall, and W. E. Eliot.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-163000.

Price codes: A06 in paper copy, A01 in microfiche. Report No. ILENR/RE-EA-89/07, January 1989. 119p, 7 fig, 12 tab, 25 ref, 3 append.

*Water quality, *Regulations, *Economic aspects, *Industrial wastewater, Dissolved solids, Chlorides, Cost-benefit analysis, Water pollution control, Reverse osmosis, Electrodialysis, Landfills, Injection wells.

Direct and indirect benefits and costs associated with reducing Borden's total dissolved solids (TDS) and cloride discharge concentrations are investigated. Six compliance alternatives involving various combinations of add-on wastewater controls and disposal of the collected waste product were analyzed with regard to feasibility and cost. Environmental threshold levels for TDS and chlorides were determined and used to develop benefits resulting from reduced pollutant concentrations. Modeling indicates that these concentrations would have to be reduced by about 28% to avert water quality violations. The least expensive of the alternatives (reverse osmosis with deep well injection) would probably increase expenditures for environmental controls at the plant from the current level of about $34.2 million to about $35.1 million (net present value of 30 year stream of costs), an increase of 3%. The study found that relatively small monetary benefits could be associated with reduced TDS and Cl discarges to the unnamed tributary because: (1) the improvement in water quality would occur in relatively confined waters whose primary use is as a conduit for industrial discharge and agricultural runoff; (2) other uses of the tributary and its waters are limited; and (3) groundwater users in the vicinity are not in close proximity to the tributary. Direct benefits were assessed under six categories, none of which is affected by choice of compliance alternative. Aggregate (30 year present value) benefits to recreation, aquatic life, health residential water supply, agriculture and aesthetics were estimated to fall in a range of about $42,000 to $125,000. (Lantz-PTT).
W91-03023

40 CFR 265 INTERIM STATUS INDICATOR-EVALUATION GROUND-WATER MONITORING PLAN FOR THE 216-B-63 TRENCH.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 7A.
W91-03024

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT): BACKGROUND DOCUMENT FOR K009 AND K010.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
R. April, and J. Labiosa.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-221469. Price codes: A04 in paper copy, A01 in microfiche. EPA Report EPA/530-SW-89-048I, June 1989. 3p, 1 fig, 9 tab, 24 ref, 3 append.

Descriptors: *Best demonstrated available technology, *Chloroform, *Industrial wastewater, *Regulations, *Waste treatment, *Wastewater treatment, Water pollution control, Land disposal, Standards.

EPA's technical support for selecting and developing treatment standards for the only regulated constituent (i.e., chloroform) for K009 and K010 wastes are documented. Section 2 of this document presents waste specific information, the number and location of facilities affected by the land disposal restrictions, manufacturing processes generating the wastes, and waste characterization data. Section 3 discusses the applicable and demonstrated technologies used to treat the waste, and Section 4 summarizes the available performance data, including data on which the treatment standards are based. Section 5 explains EPA's determination of best demonstrated available technology (BDAT), while Section 6 discusses the selection of the regulated constituent and deletion of some K009 and K010 constituents originally selected in the proposed rule. Determination of the treatment standards is presented in Section 7. The performance standards for chloroform in K009 and K010 nonwastewaters have been established based on a transfer of the chloroform treatment standard established for K009 wastes and are based on the total concentration analysis of the ash residuals for chloroform generated during incineration of K019 waste. The BDAT level of performance standards for K009 and K010 wastewaters are promulgated based on a transfer of treatment performance data from EPA's Office of Water for wastewaters that are believed to be similar to and/or to contain constituents present in K009 and K010 wastewaters. These data were used to establish the Effluent Limitation Guidelines and Standards for the Organic Chemicals Plastics and Synthetic Fibers Industries. If the concentrations of the regulated constituent, as generated or treated, are lower than or equal to the promulgated BDAT treatment standard, than the wastes are not prohibited from being placed in land disposal units. (Lantz-PTT)
W91-03028

GUIDANCE ON REMEDIAL ACTIONS FOR CONTAMINATED GROUND WATER AT SUPERFUND SITES.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-184618. Price codes: A06 in paper copy, A01 in microfiche. EPA Report EPA/540/G-88/003, December 1988. 98p, 19 fig, 19 tab, 11 exhibits, 6 append.

Descriptors: *Cleanup operations, *Groundwater pollution, *Groundwater quality, *Standards, *Superfund, *Water pollution treatment, Environmental protection, Regulations.

Information is provided that can be used in the process of investigating and assessing remedial actions for contaminated groundwater. The report may be considered a primer on pertinent aspects of groundwater contamination that are important to the development of sound remedies. The goal of Superfund groundwater remediation is to protect human health and the environment by restoring groundwater to its beneficial uses within a reasonable time frame, given the particular site circumstances. The Groundwater Protection Strategy (GWPS) plays an important role in the groundwater remedial action decision making process because the Superfund program generally applies the basic framework outlined in the strategy for protecting groundwater according to its current and future vulnerability, use and value. Before initiating remedial investigation/feasibility study (RI/FS) activities, site management planning should be conducted, and cleanup levels for groundwater must be selected to maintain the groundwater's beneficial uses. If the groundwater is potentially potable, cleanup levels are determined according to health based standards for drinking water. If the groundwater discharges into an aquatic habitat, cleanup levels may be based on those protective of aquatic life. Aggregate effects of multiple contaminants found in groundwater should be assessed to insure that risks do not exceed protective levels. Remedial action objectives are developed after site characterization and specify the area of attainment, the restoration time frame, and cleanup levels. (Lantz-PTT)
W91-03031

WATER: LAWS AND MANAGEMENT.
For primary bibliographic entry see Field 6E.
W91-03032

TWO STATES, TWO POLICIES: WETLANDS AND MINING IN ALASKA AND PENNSYLVANIA.
Pennsylvania State Univ., University Park. Graduate School.
For primary bibliographic entry see Field 6E.
W91-03033

OVERCOMING INSTITUTIONAL BARRIERS AND CONSTRAINTS TO WATER QUALITY MANAGEMENT.
University of Tennessee, Planning Research Center, Knoxville, TN.
G. E. Bowen, and G. E. Ferguson.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 2B-5--2B-16, 5 tab, 4 ref.

Descriptors: *Institutional constraints, *Public policy, *Tennessee, *Water management, *Water quality, *Water quality management, *Water resources management, Economic aspects, Land use, Legal aspects, Regulations, Water pollution control.

Water quality management constraints and barriers include scientific, legal, policy, administrative, land use, and technical dimensions. In order to understand water quality constraints and barriers in Tennessee a delphi process was undertaken in which 30 Tennessee state experts participated. The experts first defined the barriers, and then rated and prioritized them. Finally, they offered alternative solutions to the major barriers which were: (1) economic interests that favor growth and development over environmental protection; (2) the absence of nonpoint source pollution legislation; (3) traditional attitudes towards land ownership and effective land use controls; (4) the inability to enforce existing regulations; and (5) the reluctance of the public to spend money for pollution control measures. The solutions proposed were then rated with regard to the following factors: (1) the impact that the solution would have on the barrier, (2) how effective would the solution be in terms of correcting or eliminating the barrier, and how feasible it is to implement the solution. The two highest rated solutions to the problem of economic interests favoring growth, were: (1) make environmental protection attractive with substantial tax deductions; and (2) work with industries to develop least cost solutions. Regarding the problem of the inability to enforce regulations, the highest rated solutions were: (1) obtain more public support; (2) elect leaders who will enforce regulations; and (3) add more inspection personnel. (See also W91-03032) (Lantz-PTT)
W91-03041

POLICY EDUCATION TO BUILD LOCAL CAPACITY TO MANAGE THE RISK OF GROUNDWATER CONTAMINATION.
Cornell Univ., Ithaca, NY. Resource Economics.
D. J. Allee, and C. W. Abdalla.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 2B-31--2B-40, 1 fig, 6 ref.

Descriptors: *Education, *Groundwater pollution, *Public participation, *Water management, *Water pollution prevention, *Water resources development, Economic aspects, Environmental protection, Governmental interrelations, Research facilities.

Extension education organizations are attempting to develop ways to make water resources participation more rewarding and successful through applying a better understanding of the policy process and the role of information at different stages of public decision making. The Kellogg Foundation is funding a seven state test, applying educational concepts that have proven successful with other, quite different policy topics. Groundwater protection as a policy issue, has characteristics that require an educational approach for solution, and managing the risk of groundwater contamination presents unique demands upon local governance capacity. The diversity of groundwater vulnerability across the landscape, the ubiquitousness of sources of hazard, the stake that local users of the resource have in its protection, the need for face-to-face management relations, and the substantial preemption of land use controls by local governments, all taken together suggest that the States and Federal government should build up their local capacity in this area. But for this to happen, both local and state leaders need policy educational support. Since so many of the groundwater protection questions involve research results and their interpretation, universities, particularly the Land Grants with their Agricultural Experiment

Stations and Water Resource Institutes, should be drawn to this window of opportunity to help create new resource management institutions in response to strong public interest. (See also W91-03032) (Author's abstract)
W91-03043

WATER USE, REUSE AND ABUSE.
General Development Corp., Miami, FL.
For primary bibliographic entry see Field 5D.
W91-03056

DISCHARGE WATER QUALITY OF PERMITTED WET DETENTION SYSTEMS.
Southwest Florida Water Management District, Brooksville.
B. T. Rushton, H. C. Hull, and C. W. Dye.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 8A-1--8A-13, 5 tab, 25 ref.

Descriptors: *Detention reservoirs, *Florida, *Wastewater disposal, *Water management, *Water quality, Dissolved oxygen, Metals, Monitoring, Southwest Florida Water Management District, Suspended solids.

A survey evaluated wet detention ponds permitted by the Southwest Florida Water Management District, by comparing their discharge effluent to state water quality standards. Preliminary results from the first 4 months of a year long study show 29% of the ponds consistently had dissolved oxygen readings below state criteria (4 mg/l), and 17% exceeded standards for total metals. Other parameters measured were within state water quality guidelines. Average total suspended solids values measured in the discharge from the detention ponds during storm events were similar to those noted from efficient sewage treatment plants (<20 mg/l). Algae blooms were common in the ponds for one sampling trip made during a month-long drought in late fall which were associated with increased suspended solids and sometimes heavy metals. (See also W91-03032) (Author's abstract)
W91-03061

ANTIDEGRADATION: A NEW LEVEL OF WATER QUALITY CONTROL. THE COLORADO EXPERIENCE.
Vranesh and Raisch, Boulder, CO.
J. R. Raisch.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 8A-17--8A-22.

Descriptors: *Antidegradation Policy, *Colorado, *Legal aspects, *Regulations, *Water management, *Water pollution control, *Water pollution prevention, *Water quality control, Clean Water Act, Dissolved oxygen, Legislation, Public policy.

The Antidegradation Policy applies where existing water quality levels are better than the water quality standards necessary to protect the use of the water. For example, a stream may have a dissolved oxygen level of 8.0 mg/L. A new discharge or diversion could cause the existing water quality levels to be lowered to 6.0 mg/l, still better than the standard of 5.0 mg/L, but significantly less than the existing quality. The Antidegradation Policy adopted by the US EPA and many of the states could allow water quality to be lowered only after determining that allowing lower water quality is necessary to accommodate important economic or social development. To date, no court has considered whether an antidegradation policy is a necessary component of a state water quality standards program under the Clean Water Quality Act. However, this issue is a major factor in an Environmental Defense Fund lawsuit over Colorado's antidegradation policy. The policy has existed for twenty years without legal review. As a result of the high priority put on antidegradation, EPA has reviewed the antidegradation policies and implementation procedures of the 50 states in late 1988. This review concluded that major problems existed in at least 40 of the states. (Author's abstract)
W91-03062

DESIGN AND LEGALITY OF AN INNOVATIVE APPROACH TO NONPOINT SOURCE CONTROL.
Environmental Defense Fund, New York.
H. Wendel, and D. Dudek.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 8A-23--8A-28, 3 ref.

Descriptors: *Legal aspects, *Management planning, *Nonpoint pollution sources, *Water pollution control, *Water quality control, Colorado, Costs, Dillon Reservoir, Water quality management.

Innovative strategies have been developed to incorporate nonpoint source control in water quality control plans within the current system of legal rights and rules. These strategies involve taking advantage of significant cost gradients that often exist between point and nonpoint source controls. Programs for trading off point source (PS) for nonpoint source (NPS) control have moved successfully from the conceptual to the implementation stage. An example of this is the phosphorous control plan for Dillon Reservoir in Summit County, Colorado. Innovative Waste Load Allocation (WLA) concepts have met with skepticism in the past due to the legal uncertainty believed to be associated with them. One concern relates to any PS emission limit relaxation that may be necessary in implementing an optional PS/NPS strategy. This important concern can be laid to rest in regard to control plans for water quality-limited situations. For such areas, PS/NPS trading strategies meeting antidegradation and antibacksliding requirements can readily be designed. (See also W91-03032) (Author's abstract)
W91-03063

STATE WATER QUALITY LAWS AND PROGRAMS TO CONTROL NONPOINT SOURCE POLLUTION FROM FOREST LANDS IN THE SOUTH.
Georgia Univ., Athens. School of Forest Resources.
F. W. Cubbage, W. C. Siegel, and P. M. Lickwar.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 8A-29--8A-37, 7 ref.

Descriptors: *Forest watersheds, *Legislation, *Nonpoint pollution sources, *State jurisdiction, *Water pollution control, *Water quality control, Best management practices, Federal jurisdiction, Florida, Georgia, Legal aspects, North Carolina, Virginia, Water quality, Water quality management.

Since enactment of the 1972 Federal Water Pollution Control Act Amendments, substantial federal and state efforts have been initiated to control nonpoint source pollution emanating from forest lands. A brief review of the background of federal laws enacted to maintain water quality is presented, along with specific reviews of state water quality statutes and programs that affect forestry in the South. State statutes and programs include general water quality laws that could be construed to apply to forestry practices, specific legislation that addresses silviculture and harvesting, related laws that indirectly affect forested lands, voluntary best management practice (BMP) programs, and financial incentives. The state programs for controlling nonpoint source pollution are summarized, based on the results of a recent survey of southern forestry and lead environmental agencies. State forestry and lead environmental agencies use educational programs to emphasize the value of BMPs to land owners and forest operators. These programs may employ written BMP manuals, workshops or on-site inspections. The states with the most active educational programs in 1987 were Virginia, North Carolina, Georgia, and Florida. Financial incentives are seen as an effective nonregulatory method of encouraging the desired land management practices. In 1987, the thirteen southern states employed a total of 24 personnel, and spent approximately $1 million on forestry-related nonpoint source pollution control. (See also W91-03032) (Lantz-PTT)
W91-03064

LEGAL ISSUES IN SURFACE WATER AND GROUNDWATER HAZARDOUS SUBSTANCES CONTAMINATION CASES.
Huey, Guilday, Kuersteiner and Tucker, Tallahassee, FL.
T. J. Guilday, and R. A. DeMeo.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 7B-7--7B-18.

Descriptors: *Groundwater pollution, *Hazardous wastes, *Legal aspects, *Surface water, *Water pollution control, Legislation, Regulations, Water quality, Water quality control.

US and Florida law is undergoing rapid change with regard to issues related to surface water and groundwater hazardous substance contamination. As advances in science reveal the previously unknown scope of contamination caused by hazardous substances, state, federal, and local regulators responsible for protecting the environment are becoming more active in bringing enforcement actions and law suits to require remediation of contamination. Recent trends include an increase in damages actions by governments and private parties against polluters for environmental damage caused by hazardous substances. In particular, traditional common law has been expanded to attempt to fashion remedies that meaningfully address contamination. Recent trends have included an expansion of tort law to encompass contamination incidents. Practitioners are encouraged to monitor the activities of the Legislature, the government regulators, and the courts as the law continues to evolve in this area. (See also W91-03032) (Lantz-PTT)
W91-03069

NATIONAL EDUCATIONAL PROGRAM IN WASTEWATER TREATMENT FOR SMALL RURAL COMMUNITIES.
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
K. Mancl.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 9B-7--9B-11, 10 ref.

Descriptors: *Education, *Rural areas, *Waste management, *Wastewater treatment, Kansas, Maryland, Ohio, Oregon, Texas, Wastewater management.

An educational program was conducted in Ohio to teach local officials about wastewater treatment. The five-session workshop covered wastewater treatment alternatives, needs assessment, system management, and resource gathering. The knowledge and skills gained were measured using a pre/post test, and surveys conducted during the workshops. Extension waste management specialists in four states (Maryland, Kansas, Texas, and Oregon) have received training and materials to conduct the workshops in their own states. (See also W91-03032) (Author's abstract)
W91-03072

WATER RESOURCES MANAGEMENT IN A SMALL CENTRAL FLORIDA COMMUNITY: TAVARES, FLORIDA.
Howard, Needles, Tammen, and Bergendoff, Orlando, FL.
T. R. Sear.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 12A-19--12A-26, 1 tab.

Descriptors: *Florida, *Local governments, *Project planning, *Storm water management, *Wastewater treatment, *Water pollution control, *Water resources management, Tavares, Water quality control, Water resources development, Wetlands.

The City of Tavares is a small Central Florida community of approximately 7,300 people, located in Lake County. The city is fortunate to be located adjacent to three major lakes and contain within its borders numerous small water bodies and wetland

areas, contributing to its accelerated growth in recent years. The City began a program of stormwater management in the Fall of 1986 with the creation of a Stormwater Management Committee. The committee assisted the City in the creation of a Stormwater Utility that began operation in the Fall of 1987. The utility has since funded the hiring of two full-time maintenance workers, and the completion of a Master Stormwater Management Study. The City is now conducting a positive program of stormwater facility maintenance, wetland purchase, water quality monitoring, and facility construction, which will allow them to better preserve their water resources in the future. Water resources preservation at the local level can only succeed when a long-term commitment is made to maintenance, monitoring, stormwater management, and wetland preservation. To their credit, the City of Tavares has made this commitment to their future. (See also W91-03032) (Lantz-PTT)
W91-03078

MODELING THE HYDROLOGIC IMPACTS OF PHOSPHATE MINING AND RECLAMATION IN CENTRAL FLORIDA.
Bromwell and Carrier, Inc., Lakeland, FL.
For primary bibliographic entry see Field 4C.
W91-03082

SILVICULTURE BEST MANAGEMENT PRACTICES-A COMPREHENSIVE ASSESSMENT.
Florida Div. of Forestry, Tallahassee.
B. W. Gay, and T. E. Demott.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 14A-1--14A-7, 3 ref.

Descriptors: *Best management practices, *Forestry, *Silviculture, *Water pollution control, *Water resources management, Florida, Forest management, Forest watersheds, Land use, Steinhatchee River Basin.

Silviculture Best Management Practices (BMPs) have been the primary tool to prevent nonpoint pollution associated with forestry operations. These practices are viewed as voluntary in Florida if satisfactory compliance continues. The State's water quality agency designated the Florida Division of Forestry (DOF) as the lead agency responsible for assessing compliance. To address this charge, the DOF has conducted biennial compliance surveys since 198I. A more intensive watershed survey has also been conducted in the Steinhatchee River basin. The survey consists of aerial site identification followed by on-the-ground inspections. A comprehensive questionnaire addresses each aspect of the timber operation with emphasis on access systems, site preparation techniques, and harvesting procedures. These inspections are conducted with the land manager and provide a valuable educational opportunity. To date, results from past surveys reflect a favorable level of compliance. In addition, these results provide useful information for targeting geographic areas in need of assistance and identifying specific practice needs. The survey technique has proven successful and will be valuable for addressing concerns pertaining to other specific watersheds, to other areas in which management guidelines are used, and to support land use options available to landowners. (See also W91-03032) (Author's abstract)
W91-03083

DEVELOPMENT OF MANAGEMENT STRATEGIES FOR BARATARIA BASIN, LOUISIANA.
Louisiana Geological Survey, Baton Rouge.
R. D. Hartman, and D. R. Cahoon.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 14B-33--14B-47, 5 fig.

Descriptors: *Barataria Basin, *Coastal zone management, *Louisiana, *Management planning, *Water quality, *Water resources management, *Wetlands, Diversion, Estuaries, Land use, Marshes, Shore protection, Tertiary wastewater treatment.

Technical recommendations concerning the management of the quality of coastal environments in Barataria Basin, Louisiana were developed from a review of strategies used in other states to preserve estuarine areas, combined with management recommendations developed for the Basin by a multidisciplinary advisory group of research managers. Wetland loss, hydrologic isolation, water quality, human and cultural resources, and economic development were identified as the primary issues affecting the Basin. The Basin was divided into 4 management units based on hydrologic isolation, marsh type and environmental problems. Specific problems and critical areas in each unit were identified, and water and land management objectives were established for each unit. Management recommendations pertinent to all units were delineated first, and include the reduction of canalization impacts, the use of wetlands for tertiary waste treatment, reducing effects of produced water discharges, and freshwater diversion. Recommendations specific to management areas include specific sites for freshwater diversion, water control structures and shoreline stabilization plans. (See also W91-03032) (Author's abstract)
W91-03095

SOUTHWEST FLORIDA MANAGEMENT DISTRICT SAVE OUR RIVERS PROGRAM.
For primary bibliographic entry see Field 4A.
W91-03096

BIOTREATMENT: THE USE OF MICROORGANISMS IN THE TREATMENT OF HAZARDOUS MATERIALS AND HAZARDOUS WASTES.
For primary bibliographic entry see Field 5D.
W91-03097

METABOLIC DIVERSITY OF MICROBIAL BTEX DEGRADATION UNDER AEROBIC OR ANOXIC CONDITIONS.
Michigan Univ., Ann Arbor. Medical Center.
For primary bibliographic entry see Field 5D.
W91-03099

BIODEGRADATION OF PCP CONTAMINATED SOILS USING IN SITU SUBSURFACE BIORECLAMATION.
Keystone Environmental Resources, Inc., Monroeville, PA.
J. R. Campbell, J. K. Fu, and R. O'Toole.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 17-27, 14 fig, 5 tab.

Descriptors: *Biodegradation, *Cleanup operations, *Groundwater pollution, *Pentachlorophenol, *Soil contamination, *Water pollution treatment, Aerobic conditions, Anaerobic conditions, Bioremediation, Leaching, Microbial degradation.

An evaluation of in situ subsurface bioremediation was conducted at a manufacturing site that had contaminated nearby soil and groundwater with pentachlorophenol (PCP). Laboratory bench scale tests showed that PCP can be biologically transformed under either aerobic or anaerobic conditions. Mass balance tests performed after a 12 week period showed that approximately I0-20% of the total PCP mass leached out from the soil and 80-90% of the PCP mass was reduced as a result of biological degradation. A remediation plan was developed for pilot scale testing of an in situ biodegradation treatment system. Soil borings were made to test baseline levels of PCP, purgeable aromatics, total organic carbon, oil and grease, and percent solids. The in situ pilot testing was monitored to evaluate immobilization/biodegradation, leaching, and contaminant migration. The degree of success of the in-situ groundwater/soil treatment system depended on the hydrogeologic conditions of the site, the physical and chemical characteristics of the soil and geology, and the characteristics of the chemicals to be biodegraded. The in situ biodegradation/immobilization of chemicals of interest associated with site soils and groundwater was achieved through anaerobic treatment. Groundwater was continually recycled through the subsurface environment (unsaturated and saturated soil) via recovery wells and recharge trenches. After 6-months of operation, soil borings showed PCP reductions of 98, 98, and 51% in soil depths of 4-6 feet, 30-32 feet, and 32-36 feet, respectively. Above grade groundwater treatment consisting of soluble metals removal, UV/ozone chemical oxidation for removal of organic constituents and tertiary treatment with activated carbon adsorption was applied before discharge of pumped groundwater to the leach field. A 99% removal of PCP from groundwater was achieved prior to discharging to the subsurface environment. (See also W91-03097) (Geiger-PTT)
W91-03100

UPDATE ON IN SITU BIOREMEDIATION OF THE FRENCH LIMITED SUPERFUND SITE.
ENSR-Celgene, Inc., Houston, TX.
R. E. Woodward, and D. K. Ramsden.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 29-32, 2 fig.

Descriptors: *Biodegradation, *Bioremediation, *Cleanup operations, *Hazardous waste disposal, *Soil contamination, *Water pollution treatment, Aeration, Bioassay, Microbial degradation, Organic pollutants, Priority pollutants, Sludge disposal, Toxicity.

Following four laboratory feasibility studies and two on-site, scaled-up, 20,000-gallon bioreactor studies, in situ bioremediation was demonstrated in a 0.5 acre cell of the French Limited Site Lagoon. The 6-month demonstration used wastewater treatment technologies related to aerobic biosludge degradation, together with regular toxicity analysis of the aqueous phase. Sludge volume was reduced >85% during the first two treatment phases. The concentration of specific organic priority pollutants in the volatile and semi-volatile group decreased dramatically. Removal kinetics were consistent with activities in each of the four treatment phases. Overall toxicity, as monitored by the Microtox bioassay, decreased significantly. Soluble chloride and sulfate increased approximately five-fold indicating effective dehalogenation and degradation of organochloride and sulfur-containing organics, respectively. The successful in situ demonstration enabled EPA Region 6 to conclude that bioremediation was the preferred technology for site remediation. EPA subsequently issued a Record of Decision for in situ bioremediation. The PRP Task Group signed a Consent Decree outlining a remedial action program. Post-demonstration tasks included a I2-month equipment evaluation phase to optimize sludge materials handling. The remedial action program defined in situ biological treatment of contaminated soils and sludges, installation of a flood control wall around the lagoon perimeter, and backfilling the lagoon to grade. This represented a landmark project for in situ bioremediation and has established precedence for use of this technology at CERCLA and RCRA sites nationwide. (See also W91-03097) (Geiger-PTT)
W91-03101

BENCH-SCALE STUDY OF THE REMOVAL OF CHROMIUM AND CYANIDE FROM CONTAMINATED GROUNDWATER.
E. Goldman, M. Weekes, and A. Fischer.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 33-39, 11 fig, 1 tab, 9 ref.

Descriptors: *Chemical precipitation, *Chromium, *Cleanup operations, *Cyanide, *Groundwater pollution, *Ion exchange, *Water pollution treatment, Catalysts, Filtration, Separation techniques.

Bench-scale (batch and continuous-flow) tests were conducted on polluted groundwater in the vicinity of the Riverbank Army Ammunition Plant (RBAAP), Riverbank, California to determine the feasibility of reducing the cyanide and chromium concentrations to less than 20 micrograms/L. The most promising treatment process determined in the batch screening tests was further evaluated in the continuous-flow tests. The process selected as optimum for the RBAAP site application was chromate reduction with ferrous sulfate, pH adjustment, and precipitation for chromium removal, followed by filtration and ion exchange for cyanide removal. The <20 microgram/L treatment level goals were obtained in this bench-scale treatment system which employed a novel use of nickel and cobalt catalysts and removed chromium and cyanide in a single process train. A full-scale treatment system is being designed and constructed based on this study. (See also W91-03097) (Author's abstract)
W91-03102

REMOVAL OF HEAVY METAL IONS FROM GROUNDWATERS USING AN ALGAL BIOMASS.
Bio-Recovery Systems, Inc., Las Cruces, NM.
D. W. Darnall, and L. D. Hyde.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 41-45, 3 fig, 5 ref.

Descriptors: *Adsorption, *Algae, *Groundwater pollution, *Heavy metals, *Wastewater treatment, *Water pollution treatment, Biofilters, Biomass, Cadmium, Copper, Lead, Mercury, Nickel, Separation techniques.

Advantage was taken of the strong affinity of algal cells for heavy metal ions to produce a material for removing heavy metal ions from contaminated groundwaters. Various species of non-living algae were immobilized in a polymeric matrix and processed into a granular material which was packed into columns through which waters containing heavy metals were passed. Heavy metal ions were adsorbed to the algal matrix, which when saturated, can be stripped of the heavy metal ions allowing reuse of the matrix. The algal-based material has three distinct advantages over precipitation and ion exchange technologies for heavy metal removal: (1) it functions well for heavy metal recovery even when calcium and magnesium are present in concentrations over 10,000 ppm; (2) organic materials do not interfere with the binding of heavy metal ions; and (3) it is capable of recovering heavy metal ions down to levels in the parts per billion range. The algal-based metal adsorbent was effective for removal of copper, cadmium, mercury and other heavy metal ions from a diversity of groundwaters including Superfund sites. Demonstration of the technology is being verified under the U.S. Environmental Protection Agency's Emerging Technology Program Evaluation (SITE) program. (See also W91-03097) (Author's abstract)
W91-03103

PILOT-SCALE BIOREMEDIATION OF CHLORINATED SOLVENT AND PNA-CONTAINING SOILS.
Monsanto Chemical Co., St. Louis, MO.
B. S. Yare, W. J. Adams, and E. G. Valines.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 47-50, 5 fig, 1 ref.

Descriptors: *Biodegradation, *Bioremediation, *Chlorinated hydrocarbons, *Cleanup operations, *Organic pollutants, *Polycyclic aromatic compounds, *Site remediation, *Soil contamination, *Water pollution treatment, Biological wastewater treatment, Hazardous wastes, Organic solvents, Pilot plants, Superfund, Texas, Waste dumps.

A slurry-phase biodegradation demonstration was undertaken to determine if biodegradation could be used to achieve the required treatment levels at the Brio Refining Superfund site located in Harris County, Texas. The impoundments at the site contained styrene and vinyl chloride still bottoms that were to be reprocessed into jet fuel. Samples of affected material and soil were collected from each of the six pits whose entire contents required treatment. Two batches of 30% solids slurry were made using affected material and soil from each of the six pits. One batch was a high carbon batch that included all of the soil, sludges and organic liquids encountered in the pit. The second batch, called the low carbon batch, included only pit cover soil, clay backfill and subsoil. The high carbon and low carbon batches from each pit were run simultaneously using two continuously-stirred, aerated bioreactors. Batches were run for about ten days at ambient temperatures. Of the twelve batches run, all but one met the required treatment requirements after ten days of treatment. The one batch that did not meet treatment requirements appeared to be the result of the inhibition of biological activity. The results of this pilot-scale demonstration indicated that biodegradation is a feasible treatment method for nearly all of the affected material and soil found at the Brio Refining site. (See also W91-03097) (Geiger-PTT)
W91-03104

BIOLOGICAL CLEANUP OF EXTENSIVE PESTICIDE CONTAMINATION IN SOIL AND GROUNDWATER.
Societe de Chimie Industrielle, Paris (France).
H. S. Borow.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 51-56, 4 fig, 3 tab.

Descriptors: *Biodegradation, *Bioremediation, *Cleanup operations, *Groundwater pollution, *Pesticides, *Soil contamination, *Water pollution treatment, Activated carbon, Biological wastewater treatment, Microbial degradation.

In 1987, a fire at a major agricultural warehouse was extinguished with water spreading pesticides into the surrounding soil, groundwater and a nearby creek. Soil and groundwater bioremediation was performed at the site which involved extensive material handling, soil and material segregation, and the use of several biological techniques. An onsite five-acre, clay-lined treatment bed was constructed, mobile bioslurry and liquid-phase bioremediation units were delivered to the treatment location. Contaminated soil from the burn site and along the length of the contaminated creek was excavated and transported to the treatment location. The soil was tested for contaminant levels, separated according to the extent of contamination, and prepared for treatment by the removal of rocks and debris. Solid-phase biotreatment of approximately 12,000 cubic yards of less contaminated soil (containing < 200 parts per million (ppm) of contaminants) was performed on the five-acre lined treatment bed. The soil was processed daily and a microbial inoculum was applied to enhance biological breakdown of the contaminants. A mobile soil slurry bioreactor system was used to treat soils with contamination > 200 ppm. This process consisted of aerobic treatment of soil mixed with water in 26,000 gallon bioreactor tanks. The slurry mixture was inoculated with pesticide-degrading bacteria and with nutrients that optimize the ability of bacteria to degrade the contaminants. Groundwater was treated with granular activated carbon and an innovative in situ bioremediation technique which reduced the treatment time by 50%. An upgradient injection gallery was established to flush treated water and nutrients, as required, through the contaminant plume. During treatment, the groundwater was monitored to guard against off-site migration. During the winter of 1987, more than five million gallons of groundwater were treated. The site was restored to its original condition and a site closure plan prepared in accordance with appropriate regulations. (See also W91-03097) (Geiger-PTT)
W91-03105

FIELD DEMONSTRATION OF A FORCED AERATION COMPOSTING TREATMENT FOR COAL TAR.
C.A.A. Bioremediation Systems, Boston, MA.
A. Taddeo, M. Findlay, M. Dooley-Danna, and S. Fogel.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 57-62, 2 fig, 6 tab, 14 ref.

Descriptors: *Aeration, *Biodegradation, *Coal tars, *Composting, *Hazardous waste disposal, Aerobic treatment, Bioremediation, Polycyclic aromatic compounds, Soil contamination.

The feasibility of using composting for on-site treatment of soils contaminated with coal tars was tested in laboratory compost microcosms using naturally-occurring bacteria. Subsequently, a field demonstration of a static pile forced aeration compost system was designed and operated to treat soil contaminated with tar. A seven cubic yard, stainless steel, mobile composting vessel was constructed and staged at an operating utility company which was a former coal gasification plant. Operation involved maintenance of oxygen, moisture, and mineral nutrient concentrations, as well as recirculation and analysis of leachate and off-gases. Analysis of compost samples indicated that approximately 94% of the total hydrocarbons were degraded, including 84% of priority pollutant polynuclear aromatic hydrocarbons and 95% of the major aromatic tar constituents. The results demonstrate that this technology has high potential for use at hazardous waste sites for biologically treating coal tar wastes. (See also W91-03097) (Author's abstract)
W91-03106

BIOREMEDIATION OF HEAVY PETROLEUM OIL IN SOIL AT RAILROAD MAINTENANCE YARD.
A. Ying, J. Duffy, G. Shepherd, and D. Wright.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 63-68, 7 fig, 2 tab.

Descriptors: *Biodegradation, *Bioremediation, *Cleanup operations, *Oil spills, *Soil contamination, *Water pollution treatment, Microbial degradation.

The biodegradation performance of heavy engine oil in soil at a railroad maintenance yard was investigated using actual oil-containing soil from a northern California rail yard. The oil on the site was heavy engine oil in the C-22+ molecular weight range. The soil was divided into over 130 model ecosystems (microcosms) where multiple combinations of treatment reagents were tested. The treatment inocula included different primary and secondary nutrients, trace metallic elements, booster proteins, various types of biodegradable surfactants and specific oil-degrading microorganisms isolated from the chosen rail yard. Each treatment combination was conducted in quintuplet for statistical purposes. The microcosms were incubated up to a period of 16 weeks. Soil samples were extracted at regular intervals and analyzed for petroleum hydrocarbon via EPA method 418.1. The degradation results were compiled and analyzed for statistical-significance performance (more than 95% certainty) for the various treatment combinations. The data revealed a degradation of up to 94% is possible (in a 16 week period) for heavy petroleum oil in concentrations up to 13,000 ppm in soil. Lower degradation performance was achieved with soil containing up to 3.5% oil. The project is now in the field demonstration phase. (See also W91-03097) (Author's abstract)
W91-03107

AIR STRIPPING/BIOREMEDIATION OF CHLORINATED HYDROCARBONS AT AN NPL SITE.
ECOVA Corp., Redmond, WA.
J. A. Cioffi.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 69-74, 3 fig, 7 tab.

Descriptors: *Air stripping, *Aromatic compounds, *Bioremediation, *Chlorinated hydrocarbons, *Groundwater pollution, *Organic pollutants, *Wastewater treatment, *Water pollution treatment, *Water treatment, Biodegradation, Biological wastewater treatment, Bioreactors, California, Fermentation, Microbial degradation.

Groundwater contaminated with chlorinated hydrocarbons, soluble organic materials, aromatic compounds, ketones, alcohols and glycols at a National Priority List site in California is being treated by a two-step process of air stripping used in conjunction with a bioreactor. Objectives used in selecting this system include onsite destruction of contaminants, minimization of long-term liability, and cost-effectiveness of the system. The combination of physical and biological techniques was effective in resolving the complex groundwater contamination problem at the facility. A mobile modular fermentation unit with temperature, oxygen, agitation, and pH controls was transported to the site. The fermentation unit was inoculated with the prepared consortium of microorganisms into a basal medium with target contaminants as a source of carbon and energy. Following a 5-day fermentation period in which the removal rates of the target organic contaminants were comparable to those observed in laboratory studies, the 150-gallon suspension was inoculated into a bioreactor containing 2,500 gallons of the contaminated groundwater. After an initial 10-day inoculation period, the bioreactor was run at a continuous 5 gallons per minute (gpm). The bioreactor was monitored daily for removal of the target contaminants. As the level of contaminants approached the discharge limits, the flow rate was increased form 5 gpm to 15-18 gpm. Upon meeting the required discharge requirements for all contaminants, the bioreactor was placed in continuous flow/discharge mode. The system was put on continuous discharge to the storm sewer under a NPDES permit in July 1987, after sample results proved that contaminant levels were consistently reduced below discharge limits at a process flow rate of 18 gpm. (See also W91-03097) (Author's abstract)
W91-03108

MANAGING GOVERNMENT REGULATION AND PUBLIC PERCEPTION OF BIOTECHNOLOGY FIELD TESTS: A CASE STUDY.
BioTechnica Agriculture, Inc., Cambridge, MA.
D. J. Glass.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 93-97.

Descriptors: *Biological treatment, *Biotechnology, *Genetic engineering, *Public relations, *Water pollution control, Case studies, Public opinion, Regulations, State jurisdiction.

Biotreatment projects may be affected by the Environmental Protection Agency's proposed approach to regulating biotechnology under the Toxic Substances Control Act (TSCA). This proposal could affect the use of certain naturally occurring or genetically engineered microorganisms in the environment, even at the research stage. Such regulation or possible parallel oversight by state and federal governments, could place even preliminary pilot bioremediation projects under increased public scrutiny, which could create public concern or opposition in local communities. Both the regulatory process and the community's interest in biotechnology activities can be managed effectively by appropriately-planned corporate programs which include guidelines for informing state agencies well in advance of field test plans in each state as well as community relations programs to inform the local citizens of the plans. A program for improved public relations regarding biotechnology projects was designed according to the following principles: (1) openness and honesty with the public about all aspects of the test and the review process; (2) the community, through its elected leaders, would learn of all developments from the source, rather than from the press or from rumors; (3) representatives would always be available to provide information and answer questions. In the case of biotreatment projects, where the hypothetical risks of engineered microorganisms will be weighed against the tangible, ongoing risks associated with the wastes needing treatment, it should not be difficult to gain public acceptance for such biotreatment projects using the proposed guidelines. (See also W91-03097) (Geiger-PTT)
W91-03111

BIODEGRADATION OF XENOBIOTICS BY SPECIFIC BACTERIA: RESEARCH AND APPLICATIONS.
Groningen Rijksuniversiteit (Netherlands). Dept. of Biochemistry.
For primary bibliographic entry see Field 5D.
W91-03113

MONITORING POPULATIONS OF 4-CHLOROBIPHENYL-DEGRADING BACTERIA IN SOIL AND LAKE WATER MICROCOSMS USING COLONY HYBRIDIZATION.
Tennessee Univ., Knoxville.
J. Packard, A. Breen, G. S. Sayler, and A. V. Palumbo.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 119-125, 2 fig, 1 tab, 18 ref. U.S. Air Force Contract F49620-89-C-0023. DOE Contract DE-ACOR21400.

Descriptors: *Bacteria, *Biodegradation, *DNA, *Monitoring, *Polychlorinated biphenyls, *Population dynamics, *Water pollution treatment, Lysimeters, Microbial degradation.

Population dynamics and maintenance of 4-chlorobiphenyl (4CB)-degrading bacteria, Alcaligenes eutrophus, added to field lysimeters and lake water microcosms were monitored by colony hybridization. Six field lysimeters containing soil from a PCB-contaminated floodplain were watered and stirred during the experiment and monitored for 1 yr. At the start of the experiment, half of the lysimeters were inoculated with A. eutrophus. The lysimeters differed in treatments over the year; some received inorganic nutrients and yeast extract and one also received biphenyl. Four 20-L microcosms were set up with water from Fort Loudon Reservoir and were supplemented with mineral salts and glucose and stirred and monitored for 2 months. A. eutrophus was inoculated into 2 of the microcosms, 1 of which was maintained with selective pressure by the addition of 4CB. One of the uninoculated microcosms also had selective pressure for 4CB-degrading organisms. A. eutrophus contains a plasmid, pSS50, which codes for a 4CB degradation pathway. Colony hybridization using the pSS50 plasmid as a probe indicated the plasmid was maintained in the inoculated lysimeters throughout the experiment. An uninoculated lysimeter which had been maintained with inorganic nutrients and yeast extract also maintained a population of 4CB-degrading bacteria which hybridized with the probe. In the lake water microcosms, the pSS50 plasmid was maintained throughout the experiment in both inoculated microcosms; it was found in higher numbers in the microcosm which received selective pressure. The uninoculated microcosm without selective pressure did not demonstrate any pSS50 plasmids above the detection limit of the colony hybridization. The uninoculated microcosm which received selective pressure maintained pSS50 plasmids throughout the experiment. The DNA probe technique was an effective monitoring tool in soil and water samples and indicated the long term survival of bacteria containing the pSS50 (PCB-catabolic) plasmid in field lysimeters and lake water microcosms. (See also W91-03097) (Author's abstract)
W91-03114

BIODEGRADATION OF AN OILY BILGE WASTE USING ALGAE.
GHR Engineering Associates, Inc., Lakeville, MA.
M. Carpenter, J. Robertson, and P. Skierkowski.
IN: Biotreatment: The Use of Microorganisms in the Treatment of Hazardous Materials and Hazardous Wastes. Proceedings of the 2nd National Conference, November 27-29, 1989, Washington, DC. Hazardous Materials Control Research Inst., Silver Spring, Maryland. 1989. p 141-150, 5 fig, 6 tab, 26 ref.

Descriptors: *Algae, *Biodegradation, *Bioremediation, *Oil spills, *Phenols, *Water pollution treatment, Aquatic bacteria, Cleanup procedures, Fate of pollutants, Fungi, Microbial degradation, Mineralization, Yeasts.

A mixed community of microorganisms was collected from the harbor at the San Diego Navy Base and was monitored in a test ecosystem containing an oily bilge waste obtained from off-loading ships. The cultures were examined in the presence and absence of the algae. It was thought that the algae might enhance the degradation of the oily waste by providing oxygen and possibly a nutrient source from dying phytoplankton for the bacterial community. Test ecosystems were subjected to a radiolabeled 14C-phenol and bilge waste mixture to ascertain the ability of the communities to mineralize the phenol and/or assimilate the labeled hydrocarbon. The community containing the algae started mineralizing the phenol (measured by 14CO2 production) 24 hr after exposure to the waste/phenol mixture. The bacteria/yeast-fungi community had a lag period of 384 hr before extensive catabolism of the labeled compound occurred. Current data indicates algae may enhance the biodegradation rate of oily bilge wastes in a mixed microbial community. (See also W91-03097) (Author's abstract)
W91-03116

SPATIAL SIMULATION TO AID IN EVALUATING AND TREATING EROSION AND WATER QUALITY PROBLEMS AFFECTING LAKE ERIE.
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
D. B. Beasley.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 566-573, 4 tab, 1 fig, 9 ref.

Descriptors: *Agricultural runoff, *Erosion control, *Eutrophication, *Lake Erie, *Model studies, *Phosphorus runoff, *Simulation, *Water pollution control, International agreements, Nutrient inputs, Sediment yield, Tillage.

Lake Erie, by far the shallowest of the Great Lakes, has one of the highest proportions of agricultural drainage. For years, eutrophication and chemical pollution have plagued the lake, but efforts to remove or alleviate municipal and industrial sources of waste have been reasonably successful. Aquatic life has been returning to normal levels. However, the extensive drainage area devoted to agriculture provides a large amount of nutrients to an already eutrophic body of water. The Tri-State Tillage Project aims to demonstrate and assess the application of various levels of conservation tillage on a variety of crops and soils in the Maumee, Portage, and Sandusky River Basins of Ohio, Indiana, and Michigan. Part of the project included estimation of erosion and nutrient yield levels using computer simulation techniques. The model used was ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation), which is an event-oriented model developed at Purdue University. Sediment and phosphorus yields were predicted for eight different management scenarios. Sediment yields ranging from 40 to

2,370 kg/ha and P yields from 0.03 to 3.50 kg/ha were predicted using this model. The simulations indicate that several scenarios would achieve reasonable reductions without extreme changes in management. However, unless no-till is used on all cropland, reductions approaching 50% and more will be achieved only with a mixture of tillage and structural best management practices (terraces, sediment basins, waterways, etc.). According to simulation results, using no-till on 50% of the group 2 soils (by far the greatest contributors of the eight soil groups recognized) would reduce annual delivery of phosphorus from the study area to Lake Erie by almost 1800 metric tons. Because the simulated sediment and P yields might be as much as 50% higher than average annual values, the reduction might be as small as 1,200 metric tons of P. This figure is still a very large portion of the 1,600-2,000 metric tons goal of the international agreement between Canada and the United States for reducing sediment and nutrient loads. (See also W91-03117) (Rochester-PTT)
W91-03164

GROUNDWATER POLLUTION PROTECTION: A MULTIDISCIPLINARY ACTION TO BE LED BY A PRACTISING HYDROGEOLOGIST AND BACKED UP BY AN ENFORCEMENT OF LAW.
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. d'Hydrogeologie.
N. Crampon.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 243-260, 53 ref.

Descriptors: *Developing countries, *Groundwater management, *Groundwater pollution, *Water pollution control, *Water pollution prevention, *Water resources development, *Water resources management, Field tests, Geohydrology, Hydrologic models, Management planning, Model studies, Path of pollutants, Rehabilitation, Solute transport, Water quality control.

Many developed countries are experiencing industrial pollution and their rural areas are becoming increasingly contaminated by nitrate. Drinking water is becoming scarcer and more expensive. Current heavy growth in developing countries is followed by water supply and sanitation requirements. Fighting groundwater pollution requires a proper knowledge of polluting activities, of their localization and of contaminant behavior with exchange and transport processes in the unsaturated and saturated subsurface. Pollution is a water quality alteration propagated into a special context. This has to be studied on geological, hydrogeological, and hydrogeochemical levels. Monitoring networks and mapping allow specification of the source, the displacement and the distortion of the contaminant plume. to predict the concentration variation over distance and time, models fitted to field data (especially tracer tests) need to be used. Finally, pollution-prevention requires adequate provisions to be made and applied. Pollution removal is always more difficult and more expensive than prevention, in spite of a few rehabilitation processes that are now being developed. The hydrogeologist is the keystone of the battle against groundwater pollution by representing the link between the scientists in the various fields that must be applied to hydrogeological conditions and by suggesting adapted means of study, control and intervention. (See also W91-03178) (Fish-PTT)
W91-03193

GROUNDWATER CONTAMINATION: PROCESSES, CHARACTERIZATION, ANALYSIS, AND REMEDIATION.
GeoTrans, Inc., Herndon, VA.
J. W. Mercer, D. A. Griffin, J. C. Herweijer, and P. Srinivasan.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 261-282, 5 fig, 3 tab, 36 ref.

Descriptors: *Cleanup, *Groundwater management, *Groundwater pollution, *Path of pollutants, *Site remediation, *Water pollution treatment, *Water resources management, Advection, Groundwater movement, Groundwater transport, Hydraulic conductivity, On-site data collections, On-site investigations, Water resources development.

The ultimate goal at a site involving groundwater contamination is remediation. To properly remediate a site, however, an understanding of the controlling processes is necessary. This requires site characterization and analysis of the resulting data. At many sites, the primary mode of transport is advection. Therefore, characterizing the groundwater flow system (i.e., hydraulic conductivity and hydraulic gradient) is critical to understanding the contamination distribution. Other important processes include sorption, chemical and biological reactions, and hydrodynamic dispersion. Sorption and reactions affect remediation. Desorption increases the time required to remediate, whereas chemical and biological reactions can aid remediation (e.g., bioreclamation). For problems involving groundwater contamination, the current practice of remediation involves some form of pump-and-treat technology. Depending on the controlling processes, this technique generally requires long time frames (10-100 years). Therefore, current research examines innovative technologies such as bioreclamation, fixation, soil venting, and in situ heating. (See also W91-03178) (Author's abstract)
W91-03194

SCUDDER'S POND RESTORATION PROJECT FOR VILLAGE OF SEA CLIFF AND TOWN OF OYSTER BAY, NASSAU COUNTY, NEW YORK.
Envirodyne Engineers, Inc., New York.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-217228. Price codes: A04 in paper copy, A01 in microfiche. Final report, January 1982. 69 p, 13 fig, 8 tab, 3 ref, 3 append.

Descriptors: *Eutrophication, *Habitat restoration, *Lake restoration, *New York, *Water quality, *Watershed management, Dredging, Nutrients, Scudders Pond, Sedimentation, Species diversity, Urbanization.

Residential development in the watershed of Scudder's pond in Oyster Bay, Long Island, New York, starting in the 1950s, has been cited as the prime reason for increased sedimentation and subsequent eutrophication, reducing it to one-half its normal size. A water quality monitoring program was initiated at Scudder's Pond several months prior to dredging. Nutrient concentrations indicated eutrophic conditions before, during, and after dredging. Biological and water quality data for the pre-dredging condition of Scudder's Pond indicate the condition to be one of limited habitat and 'stress' in terms of potential for diverse aquatic life. Sufficient qualitative and semi-quantitative information is available from the studies to indicate that the dredging program has effected some improvement in the pond's condition. Information indicating such an improvement includes: increased plankton diversity; reduced predominance of blue-green algae; post-dredging presence of a relatively large Cryptomonas population (generally accepted as indicative of conditions in which organic decomposition has been completed and a water body can be considered 'clean'); and physical removal of a significant quantity of organic-laden sediments from the pond. The pond remains, however, a water body with insufficient depth to provide for seasonal turnover, limited habitat diversity, and probable high nutrient input, based on watershed land use and drainage patterns. Whether or not the pond has been converted to a self-sustaining viable ecosystem remains to be seen. (Fish-PTT)
W91-03218

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR CYANIDE WASTES.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
R. April, and M. Chatmon-McEaddy.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-221485. Price codes: A14 in paper copy, A01 in microfiche. Report no. EPA/530-SW-89-0484, June 1989. 317 p, 10 fig, 63 tab, 73 ref, 3 append. Contract no. 68-01-7053.

Descriptors: *Administrative regulations, *Best available technology, *Cyanide, *Industrial wastewater, *Metal-finishing wastes, *Waste treatment, *Water pollution treatment, *Water quality standards, Chemical precipitation, Electroplating, Filtration, Heat treatment, Metals, Performance evaluation, Sludge drying, Waste characteristics, Wastewater oxidation, Wastewater treatment.

The Environmental Protection Agency (EPA) is promulgating treatment standards based on best demonstrated available technology (BDAT) for cyanide-containing electroplating and metal heat treating wastes and for commercial chemical product wastes. The waste characterization data available to the Agency for the cyanide-containing wastes has been tabulated. To determine BDAT, the EPA examined all available performance data for the demonstrated technologies to determine whether one of these technologies performs significantly better than the others. The technology that performs best on a particular waste or waste subcategory was then evaluated to determine whether it is commercially available and provides 'substantial' treatment. Constituents selected for regulation must satisfy the following criteria: (1) they must be on or indicators of constituents on the BDAT list of regulated constituents; (2) they must be present in, or suspected of being present in, the untreated waste; and (3) the selected constituents must be easier to treat than any waste constituent from which performance data are transferred. Air oxidation was found to have the best treatment performance for electroplating operations cyanide wastes; list metals may require treatment by chemical precipitation followed by filtration and sludge dewatering. Electrolytic oxidation followed by alkaline chlorination provides appropriate measures for metal heat treating cyanide wastes; list metals wastes from this process are best treated by stabilization. Other miscellaneous wastes of concern can best be treated by ultraviolet-light enhanced ozonation, wet air oxidation, or incineration. (Fish-PTT)
W91-03219

SECONDARY ECONOMIC IMPACT OF ACID DEPOSITION CONTROL LEGISLATION IN SIX COAL PRODUCING STATES.
Battelle Pacific Northwest Labs., Richland, WA.
M. J. Scott, and S. J. Guthrie.
Available from the National Technical Information Service, Springfield, Virginia 22161, as DE89-005487. Price codes: A04 in paper copy, A01 in microfiche. Report no. PNL-6669/UC-11, December 1988. 66 p, 1 fig, 17 tab, 15 ref, append. Contract no. DE-AC06-76RL0 1830.

Descriptors: *Acid rain effects, *Air pollution control, *Coal mining, *Economic impact, *Emission control, *Water pollution prevention, Coal wastes, Employment, Illinois, Indiana, Kentucky, Legislation, Ohio, Pennsylvania, Powerplants, Sulfur, West Virginia.

Significant policy concern has been expressed concerning the dollar costs to the nation's economy of achieving the intended effects of acid rain control legislation and the potential impacts on economic activity--in particular, losses of both coal mining and secondary service sector employment in states and regions dependent on the mining of high sulfur coal. The states selected for the analysis are those in which losses in high sulfur coal production are expected as a result of many acid rain control proposals. The selected scope of the study highlights the most obvious negative employment effects of such a program. The two pieces of legislation considered are the Proxmire and Mitchell Bills, which call for reduced sulfur emissions from power plants, have been predicted to cause switch-

ing from high to low sulfur coal, and may also force utilities to install more effective scrubbers. The most obvious of the negative local economic effects of acid deposition control is expected to be the effects of coal switching on six traditional coal producing states in the Appalachian and Midwestern coal producing regions: Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia. Under either bill the overall economic impacts are significant, particularly in three states: Illinois, Ohio, and Pennsylvania. The absolute impacts represent less than one percent of the 1986 level of economic activity in the states in which they occur. Sensitivity cases confirmed the importance of scrubber technology in reducing the economic effects of changing coal production. (Fish-PTT)
W91-03220

DEVELOPING A STATE WELLHEAD PROTECTION PROGRAM: A USER'S GUIDE TO ASSIST STATE AGENCIES UNDER THE SAFE DRINKING WATER ACT.
Environmental Protection Agency, Washington, DC. Office of Ground-Water Protection.
For primary bibliographic entry see Field 5F.
W91-03222

ANALYSIS OF PERFORMANCE LIMITING FACTORS (PLFS) AT SMALL SEWAGE TREATMENT PLANTS.
Environmental Protection Agency, Washington, DC. Office of Municipal Pollution Control.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-193346. Price codes: A03 in paper copy, A01 in microfiche. Report no. OMPC-10-89, April 1989. 20 p, 3 tab.

Descriptors: *Clean Water Act, *Performance evaluation, *Wastewater facilities, *Wastewater management, *Wastewater treatment, Administrative decisions, Cost analysis, Operating policies, Systems engineering.

The Environmental Protection Agency has long been gathering data on the successes and problems of federally funded wastewater treatment systems. Since 1982, the On-Site Operator Assistance Program, created under Section 104(g) (1) of the Clean Water Act, has been sending technical experts to small POTWs to help operators and managers solve debilitating problems. Since the program's beginning, the '104' troubleshooters have compiled operation and maintenance evaluations (OMEs) for the plants they have visited. This wealth of technical information has recently been analyzed to discover what generalized practical advice can be offered about solving operational problems at small POTWs. Analysts examined 150 POTWs selected to be representative of all plants in the database, not just nationally, but within EPA Regions. Some conclusions and recommendations made are: activated sludge may not be a good design choice for many small plants; fixed media or lagoons may be better options. Plant inflexibility undermines operability. Small plants have front-end and back-end problems with process design; grit removal and sludge dewatering and disposal options should be considered. Design engineers and community administrators should agree on realistic loading levels for the facility. Staffing difficulties aggravate poor performance; plant administrators should increase operator status and visibility, seek to attract better staff, and strive to keep good staff. Plant budgets and user charges may be too low. Municipal support is a subtle but vital need. (Fish-PTT)
W91-03223

NNEPS (NATIONAL NETWORK FOR ENVIRONMENTAL POLICY STUDIES) FINAL REPORT: EPA (ENVIRONMENTAL PROTECTION AGENCY) REGION 1 WELLHEAD PROTECTION EFFORTS.
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
P. L. Stern.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-203764. Price codes: A03 in paper copy, A01 in microfiche. Report no. 600/9-89/050, August 1988. 19 p, append. Contract no. U-913-992-01-0.

Descriptors: *Environmental policy, *Geographic information systems, *Government supports, *Groundwater management, *Water pollution prevention, *Water resources management, Computer programs, Groundwater pollution, Groundwater recharge, Risk assessment, Water pollution sources, Water quality management.

Three wellhead protection projects were undertaken in EPA's Region One: the Cape Cod Aquifer Management Plan (CCAMP); Region One's Priority Ground Water Resource-Based Mapping Project: the Nashua Regional Planning Commission Pilot Area; and the Chesprocott Groundwater Protection Project. All three projects are aimed at preventing contamination of community wells. CCAMP serves as a prototype for Region One's wellhead protection efforts and may be broken down into four main phases: delineating the critical groundwater recharge area of each community well, identifying and assessing the risk of existing and future sources of contaminants within the Wellhead Protection Area (WHPA), examining the adequacy of existing management strategies to prevent groundwater contamination, and implementing local management controls based on the results of the first steps. The other two wellhead protection projects were based on CCAMP, and essentially follow the same steps. All three projects use Geographic Information System (GIS) technology. The location and essential information on wells and sources of contamination are first checked in the field, and then digitized into the GIS computer system. The result is a state-of-the-art management tool which will be of tremendous value to all agencies involved in groundwater management. All three projects develop and refine management ideas and methodologies on the prevention of groundwater contamination, which may be used by local and regional agencies concerned with protecting their groundwater resources. (Fish-PTT)
W91-03227

AEROBIC DENITRIFICATION AS AN INNOVATIVE METHOD FOR IN SITU BIOLOGICAL REMEDIATION OF CONTAMINATED SUBSURFACE SITES.
Air Force Engineering and Services Center, Tyndall AFB, FL. Engineering and Services Lab.
L. N. Britton.
Available from the National Technical Information Service, Springfield, Virginia 22161, as AD-A208 812. Price codes: A05 in paper copy, A01 in microfiche. Report no. ESL-TR-88-40, January 1989. 82 p, 16 fig, 10 tab, 74 ref, append. Contract no. FO 8635-86-C-0158.

Descriptors: *Aerobic treatment, *Bioremediation, *Denitrification, *In situ treatment, *Site remediation, *Water pollution treatment, Biodegradation, Enrichment, Nitrates, Nutrients, Organic compounds, Oxygen demand, Phenols, Subsurface water.

Laboratory testing was conducted of an aerobic denitrification concept for the enhancement of in situ bioremediation of subsurface sites. Microbial enrichments using phenol, dodecane, toluene, naphthalene, and methylene chloride demonstrated that many soil organisms classically associated with degradation of these organics are also capable of respiring with nitrate. Chemostat experiments with an isolate from the enrichments were performed to follow phenol degradation at varying oxygen concentrations. Nitrate respiration and aerobic phenol degradation could occur simultaneously at oxygen concentrations as high as 10% in the sparging gas. Thus the concept of aerobic denitrification was proven. An enhancement of biodegradation of phenol occurred when the isolate was provided nitrate, in lieu of oxygen, as a final electron acceptor for respiration. This enhancement was attributed to the decreased oxygen demand for phenol oxidation. Tentative evidence using a mixed culture demonstrated that nitrate could increase mineralization of certain organics in limiting oxygen. The study provided proof of concept that the addition of nitrate could enhance in situ biodegradation of organic contaminants in subsurface sites by decreasing the oxygen demand. (Fish-PTT)
W91-03229

DRINKING WATER HEALTH DOCUMENT ON STYRENE.
Environmental Protection Agency, Cincinnati, OH. Office of Drinking Water.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-192272. Price codes: A12 in paper copy, A01 in microfiche. Final Report no. ECAO-CIN-409, January 1988. 262 p, 1 fig, 20 tab, 294 ref.

Descriptors: *Administrative regulations, *Drinking water, *Safe Drinking Water Act, *Styrene, *Water quality standards, *Water treatment, Carcinogens, Performance evaluation, Population exposure, Public health, Toxicology, Water pollution control.

The Safe Drinking Water Act, as amended in 1986, requires the Administrator of the Environmental Protection Agency (EPA) to publish maximum contaminant level goals (MCLGs) and promulgate National Primary Drinking Water Regulations for each contaminant, which, in the judgment of the Administrator, may have an adverse effect on public health and which is known or anticipated to occur in public water systems. The Office of Drinking Water of the EPA has prepared a Drinking Water Criteria Document on Styrene. This Criteria Document is an extensive review of the following topics: physical chemical properties of styrene, toxicokinetics and human exposure to styrene, health effects of styrene in humans and animals, mechanisms of toxicological effect of styrene, and quantification of toxicological effects of styrene. Styrene is a clear, colorless liquid with a characteristic odor, molecular weight of 104.16, vapor pressure of 4.3 torr, and a water solubility of 320 mg/L. Animal studies indicate that distribution of absorbed styrene is widespread and rapid, but is fairly readily eliminated. Exposure estimates for styrene in drinking water (low-high) are 0-0.25 microg/L, in food 100 microg/kg, and in air 0-6,500 microg/cu m. The major source of exposure is from ambient and indoor air. When the animal bioassay data and the metabolic/genotoxicity data are considered, there is a reasonable basis for classifying styrene as having a 'sufficient' level of carcinogenic evidence in animal test systems, but there are inadequate data to indicate that styrene is a human carcinogen. (Fish-PTT)
W91-03230

REGULATORY IMPACT ANALYSIS: BENEFITS AND COSTS OF FINAL SURFACE WATER TREATMENT RULE.
Miller (Wade) Associates, Inc., Arlington, VA.
For primary bibliographic entry see Field 5F.
W91-03235

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR ORGANOPHOSPHORUS WASTES.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
R. April, and M. Cunningham.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-221444. Price codes: A04 in paper copy, A01 in microfiche. Report no. EPA/530-SW-89-048G, June 1989. 4 fig, 10 tab, 10 ref. Contract no. 68-01-7053.

Descriptors: *Administrative regulations, *Organophosphorus compounds, *Waste management, *Waste treatment, *Wastewater treatment, *Water quality standards, Carbon filters, Incineration, Land disposal, Performance evaluation, Pesticides, Waste characteristics, Wastewater management.

The Environmental Protection Agency (EPA) is establishing treatment standards based on the best demonstrated available technology (BDAT) for organophosphorus wastes. These wastes are specif-

ically generated in the production of phorates and disulfoton (organic pesticide products). Since the organophosphorus wastes contain organics, the technologies applicable to the untreated listed wastes should include those that destroy or reduce the total amount of various organic compounds in the waste. For wastewaters and nonwastewaters, the EPA has identified incineration as an applicable and demonstrated technology to treat the organophosphorus wastes. However, it seemed impractical to require all wastewater streams to be incinerated; thus, the EPA is promulgating 'Incineration or Carbon Adsorption as a Method of Treatment.' The residual from nondestructive treatment, i.e., the spent carbon, is still considered to be the same waste code as before treatment, and must be managed as such. It therefore must be incinerated prior to land disposal. (Fish-PTT)
W91-03236

40 CFR 265 INTERIM-STATUS GROUND-WATER MONITORING PLAN FOR THE 2101-M POND.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5A.
W91-03238

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR K043.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
R. April, and J. Vorbach.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-221493. Price codes: A03 in paper copy, A01 in microfiche. Report no. EPA/530-SW-89-048L, June 1989. 45 p, 12 tab, 13 ref, 2 append.

Descriptors: *Administrative regulations, *Pesticides, *Waste disposal, *Waste management, *Wastewater treatment, *Water pollution prevention, *Water quality standards, Chlorinated hydrocarbons, Incineration, Land disposal, Waste characteristics, Wastewater management.

In accordance with the Resource Conservation and Recovery Act (RCRA), the Environmental Protection Agency (EPA) is establishing best demonstrated available technology (BDAT) treatment standards for K043 waste (2,6-dichlorophenol waste from the production of 2,4-dichlorophenoxyacetic acid by the pesticides industry). Compliance with the BDAT treatment standards is a prerequisite for the placement of the waste in facilities designated as land disposal units. K043 waste contains primarily chlorinated organic compounds, less than 2 percent ash, and no water. The EPA has identified fuel substitution and incineration as applicable technologies for treating the organic constituents in untreated K043 waste. Because K043 waste contains only trace amounts of BDAT list metals, residuals are not expected to contain treatable levels of these metals; therefore, no applicable technologies have been identified. Incineration is the only 'demonstrated,' 'best,' and 'available' technology for K043 waste, and is therefore BDAT. The EPA is regulating 13 of the 21 candidates either detected or believed to be present in K043 waste, including the seven volatile and semivolatile candidates, but is not regulating any metal constituents. Treatment standards for regulated semivolatile constituents range from 0.34 (2,6-dichlorophenol) to 7.6 mg/L (2,4,6-trichlorophenol) for nonwastewater, and 0.013 to 0.039 mg/L for the same wastewater constituents. The only volatile constituent is tetrachlorocthene with a treatment standard of 1.7 mg/L for nonwastewater, and 0.006 mg/L as a wastewater constituent. (Fish-PTT)
W91-03241

RCRA GROUND-WATER MONITORING PROJECTS FOR HANFORD FACILITIES: ANNUAL PROGRESS REPORT FOR 1988.
Battelle Pacific Northwest Labs., Richland, WA.
R. M. Fruland, and R. E. Lundgren.
Available from the National Technical Information Service, Springfield, Virginia 22161, as DE89-011028. Price codes: A05 in paper copy, A01 in microfiche. Report no. PNL-6852, April 1989. 87 p, 23 fig, 8 tab, 21 ref. Contract no. DE-AC06-76RLO 1830.

Descriptors: *Groundwater pollution, *Hazardous wastes, *Monitoring, *Path of pollutants, *Radioactive waste disposal, *Resource Conservation and Recovery Act, *Washington, *Waste disposal, *Water quality, Administrative regulations, Drinking water, Groundwater level, Hazard assessment, Water pollution sources, Water quality standards.

Fourteen Hanford Site groundwater monitoring projects in Washington State, covering 16 hazardous waste facilities and one nonhazardous waste facility, are being conducted according to federal regulations based on the Resource Conservation and Recovery Act (RCRA) of 1976 and the State of Washington Administrative Code. All of the groundwater monitoring projects are under interim-status regulations, and most are in their first year of background groundwater monitoring. Only two are groundwater quality assessment monitoring projects. The status of the project and the work conducted during calendar year 1988 have been summarized. The water-level elevations for 1988, and the indicator parameters for the one project that has reached this phase have been compiled. For groundwater quality assessment projects, water-table evaluations are followed by a summary of 1988 analytical results for constituents above drinking water standards. There are two constituents recorded by several projects that are currently suspected of not representing true groundwater conditions: methylene chloride (dichloromethane) and chromium. The occurrence of these constituents are being carefully monitored and evaluated to determine their true sources. (Fish-PTT)
W91-03242

WETLAND CREATION AND RESTORATION: THE STATUS OF THE SCIENCE.
For primary bibliographic entry see Field 2L.
W91-03244

WETLAND MITIGATION ALONG THE PACIFIC COAST OF THE UNITED STATES.
San Francisco State Univ., Tiburon, CA. Tiburon Center for Environmental Studies.
For primary bibliographic entry see Field 2L.
W91-03245

CREATION AND RESTORATION OF TIDAL WETLANDS OF THE SOUTHEASTERN UNITED STATES.
North Carolina State Univ., Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 2L.
W91-03246

CREATION AND RESTORATION OF COASTAL PLAIN WETLANDS IN FLORIDA.
Lewis Environmental Service, Inc., Tampa, FL.
For primary bibliographic entry see Field 2L.
W91-03247

CREATION AND RESTORATION OF COASTAL WETLANDS IN PUERTO RICO AND THE U.S. VIRGIN ISLANDS.
Lewis Environmental Service, Inc., Tampa, FL.
For primary bibliographic entry see Field 2L.
W91-03248

CREATION AND RESTORATION OF COASTAL WETLANDS OF THE NORTHEASTERN UNITED STATES.
For primary bibliographic entry see Field 2L.
W91-03250

REGIONAL ANALYSIS OF THE CREATION AND RESTORATION OF SEAGRASS SYSTEMS.
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
For primary bibliographic entry see Field 2L.
W91-03251

CREATION AND RESTORATION OF FORESTED WETLAND VEGETATION IN THE SOUTHEASTERN UNITED STATES.
For primary bibliographic entry see Field 2H.
W91-03252

FRESHWATER MARSH CREATION AND RESTORATION IN THE SOUTHEAST.
Erwin (Kevin L.) Consulting Ecologist, Inc., Fort Myers, FL.
For primary bibliographic entry see Field 2H.
W91-03253

RESTORATION AND CREATION OF PALUSTRINE WETLANDS ASSOCIATED WITH RIVERINE SYSTEMS OF THE GLACIATED NORTHEAST.
For primary bibliographic entry see Field 2H.
W91-03254

REGIONAL ANALYSIS OF THE CREATION AND RESTORATION OF KETTLE AND POTHOLE WETLANDS.
For primary bibliographic entry see Field 2H.
W91-03255

REGIONAL ANALYSIS OF FRINGE WETLANDS IN THE MIDWEST: CREATION AND RESTORATION.
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 2H.
W91-03256

CREATION AND RESTORATION OF RIPARIAN WETLANDS IN THE AGRICULTURAL MIDWEST.
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 2H.
W91-03257

CREATION AND RESTORATION OF RIPARIAN HABITAT IN SOUTHWESTERN ARID AND SEMI-ARID REGIONS.
SWCA, Inc., Tucson, AZ.
For primary bibliographic entry see Field 2H.
W91-03258

RESTORATION OF DEGRADED RIVERINE/RIPARIAN HABITAT IN THE GREAT BASIN AND SNAKE RIVER REGIONS.
White Horse Associates, Smithfield, UT.
For primary bibliographic entry see Field 2E.
W91-03259

WETLANDS RESTORATION/CREATION/ENHANCEMENT TERMINOLOGY: SUGGESTIONS FOR STANDARDIZATION.
Lewis Environmental Service, Inc., Tampa, FL.
For primary bibliographic entry see Field 2H.
W91-03261

RESTORATION OF THE PULSE CONTROL FUNCTION OF WETLANDS AND ITS RELATIONSHIP TO WATER QUALITY OBJECTIVES.
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
For primary bibliographic entry see Field 2H.
W91-03265

WETLAND AND WATERBODY RESTORATION AND CREATION ASSOCIATED WITH MINING.
Pennsylvania State Univ., University Park. Forest Resources Lab.
For primary bibliographic entry see Field 4C.
W91-03270

WASTE MANAGEMENT SCHEMES OF POTASH MINES IN SASKATCHEWAN.
Manitoba Hydro, Winnipeg.
J. E. Tallin, D. E. Pufahl, and S. L. Barbour.
Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 4, p 528-542, August 1990. 14 fig, 25 ref.

Descriptors: *Brine disposal, *Canada, *Mine wastes, *Waste management, *Water pollution prevention, Case studies, Dykes, Groundwater pollution, Linings, Potash, Wastewater disposal, Wastewater treatment.

Saskatchewan's potash industry, when operating at capacity, produces 28 million tons of salt tailings and 11 million cu m of concentrated brine per year. The seepage of brine into the surrounding soil and groundwater presents a challenge to waste management. Diversion ditches are used to collect contaminated seepage. Where there is danger of contaminating an underlying aquifer, liners may be beneficial. Cutoff walls consist of a trench excavated through a permeable strata and backfilled with a low-permeability material to prevent lateral spreading of contaminants through the strata. The slurry trench method uses a low-permeability soil-water slurry to keep the trench open during the excavating and backfilling operations. Interceptor ditches intercept groundwater flow occurring in shallow permeable deposits, however, regular maintenance is needed to ensure their proper drainage in loose deposits containing silt and fine sand. Buried drains consist of a perforated pipe at the bottom of a trench backfilled with sand or gravel to act as a filter between the natural soil and the pipe. The Potash Corporation of Saskatchewan Mining Limited (PCS), Cory Division maintains tailings and slime settling ponds with dykes and a slurry trench cutoff wall. The Potash Company of America Limited has a waste containment area consisting of a system of ponds including Patience Lake. A dyke was constructed across the north end of the lake to prevent migration of the brines to streambeds. The PCS, Lanigan Division has a waste disposal basin with an inner and an outer pond. Dykes surrounding both the inner and outer ponds were designed with cutoffs. A seepage interceptor drain was recently installed to intercept seepage occurring through or beneath the cutoff. A diversion ditch was upgraded to divert runoff water from the site and prevent it from entering the ponds. The PCS, Rocanville Division has ponds lined with a polyethylene membrane because the surficial deposits are very permeable. Newer ponds are lined with a high-density polyethylene. Brine losses from the original ponds are intercepted by collector ditches. Additional pump wells were installed to inhibit the advancement of the brine plume in the inter-till aquifer. (Geiger-PTT)
W91-03304

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES.
For primary bibliographic entry see Field 2F.
W91-03311

IMPACT OF INTENSIVE IRRIGATION ON GROUNDWATER REGIMEN IN PARTS OF OSMANSAGAR AREA, R. R. DISTRICT, A. P., INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
G. Shankar Narayana, D. Vidyanath, and J. V. S. Murty.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 709-714, 1 tab, 5 ref, map.

Descriptors: *Geohydrology, *Groundwater pollution, *India, *Irrigation effects, *Nonpoint pollution sources, *Water pollution sources, Aquifers, Conductivity, Groundwater chemistry, Groundwater management, Sulfates, Vine crops.

The groundwater regime around the Twin Cities (India) has deteriorated greatly since the 1960s, when water was uniformly palatable for drinking. Effects have been greatest in extensively irrigated tracts. Specific electrical conductance of the groundwater in extensively irrigated areas ranges from 2850-5000 mmhos/cm at 25 C. The concentration of sulfates also is very high. Physiography, hydrogeology, and water chemistry of this area were studied as part of an assessment of the effects of irrigation on local groundwater. High electrical conductivity values were recorded for the groundwaters of vineyards; the older the vineyard, the higher the electrical conductivity value. Use of groundwater from intensively irrigated areas in low-potential aquifers of the peninsular basement gneissic complex should be stopped. If not, the soil of these areas will deteriorate, turning vast irrigated tracts into wastelands. (See also W91-03311) (Rochester-PTT)
W91-03334

SAFEGUARDS FOR GROUNDWATER POLLUTION IN INDIA.
Malvia Regional Engineering Coll., Jaipur (India).
R. D. Verma.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 841-851, 24 ref.

Descriptors: *Groundwater management, *Groundwater pollution, *India, *Urbanization, *Water pollution prevention, Agricultural runoff, Comparison studies, Fertilizers, Groundwater reservoirs, Organic solvents, Pesticides, Solid wastes, United States, Wastewater disposal, Wastewater pollution.

Groundwater pollution has become a major issue in the development of natural resources and the protection of the environment. Many cases of groundwater pollution in India have been reported. A review of these reports identifies the following causes: haphazard urban development without adequate attention to sewage and waste disposal, rapid industrialization without proper treatment and disposal of waste products, unsanitary dumping of refuse and other solid wastes near aquifers, excessive use of fertilizers and pesticides for agricultural development and poor drainage in agricultural soils. The use of groundwater reservoirs for waste storage and artificial recharge, if not properly planned and designed, would seriously impair groundwater quality. The presence of organic chemicals, especially solvents, in groundwater supplies has been reported from the United States and other industrialized countries. The hazardous wastes generated every year in the developed countries, when not properly disposed of, have caused severe groundwater pollution. Examining the experiences in developed countries with respect to future industrial development and water usage in India shows that, if adequate long-term safeguards are not imposed to prevent groundwater pollution, the quality of the groundwater could become a limiting factor for the use of this resource. (See also W91-03311) (Author's abstract)
W91-03346

HYDROCHEMICAL CLASSIFICATION OF THE GROUNDWATER OF THE WADI AL BIH WELLFIELD IN THE NORTHERN PART OF THE UNITED ARAB EMIRATES.
United Arab Emirates Univ., Al Ain. Dept. of Geology
For primary bibliographic entry see Field 2K.
W91-03347

NITRATE POLLUTION OF GROUNDWATER IN LUCKNOW AREA, U. P.
Central Ground Water Board, Lucknow (India).
For primary bibliographic entry see Field 5B.
W91-03349

SCIENTIFIC BACKGROUND FOR THE DEVELOPMENT OF REGULATIONS FOR RADIONUCLIDES IN DRINKING WATER.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
P. Milvy, and R. Cothern.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 1-16. 3 fig, 10 tab, 20 ref.

Descriptors: *Drinking water, *Legal aspects, *Legislation, *Radioisotopes, *Regulations, *Water quality standards, *Water treatment, Economic aspects, Public health, Radioactivity effects, Radon, Risk assessment, Uranium.

The occurrence, exposure, and risks posed by naturally occurring radionuclides in public drinking water supplies were examined. In the context of these data and considering the feasibility and cost of compliance, several regulatory approaches that could be implemented to protect public health were considered. The hypothetical, but realistic maximum contaminant levels for radon and uranium and the effect of these standards on reducing the health risks of drinking water caused by these two radionuclides were also examined. It is suggested that the flexibility of the Safe Drinking Water Act allows setting of the maximum contaminant levels for the regulation of radon's and uranium's alpha particle effects at levels that are not totally independent of each other, but that are interrelated such that maximum health benefits are achieved. To achieve this requires a policy that emphasizes a relatively stringent radon standard. It can be achieved by relaxing the uranium standard at little sacrifice to health, but with a large saving of resources. To justify this, these resources must then be used to reduce the considerably greater risk posed by radon. A net reduction in risk is achieved at no increased resource expenditure. It is noted that neither the uranium nor the radon maximum contaminant level is set at a level that significantly exceeds the level of risk considered by the U.S. Environmental Protection Agency as being protective of public health. (See also W91-03366) (Author's abstract)
W91-03367

TREATMENT TECHNOLOGY FOR REMOVING RADON FROM DRINKING WATER SUPPLIES.
New Hampshire Univ., Durham. Environmental Research Group.
For primary bibliographic entry see Field 5F.
W91-03370

REMOVAL OF URANIUM FROM DRINKING WATER BY CONVENTIONAL TREATMENT METHODS.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5F.
W91-03377

PRICE OF CONFIDENCE: THE RATIONALITY OF RADIUM REMOVAL FROM DRINKING WATER.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W91-03380

CONTRACTORS, INJECTION WELLS, AND THE TC RULE.
National Water Well Association, Worthington, OH.
C. Reimer.
Water Well Journal WWJOA9, Vol. 44, No. 11, p 61-62, November 1990. 1 tab.

Descriptors: *Hazardous wastes, *Injection wells, *Regulations, *Toxicity, *Underground waste disposal, *Waste disposal, *Water pollution sources, Chemical wastewater, Disposal wells, Environmental protection, Industrial wastes, Sewers, Storage tanks.

With the Resource Conservation and Recovery Act (RCRA), there are two mechanisms for determining if wastes are hazardous. One mechanism is for EPA to identify and list particular wastes. The second mechanism is a determination by the waste generator based on knowledge or testing that the waste is 'characteristically' hazardous. Wastes are characteristically hazardous due to ignitability, reactivity, corrosivity, or toxicity characteristic (TC rule). The TC rule replaces the extraction procedure. It expands the number of wastes that will be considered hazardous because of its new procedures and because it adds 25 organic constituents to the list that must be considered. Because of the TC regulation, some formerly nonhazardous injection fluids will now be considered hazardous waste. Some Class V (shallow injection wells that dispose of hazardous or radioactive wastes into or above an underground source of drinking water) wells will be reclassified as prohibited Class IV because they inhibit a newly defined 'characteristic' hazardous waste at a concentration greater than the regulatory level into or above an underground source of drinking water. Operations that EPA has identified as potentially having Class IV wells include industrial facilities in areas that are not sewered or in which a request to discharge into the sanitary sewer has been denied. Industry types most likely to generate characteristically hazardous waste are those which many facture petroleum products, textiles, industrial organic chemicals, plastic materials and synthetic resins, synthetic rubber, cellulosic and other man-made fibers, electronic manufacturers, and small plating and other metal fabricating operations. Automobile service stations, repair shops, and car washing activities in unsewered areas or municipalities with restrictions on sewer hookups for industries may also have class IV wells, as may large tank farms and chemical storage facilities. (Lantz-PTT)
W91-03391

WATER QUALITY CHANGES ASSOCIATED WITH ROTARY DITCHED AND BREACHED MOSQUITO CONTROL IMPOUNDMENTS IN MOSQUITO LAGOON.
East Volusia Mosquito Control District, Daytona Beach, FL.
For primary bibliographic entry see Field 2L.
W91-03439

PRECIPITATION CHEMISTRY: ATMOSPHERIC LOADINGS TO THE SURFACE WATERS OF THE INDIAN RIVER LAGOON BASIN BY RAINFALL.
Bionetics Corp., Cocoa Beach, FL.
For primary bibliographic entry see Field 2K.
W91-03440

COMPLEMENTARY INVESTIGATIVE TECHNIQUES FOR SITE ASSESSMENT WITH LOW-LEVEL CONTAMINANTS.
Science Applications International Corp., Golden, CO. Environmental Remediation Div.
M. E. Byrnes, R. W. Nelson, R. G. La Poe, D. E. Lundquist, and W. McNeill.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 4, p 90-95, Fall 1990. 4 fig, 4 ref.

Descriptors: *Groundwater pollution, *On-site investigations, *Organic chemicals, *Site remediation, *Water pollution sources, *Water pollution treatment, Aerial photography, California, Chemical analysis, Chlorinated hydrocarbons, Groundwater movement, Hazardous wastes, Landfills, Mass spectrometry, Permeability, Physical analysis, Vandenberg Air Force Base, Water quality monitoring.

A remedial investigation was performed in an area downgradient from an abandoned missile silo at Vandenberg Air Force Base, California, as part of the United States Air Force Installation Restoration Program. A number of complementary investigative techniques were used to assure a reliable assessment of site contamination. These included the review of aerial photographs, the use of an organic vapor analyzer, and a carbon adsorption/mass spectrometer method to conduct a soil-gas survey; magnetic and electromagnetic geophysical surveys; bedrock permeability testing; and the chemical analysis of soil, sediment, surface water and groundwater samples. The results from this investigation revealed the presence of an undocumented landfill and a small trichloroethylene plume in groundwater at concentrations ranging from 6.7 to 31 ppb. The investigation also identified local groundwater flow direction, provided strong evidence of the location of potential sources of contamination, and defined the downgradient extent of groundwater contamination. Because the identified contaminants have not yet reached the environmentally sensitive wetland at the base of the slope below this facility, there is still time to propose remedial alternatives that would protect this area. (Author's abstract)
W91-03445

GROUND WATER MONITORING AT WELLHEAD PROTECTION AREAS.
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
P. D. Meyer.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 4, p 102-109, Fall 1990. 6 fig, 20 ref.

Descriptors: *Groundwater quality, *Monitoring, *Network design, *Water quality control, *Water quality monitoring, *Wellhead protection, *Wells, Geohydrology, Nonpoint pollution sources, Water pollution sources, Water quality management.

Wellhead protection (WHP) programs have no included a comprehensive groundwater monitoring strategy. The elements of wellhead protection program important from a monitoring perspective are the management objectives, the types of potential contaminant sources, and the locations of those sources with respect to the wellhead protection area (WHPA) boundary. Hydrogeologic monitoring provides the basic information on which WHPA delineation is based. A comprehensive groundwater monitoring program for WHP program assessment includes five strategies: (1) monitoring at the water supply well(s); (2) monitoring at the boundaries of the WHPA zone(s); (3) monitoring of a particular point source; (4) monitoring of a non-point source; and (5) monitoring without regard to any boundaries or specific sources. (MacKeen-PTT)
W91-03447

METHODS DEVELOPMENT AND IMPLEMENTATION FOR THE NATIONAL PESTICIDE SURVEY.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W91-03507

TOXICOLOGY AND DRINKING WATER REGULATIONS.
R. W. Pontius.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 10, p 14-17, 90, October 1990. 2 tab.

Descriptors: *Drinking water, *Safe Drinking Water Act, *Toxicology, *Water quality standards, *Water treatment, Carcinogens, Environmental Protection Agency, Epidemiology, Specifications, Water policy, Water pollution.

The US Safe Drinking Water Act requires the US EPA to regulate drinking water contaminants to protect public health. For each contaminant specified in the Safe Drinking Water Act or those that may have any adverse effect on health the US EPA must establish a nonenforceable maximum contaminant level goal and an enforceable maximum contaminant level or treatment technique. A maximum contaminant level goal is established for a contaminant based on toxicology data on the contaminant's potential health effects associated with drinking water. Data evaluated include human epidemiology or clinical studies and animal-exposure studies. Language specifying how known or probable human carcinogens (Category I) are to be regulated is not contained in the Safe Drinking Water Act, but congressional guidance was provided in House Report 93-1185. US EPA must consider the possible impact of synergistic effects, long-term and multistage exposures and the existence of more susceptible groups in the population. For noncarcinogenic (category III) contaminants, US EPA determines a no effect level (known as the reference dose) for chronic or lifetime periods of exposure. Category II contaminants are not regulated as human carcinogens; however, they are treated more conservatively than category III contaminants. The Safe Drinking Water Act requires the US EPA to set either a maximum contaminant level or a treatment technique for each contaminant that has a maximum contaminant level goal. Maximum contaminant levels must be set as close to their respective maximum contaminant level goals as feasible with the use of best available technology, taking costs into consideration. (Mertz-PTT)
W91-03526

ELECTROCHEMICAL PROCESSING OF SOILS: THEORY OF PH GRADIENT DEVELOPMENT BY DIFFUSION, MIGRATION, AND LINEAR CONVECTION.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
Y. B. Acar, R. J. Gale, G. A. Putnam, J. Hamed, and R. L. Wong.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 6, p 687-714, August 1990. 9 fig, 39 ref.

Descriptors: *Cleanup, *Decontamination, *Electro-osmosis, *Electrochemistry, *Model studies, *Soil chemistry, *Soil contamination, *Soil treatment, *Water pollution treatment, Flow pattern, Hydrogen ion concentration, Interstitial water, Mathematical equations, Physicochemical treatment, Soil processing, Theoretical analysis.

A theory, based on the Nernst-Planck equations, is presented for pH gradient development during the electrochemical processing of soils. The theory can be applied to techniques using electrochemical processing for the decontamination of polluted media. Formation of an acidic front at the anode from water electrolysis and the induced electro-osmotic flow of pore fluid contribute to facilitate removal of contaminants. The model provides a first-order, mathematical framework to examine the flow patterns and chemistry generated in electro-osmosis. Analytical solutions were compared with the numerical results obtained by the finite element method (FEM) with some preliminary experimental results. The FEM results were in good agreement with the analytical solutions of the model for diffusion only conditions. For the case of one-dimensional ion flow by diffusion and convection, agreement is good at earlier stages of the process, when the boundary conditions at the outlet are not felt. Upstream-downstream effects are included in the model, but consolidation effects, neutralization, and ion exchange reactions need to be quantified and incorporated into the model. The physical basis of electro-osmosis phenomena needs to be better established. Modeling approaches of this type should assist scale-up of this technology for common inorganic toxic pollutants. (Author's abstract)
W91-03539

POND SEEPAGE IN TWO AND THREE DIMENSIONS.
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W91-03545

SUPERFUND RECORD OF DECISION: MONTGOMERY TOWNSHIP HOUSING DEVELOPMENT, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-204770/AS. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R02-88/060. June 1988. 63p, 8 fig, 6 tab.

Descriptors: *Cleanup operations, *New Jersey, *Path of pollutants, *Superfund, *Trichloroethylene, Air stripping, Costs, Water supply, Wells.

The Montgomery Township Housing Development (MTHD) site is located in Somerset County, New Jersey. The Rocky Hill Municipal Wellfield (RHMW) Superfund site is also covered by this remedial action because of its proximity to the MTHD and the similarity of the contaminants present. The 72-acre MTHD site is a development which includes 71 private homes, with an additional 6 homes affected by the contamination in the surrounding residential areas. The RHMW consists of a two-acre tract of land in the Borough of Rocky Hill, which supplies public water to the residents of Rocky Hill. In 1978, a study of the RHMW revealed trichloroethylene (TCE) contamination, which led to closure of one well and eventual installation of an air stripping treatment unit on the well in 1983. Concern over the groundwater contamination in Rocky Hill spurred the initial sampling of residential wells in MTHD from December 1979 to January 1980. In March 1981, Elizabethtown Water Company water lines were installed in MTHD, and residents were advised not to use well water. Twenty homes initially elected to connect to the municipal supply, and at the present time 38 residences have hooked up. In September 1987, an operable unit Record of Decision (ROD) was signed by EPA, which provides for the supply of alternate water through the permanent hookup of all MTHD residences, and six residences outside of MTHD, to the available public water supply system. Incomplete field investigations have identified 13 possible sources of contamination. The nearby Princeton Gamma Tech property has been identified as a primary source of TCE contamination in the area. The primary contaminant of concern affecting the groundwater is TCE. The selected remedial action for this site includes: groundwater pump and treatment using air stripping and reinjection of the treated water back into the aquifer; connecting any remaining affected residences to the public water supply and sealing of remaining private water supply and monitoring wells within the contaminant plume; and implementation of groundwater monitoring. Present worth cost for this remedial action is $2,548,000 with annual O&M costs of $94,000. (Author's abstract)
W91-03561

SUPERFUND RECORD OF DECISION: EWAN PROPERTY, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA 22161, as PB89-196769/AS. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/ROD/R02-88/073. September 1988. 111p, 8 fig, 7 tab.

Descriptors: *Cleanup operations, *New Jersey, *Path of pollutants, *Soil contamination, *Superfund, *Volatile organic compounds, Chromium, Costs, Decontamination, Excavation, Incineration, Lead, Metals.

The 43-acre Ewan Property site is located in a predominantly agricultural and residential area of Shamong Township, Burlington County, New Jersey. Private residences are provided domestic water from wells as close as one mile downgradient from the site, drawing from an aquifer that extends from beneath the site. The site is broken into two study areas, Area A and Area B. Area A, consisting of nine acres, is the area of 500 to 8,000 55-gal drums containing hazardous industrial wastes were disposed of in trenches in Area A, and the trenches were subsequentially backfilled with soil. Investigations also revealed that many of the drums are ruptured, corroded or leaking. Soil and groundwater samples indicate the presence of VOCs and metals. It is estimated that Area A has 4,500 sq yd of highly contaminated soil and waste material, and 29,500 sq yd of moderately contaminated soil. Primary contaminants of concern affecting soil and groundwater are VOCs such as benzene, TCE, PCE, and xylenes, and metals including chromium and lead. The selected remedial action for this site includes: construction of decontamination, staging and waste characterization areas; excavation, staging and characterization of waste materials with offsite incineration of all appropriate wastes (approximately 4,500 sq yd of buried drums and heavily contaminated soil); temporary onsite storage and assessment of non-incinerable wastes to determine proper disposal method; and monitoring of air and groundwater during remedial activities. The estimated present worth cost of the selected remedy is $21,153,000 with estimated annual O&M costs of $22,000. (Author's abstract)
W91-03562

SUPERFUND RECORD OF DECISION: DORNEY ROAD, PA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA 22161, as PB89-196745/AS. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/RO3-88/056. September 1988. 57p, 4 fig, 6 tab.

Descriptors: *Cleanup operations, *Groundwater pollution, *Path of pollutants, *Pennsylvania, *Soil contamination, *Superfund, *Volatile organic compounds, Arsenic, Chromium, Costs, Landfills, Leachates, Metals, Phenols.

The Dorney Road Landfill site is located in Lehigh County, Pennsylvania. The site is approximately 27 acres, bounded on the east by Dorney Road, and extends westward such that the southwest corner is in Longswamp Township, Berks County. Land use in the area is rural, residential and agricultural. The population within an 0.25 mile radius of the site is estimated to be approximately 20 people. Currently, 1 residence is located within 1,000 feet of the site and 3 residences are within 2,000 feet of the site. The water supply for these nearby homes is groundwater from private wells. The majority of the site is presently owned by R. Emory Mabry. Beginning in 1952, an abandoned iron mine pit on the site was used as an open dump. From 1966 to 1978, an unpermitted landfill was operated in the same mine pit. In 1986, EPA conducted a removal action and regraded the landfill to prevent runoff and erosion of landfill material from migrating to neighboring property. In 1980 and 1982, EPA investigations revealed elevated levels of VOCs, metals and phenols in groundwater and leachate-samples. This remedial action will prevent dermal contact and incidental ingestion of landfill soil and solid waste. It will also minimize the continued leaching of precipitation and onsite ponded waters through the contaminated landfill. A subsequent remedial action will address the groundwater under the site. The primary contaminants of concern affecting the soil, groundwater and surface water are VOCs including benzene, toluene and xylenes, metals including arsenic and chromium, and other organics including phenol and PAHs. The selected remedial action for this site includes: offsite disposal of approximately 700,000 gallons of onsite pond water; construction of a dike and diversion ditch system to control runon/runoff; regarding and installation of a multilayer landfill cap and a gas collection system; groundwater monitoring; and deed and access restrictions. The estimated present worth cost for this remedial action is $14,000,000 with estimated annual O&M costs of $42,000. (Author's abstract)
W91-03563

SUPERFUND RECORD OF DECISION: G.E. WIRING, PR.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA 22161, as PB189518/AS. Price codes: AO3 in paper copy, AO1 in microfiche. Report No. EPA/ROD/RO2-88/069. September 1988. 36p, 6 fig, 2 tab.

Descriptors: *Cleanup operations, *Groundwater pollution, *Mercury, *Path of pollutants, *Puerto Rico, *Superfund, Costs, Industrial wastes, Remedial action plans, Soil contamination.

The GE Wiring Devices site is located in Juana Diaz, Puerto Rico. The General Electric Company (G.E.) owns and operates a five-acre wiring devices plant at this site, which assembled silent mercury switches from 1957 until 1969. Approximately half a ton of mercury was discarded along with 4,000 cu yd of defective switch parts and plastic scraps in an onsite waste-fill area about 1 acre in area and 1 to 4 feet deep. Several residences are located approximately 400 feet south of the waste-fill area, which is surrounded by a concrete retaining wall and a fence. Groundwater in the area is used as a source of drinking water with a public supply well located approximately 1,500 feet west of the waste-fill area. In addition, groundwater flows to the west toward the San Jacaquas River. About 500,000 gallons of perched water has accumulated within the waste-fill area as a result of precipitation/recharge. Evidence indicates that contamination of the water table is occurring due to the migration of perch water through the clay layer that exists beneath the waste-fill area. Approximately 1,500 cu yd of near-surface soil south and downgradient of the waste-fill area has been contaminated by mercury primarily as a result of previous surface runoff from the plant area. The primary contaminant of concern affecting the groundwater, soil, and debris is mercury. The selected remedial action for this site includes: onsite hydrometallurgical treatment of the waste-fill materials, perched water, and contaminated near-surface soil with disposal of the treatment residue in the former waste-fill area, followed by covering with a clean soil cover, and onsite treatment of the process leaching agent with discharge to a publicly-owned treatment works; additional investigation of the groundwater to determine the extent of contamination; and limited groundwater monitoring, provided there is no need for groundwater remediation. The estimated capital cost for this remedial action is $1,912,870. There are no O&M costs associated with this remedy. (Author's abstract)
W91-03565

SUPERFUND RECORD OF DECISION: NL/TARACORP/GOLDEN AUTO, MN.
Available from the National Technical Information Service, Springfield, VA 22161, as PB189542/AS. Price codes: AO3 in paper copy, AO1 in microfiche. Report No. EPA/ROD/RO5-88/077. September 1988. 30p, 4 fig.

Descriptors: *Cleanup operations, *Groundwater pollution, *Industrial wastes, *Lead, *Minnesota, *Path of pollutants, *Soil contamination, *Superfund, Asphalt capping, Drinking water, Monitoring, Soil remediation.

The NL/Taracorp/Golden Auto Parts site is located in St. Louis Park, Hennepin County, Minnesota. A secondary lead smelting facility operated onsite from 1940 until 1982. Land use adjacent to the site is light industry. There are residental areas within 0.25 mile of the site to the north, east, and west. Aquifers beneath the site serve as primary sources of drinking water in the area, supplying 90 percent of all groundwater used in the region. The site was originally owned by NL Industries, Inc., but was later divided and each portion sold to a succession of owners. One of these owners, Taracorp, owned and operated the lead smelting facility from August 1979 until February 1981. Secondary lead smelting operations recovered lead from lead plates, battery fragments, and lead containers. The industrial operations and onsite waste disposal activities resulted in elevated lead levels in air and onsite soil. Under a Consent Order, NL conducted onsite investigations and cleanup activities between 1985 and 1988 including soil remediation, capping the site with asphalt, and establishing a long-term groundwater monitoring program. As part of the Consent Order, NL was also required to investigate and, if necessary, clean up soil near the site possibly contaminated by windblown contaminants. This remedial action addresses the possibility of offsite soil contamination. Investigations indicate that offsite soil does not contain elevated levels of lead attributable to the site. There are no contaminants of concern attributable to the site affecting the offsite soil. The selected remedial action for this site is a no action remedy. The one residential yard that exceeds state and ATSDR

guidance levels for soil lead is not clearly attributable to the site, but will be addressed through a cooperative cleanup by NL Industries. There is no capital cost or O&M associated with this remedial action. (Author's abstract)
W91-03566

SUPERFUND RECORD OF DECISION: BROWN WOOD PRESERVING, FL.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-104795/AS. Price codes: AO in paper copy, AO1 in microfiche. Report No. EPA/ROD/RO4-88/034. April 1988. 358p, 3 fig, 7 tab.

Descriptors: *Cleanup operations, *Creosote, *Florida, *Groundwater pollution, *Path of pollutants, *Soil contamination, *Superfund, Biodegradation, Costs, Offsite disposal, Organic compounds, Polycyclic aromatic hydrocarbons.

The 55-acre Brown Wood Preserving Site is located approximately two miles west of the City of Live Oak, Suwannee County, Florida. The site is located in karst terrain in which sinkholes are a common geological feature. The areas surrounding the site are considered rural and light agricultural. There are four private wells located along the site periphery that obtain water from an aquifer 20-100 feet below the site. The public water supply wells for the City of Live Oak are located less than two miles away. The site contains a former wood preserving plant facility, which pressure treated timber products with creosote and some pentachlorophenol (PCP) for thirty years between 1948 and 1978. During this time, several different companies operated the facility. In addition, the facility was rebuilt following a fire in February 1974. Sludge and contaminated soils have been identified in the immediate vicinity of the plant site and an upgradient lagoon. This three-acre lagoon drains approximately 74-acres and contains water provided above approximately 3,000 cu yds of creosote sludge and contaminated soil. In addition, small amounts of solidified creosote and PCP are contained in onsite storage tanks and retorts. In 1981, EPA was notified by one of the former facility owners that hazardous waste may have been handled at the site. In July 1982, the Florida Department of Environmental Regulation (FDER) inspected the site and detected a number of organic compounds. An action, completed in February 1988, resulted in the removal of approximately 200,000 gallons of lagoon water and 15,000 tons of contaminated lagoon sludge and soil. The primary contaminants of concern affecting the soil, sediments, sludge, and wastewater are creosote constituents including Polycyclic aromatic hydrocarbons. The selected remedial action for this site includes: removal and treatment, if necessary, of lagoon water with discharge to a publicly-owned treatment works; excavation, treatment, and offsite disposal of approximately 1,500 tons of the most severely contaminated soil and sludge; onsite biodegradation of approximately 10,000 tons of the remaining soils in a 14-acre treatment area constructed with a liner and an internal drainage and spray irrigation system; covering of the treatment area with clean fill after bioremediation; and groundwater monitoring. The estimated present worth cost for this remedial action is $2,740,000. (Author's abstract)
W91-03567

ANIMAL WASTE POLLUTION AND ITS CONTROL (JAN 70-JUN 89). CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W91-03573

HEALTH ASSESSMENT FOR WHITTAKER CORPORATION NATIONAL PRIORITIES LIST (NPL) SITE, MINNEAPOLIS, HENNEPIN COUNTY, MINNESOTA, REGION 5, CERCLIS NO. MND006252233.
Agency for Toxic Substances and Disease Registry, Atlanta, GA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-100314/AS. Price codes: AO3 in paper copy, AO1 in microfiche. 1989. 13p. 3 ref.

Descriptors: *Cleanup operations, *Hazardous wastes, *Industrial wastes, *Minneapolis, *Public health, Industrial coatings, Remediation, Resins, Volatile organic compounds.

The Whittaker Corporation Site is a National Priorities List site located in Minneapolis, Hennepin County, Minnesota. Resins and industrial coatings are manufactured at the site. Without remediation, the site is of potential public health concern because of the risk to human health resulting from possible exposure to hazardous substances at unknown concentrations which, if elevated, may result in adverse human health effects. Human exposure to VOCs may occur via inhalation of contaminants in off-site soils, groundwater, and air and ingestion of and dermal contact with contaminants in off-site and groundwater. Recommendations include: providing adequate personal protective equipment for remediation workers; prevention of the installation of water supply wells into the contaminated aquifers; monitoring of wells until remediation is completed; and possible off-site transport of hazardous contaminants. (White-Reimer-PTT)
W91-03574

SURVEY REPORT: STATE ACTIVITIES TO PROTECT GROUND WATER FROM PESTICIDES.
Virginia Univ., Charlottesville. Div. of Urban and Environmental Planning.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-203954/AS. Price codes: AO6 in paper copy, AO1 in microfiche. Report No. 600/9-89/053. August 1988. 114p.

Descriptors: *Environmental management, *Groundwater pollution, *Groundwater quality, *Pesticides, *Regulations, *Water pollution control, *Water pollution prevention, Drinking water, Economic aspects, Monitoring, Training programs.

This report is part of the National Network for Environmental Management Studies conducted under the auspices of the Office of Cooperative Environmental Management, U.S. Environmental Protection Agency. It presents the results of a survey, conducted in the summer of 1988, to determine what states are doing to protect groundwater from pollution by pesticides. The report also highlights a variety of methods used by the states to finance their programs. Major components of state activities to protect groundwater may include: (1) an official groundwater protection strategy; (2) a pesticide management plan; (3) groundwater monitoring for pesticides; (4) regulatory programs; (5) groundwater classification; (6) pesticide user education; and (7) integrated pest management. State monitoring for pesticides in groundwater ranges from extensive ongoing programs to limited sampling in response to complaints or suspected problems. Regulatory programs include: groundwater quality standards for pesticides; the use of maximum containment levels (MCLs) to protect current or potential drinking water sources; requirements for specific control devices; regulation of distribution, sale, handling, storage, disposal and use of pesticides. Non-regulatory programs play a major role in many states' efforts to protect their groundwater from pesticides by: conducting seminars and voluntary training sessions for users of pesticides; developing integrated data systems; and integrating pest management and well head protection. A few states are working toward developing the capacity to overly groundwater vulnerability information with pesticide usage data in order to pinpoint potential groundwater contamination problems. The survey report will be used by EPA Headquarters and Regional personnel to prepare for presentations before states and their audiences. Kept in a looseleaf folder, the summaries can be separately revised as new information becomes available. (Author's abstract)
W91-03575

ADVANCED UTILITY SIMULATION MODEL, ANALYTICAL DOCUMENTATION, STATE LEVEL MODEL (VERSION 1.0).
Illinois Univ. at Urbana-Champaign. Coll. of Engineering.
For primary bibliographic entry see Field 7C.
W91-03581

SUPERFUND RECORD OF DECISION: OLD SPRINGFIELD LANDFILL, VT.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-204754. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/ROD/R01-88/033, September 1988. 215p, 3 fig, 12 ref, append.

Descriptors: *Cleanup operations, *Landfills, *Old Springfield Landfill, *Superfund, *Vermont, *Water pollution sources, Costs, Industrial wastes, Leachates, Municipal wastes, Organic compounds, Polychlorinated biphenyls, Site remediation, Tetrachloroethene, Trichloroethene, Waste disposal.

The Old Springfield Landfill site is located approximately one mile southwest of the city center in Springfield, Windsor County, Vermont. The landfill was operated by the Town of Springfield between 1947 and 1968 for the disposal of municipal solid waste and hazardous industrial liquid and semi-liquid waste. The site is currently owned by Springfield Mobile Home Estates, which operates a trailer park currently consisting of 38 mobile homes. Approximately 60 people reside in the Springfield Mobile Estates trailer park, built on top of the landfill. The site first came to the attention of the Vermont Department of Health because of a complaint by a nearby resident of foul-smelling water. Investigation of the site found volatile organic compound (VOC) contamination in a spring and in a residential well near the mobile home park. EPA began investigations at the site in 1976. Four areas of contamination have been identified at the site where industrial waste was either disposed of in discrete trenches or mixed with the municipal waste. This remedial action addresses landfill seepage and groundwater contamination. The remedial action is designed for management of contaminant migration and study of final remediation alternatives. The primary contaminants of concern affecting the groundwater, soil, and sediments are VOCs including benzene, tetrachloroethene, trichloroethene, toluene, and other organics including polychlorinated biphenyls and polycyclic aromatic hydrocarbons. The selected remedial action for this site includes: construction of an underground collection system to collect leachate; installation of wells for extraction of contaminated groundwater; onsite treatment of the collected leachate and extracted groundwater, or discharge to the Publicly Owned Treatment Works for treatment; institutional controls; and conducting additional studies to determine the feasibility of isolating water materials from the groundwater (e.g., french drain, slurry wall, or waste removal). The estimated present worth cost for this remedial action in $5,374,000 with annual O&M costs of $173,000. (Author's abstract)
W91-03586

SUPERFUND RECORD OF DECISION: WILDCAT LANDFILL, DE.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-196752. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R03-88/052, June 1988. 56p, 10 fig, 2 tab, 2 append.

Descriptors: *Cleanup operations, *Delaware, *Landfills, *Superfund, *Water pollution sources, *Wildcat Landfill Site, Benzene, Costs, Groundwater pollution, Heavy metals, Industrial wastes, Latex, Monitoring, Polychlorinated biphenyls, Site remediation, Volatile organic compounds, Waste disposal.

The Wildcat Landfill site is located 2.5 mi southeast of Dover in Kent County, Delaware. The 44-acre site is bordered to the north and east by the St. Jones River and its associated wetlands, and to the south and west by residential and commercial developments. A pond created by construction of the landfill, is located directly adjacent to the site along the northwestern edge. The pond is the subject of a second operable unit for the site. Portions of the site lie within the 100-year floodplain of the St. Jones River. The site was operated as a permitted sanitary landfill between 1962 and 1973, accepting both municipal and industrial wastes. Industrial wastes suspected to have been disposed include latex waste and paint sludges. Throughout its 11 years of operation, the facility routinely violated operating and other permits issued by regulating agencies. EPA began investigating the site in 1982. Typical wastes encountered at the site included municipal refuse latex in strips and sheets; scattered crushed, empty, or intact drums; and manufactured plastic items. Much of the waste is located on low-lying wetland. Consequently, in that area of the landfill, wastes are in direct contact with the, surficial sand aquifer. The primary contaminants of concern affecting the soil and groundwater are volatile organic compounds including benzene, other organics including PCBs, and metals including arsenic and lead. The selected remedial action for this site includes: grading, installation of a soil cover, and revegetation of onsite direct contact risk areas; removal and offsite disposal of drums containing wastes by landfilling (if not hazardous) or incineration (if hazardous); replacement of two domestic wells adjacent to the site; institutional controls including well and land use restrictions; and groundwater monitoring. The estimated present worth cost for this remedial action is $5,400,000. (Author's abstract)
W91-03587

WATER POLLUTION ABATEMENT EXPENDITURES IN THE WISCONSIN PAPER INDUSTRY.
Wisconsin Univ.-Madison.
T. B. Petersen.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-189765. Price codes: A04 in paper copy, A01 in microfiche. EPA Report No. 600/9-89/017, 1988. 48p, 5 fig, 7 tab. EPA Grant No. U-912840.

Descriptors: *Costs, *Pulp and paper industry, *Water pollution control, *Wisconsin, Alabama, Comparison studies, Dioxins, Economic aspects, Georgia, Industrial wastewater, Polychlorinated biphenyls, Standards, Wastewater treatment.

This study estimates the costs incurred by paper mills in the State of Wisconsin to comply with water pollution control requirements, and compares these costs to those incurred by similar mills in other states. Compared to 1965, discharges of conventional pollutants from Wisconsin's 47 paper mills have been reduced by about 90%. Current operating costs for treatment systems at Wisconsin paper mills are approximately $60 million annually. Paper mills in Georgia and Alabama spend less for wastewater treatment than Wisconsin mills as a result of several differences including: age and size of mills, product mix, production technology, and waste treatment technology. Paper mills in Wisconsin appear to be controlling wastewater discharges more effectively than mills in the other States based on the comparative incidence of discharge permit violations. The focus of wastewater treatment in Wisconsin paper mills is on toxic pollutants, especially dioxins and polychlorinated biphenyls (PCBs). Control of these toxic pollutants, which occur at low concentrations in mill effluent but which bioaccumulate to high concentrations in fish tissue, is costly and controversial. (Author's abstract)
W91-03589

EFFLUENT FEES: POLICY CONSIDERATIONS ON A SOURCE OF REVENUE FOR INFRASTRUCTURE FINANCING.
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
P. Casey.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-203780. Price codes: A03 in paper copy, A01 in microfiche. EPA Report No. 600/9-89/051, August 9, 1988. 32p, 2 fig, 17 ref.

Descriptors: *Effluent charges, *Environmental protection, *Financing, *Wastewater facilities, Cost-benefit analysis, Economic aspects, Federal jurisdiction, State jurisdiction, Taxes.

With the phasing out of EPA's construction grants program and the implementation of State Revolving Funds (SRF's), it appears that more money will be needed for the financing of wastewater treatment facilities in the next twenty years. Infrastructure needs for wastewater treatment facilities will increase significantly due to required replacement and upgrading needs, while users fees may be significantly understated due to years of capital subsidies. With Federal seed capital for the SRF's stopping after 1994, alternative sources of funding will be necessary. An effluent fee program could both offer a way to make the polluter pay and provide a reliable financing mechanism for the SRF's. This paper discusses the experience of effluent fees in Europe, and proposes an effluent fee program that would provide needed capital to the State Revolving Fund. The fee would be tied into the National Pollutant Discharge Elimination System permits through gradual implementation. Various options for settling the fee and enforcement procedures are also discussed. (Author's abstract)
W91-03592

IN SITU AQUIFER RECLAMATION BY CHEMICAL MEANS: A FEASIBILITY STUDY.
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
G. R. Peyton, M. H. LeFaivre, and M. A. Smith.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-197123/AS. Price codes: A05 in paper copy, A01 in microfiche. Report no. HWRIC RR-028, September 1988. 91p, 19 fig, 6 tab, 52 ref. HWRIC Project No. HWR86-011.

Descriptors: *Chemical treatment, *Cleanup operations, *Groundwater pollution, *In situ treatment, *Organic pollutants, *Water pollution treatment, Benzene, Feasibility studies, Free radicals, Reclamation.

Cleanup of groundwater contaminated by organic chemicals that adsorb to aquifer solids may require decades if the water is pumped to the surface to be treated by conventional technologies. In site treatment means treatment of the contaminant while it is still in the aquifer. It could conceivably take place at the rate at which the treatment can be transported to the contaminant. Although in situ biotic processes appear promising in many aquifer reclamation applications, chemical in situ reclamation using free-radical processes represents a complementary, and in some respects more general, method of destroying organic contaminants in aquifers. A feasibility study was conducted that demonstrated that chemical in situ aquifer reclamation can be feasible in at least some situations. In one experiment, 58 ppm (in the pore water) of benzene, used as the model contaminant, was 62% destroyed when the experiment was terminated at the end of two months. Reactive free radicals were generated from more stable water-soluble reagents which are pumped to the contamination region. The rate of generation of free radicals was not predictable from batch solution kinetic studies, but was accelerated, apparently due to the presence of promoter substances formed in the reaction of free radicals with soil material. The presence of 50 ppm alkalinity had no detrimental effect on the process. (Author's abstract)
W91-03598

SUPERFUND RECORD OF DECISION: CROYDEN TCE SPILL, PA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-229512. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R03-89/066, December 1988. 55p, 2 fig, 7 tab.

Descriptors: *Chlorinated hydrocarbons, *Cleanup operations, *Path of pollutants, *Pennsylvania, *Superfund, *Volatile organic compounds, Industrial wastes, Polychloroethane, Tetrachloroethane, Water pollution.

The Croyden TCE Spill site is located in Bristol Township, Bucks County, Pennsylvania. Volatile organic compound (VOC) contamination in the groundwater has been detected over a 3.5 sq mi area referred to as the study area. The study area is predominantly residential with an estimated 3,000 residents. A small southeastern portion of the study area containing elevated levels of VOCs, particularly TCE, and numerous potential source areas have been identified and are referred to collectively as the 'focused area of investigation.' This smaller area is composed of the Croyden residential community and several manufacturing and commercial establishments. The study area is bordered on the south by the Delaware River. Neshaminy Creek, which borders the study area to the west, and Hog Run Creek which flows through the focused area of investigation, both discharge to the river. Although the source of contamination has not been identified, the contaminant plume appears to be flowing south-southeast into the East Branch of Hog Run Creek and probably into the Delaware River. EPA identified the Croyden site following a series of studies beginning in 1984 conducted on the Rohm & Haas site, an industrial landfill, located on the southern boundary of the site. The primary contaminants of concern affecting the groundwater are TCE and PCE. The selected remedial action for the site includes connecting approximately 13 residences to the public water supply system via the construction of new water services lines, mains, hydrants, and valves; and groundwater monitoring to ensure that homes located outside of the TCE-contaminated zone will not be at risk from the migrating plume. The estimated present worth cost for this remedial action is $106,000 with annual O&M cost of $3,400 for 30 years. (Author's abstract)
W91-03601

SUPERFUND RECORD OF DECISION: ORDOT LANDFILL, GU.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-225569/AS. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/R09-88/022, September 1988, 44p, 2 fig, 2 tab, append.

Descriptors: *Groundwater pollution, *Guam, *Landfills, *Superfund, *Water pollution control, Drinking water, Hazardous wastes, Iron, Leaching, Manganese, Public health.

The Ordot Landfill site is located on the Island of Guam. The landfill is in a volcanic upland region, where site runoff flows directly into the adjacent Lonfit River. Water wells have not been drilled in the volcanics near the landfill. There is concern, however, that a suspected fault near the landfill may provide a hydrologic connection between the contaminants at Ordot Landfill and Guam's major drinking water aquifer located in the northern limestone province of Guam. The landfill is presently managed and operated by the Guam Department of Public Works, and has been receiving uncontrolled municipal wastes since before World Water II. Because it is the only major public waste disposal site on Guam it has received some hazardous waste during its history, including spent industrial and commercial chemicals, PCB-contaminated oils from transformers, and perhaps munitions. The facility uses almost the entire 47-acre waste disposal area, with only approximately 4 to 7 acres of the oldest portion of the landfill not currently in use. The current depth of disposed wastes is approximately 100 ft. In March 1986, EPA found Ordot Landfill in violation of the Clean Water Act for discharging landfill leachate to the Lonfit River without an NPDES permit. The 1987 initial site characterization study concluded that surface flow through the landfill is the source of leachate,

the site is hydrologically isolated from the island's sole source aquifer, there is an absence of organic contaminants, inorganic contamination is below the appropriate maximum contaminant limits (MCLs), and no air quality problems exist. The study concluded that current threats to human health and the environment are a result of poor landfill operation practices and not a result of the few acres of the landfill which are no longer in operation. The primary contaminants of concern affecting the groundwater and surface water include iron and manganese. The selected remedial action for this site is the no action alternative. EPA concludes that threats to human health and the environment can best be mitigated through addressing operation and maintenance of the landfill, and that the appropriate mechanism for implementing these controls is through enforcement of the Clean Water Act. Further, EPA concludes that any remedial action to address the inactive portion of the landfill would be jeopardized or nullified unless operation practices at the active disposal areas are improved. No costs are associated with the no action alternative. (Author's abstract)
W91-03607

SECOND CONFERENCE ON THE MANAGEMENT OF THE ILLINOIS RIVER SYSTEM: THE 1990S AND BEYOND.
For primary bibliographic entry see Field 6A.
W91-03608

WATER QUALITY IMPACTS OF ILLINOIS RIVER COMMERCIAL NAVIGATION.
Illinois State Water Survey, Peoria. Water Quality Section.
T. A. Butts, and D. B. Shackleford.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 19-27, 2 fig, 6 tab.

Descriptors: *Algal growth, *Environmental effects, *Illinois, *Illinois River, *Navigation, *Water quality, Barges, Ecological effects, Monitoring.

The Illinois Waterway is subjected to heavy commercial barge traffic. The opportunity to study the possible effects this traffic has on water quality was presented during two months of the summer of 1987, when the U.S. Army Corps of Engineers shut down operations at the Peoria and LeGrange dams for lock repairs. Physical, chemical and biological data were collected prior to the shutdown, during the shutdown, and after reopening during 1987 and during the summer of 1988. The data was rigorously analyzed using mathematical statistical procedures with the results revealing that in general, barge traffic does not appear to affect long-term water quality. Water clarity, as indicated by turbidity, suspended solids, and Secchi disk readings was better during 1988 when barge traffic was normal than during 1987 when the Peoria pool was not subjected to normal traffic. The significantly lower DOs during the summer of 1988 can be attributed to record high temperatures and persistent low flows rather than normal summer barge traffic. Barge traffic did not appear to have a marked effect on benthic macroinvertebrates since densities, diversity, and species numbers were greater during corresponding periods of 1988 than during 1987. Overall pool sediment conditions appeared comparable during both years, however, some localized changes may have occurred, particularly in the deep channel areas immediately above the two dams. Only algae densities appeared to be affected to some degree by barge traffic. The geometric mean of the algae density during 1988 was less than half of that encountered in 1987. The reason for such a reduction without a commensurate reduction in water quality is unclear at this time. However, if barge movement intrinsically keeps algal growth down, this could be looked upon as a benefit rather than a detriment. (See also W91-03608) (Lantz-PTT)
W91-03610

COMMENTS FOR ILLINOIS RIVER CONFERENCE PEORIA, OCTOBER 3-4, 1989.
Illinois State Water Survey Div., Champaign.
R. G. Semonin.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 41-45.

Descriptors: *Environmental effects, *Illinois, *Illinois River, *Management planning, *Peoria Lake, *Sedimentation, *Water quality, *Water resources management, Environmental protection, Public policy, Water quality management, Water resources development, Watershed management.

A rare opportunity is available to define and manage the future of the river with the support and encouragement of the people who work, live, and recreate along and on its waters. Movement must be made toward developing the best possible management programs for the river and its lakes, and to improve the environmental and ecological integrity of the river and lake areas. Peoria Lake must be viewed as a part of the Illinois River rather than as a separate entity; whatever is down to the Lake is down to the River and vice versa. Any programs established for the lake must be compatible for the river also, and must include the entire river basin. A comprehensive management plan for Peoria Lake must include two major components: (1) control of sediment input to the lake is essential; and (2) the disposition of the sediment in the lake and along its shoreline must be carefully considered. Major findings in recent Peoria Lake studies have found: (1) The lake had lost 68% of its 1903 capacity by 1985; (2) The average depth of the lake was reduced from 8 feet in 1903 to 2.6 ft in 1985; (3) The sediment rate in Peoria Lake is highest among the large reservoirs and lakes in Illinois; (4) The sedimentation rate in the upper lake is higher than in the lower lake; (5) The sediment rate in recent years has been higher than in earlier years; (6) The annual capacity loss is 2,000 acre-feet; and (7) The annual sedimentation rate is 2 million tons of sediment. (See also W91-03608) (Lantz-PTT)
W91-03613

PEORIA LAKE SEDIMENTATION AND PROPOSED ARTIFICIAL ISLANDS.
Illinois State Water Survey Div., Champaign.
M. Demissie.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 46-57, 6 fig, 2 tab, 9 ref.

Descriptors: *Artificial islands, *Illinois, *Lake restoration, *Peoria Lake, *Reservoir silting, *Reservoirs, *Sedimentation, Dredging, Islands, Lake sediments, Navigation, Recreation, Sedimentation rates.

Sedimentation in Peoria Lake has occurred at two distinct rates. For the period from 1903 to 1965, the sedimentation rate for Peoria Lake 0.63%/yr, which is relatively high but within the range for sedimentation rates for other large lakes and reservoirs in Illinois. The sedimentation rate for the period from 1965-1985 was 1.44%/yr, which is more than double the rate of the previous period and by far the highest sedimentation rate among the large lakes and reservoirs in Illinois. As sedimentation continues at the present rate, much of the lake outside of the navigation channel will be transformed into mudflats and wetland areas that will be flooded annually. The need for rehabilitation of Peoria Lake is therefore apparent. After evaluating many alternatives, the Illinois State Water Survey recommended a comprehensive plan, the creation of artificial islands by selective dredging of certain areas. The major benefits of selective dredging and island construction in Peoria Lake could include: (1) Improved and diversified aquatic and riparian habitats; (2) Dredged material disposal sites for both navigation channel maintenance and selective dredging; (3) Reduction of wind and navigation-induced resuspension of sediment and turbidity; (4) Reduction of sedimentation rates in the areas where islands are constructed; (5) More suitable water-based recreational sites at Peoria Lake. (See also W91-03608) (Lantz-PTT)
W91-03614

HABITAT RESTORATION FOR FISH AND WILDLIFE IN BACKWATER LAKES OF THE ILLINOIS RIVER.
Illinois State Water Survey, Peoria. Water Quality Section.
D. Roseboom, R. Twait, and D. Sallee.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 65-68, 4 ref.

Descriptors: *Backwater effect, *Habitat restoration, *Illinois, *Illinois River, *Lake restoration, *Peoria Lake, Aquatic habitats, Ecosystems, Fish, Fisheries, Recreation, Sedimentation, Wildlife.

The Lake Peoria Habitat Restoration project was sponsored by the Illinois Department of Conservation with Sport Fish Restoration funds to create a fish habitat; the Illinois River and Lake Peoria were once the greatest fishing and hunting areas in Illinois. Excessive rates of sedimentation are destroying Lake Peoria along with all of the backwater lakes of the Illinois River. Concurrent with this increased sedimentation, much of the aquatic vegetation disappeared between 1950 and 1965; high rates of sedimentation buried aquatic vegetation between thick layers of fluid sediments. Wave action prevents natural revegetation by uprooting young plants from the fluid sediments. When the aquatic vegetation died off, populations of waterfowl and game fish declined quickly. The Lake Peoria Restoration project has developed low cost techniques to restore aquatic vegetation. For example, when placed behind a tire breakwater, arrowhead and pondweed plantings have been successful. Both the breakwater and plant beds have survived two winters after initial plantings. The breakwater also serves as an artificial reef. Game fish response has been quick and dramatic. The number of fish species has doubled and the numbers of fish have quadrupled. The vegetated area serve as a nursery for young bluegill, channel catfish and bass. In 1989, large bluegill were found on the vegetated site only. The number and total weight of bluegill and channel catfish in the vegetated area exceeded the number and total weight of all fish (mainly carp) in the control area. (See also W91-03608) (Author's abstract)
W91-03616

BENEFITS OF TARP TO THE ILLINOIS RIVER.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5D.
W91-03617

ENVIRONMENTAL MANAGEMENT PROGRAM PROPOSALS: THE ILLINOIS BASIN.
Illinois State Dept. of Transportation, Springfield.
B. Donels.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 77-80.

Descriptors: *Environmental effects, *Environmental policy, *Illinois, *Illinois River Basin, *Management planning, *Water pollution control, *Water resources management, Environmental protection, Federal jurisdiction, Habitat protection, Illinois River, Long-term planning, Mississippi River, Monitoring, Peoria Lake, Project planning, Recreation.

The environmental Management Plan, established by Congress in 1986, is composed of 5 program

elements: (1) Habitat improvement projects; (2) Long-term resource monitoring; (3) Recreational projects; (4) Recreation economics study; and (5) Navigation traffic monitoring. The US Army Corp of Engineers implements the Environmental Program. Nine major Environmental Management Program Habitat Improvement Projects are recommended for design and eventual implementation in the Illinois basin. These projects include the Peoria Lake island construction and habitat improvement project; the Banner Marsh Habitat Rehabilitation and Enhancement Project in the LeGrange Pool; The Rice Lake Complex Habitat Rehabilitation and Enhancement--Phase I project in the La Grange Pool; the Chautauqua Lake project in La Grange Pool; the Sanganois Wildlife Area Project; the Alton Pool side channels near the mouth of the Illinois River; the Stump Lake project; the Swan Lake Refuge; and, the Calhoun Point project. (See also W91-03608) (Lantz-PTT)
W91-03618

ILLINOIS RIVER AND PEORIA LAKES: IT'S TIME TO ACT.
Caterpillar Tractor Co., Peoria, IL.
For primary bibliographic entry see Field 6A.
W91-03621

VALUE OF CITIZEN STREAM QUALITY MONITORING AS AN EDUCATIONAL TOOL.
Wheaton Park District, IL.
B. S. McDonald.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 133-138.

Descriptors: *Education, *Illinois, *Monitoring, *Public participation, *Water quality, Aquatic environment, Data acquisition, Ecosystems, Macroinvertebrates, Streams, Training, Water sampling.

Stream Quality Monitoring (SQM) is an educational and data collection tool used by natural resource agencies to promote stream awareness and protection. SQM is based on the analysis of a stream macroinvertebrate population according to their relative tolerance to pollution. By simply looking at a stream's macroinvertebrate population, the general health of the aquatic system can be determined. Over the past few years SQM has gained wide acclaim across the country as an excellent citizen involvement and educational/interpretive program. Concerned citizens, conservation groups, and schools have adopted streams or segments of streams to monitor the quality of the water using this method. Networks of groups working throughout a watershed can help determine problem areas and sometimes are successful at finding the problem source. The equipment is inexpensive and the technique is simple. There is presently an Illinois SQM program being developed for implementation on a statewide basis and should be available by Spring 1990. (See also W91-03608) (Author's abstract)
W91-03624

USEPA PERSPECTIVE ON NONPOINT POLLUTION CONTROL AND WETLANDS FUNCTION.
Environmental Protection Agency, Chicago, IL. Region V.
R. Pepin, T. Davenport, and D. Ehorn.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 171-174.

Descriptors: *Federal jurisdiction, *Illinois, *Nonpoint source pollution, *Regulations, *Water pollution control, *Wetlands, National Pollutant Discharge Elimination, Permits, Water pollution prevention, Water pollution sources.

Historically, the major emphasis on the national water pollution control program has be the controlling and elimination of the discharge of pollutants from point sources. This focus has resulted in drastic reductions of a variety of pollutants through direct elimination under the National Pollutant Discharge Elimination System (NPDES) permit program. As a result of point source control successes, nonpoint source water pollution has emerged more clearly as a major continuing source of pollution to the Nation's waterways, threatening or prohibiting full attainment of water quality goals of the Clean Water Act. The nature, extent and effect of nonpoint source pollution on the waters of the state are assessed. The Region V Wetlands program consists of enforcement, public information and education, advanced identification, state program delegation, and public notice and review of proposals to fill wetlands. As part of a review, the US EPA looks at the technical merit of the proposed standards. US EPA has also issued guidance in the form of two documents: the Water Quality Standards Handbook and the Technical Support Document for Water Quality-Based Effluent Limits. Numeric criteria are quantifiable levels of specific pollutants or classes of pollutants. In the past there was typically one number for a particular pollutant that was not to have been exceeded. This approach failed to take into account possible adverse effects from long-term or repeated exposures. US EPA, therefore, has been recently advocating a two level approach for pollutants: a short-term or acute value, and a long-term, or chronic value. (See also W91-03608) (Lantz-PTT)
W91-03631

NUTRIENT LOADING STATUS OF THE CONESTOGA RIVER BASIN, 1985-1989.
Susquehanna River Basin Commission, Harrisburg, PA. Resource Quality Management and Protection Div.
For primary bibliographic entry see Field 5B.
W91-03647

STATE GROUNDWATER PROTECTION POLICIES: A LEGISLATOR'S GUIDE.
National Conference of State Legislatures, Denver, CO.
L. Morandi.
National Conference of State Legislatures, Denver, Colorado. May 1989. 81p, 4 tab, 22 ref, append. Edited by Sharon Schwoch.

Descriptors: *Environmental protection, *Groundwater policy, *Legislation, *State jurisdiction, *Water pollution prevention, Case studies, Federal jurisdiction, New York, Public policy, Regulations, Wisconsin.

State governments are taking the lead in formulating groundwater protection policy. While executive agencies took the lead in fashioning the initial state groundwater programs, state legislatures have assumed the major responsibility for program development during the past six years. Federal groundwater policy consists of a series of uncoordinated statutes addressing specific sources of pollution--Resource Conservation and Recovery Act (RCRA) and Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)--or groundwater only peripherally--Clean Water Act and Safe Drinking Water Act. It also is comprised of an Environmental Protection Agency (EPA) strategy that emphasizes the predominant role of the states and the need to strengthen their institutional management capacity. There has been significant state legislative activity beginning with passage of Wisconsin's 1983 Act 410. While much of the legislation has been directed at regulating specific discharge sources--primarily agricultural chemicals and underground storage tanks--comprehensive policies capable of integrating a range of pollutants into a single management framework also have been adopted. New York's land use/aquifer protection law served as a blueprint for the 1986 Safe Drinking Water Act amendments that established a federal sole source aquifer protection demonstration program. Nebraska extended the land use management concept to water use management with passage of legislation to minimize irrigation-induced nitrate concentrations in groundwater. Because of the close physical ties between a diverse set of land use activities and groundwater quality, groundwater law will affect a wide range of vested interest groups. Consensus building may be required to supplement the adversarial nature of the legislative process if agreement on complex groundwater policy is to be reached and sustained through policy implementation. Translating legislative intent into administrative action has been an evolutionary process for groundwater. The availability of preventive action limits has provided a tool to define the onset of pollution and control additional degradation regardless of what standard is used as a ceiling. The document is intended to be a practical guide for state legislators as they consider groundwater protection policies. (Lantz-PTT)
W91-03657

ECONOMIC IMPLICATIONS OF GROUNDWATER CONTAMINATION TO COMPANIES AND CITIES.
Freshwater Foundation, Navarre, MN.
For primary bibliographic entry see Field 5C.
W91-03660

WATER AND THE ENVIRONMENT: THE IMPLEMENTATION OF EUROPEAN COMMUNITY DIRECTIVES ON POLLUTION CAUSED BY CERTAIN DANGEROUS SUBSTANCES DISCHARGED INTO THE AQUATIC ENVIRONMENT.
Department of the Environment, Cardiff (Wales). Welsh Office.
Department of the Environment, Cardiff, Wales. Circular 7/89, March 30, 1989. 86p, 2 append.

Descriptors: *Environmental protection, *European Economic Community, *Hazardous wastes, *Regulations, *Wales, *Water pollution control, *Water quality control, Aquatic environment, Asbestos, Bioaccumulation, Organic compounds, Standards.

The Secretaries of State for the Environment and for Wales are directed to draw to the attention of the relevant authorities European Community Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community, and those directives made within its framework. These directives provide for the control of the discharge of certain dangerous substances into the aquatic environment. DOE Circular 18/85 of 2 September 1985 instructed and advised water authorities on the implementation of these directives. This Circular up-dates and adds to that advice, partly in the light of new directives, and therefore supersedes the previous circular. It also constitutes formal advice on implementing the requirements of certain decisions on the control of dangerous substances under the Paris Convention (on the protection of the North sea from pollution from land-based sources) which closely mirror the requirements of these directives. This circular also instructs competent authorities on the implementation of the relevant provisions of directive 87/217/EEC on the prevention and reduction of environmental pollution by asbestos, which does not fall within the framework of directive 76/464/EEC. The Annex to Directive 76/464/EEC comprises a list of families and groups of dangerous substances, selected mainly on the basis of their toxicity, persistence and bioaccumulation (List I), and a separate list (List II) of substances that can also have deleterious effects on the aquatic environment, which may, however, 'be confined to a given area and which depend on the characteristics and location of the water into which they are discharged'. Article 2 of the directive requires that Member States take steps to eliminate pollution by List I substances and to reduce pollution by List II substances. The Directive provides for different methods of control for List I and List II substances, although in each case it is a basic requirement that discharges to the aquatic environment must be authorized and emission standards laid down. (Lantz-PTT)
W91-03661

GREAT LAKES: LIVING WITH NORTH AMERICA'S INLAND WATERS.

For primary bibliographic entry see Field 2H.
W91-03672

AGENDA FOR THE MANAGEMENT OF THE GREAT LAKES ON A LONG TERM ECOSYSTEM BASIS.
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 6E.
W91-03675

REMEDIAL ACTION PLANS: A GREAT LAKES PROGRAM WHOSE TIME HAS COME.
International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 6B.
W91-03677

MANAGEMENT OF LAKE ONTARIO RESOURCES: A HOLISTIC PERSPECTIVE.
State Univ. of New York at Buffalo.
For primary bibliographic entry see Field 2H.
W91-03678

CHICAGO AND ITS LAKEFRONT: LIVING ON THE EDGE.
Chicago Shoreline Protection Commission, IL.
For primary bibliographic entry see Field 6G.
W91-03679

UNITED STATES NONPOINT SOURCE PHOSPHORUS REDUCTION EFFORT.
Environmental Protection Agency, Chicago, IL. Region V.
R. Christensen, T. E. Davenport, and B. A. Kirschner.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 173-177, 4 tab, 2 ref.

Descriptors: *Governmental interrelations, *Great Lakes, *Lake management, *Phosphorus, *Water pollution control, *Water quality management, *Water resources management, Eutrophication, Farm wastes, Interagency cooperation, Lake Erie, Lake Ontario, Municipal wastewater, Nonpoint pollution sources, Nutrient removal, Pollution load, Regulations, Water quality control, Water quality standards.

A general framework for reducing phosphorus loadings to the Great Lakes was set forth in Annex 3 of the Great Lakes Water Quality Agreement of 1978. This document established base and future phosphorus loads for each of the Great Lakes, presenting a general plan for decreasing eutrophication and improving water quality in the Lakes system. The governments of the U.S. and Canada were to confirm these target loads within 18 months of signing the agreement. In 1983, a Supplement to Annex 3 was developed and approved, providing a more detailed plan for reducing phosphorus by confirming the load reduction goals set in the original Annex document and by determining that further reductions would be needed after municipal treatment plants had achieved the required phosphorus load reductions. The Supplement recommended annual load reductions for each of the Great Lakes and for several key embayments over a five-year period ending in 1990. The Supplement placed special emphasis on reducing phosphorus loadings to Lake Erie, Lake Ontario, and Saginaw Bay. In order to achieve these target goals, each state and province was required to develop and implement a detailed phosphorus load reduction plan for each waterbody in question. The purpose of the state plans was to ensure that each state would achieve full compliance with point source discharge limits and that agricultural phosphorus loads were reduced through conservation tillage and improved nutrient management. The allocation of load reductions among states primarily reflects the potential in each state for reducing phosphorus loading to each waterbody in question. The State Phosphorus Reduction Plans were consolidated in the overall U.S. Plan. (See also W91-03672) (Author's abstract)
W91-03691

PHOSPHORUS LEVELS IN ONTARIO STREAMS TRIBUTARY TO THE GREAT LAKES A DECADE AFTER PLUARG.
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5B.
W91-03695

LAKE MICHIGAN TOXIC POLLUTION CONTROL/REDUCTION STRATEGY.
Environmental Protection Agency, Chicago, IL. Region V.
K. A. Fenner, and T. E. Davenport.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 221-226, 1 tab.

Descriptors: *Clean Water Act, *Great Lakes, *Lake Michigan, *Lake management, *Water Quality Act, *Water pollution control, *Water quality management, *Water resources management, Environmental policy, Governmental interrelations, Illinois, Indiana, Interagency cooperation, Lake restoration, Michigan, Model studies, Wisconsin.

Two goals in both the Clean Water Act and the 1978 Great Lakes Water Quality Agreement are: to restore, protect, and enhance the physical, chemical, and biological integrity of the Great Lakes. Lake Michigan is the largest body of fresh water totally within the borders of the U.S. It is used by millions as a drinking water supply and for recreation, such as boating, swimming, and sport fishing. It is also an important commercial fishery and transportation resource. At present however, lake uses are impaired because of the concentration of toxic pollutants found in its waters, sediments, fish, and birds. In recognition of these facts, Region V of the U.S. Environmental Protection Agency (EPA) and the states of Illinois, Indiana, Michigan, and Wisconsin have agreed to work together to end the Lake's toxic substance pollution problem. The Lake Michigan Toxic Pollutant Control/Reduction Strategy has been prepared as an implementation plan to eliminate toxic pollutant problems from the Lake Michigan system. The Strategy proposes a two-phase process to guide restoration efforts beginning in 1986. Phase 1 is intended to define, quantify, and control the major sources of pollutants of concern (POCs) to Lake Michigan (1986-1991), and Phase 2 is designed to use models to determine if further controls are necessary. Region V Water Division established an intra-agency, multimedia workgroup to facilitate and track implementation of the Strategy within the EPA. Implementation of this Strategy will be closely coordinated with the Great Lakes Governors' Toxic Control Agreement and The Water Quality Act of 1987. (See also W91-03672) (Fish-PTT)
W91-03696

NONPOINT POLLUTION: 1988-POLICY, ECONOMY, MANAGEMENT, AND APPROPRIATE TECHNOLOGY.
Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. 314p. Edited by V. Novotny.

Descriptors: *Economic aspects, *Environmental policy, *Nonpoint pollution sources, *Water policy, *Water pollution control, *Water pollution sources, *Water resources management, Governmental interrelations, Groundwater quality, Land use, Legal aspects, Management planning, Political aspects, Storm water management, Technology, Watershed management.

Pollution control is an enormous political and legal challenge. In the United States the Commerce Clause of the Constitution, in a strange process, constitutes the legal and political foundation of the point source control. It was reinterpreted as giving authority to the Federal Government to control point discharges of pollution into navigable waters. Unfortunately, the point source definition covered only about 50 percent of pollution loads. The rest originated from diffuse (nonpoint) sources for which controls are difficult to legislate and implement. Nonpoint pollution is generally caused by use and misuse of the land. In the last 15 years, various means of controlling nonpoint pollution have been developed which are generically known as 'Best Management Practices.' A political and institutional mechanism is emerging to implement these practices wherever surface or groundwater quality is impaired. The Nonpoint Pollution Symposium contains papers that are devoted primarily to nontechnical issues and to the solutions of nonpoint pollution abatement programs and they also contribute to the discussion on the nontechnical topics of diffuse pollution abatement. They are generally grouped into the categories: policies of nonpoint pollution abatement; economics, economic efficiency, and equity of the programs; NPS abatement programs--institutions and regional, state, and watershed approaches; urban stormwater management--legal and institutional aspects; innovative approaches to urban stormwater management; and surface and groundwater quality impact of diffuse pollution and its mitigation. (See W91-03705 thru W91-03736) (Fish-PTT)
W91-03704

FEDERAL ENVIRONMENTAL LEGISLATIVE PROCESS.
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 6E.
W91-03705

GROUNDWATER QUALITY: THE ROLE OF AGRICULTURAL POLITICS AND POLICY.
Iowa Univ., Iowa City. Dept. of Geography.
For primary bibliographic entry see Field 6E.
W91-03706

GROUND WATER POLICY OF USDA.
Department of Agriculture, Washington, DC.
For primary bibliographic entry see Field 6E.
W91-03707

REDUCING NITROGEN POLLUTION FROM CROP PRODUCTION SYSTEMS: A WATERSHED PERSPECTIVE.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
P. E. Norris, and L. A. Shabman.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 29-38, 1 tab, 17 ref.

Descriptors: *Crop production, *Nitrogen compounds, *Nonpoint pollution sources, *Water policy, *Water pollution control, *Water pollution sources, *Water resources management, *Watershed management, Agricultural chemicals, Agricultural practices, Farm wastes, Farming, Fertilizers, Groundwater pollution, Groundwater recharge, Nutrient transport, Reforestation, Riparian land, Riparian vegetation, Surface-groundwater relations.

There are two complementary strategies that promise to reverse the trends in nitrogen (N) pollution identified over 25 years ago, when viewed from a whole watershed perspective. Most generally, these can be described as (1) substitution of inputs in farm production systems, and (2) selective and targeted reforestation of cropland along water bodies. The input substitution strategy seeks to reduce the total amount of commercially manufactured N fertilizer applied to cropland. Commercially manufactured fertilizer is highly susceptible to runoff and leaching. Substitutes for one time application of commercial N fertilizer may be any combination of the following: substitute planting of winter cover crops and rotation changes to serve as N sinks and sources; and substitute animal waste from beef, poultry and hog production systems. Promoting adoption of the necessary substitutions in farming systems will be the policy challenge facing water quality managers and will take water quality management beyond the typical agricultur-

al nonpoint source control programs that are now in place. A cropland reforestation strategy, as a complement to input substitution, would seek to increase the extent of wooded riparian habitat along stream bodies. There is substantial evidence that such wooded habitat can be an effective trap for nutrients carried in surface water runoff and in groundwater recharge to surface waters. Management of riparian woodlands through selective harvesting may, in turn, increase N uptake by the trees. Combining the forested woodland buffer with changes in farm production systems could increase the reliability of either system taken separately as an effective N pollution management strategy. (See also W91-03704) (Fish-PTT)
W91-03708

ECONOMIC IMPLICATIONS OF THE FOOD SECURITY ACT OF 1985'S DISCRETIONARY ENVIRONMENTAL PROVISIONS.
Economic Research Service, Washington, DC.
For primary bibliographic entry see Field 6E.
W91-03710

NONPOINT POLLUTION POLICIES AND POLITICS: THE ROLE OF ECONOMIC INCENTIVES.
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. B. Braden.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 57-65, 13 ref.

Descriptors: *Economic aspects, *Economic incentives, *Environmental policy, *Nonpoint pollution sources, *Political aspects, *Water policy, *Water pollution control, *Water quality control, *Water resources management, Alternative planning, Compliance, Cost-benefit analysis, Design standards, Effluent charges, Fines, Permits, Regulations, Subsidies, Water pollution sources.

Economic incentives have been utilized to a remarkable extent already in diffuse source pollution control programs. But, those programs have a long way to go, and economic incentives can contribute far more than they have to date. Four specific forms of economic incentives and their potential to contribute to nonpoint pollution abatement were considered: (1) fees for polluting inputs; (2) fines and 'alternative controls' combined with design standards; (3) further applications of cross compliance; and (4) abatement subsidies. Subsidies are not a viable primary instrument for diffuse source pollution abatement program. They are too costly and subject to perversion. Far more appropriate incentives will result if more responsibility for abatement is placed on polluters. In the nonpoint source case, there seems to be little option but to do this through design standards that, if complied with by all, would accomplish desired objectives for ambient water quality. The design standards would provide a basis for considering alternative control systems both for individuals and as part of a regional 'bubble.' Transferability of permits would provide the incentives to participate in collective strategies and supernormal abatement. In these ways, a fundamentally regulatory system could be made more flexible, individuals would retain some freedom of choice, and collective solutions would be encouraged. (See also W91-03704) (Fish-PTT)
W91-03711

INSTITUTION-SENSITIVE APPROACH TO THE USE OF ECONOMIC INSTRUMENTS FOR NONPOINT SOURCE WATER POLLUTION CONTROL.
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
E. Feitelson.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 67-76, 1 tab, 13 ref, append.

Descriptors: *Economic aspects, *Economic incentives, *Environmental policy, *Land use, *Legal aspects, *Nonpoint pollution sources, *Water pollution control, *Water pollution sources, *Water resources management, Administrative agencies, Alternative planning, Chesapeake Bay, Economic feasibility, Maryland, Nonstructural alternatives, Regulations, Research priorities, Water policy.

Land use controls are often suggested as the primary tool for controlling nonpoint source water pollution. They are limited, however, in dealing with existing land uses and by the U.S. Constitution. They are also criticized on efficiency grounds. Economists often suggest economic instruments as alternatives for regulations, yet the implementation of such instruments has been tentative at best. Literature reviews reveal a number of institution-related issues impeding more extensive use of economic instruments. Economic instruments should complement land use controls for nonpoint source water pollution control. A generalized approach to the choice of economic instruments, if any, is suggested. It is based on answering three questions regarding the goals of the implementing authority, whom it wants to shoulder the burden, its market situation and administrative capabilities. The first two questions define the desirability set out of a general opportunity set of all possible instruments. The latter question defines the feasibility set. The chosen economic instruments will be found in the intersection between the desirability and feasibility sets. Examination of case of the Chesapeake Bay, Maryland, reveals the lack of information regarding institutional desires and the lack of data regarding the minimal requirements for implementing various economic instruments. These are suggested as future research directions. (See also W91-03704) (Author's abstract)
W91-03712

ECONOMICS OF SILVICULTURAL BEST MANAGEMENT PRACTICES.
Forest Service, Atlanta, GA.
G. E. Dissmeyer, and E. Frandsen.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 77-86, 4 tab, 12 ref.

Descriptors: *Best management practices, *Cost-benefit analysis, *Economic aspects, *Forest management, *Nonpoint pollution sources, *Resources management, *Water pollution control, Environmental policy, Land use, Soil management, Water policy, Water resources management.

Implementing best management practices (BMPs) for managing nonpoint sources of pollution is often viewed as a cost with no returns by the majority of forest landowners and managers. However, a national effort by the U.S. Department of Agriculture (USDA) Forest Service found that a wide variety of BMPs can produce positive economic returns to the landowner. For the purposes of this project, the Forest Service policy adopted the concept that the resource activity or program incurring the costs must account for the benefits derived. To be useful to the project, examples had to meet two criteria: (1) investments in soil and water resource management were made; and (2) identifiable induced outputs resulted from implementing soil and water resource management. The project developed five matrices to estimate economic benefits from soil and water resource management for the emphasis areas. Three examples demonstrated the application of these concepts, matrices, and analytical procedures. It was concluded that economic analyses of BMPs provides several positive results: (1) they demonstrate the potential value of implementing BMPs to the landowner and forest operator; (2) induced resource outputs from implementing BMPs can be estimated using interdisciplinary skills and tools; (3) by translating BMP implementation into cost savings, it fosters better communication between nonpoint source pollution managers and forest landowners, foresters, and forest operators; and (4) economic evaluations of BMPs and nonpoint source management projects will identify where they are cost-effective. These procedures will be useful to a variety of governmental agency, industrial, university, and private applications. (See also W91-03704) (Fish-PTT)
W91-03713

EQUITY AND EFFICIENCY ASPECTS OF ALTERNATE STORMWATER MANAGEMENT FINANCING SYSTEMS.
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
G. Lindseyl.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 87-96, 1 tab, 14 ref.

Descriptors: *Cost-benefit analysis, *Economic aspects, *Economic efficiency, *Economic evaluation, *Financing, *Nonpoint pollution sources, *Storm water management, *Urban runoff, *Water resources management, Public policy, Taxes, User charges, Utilities, Water policy.

Although storm water management historically has been regarded as a public good, it has characteristics of private goods as well. Economic theory suggests that gains in efficiency can be achieved by using charges rather than taxes to finance storm water management. Data from a survey of storm water utilities show that most utilities are financed by a combination of user charges and taxes. Data indicate that nonresidential users are more likely than residential users to provide on-site controls in response to charges. Considering this, the use of taxes rather than charges for residential users would tend to resemble the structure that might be imposed by utilities using Ramsey pricing. In a comparison of payments under user charge and property tax systems, it was shown that residential users would pay less under a charge system than under a tax system, while industrial and tax-exempt users, among others, would pay more. It was suggested that user charges may provide opportunities for increases in equity as well as efficiency. Finally, using simple public choice concepts, it was shown that local officials would be likely to support a proposal to a user charge system. (See also W91-03704) (Fish-PTT)
W91-03714

REVENUE SOURCES FOR NONPOINT SOURCE POLLUTION ABATEMENT: AN ECONOMIC ANALYSIS.
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. B. Braden, R. L. Farnsworth, J. W. Mill, W. D. Seitz, and D. L. Uchtmann.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 97-106, 14 ref.

Descriptors: *Cost-benefit analysis, *Economic evaluation, *Financing, *Nonpoint pollution sources, *Taxes, *Water pollution control, *Water resources management, Government finance, Illinois, Payment, User charges, Water policy.

Pressure for abatement of nonpoint source pollution is growing. These abatement programs could turn out to be extremely expensive, especially if the 'polluters pay' principle continues to be shunned. Nontraditional revenue sources for nonpoint source pollution abatement include: erosion taxes, fertilizer and pesticide taxes, property taxes and assessments, potable water use taxes and surcharges, recreation license fees, recreation access fees, and excise taxes on recreation equipment and fuel. Where possible, the revenue-generating potential of each was evaluated using illustrative data from Illinois. The results point to potable water surcharges and recreation license fees as particularly promising mechanisms for state governments. Property taxes, special property assessments and potable water surcharges are promising mechanisms for local governments. (See also W91-03704) (Author's abstract)
W91-03715

NONPOINT SOURCE REGULATION--A WATERSHED APPROACH.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 4D.
W91-03717

IMPLEMENTATION OF THE NEBRASKA NITRATE CONTROL LEGISLATION.
Nebraska Natural Resources Commission, Lincoln.
For primary bibliographic entry see Field 6E.
W91-03719

CREATING SUCCESSFUL PROGRAMS: THE INNOVATIVE TOUCH.
Weston (Roy F.), Inc., Washington, DC.
C. M. Gesalman, A. L. Marasco, and M. Elliott.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 141-148, 3 ref.

Descriptors: *Alternative planning, *Nonpoint pollution sources, *Water policy, *Water pollution control, *Water resources management, Compliance, Financing, Florida, Idaho, Illinois, Interagency cooperation, Iowa, Management planning, Maryland, Minnesota, Oregon, Pennsylvania, Regulations, Technology, Utah, Virginia, Washington, Water pollution sources, Wisconsin.

Concepts and characteristics associated with creative nonpoint source pollution problem solving include formation of unusual partnerships (Tillamook Bay, Oregon; Lake Springfield, Illinois), development of creative funding sources (Utah; Bellevue, Washington; Idaho forests), planning for results (Big Spring, Iowa; Queen Anne County, Maryland), targeting (Wisconsin; Susquehanna River, Pennsylvania; Chesapeake Bay, Maryland), use of new technologies (Virginia; southeastern Minnesota), creative recasting of the problem (Florida), and self-regulation for better compliance (Tillamook Bay, Oregon; Illinois farming; Idaho forests). These concepts might help managers of newer programs save time, money, and energy in solving their own problems, as well as give a boost to programs that may be in need of a new direction or approach. In addition, they are a starting point for gathering information on other creative program approaches. The Environmental Protection Agency and the states are moving into a new phase of the nonpoint source control effort with the initiatives created by the 1987 amendments to the Clean Water Act. New ideas will be needed to solve the current generation of problems. (See also W91-03704) (Fish-PTT)
W91-03720

INTEGRATED RESOURCE MANAGEMENT: REGION V'S NONPOINT SOURCE CONTROL AND CLEAN LAKES PROGRAM.
Environmental Protection Agency, Chicago, IL. Region V.
T. E. Davenport, D. E. Roberts, B. A. Kirshner, and C. E. Loggins.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 149-154, 4 ref.

Descriptors: *Administrative agencies, *Environmental policy, *Lake restoration, *Nonpoint pollution sources, *Water pollution control, *Water resources management, Drinking water, Eutrophic lakes, Farm wastes, Governmental interrelations, Illinois, Lake management, Minnesota, Recreation, South Dakota, Water quality control, Water quality management.

The U.S. Environmental Protection Agency's Region V has thousands of lakes, most of which are located in Minnesota, Wisconsin, and Michigan. These lakes provide drinking water and/or recreational opportunities for millions of people each year. Generally, lakes located in the southern portion of these states have been affected by long-term degradation processes such as runoff from agricultural and urban areas. Historically, the Clean Lakes Program has focused on in-lake measures. While these solutions provide enhanced recreation potential in the short term, they are extremely costly and often do not address the basic causes of eutrophication. The Clean Lakes Program received low levels of funding over the past several years and therefore very few lakes have been rehabilitated. The Region has been involved in 71 individual lake restoration projects as part of the Clean Lakes Program in the last ten years. Some examples which highlight the Regional approach are: Lake Le-Aqua-Na in northwestern Illinois, Clearwater Chain-of-Lakes in Minnesota, and Big Stone Lake on the Minnesota and South Dakota border. In order to increase program participation and accomplishments, Region V will encourage the states to redirect their programs to implement comprehensive solutions. There are many lakes within the Region where management solutions can improve quality. (See also W91-03704) (Author's abstract)
W91-03721

SOUTHEASTERN MINNESOTA COOPERATES TO DEVELOP AN INNOVATIVE APPROACH TO NONPOINT POLLUTION.
Zumbro/Root River Water Quality Task Force, Minnesota.
For primary bibliographic entry see Field 6E.
W91-03722

INTEGRATED EXPERIENCE--THE MILWAUKEE RIVER EAST-WEST BRANCH WATERSHED RESOURCE MANAGEMENT PLAN.
Wisconsin Dept. of Natural Resources, Milwaukee.
For primary bibliographic entry see Field 4D.
W91-03723

STORMWATER PERMITS--A POINT SOURCE UMBRELLA FOR NONPOINT POLLUTION PROBLEMS.
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
V. Novotny.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 173-182, 2 tab, 12 ref.

Descriptors: *Nonpoint pollution sources, *Permits, *Storm water management, *Water pollution control, *Water resources management, Administrative regulations, Economic aspects, Financing, Legal aspects, Regulations, Wastewater disposal, Water policy, Water pollution sources, Water quality control.

Point source pollution has a statutory definition that includes pollution carried by pipes, ditches, channels, tunnels, and concentrated animal operation. In contrast, nonpoint pollution is everything else. In order to enforce or regulate pollution abatement, a 'pointization' of nonpoint sources is legally needed. The present trend is to expand the definition of point sources to the remaining sources in order to make them legally eligible for mandated control. Installing storm sewers is a polluting activity which must be subjected to a permit system. Some problems exist, such as who should pay for pollution abatement and what type of permit is necessary, and several legal and technical (administrative) problems must be resolved. A stormwater permit system is an ambitious pollution abatement program which is unparalleled in scope. If not properly and carefully designed it could become an administrative nightmare. Since it addresses mostly local problems, the financing mechanisms will not be the same as those for point source pollution but abatement may not be as costly. It can be expected that the 'polluter pays' principle will be prevalent. Application of the National Pollution Discharge Elimination System (NPDES) permit system to urban stormwater sources is necessary due to externalities and diseconomics involved and general inefficiency of voluntary approaches. Institutional arrangements for this program are not yet in place and must evolve from existing agencies and programs. Regional solutions and approaches may be needed in water-quality-limited situations. (See also W91-03704) (Author's abstract)
W91-03724

STORMWATER NONPOINT SOURCE POLLUTION CONTROL.
Environmental Protection Agency, Chicago, IL. Region V.
R. G. Newport, and T. E. Davenport.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 183-193, 8 ref.

Descriptors: *Nonpoint pollution sources, *Permits, *Storm water management, *Urban runoff, *Water pollution control, *Water resources management, Cost analysis, Economic aspects, Interagency cooperation, Management planning, Michigan, Pollution load, Storm sewers, Storm wastewater, Water policy, Water pollution sources, Water quality control.

Urban stormwater has been found to include significant quantities of pollutants, and in many areas adversely affects water quality and impairs achievement of designated water resource uses. The Rouge Basin in southeast Michigan is a significant example of a situation where stormwater is contributing to use impairment. To address urban stormwater problems, the U.S. Environmental Protection Agency and state pollution control agencies will be issuing discharge permits to the owner/operators of stormwater collection and conveyance systems and the related outfalls. These permits will require data collection and reporting, and the development and implementation of programs for reducing pollutant loadings to receiving waters. Programs in some cases will call for capital improvements, but in many instances the cost-effective approaches for solving the problems will be Best Management Practices (BMPs). These BMPs will reduce the introduction of pollutants to the storm sewer systems, by managing nonpoint sources (NPS) of pollution. Requiring nonpoint source control components as part of stormwater permits will ensure: (1) that the permits will address all pollutants originating from nonpoint sources; (2) that the BMPs required under the permits will economically control the pollutants identified; and (3) that the NPS control activities identified as being necessary will be fully implemented. This approach is being recommended for use as part of the Remedial Action Plan developed for cleaning up the Rouge River. (See also W91-03704) (Author's abstract)
W91-03725

MARYLAND'S STORMWATER MANAGEMENT PROGRAM.
Maryland Dept. of the Environment, Annapolis. Sediment and Stormwater Div.
R. L. Kort.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 195-201, 7 ref.

Descriptors: *Maryland, *Nonpoint pollution sources, *Storm water management, *Urban drainage, *Water pollution control, *Water resources management, Administrative regulations, Interagency cooperation, Management planning, Urban hydrology, Wastewater management, Wastewater treatment, Water policy, Water pollution sources, Water quality control, Water quality standards.

The adverse impacts of urbanization have contributed to a decline in the water quality of some of Maryland's streams and rivers, and the Chesapeake Bay. One of the state of Maryland's initiatives in response to this was the creation of a statewide storm water management (SWM) program in 1982. This multipurpose program addresses a full range of hydrologic consequences and not just traditional runoff peak control. The Maryland Department of

the Environment administers the program and is responsible for program implementation, plan review and approval, grants administration, education and training, and inspection and enforcement. Local jurisdictions administer their own programs that must meet minimum state standards. Water quality measures to enhance pollutant removal are emphasized. Practices used for the treatment of storm water include infiltration structures, shallow marsh creation, extended detention basins, and water quality inlets. Retrofitting of existing SWM structures is done to enhance pollutant removal. Maryland's erosion and sediment control program is a key part of management efforts. Research and monitoring are conducted, and use of innovative practices is encouraged. (See also W91-03704) (Author's abstract)
W91-03726

NEW STRATEGIES IN URBAN DRAINAGE AND STORMWATER POLLUTION CONTROL IN SWITZERLAND.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 6E.
W91-03727

AESTHETIC IMPLEMENTATION OF NONPOINT SOURCE CONTROLS.
Camp, Dresser and McKee, Inc., Cincinnati, OH.
L. A. Roesner.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 213-223, 5 fig, 2 tab, 14 ref.

Descriptors: *Aesthetics, *Nonpoint pollution sources, *Water pollution control, *Water pollution sources, *Water resources management, Artificial wetland treatment, Detention reservoirs, Infiltration, Land development, Land management, Landscaping, Recreation facilities, Urban runoff, Water policy.

To many people, nonpoint source (NPS) pollution controls are unsightly, necessary evils that are required to protect our receiving waters from pollution by this source. However, such a condition need not exist if the designer will integrate these facilities into the overall landscaping design of a development. Approximately four percent of the developed land is required for NPS controls. If properly designed, these facilities can serve dual recreational/aesthetic functions, as well as provide effective NPS controls. But effective NPS pollution reduction requires that the rate at which runoff is allowed to enter and pass through the drainage system is slowed, and that as much direct runoff as possible is eliminated. This means that NPS controls should be used wherever possible to encourage on-site infiltration. Nonpoint source controls such as these can be grouped into three classes: (1) detention ponds, including both wet and dry basins; (2) infiltration devices such as basins and trenches; and (3) surface filtration devices like buffer strips, grasslined channels or swales, and wetlands. In general, the most efficient are the infiltration devices. Detention basins, particularly wet detention ponds, are second to infiltration devices in efficiency. Surface filtering is the least effective, and is generally used only in combination with one or both of the other kinds of controls. To create aesthetically pleasing NPS control devices, it is not surprising to find that functional design must go hand in hand with landscaping considerations; this is particularly true in the case of detention ponds and wetlands, where the plantings are most visible. (See also W91-03704) (Fish-PTT)
W91-03728

WETLANDS: A FUTURE NONPOINT POLLUTION CONTROL TECHNOLOGY.
Wetlands Research, Inc., Chicago, IL.
D. L. Hey.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 225-235, 1 fig, 4 tab, 6 ref.

Descriptors: *Artificial wetland treatment, *Nonpoint pollution sources, *Wastewater treatment, *Water pollution control, *Water pollution sources, *Water resources management, *Wetlands, *Wetlands treatment, Economic aspects, Environmental impact, Flood control, Habitats, Illinois, Interagency cooperation, Political aspects, Water policy, Water pollution treatment, Water quality management, Wetland restoration.

Nonpoint pollution encompasses more than just the washoff of contaminants and the dispersion of those contaminants in the receiving water body. it also involves the capacity of the terrestrial and aqueous environments to detain and process the contaminants without adverse effects. Accordingly, control technologies must encompass both washoff and effective treatment. Wetlands, serving as the transition between land and water, uniquely combine these components. The Des Plaines River Wetlands Demonstration Project in Wadsworth, Illinois, is testing the economic efficiency and political acceptability of building and managing wetlands for nonpoint pollution control. A full-scale, 450-acre research facility is being constructed with financial support from industries, foundations, private contributors, and local, state, and federal agencies. The supporters, regardless of political philosophy, recognize the need for managing our water resources more efficiently and effectively. Wetlands offer a technology for achieving this goal. The Des Plaines project offers a means for developing this technology. The objectives of this project are to: demonstrate the benefits of wetland restoration for water quality improvement, flood control, and fish and wildlife habitat enhancement; formulate and evaluate restoration and maintenance techniques; and develop alternatives to existing environmental investment strategies and regulatory programs. A significant portion of these wetlands can be replaced or restored so that they provide the desired benefits more efficiently. Replacing 10 percent of the lost wetlands would be a modest beginning. (See also W91-03704) (Author's abstract)
W91-03729

WATER QUALITY PERFORMANCE OF A DETENTION BASIN-WETLAND TREATMENT SYSTEM IN AN URBAN AREA.
Metropolitan Council, St. Paul, MN.
P. Wotzka, and G. Oberts.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 237-247, 8 fig, 3 tab, 9 ref.

Descriptors: *Detention reservoirs, *Nonpoint pollution sources, *Wastewater treatment, *Water resources management, *Wetlands, *Wetlands treatment, Climatic effects, Minnesota, Nutrient removal, Performance evaluation, Phosphorus, Precipitation, Runoff, Settleable solids, Snowmelt, Watershed management.

The McCarrons Treatment System is a surface water management facility consisting of a detention pond followed by six 'chambered' wetlands designed to improve the water quality of Lake McCarrons in Roseville, Minnesota. The system is located at the bottom of a 243 hectare urban watershed. Most of the reduction in pollutants occurs in the detention pond. Performance conclusions are based on results from 21 of the 57 rainfall events and 4 periods of snowmelt. Climatic conditions and the precipitation during the 21 months of study were not 'normal,' but rather reflective of a mild, dry period with a major rainfall event and two very wet months. The detention pond is considered to be currently performing at the best level that can be expected. Attributes thought to contribute positively to treatment levels in the pond include diffuse inflow from three separate tributaries, a low dissolved phosphorus to total phosphorus (DP:TP) ratio, and newly exposed peat soils with a high affinity for attracting TP. Changes in the design of the outlet structure could improve the effectiveness of the detention pond in treating snowmelt. The post-detention wetland system was intended to 'polish' outflows from the detention pond before the water discharged to the lake. The wetland continues the process of settling solids begun in the pond, but is less effective in removing soluble nutrients. This situation is partially related to additional inputs to the wetlands from another tributary, overland runoff, and atmospheric deposition. Even though nutrient removal in the wetland is not high, there is a net reduction so the wetland is performing as expected. (See also W91-03704) (Author's abstract)
W91-03730

NPSP ABATEMENT PROGRAM FOR THE LAGOON OF VENICE.
Padua Univ. (Italy). Ist. di Chimica Industriale.
G. Bendoricchio.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 249-260, 3 fig, 3 tab, 10 ref.

Descriptors: *Italy, *Nonpoint pollution sources, *Venice Lagoon, *Water pollution control, *Water pollution sources, *Water resources management, Artificial wetland treatment, Hydrologic models, Research priorities, Trophic level, Urban drainage, Waste load, Water policy, Water pollution treatment, Wetlands.

The Lagoon of Venice is a partially hypertrophic lagoon of the northern Adriatic Sea in Italy. The pollution of the Lagoon of Venice is a local technical and political issue but, at the same time, it is a problem of international interest due to the historical and cultural value of the city. The pollution abatement program (PAP) considers all the pollution sources responsible for potential pollutant load to the Lagoon of Venice. This global approach is needed due to the large pollutant load, of which the nonpoint sources constitute about 50% of present and future loads. The relative magnitude of the nonpoint source requires special attention. However, only $400 million will be made available for the abatement of both agricultural and urban nonpoint sources, another $200 million for diversion of rivers, and $150 million for irrigation, from the total amount of about $5 billion available for the entire PAP of the Lagoon of Venice. The evaluation of the expected benefits of such an abatement program on a complex system such as the Lagoon of Venice, will be possible only by using a general trophic model of the lagoon which has not yet been developed and validated. This is one of the joint research topics that must be developed in the near future with the experimental application of a wetlands abatement system and an evaluation of the natural assimilation abatement of nutrients that can occur during transport in the rivers. The technical analysis of the single sources developed for the PAP indicates the feasibility of some abatement activities similar to those carried out for other polluted lakes and rivers in the world. (See also W91-03704) (Fish-PTT)
W91-03731

WATER QUALITY AND THE CONSERVATION RESERVE PROGRAM: IMPLICATIONS OF TARGETING SALINE CROPLANDS.
Economic Research Service, Washington, DC.
M. P. Aillery.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 261-270, 1 fig, 23 ref.

Descriptors: *Conservation, *Cropland, *Environmental policy, *Government finance, *Nonpoint pollution sources, *Saline soils, *Water resources management, Cost-benefit analysis, Crop production, Farming, Governmental interrelations, Irrigation, Water policy.

The Conservation Reserve Program (CRP) of the 1985 Food Security Act provides an opportunity for improved water quality and higher farm prices through retirement of environmentally-sensitive

croplands. Although current enrollment is limited to highly erodible soils and stream buffers, salinity is cited as one of several criteria which may be used to determine future cropland eligibility. Extending CRP eligibility to highly saline irrigated soils has an effect on acreage enrollment, water quality, production control, and program cost. Modification of program eligibility criteria to include irrigated saline croplands will not significantly expand the national acreage pool, although local effects may be important. Potential new enrollment is limited by additional eligible acreage, county enrollment ceilings, and enrollment incentives for irrigated lands. Offsite water quality benefits attributable to reduced salt-loading may be very significant. However, enrollment of irrigated saline cropland is less cost-effective than currently eligible cropland from a commodity supply perspective. State involvement in support of a CRP salinity provision is likely to increase program effectiveness. (See also W91-03704) (Author's abstract)
W91-03732

RESULTS OF FIFTEEN YEARS OF CONTINUOUS MONITORING OF WATER QUALITY IN THE RUHR RIVER HEAVILY AFFECTED BY RESIDUAL POINT AND NONPOINT POLLUTION.
Ruhrverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-03733

BIOMANIPULATION: RETROSPECTIVE AND FUTURE DEVELOPMENT.
Kinneret Limnological Lab., Tiberias (Israel).
M. Gophen.
Hydrobiologia HYDRB8, Vol. 200/201, p 1-11, August 27, 1990. 117 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Bioremediation, *Lake restoration, *Limnology, *Water quality management, Ecosystems, Eutrophication, Fish management, Food chains, Lakes, Trophic level.

Biomanipulation (as defined by Shapiro) and top-down or consumer-controlled forces refer to the control of natural organisms to improve water quality rather than through nutrient management. A cornerstone of biomanipulation studies was established during the late fifties and early sixties when the effect of fish on water quality via zooplankton predation was shown. Biomanipulation through animals other than fish or zooplankton also has been noted. The classical limnological concept of lake trophic-dynamics goes from nutrients through phytoplankton to zooplankton and fish. Therefore, top-down forces as a tool for manipulation was seen as a pioneering approach. During the seventies, many studies of trophic cascading effects of fish through zooplankton predation on phytoplankton were carried out. The removal of macrophytes by grass carp also has been investigated and was implemented as a practical way of controlling these plants. During the eighties the concept of biomanipulation was broadened to include other aspects of the complex interactions between food-web components such as the different nutrient flux pathways. To be able to make long-term predictions for water quality improvement in lakes and reservoirs, the combined analysis of both top-down and bottom-up forces is required. (See also W91-03762) (Author's abstract)
W91-03761

BIOMANIPULATION: THE NEXT PHASE--MAKING IT STABLE.
Minnesota Univ., Minneapolis. Limnological Research Center.
J. Shapiro.
Hydrobiologia HYDRB8, Vol. 200/201, p 13-27, August 27, 1990. 2 fig, 1 tab, 80 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Bioremediation, *Fish management, *Lake restoration, *Limnology, *Water quality management, Aquatic habitats, Ecosystems, Fish establishment, Food chains, Lakes, Literature review.

Review of the literature on biomanipulation shows that fish manipulations have occurred through the following methods: piscivore catch restriction; habitat enhancement; piscivore removal; planktivore exclusion; planktivore removal by selective catch, lake emptying, fish poisons, fish disease, winterkill, and summerkill; habitat expansion or contraction; planktivore addition; and natural events. The methods can be classified as deliberate, inadvertent, or natural, all of which have successful and unsuccessful examples. However, the problem of perpetuation of successful results remains unsolved. It is proposed that this may be resolved through use of a refuge or refuges from among the following: low light intensity refuge; low temperature refuge; low dissolved oxygen refuge; physical concealment refuge; visual clutter refuge; behavior modification refuge; and predator inefficiency refuge. Perhaps through the use of such mechanisms large herbivorous zooplankters can continue to exist in lakes. (See also W91-03761) (Author's abstract)
W91-03762

ARE BLUE-GREEN ALGAE A SUITABLE FOOD FOR ZOOPLANKTON: AN OVERVIEW.
Istituto Italiano di Idrobiologia, Pallanza (Italy).
For primary bibliographic entry see Field 2H.
W91-03763

EFFECTIVENESS OF PHYTOPLANKTON CONTROL BY LARGE-BODIED AND SMALL-BODIED ZOOPLANKTON.
Warsaw Univ. (Poland). Dept. of Hydrobiology.
P. Dawidowicz.
Hydrobiologia HYDRB8, Vol. 200/201, p 43-47, August 27, 1990. 6 fig, 19 ref.

Descriptors: *Algal control, *Biocontrol, *Biomanipulation, *Lake restoration, *Limnology, *Phytoplankton, *Poland, *Water quality management, *Zooplankton, Daphnia, Food habits, Lake Ros, Lakes, Nutrients, Phosphorus, Plant growth.

Employing in situ enclosures containing inocula of lake zooplankton (mainly Daphnia galeata, D. cucullata, and Bosmina spp.) from the moderately eutrophic Lake Ros (Northern Poland) or large-bodied D. magna, several observations were made on succession of phytoplankton. Whereas D. magna could control the density of all phytoplankton size classes, the lake zooplankton could not suppress the large-sized phytoplankters or net phytoplankton. The lake zooplankton was able to control the density of small algae (< 50 micrometer), but its effect on large algae may be opposite, i.e., a promotion of net phytoplankton growth by removing small-sized algae that can out-compete net phytoplankton for limited phosphate-P resources (< 5 microgram P/L). Since efficiency of phytoplankton density control by D. magna decreased with an increase in net phytoplankton abundance, biomanipulation could not be successful without introducing or maintaining a high population of large-bodied cladoceran species before high densities of large algae would make the control of phytoplankton inefficient. (Author's abstract)
W91-03764

ANALYSIS OF PHYTOPLANKTON-ZOOPLANKTON RELATIONSHIPS IN AN OLIGOTROPHIC LAKE UNDER NATURAL AND MANIPULATED CONDITIONS.
Granada Univ. (Spain). Dept. de Biologia Animal, Ecologia y Genetica.
For primary bibliographic entry see Field 2H.
W91-03765

BIOMANIPULATION BY INTRODUCTION OF HERBIVOROUS ZOOPLANKTON: A HELPFUL SHOCK FOR EUTROPHIC LAKES.
Institut fuer Entwicklung und Forschung Dr. Vielberth K.G., Regensburg (Germany, F.R.).
J. Theiss, K. Zielinski, and H. Lang.
Hydrobiologia HYDRB8, Vol. 200/201, p 59-68, August 27, 1990. 6 fig, 31 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Eutrophic lakes, *Germany, *Lake restoration, *Limnology, *Transparency, *Water quality control, *Zooplankton, Ammonia, Bioremediation, Chlorophyll, Daphnia, Dissolved oxygen, Food habits, Gewerbepark Pond, Limnocorrals, Macrophytes, Nitrogen, Phosphorus, Turbidity, University Pond, Water quality management.

In 1988 and 1989, Daphnia magna was introduced into the Gewerbepark Pond and into the University Pond (both in Regensburg, Germany) and into a limnocorral (10 m diameter, 5 m deep) in Posfelden Reservoir. Limnological parameters were monitored in all three water bodies for 3 mo or more. The objective of the experiments was to induce a clear-water period in turbid eutrophic waters by direct manipulation of the zooplankton community. Introduction of 4 million individuals of D. magna (10 individuals/L) caused a long-lasting clear-water period in the limnocorral. While Secchi-disc transparency in the reservoir decreased from 1.3 to < 1 m during summer, transparency increased to a stable level of about 4 m in the corral. Despite very low phytoplankton biomass, D. magna was abundant. The experiment was terminated after 3 mo because of oxygen depletion in the corral. In the Gewerbepark Pond, 3.3 million individuals of D. magna (0.6 individuals/L) were introduced at the beginning of August. The daphnids soon increased 60-fold in their density, causing a persistently high water transparency and low phytoplankton biomass up to November. Ammonia concentration rose steeply, whereas that of nitrate and oxygen decreased. Subsequently in summer, concentrations of chlorophyll and organic P and N were extremely low. Instead of the phytoplankton, Elodea canadensis grew enormously and covered 12% of the pond surface. The biomanipulation experiment in University Pond failed, probably due to predation by carp. (Author's abstract)
W91-03766

ZOOPLANKTON-PHYTOPLANKTON INTERFACE IN LAKES OF CONTRASTING TROPHIC STATUS: AN EXPERIMENTAL COMPARISON.
California Univ., Davis. Div. of Environmental Studies.
For primary bibliographic entry see Field 2H.
W91-03767

WHY DO CLADOCERANS FAIL TO CONTROL ALGAL BLOOMS.
Warsaw Univ. (Poland). Dept. of Hydrobiology.
Z. M. Gliwicz.
Hydrobiologia HYDRB8, Vol. 200/201, p 83-97, August 27, 1990. 11 fig, 87 ref. Polish CPBP 10.2 Grant.

Descriptors: *Algal control, *Biomanipulation, *Bioremediation, *Eutrophication, *Lake restoration, *Limnology, *Water quality management, *Zooplankton, Algae, Cyanophyta, Daphnia, Ecosystems, Eutrophic lakes, Lake management, Phytoplankton.

Field studies show that even at high nutrient loads phytoplankton may be kept at low levels by filter-feeding zooplankton for a period of weeks (spring clear-water period in lakes) or months (low-stocked fish ponds). Laboratory experiments have shown that large-bodied Daphnia can utilize filamentous algae. In the field, this is not always the case, however. Even when protected from predation, large cladocerans often cannot grow and reproduce fast enough to prevent bloom formation. Sometimes they disappear when the bloom becomes dense, and the biomanipulation approach is no longer applicable. Recent experimental data on four differently-sized Daphnia species were used in an attempt to: (1) explain why cladocerans fail to control filamentous cyanobacteria when filament density is high and (2) determine the critical filament density at which Daphnia becomes ineffective. At this critical concentration, Daphnia growth and reproduction is halted, and no positive numerical response to growing phytoplankton standing crop should be expected from the Daphnia population. Bloom formation thus becomes irreversible. The question of how to overcome this obstacle in the biomanipulation approach may become one of the most challenging questions in

plankton ecology in the near future. (Author's abstract)
W91-03768

STRUCTURAL AND GRAZING RESPONSES OF ZOOPLANKTON COMMUNITY TO BIOMANIPULATION OF SOME DUTCH WATER BODIES.
Limnologisch Inst., Nieuwersluis (Netherlands).
R. D. Gulati.
Hydrobiologia HYDRB8, Vol. 200/201, p 99-118, August 27, 1990. 6 fig, 4 tab, 46 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Food habits, *Lake restoration, *Limnology, *Netherlands, *Zooplankton, Biomass, Bioremediation, Comparison studies, Cyanophyta, Daphnia, Ecosystems, Eutrophic lakes, Organic carbon, Performance evaluation, Seston, Water quality management.

Structure and grazing activities of crustacean zooplankton were compared in five lakes undergoing manipulation with several unmanipulated eutrophic (shallow) and mesotrophic (deep) lakes in The Netherlands. Daphnia hyalina (= D. galeata) and D. cucullata generally co-occurred in the unmanipulated lakes, but in the manipulated lakes both D. hyalina and other large-bodied daphnids, D. magna, D. pulex were the important grazers. In the biomanipulated lakes, an increase in individual crustacean size and of zooplankton mass were reflected in a decrease in seston concentration, higher Secchi-disk depth, and a marked decrease in the share of phytoplankton volume consisting of cyanobacteria. The biomass relationship between seston (150 micrometer) and zooplankton indicated a Monod type relationship, with an initial part of the curve in which the zooplankton responds linearly to the seston increase up to about 2 mg C/L, followed by a saturation of zooplankton mass (0.39 mg C/L) at 3-4 mg C/L seston, and an inhibitory effect on zooplankton mass at seston levels > 4 mg C/L. The last of these effects is related to predominance in the seston of cyanobacteria. In the biomanipulated lakes, the zooplankton grazing rates often exceeded 100% per day during the spring, and food levels generally dropped to < 0.5 mg C/L. The computed specific clearance rate (SCR) of zooplankton of 1.9 L/mg Zoopl C is well within the range of SCR values (1.7-2.2 L/mg C) from deep and mesotrophic waters, but about an order of magnitude higher than in the eutrophic lakes, with the food levels 10-fold higher. For 25% per day clearance of lake seston, between 35 and 60 individ./L are needed in the biomanipulated lakes versus 1200-1300 individ./L in the eutrophic lakes. Similarly, about 10-15 more crustacean grazers are required to eliminate the daily primary production the eutrophic lakes than in the biomanipulated lakes. The biomass values of zooplankton needed to clear the daily primary production in the eutrophic waters were 0.1-0.2 mg C/L in the biomanipulated lakes, but about 0.45 mg C/L in the unmanipulated eutrophic waters. Only if water was kept clear by zooplankton was the seston budget balanced (primary production vs removal by grazing). Usually, the input exceeded the removal by zooplankton. Thus, estimated seston loss could be attributed to sedimentation and mineralization. (Author's abstract)
W91-03769

BIOMANIPULATION AND FOOD-WEB DYNAMICS: THE IMPORTANCE OF SEASONAL STABILITY.
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 2H.
W91-03770

IMPACT OF WHITEFISH ON AN ENCLOSURE ECOSYSTEM IN A SHALLOW EUTROPHIC LAKE: SELECTIVE FEEDING OF FISH AND PREDATION EFFECTS ON ZOOPLANKTON COMMUNITIES.
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
For primary bibliographic entry see Field 2H.
W91-03771

IMPACT OF WHITEFISH ON AN ENCLOSURE ECOSYSTEM IN A SHALLOW EUTROPHIC LAKE: CHANGES IN NUTRIENT CONCENTRATIONS, PHYTOPLANKTON AND ZOOBENTHOS.
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
For primary bibliographic entry see Field 2H.
W91-03772

FADING RECOVERY: THE ROLE OF ROACH (RUTILUS RUTILUS L.) IN MAINTAINING HIGH PHYTOPLANKTON PRODUCTIVITY AND BIOMASS IN LAKE VESIJARVI, SOUTHERN FINLAND.
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
J. Horppila, and T. Kairesalo.
Hydrobiologia HYDRB8, Vol. 200/201, p 153-165, August 27, 1990. 5 fig, 1 tab, 20 ref.

Descriptors: *Algal control, *Biocontrol, *Finland, *Lake management, *Lake restoration, *Limnology, *Water quality control, Biomass, Bioturbation, Cyanophyta, Enclosures, Eutrophic lakes, Eutrophication, Fish, Lake Vesijarvi, Mesocosms, Phytoplankton, Primary productivity, Roach, Sediment recycling, Wastewater pollution.

For 60 yr, Lake Vesijarvi, especially the Enonselka basin (2600 ha), received sewage water discharge from the City of Lahti. In 1976 the municipal sewage loading was diverted from the lake. Initially, the recovery of the lake proceeded well but after some years summer blooms of blue-green algae (Aphanizomenon, Microcystis) increased again. High biomass of roach (Rutilus rutilus L.) was considered to play an important role in maintaining high algal productivity and biomass in the lake water. Field experiments in mesocosms (22-24 cu m) with different densities of roach suggested that fish biomass should be less than 30 g/sq m, or 300 kg/ha, to ensure a significant reduction in the current productivity and biomass of phytoplankton. Bioturbation of sediments and recycling of nutrients, rather than zooplanktivory, seemed to be the main factors linking roach to water quality in the mesocosms. The results suggest that the current (estimated) biomass of fish in Lake Vesijarvi (500 kg/ha), composed mainly of roach and smelt) is one of the key factors maintaining high algal productivity in the lake. The current results probably are best applied to littoral areas, where densities of roach are greatest, rather than to the entire lake. (Rochester-PTT)
W91-03773

BOTTOM-UP EFFECTS OF BREAM (ABRAMIS BRAMA L.) IN LAKE BALATON.
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
For primary bibliographic entry see Field 2H.
W91-03774

APPLICABILITY OF PLANKTONIC BIOMANIPULATION FOR MANAGING EUTROPHICATION IN THE SUBTROPICS.
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
T. L. Crisman, and J. R. Beaver.
Hydrobiologia HYDRB8, Vol. 200/201, p 177-185, August 27, 1990. 6 fig, 1 tab, 32 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Florida, *Lake management, *Lake restoration, *Plankton, *Subtropic zone, *Water quality control, Algae, Biomass, Bioremediation, Crustaceans, Ecosystems, Eutrophic lakes, Fish, Fish management, Life history studies.

Although large-bodied cladocerans such as Daphnia can reduce algal biomass significantly in temperate lakes if freed from fish predation, the applicability of such biomanipulation techniques for eutrophication management in the subtropics and tropics has been examined only recently. Subtropical cladoceran assemblages differ from those of temperate lakes by their low species richness, early summer gametogenesis, and greatly reduced body size. Eutrophic Florida lakes are dominated by pump-feeding fish rather than by size-selective planktivores as in temperate lakes. Cladocerans in Florida lakes can increase in abundance significantly if freed from fish but fail to have an impact on algal biomass or composition. The greatest potential for using biomanipulation to manage phytoplankton-dominated lakes in the subtropics and tropics lies with phytophagous fish. Future research should concentrate on defining the effect of individual fish taxa on phytoplankton composition and community structure, nutrient cycling, and planktonic productivity before embarking on whole-lake manipulation projects. (Author's abstract)
W91-03775

CONDITIONS FOR EFFECTIVE BIOMANIPULATION: CONCLUSIONS DERIVED FROM WHOLE-LAKE EXPERIMENTS IN EUROPE.
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
J. Benndorf.
Hydrobiologia HYDRB8, Vol. 200/201, p 187-203, August 27, 1990. 4 fig, 3 tab, 56 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Food chains, *Lake management, *Lake restoration, *Limnology, *Water quality control, Fish, Food habits, Light, Nutrients, Performance evaluation, Phosphorus, Refugia.

Since indirect effects, feedback mechanisms, and time lag play an important role in top-down manipulated food webs, conclusions regarding the reliability of biomanipulation as a management tool should be derived only from whole-lake studies, the results of which were followed for at least 3-5 yr. There are only a few experiments of that type, from which the following conclusions can be draw: (1) food web manipulation should be combined with resource limitation measures (nutrients or light) if a 'biomanipulation-efficiency threshold of the phosphorus loading' is exceeded; (2) the critical biomass of undesirable fish shows a very wide range of variation (20-1000 kg/ha) and depends on several factors, such as species and age of fish, total food assemblage, and refugia; (3) the maximum possible stability of food web manipulation is probably achieved at a biomass of undesirable fish a little below the critical biomass rather than by extermination of these fish; (4) high piscivore diversity increases stability and reliability of food web manipulations; and (5) various techniques of food web manipulation should be combined, except poisoning the entire fish community. (Author's abstract)
W91-03776

FISH MANIPULATION AS A LAKE RESTORATION TOOL IN SHALLOW, EUTROPHIC TEMPERATE LAKES: 1. CROSS-ANALYSIS OF THREE DANISH CASE-STUDIES.
National Environmental Research Inst., Silkeborg (Denmark). Div. of Freshwater Ecology.
E. Jeppesen, M. Sondergaard, E. Mortensen, P. Kristensen, and B. Riemann.
Hydrobiologia HYDRB8, Vol. 200/201, p 205-218, August 27, 1990. 4 fig, 3 tab, 65 ref.

Descriptors: *Biomanipulation, *Bioremediation, *Eutrophic lakes, *Fish management, *Lake restoration, *Limnology, Algal blooms, Biomass, Case studies, Chlorophyta, Cyanophyta, Denmark, Diatoms, Ecosystems, Fish, Frederiksborg Castle Lake, Lake Sobygard, Lake Vaeng, Nitrogen, Nutrients, Phosphorus.

The use of fish manipulation as a tool for lake restoration in eutrophic lakes has been investigated since 1986 in three shallow, eutrophic Danish lakes. The lakes differ with respect to nutrient loading and nutrient levels (130-1000 microgram P/L, 1-6 mg N/L). A 50% removal of planktivorous fish in the less eutrophic, cyanobacteria-diatom-dominated Lake Vaeng caused marked changes in lower trophic levels, P concentration, and transparency. Only minor changes occurred after a 78% removal of planktivorous fish in eutrophic, cyanobacteria-dominated Frederiksborg Castle Lake. In the hypertrophic, green algae-

dominated Lake Sobygard a low recruitment of all fish species and a 16% removal of fish biomass created substantial changes in trophic structure, but no decrease in P concentration. The different response pattern is interpreted as: (1) a difference in density and persistence of bloom-forming cyanobacteria caused by between-lake variations in nutrient levels and probably mixing and flushing rates; (2) a difference in specific loss rates through sedimentation of the algal community prevailing after the fish manipulation; (3) a decreased impact of planktivorous fish with increasing mean depth; and (4) a lake-specific difference in ability to create a self-increasing reduction in the P level in the lake water. This in turn seems related to the P loading. (See also W91-03778) (Author's abstract)
W91-03777

FISH MANIPULATION AS A LAKE RESTORATION TOOL IN SHALLOW, EUTROPHIC, TEMPERATE LAKES 2: THRESHOLD LEVELS, LONG-TERM STABILITY AND CONCLUSIONS.
National Environmental Research Inst., Silkeborg (Denmark). Div. of Freshwater Ecology.
E. Jeppesen, J. P. Jensen, P. Kristensen, M. Sondergaard, and E. Mortensen.
Hydrobiologia HYDRB8, Vol. 200/201, p 219-227, August 27, 1990. 5 fig, 35 ref.

Descriptors: *Algal control, *Biomanipulation, *Bioremediation, *Fish management, *Lake restoration, *Limnology, *Water quality control, Cyanophyta, Denmark, Eutrophic lakes, Fish, Phosphorus, Phytoplankton, Transparency.

Empirical studies on relationships between concentration of total P in lake water and the occurrence of phytoplankton, submerged macrophytes, and fish in Danish lakes were combined with results from three whole-lake fish manipulation experiments. After removal of less than 80% of the planktivorous fish stock, a short-term trophic cascade was obtained in the nutrient regimes, where large cyanobacteria were not strongly dominant and persistent. In shallow Danish lakes, cyanobacteria dominated the phytoplankton most often in the P-range between 200 and 1000 microgram P/L. Long-term effects are suggested to be closely related to the ability of the lake to establish a permanent and wide distribution of submerged macrophytes and to create self-perpetuating increases in the ratio of piscivorous to planktivorous fish. The maximum depth at which submerged macrophytes were absent in lake > 10 ha and with P levels above 250-300 microgram P/L, but still abundant in some lakes < 3 ha at 650 microgram P/L. These results support the alternative stable state hypothesis (clear or turbid water stages). Planktivorous fish > 10 cm numerically contributed more than 80% of the total planktivorous and piscivorous fish (> 10 cm) in the pelagic zone of lakes with concentrations of P above 100 microgram/L. Below this threshold level the proportion of planktivores decreased markedly to about 50% at 22 microgram P/L. The extent of the shift in depth colonization of submerged macrophytes and fish stock composition in three whole-lake fish manipulations follows closely the predictions from the relationships derived from the empirical study. It is concluded that a long-term effect of a reduction in the density of planktivorous fish can be expected only when the external P loading is reduced to below 0.5-2.0 g per sq m/yr. This loading is equivalent to an in-lake summer concentration below 80-150 microgram P/L. Fish manipulation as a restoration technique seems most efficient in shallow lakes. (See also W91-03777) (Rochester-PTT)
W91-03778

PHYTOPLANKTON BIOMASS REDUCTION AFTER PLANKTIVOROUS FISH REDUCTION IN A SHALLOW, EUTROPHIC LAKE: A COMBINED EFFECT OF REDUCED INTERNAL P-LOADING AND INCREASED ZOOPLANKTON GRAZING.
National Environmental Research Inst., Silkeborg (Denmark). Div. of Freshwater Ecology.
M. Sondergaard, E. Jeppesen, E. Mortensen, E. Dall, and P. Kristensen.
Hydrobiologia HYDRB8, Vol. 200/201, p 229-240, August 27, 1990. 7 fig, 2 tab, 43 ref.

Descriptors: *Biomanipulation, *Bioremediation, *Eutrophic lakes, *Lake restoration, *Limnology, *Phosphorus, *Water quality control, Biomass, Bream, Denmark, Ecosystems, Food chains, Lake Vaeng, Light, Macrophytes, Phytoplankton, Roach, Submerged plants, Zooplankton.

No recovery was recorded in the shallow and eutrophic Lake Vaeng, Denmark, after a sewage diversion in 1981, due to an internal P loading and a dominance of planktivorous fish. To improve water quality by biomanipulation, a total of 2.5 tons of bream (Abramis brama) and roach (Rutilus rutilus) was removed during 1986 and the spring of 1987. The planktivorous/benthivorous fish biomass thereby was reduced by approximately 50%, from 30 to 16 g ww/sq m. After the reduction, the biological structure of the lake changed markedly. The zooplankton changed from a dominance by rotifers to larger cladocerans. Zooplankton mean biomass increased from 0.4 mg dw/L in 1986 to 2.7 mg dw/L in 1987 and 1.3 mg dw/L in 1988. Phytoplankton biomass decreased from a mean summer level of 25 cu mm/L in 1986 to 12 cu mm/L in 1987 and to 7 cu mm/L in 1988. After the fish removal, the internal P loading was reduced markedly. This reduction is considered primarily to be due to reduced sedimentation, and by the increased micro-benthic primary production and P uptake. Submerged macrophytes, mainly Potamogeton crispus and Elodea canadensis, increased in abundance due to improved light climate at the lake bottom. (Author's abstract)
W91-03779

ECOLOGICAL CONSEQUENCES OF A MANUAL REDUCTION OF ROACH AND BREAM IN A EUTROPHIC, TEMPERATE LAKE.
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
B. Riemann, K. Christoffersen, H. J. Jensen, J. P. Muller, and C. Lindegaard.
Hydrobiologia HYDRB8, Vol. 200/201, p 241-250, August 27, 1990. 6 fig, 3 tab, 40 ref. Danish Natural Science Research Council Grant 11-6934.

Descriptors: *Biocontrol, *Biomanipulation, *Bioremediation, *Ecosystems, *Fish management, *Food chains, *Water quality control, Bream, Denmark, Eutrophic lakes, Lake Frederiksborg Slotsso, Lake restoration, Nutrients, Oxygen, Perch, Phytoplankton, Roach, Water quality management.

A biomanipulation experiment was carried out in the eutrophic Lake Frederiksborg Slotsso (Denmark). During 1987 and 1988, densities of roach (Rutilus rutilus) and bream (Abramis brama) were reduced and large-sized perch (Perca fluviatilis) were added. Nutrients, oxygen, phytoplankton, zooplankton, fish, and zoobenthos were measured for 2 yr after the manipulation and compared with results obtained 2 yr before the manipulation. A total amount of 6524 kg wet weight of roach and bream was removed. Roach and bream constituted 45% of the total fish biomass after the reduction, compared with 78% before the manipulation. Recruitment of roach decreased, and mortality rates of young-of-the-year perch were lower after the fish reduction. After the manipulation, decreases in phytoplankton biomass coincided with increases in zooplankton biomass during spring and autumn periods, but the mid-summer level of the biomass of cyanobacteria did not change. Inorganic nutrients generally increased, but no significant changes were found, either in the oxygen budget or in the community structure or quantitative distribution of zoobenthos after the fish manipulation. Although the effects of the fish manipulations were not as pronounced as those found in lakes with lower nutrient regimes, the results indicate positive changes in the water quality. Nevertheless, it is probably necessary to continue a fish reduction program to maintain or further improve the water quality. (Author's abstract)
W91-03780

PREDICTABILITY AND POSSIBLE MECHANISMS OF PLANKTON RESPONSE TO REDUCTION OF PLANKTIVOROUS FISH.
Oslo Univ. (Norway). Dept. of Limnology.
A. Lyche, B. A. Faafeng, and A. Brabrand.
Hydrobiologia HYDRB8, Vol. 200/201, p 251-261, August 27, 1990. 2 fig, 1 tab, 35 ref.

Descriptors: *Algal control, *Biocontrol, *Biomanipulation, *Bioremediation, *Food chains, *Lake restoration, *Plankton, *Predation, *Water quality control, Carbon, Carbon-phosphorus ratio, Cyanophyta, Denmark, Fish, Gjersjoen, Helgetjern, Phosphorus, Phytoplankton, Tissue analysis, Zooplankton.

The predictability of plankton response to reductions of planktivorous fish was investigated by comparing the plankton community in three biomanipulated lakes and 10 unmanipulated lakes differing in intensity of fish predation. Data collected on total P, phytoplankton, and zooplankton biomass and share of cyanobacteria and large grazers, as well as specific growth rate of phytoplankton, were further used to test some of the proposed underlying response mechanisms. In the biomanipulated lakes, the algal biomass and share of cyanobacteria decreased, specific growth rate of phytoplankton increased, and zooplankton biomass and share of large grazers increased or remained unchanged. This pattern was largely reflected in the differences in food-chain structure between the unmanipulated lakes with high versus those with low fish predation. The qualitative response to planktivorous fish reduction thus seems largely predictable. The biomanipulated lakes differed, however, in magnitude of response: the smallest, hypertrophic, rotenone-treated lake (Helgetjern) showed the most dramatic response, whereas the large, deep mesotrophic lake (Gjersjoen), which was stocked with piscivorous fish, showed more moderate response, probably approaching a new steady state. These differences in response magnitude may be related to different perturbation intensity (rotenone treatment versus stocking with piscivores), food-chain complexity, and trophic state. Both decreased P concentration and increased zooplankton grazing probably are important mechanisms underlying phytoplankton response to biomanipulation in many lakes. The results provide tentative support to the hypothesis that under conditions of P limitation, increased zooplankton grazing can decrease algal biomass via two separate mechanisms: reduction of the P pool in the phytoplankton, and reduction of the C:P ratio within the phytoplankton cells. (Author's abstract)
W91-03781

OLIGOTROPHICATION AS A RESULT OF PLANKTIVOROUS FISH REMOVAL WITH ROTENONE IN THE SMALL, EUTROPHIC, LAKE MOSVATN, NORWAY.
Rogalandsforskning, Stavanger (Norway). Aquaculture and Water Research Group.
S. Sanni, and S. B. Waervagen.
Hydrobiologia HYDRB8, Vol. 200/201, p 263-274, August 27, 1990. 4 fig, 1 tab, 46 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Eutrophic lakes, *Fish management, *Lake restoration, *Limnology, *Oligotrophic lakes, *Water quality control, Algal control, Biomass, Bioremediation, Chlorophyll a, Daphnia, Lake Mosvatn, Lake management, Nitrogen, Norway, Phosphorus, Rotenone, Rotifers, Transparency, Whitefish, Zooplankton.

In September 1987 the shallow, eutrophic, Lake Mosvatn (Norway) was treated with rotenone to eliminate planktivorous fish (mainly whitefish, Coregonus lavaretus L.), and the effects were studied. The first summer after treatment the zooplankton community changed markedly from rotifer dominance and few grazers, to a community with few rotifers and many grazers. Accordingly there was a five-fold increase in the biomass of Daphnia galeata. Adult females of D. galeata approximately doubled their weight. The decrease in rotifer biomass probably was mainly due to a loss of food by competition with the daphnids. The phytoplankton community also was markedly affected. Prior to

treatment Secchi depth was 1.7 m and chlorophyll-a was 23 microgram/L in summer. After treatment there was an increase in the proportion of small and gelatinous algae and the mean chlorophyll concentration fell to 7 microgram chlorophyll a/L. Secchi depth increased to > 2.3 m (bottom-sight most of the season). After the treatment there also were fewer cyanobacterial blooms. This seems to be related to oligotrophication caused indirectly by increased grazing by the zooplankton. Total nutrient concentrations were affected. Prior to treatment the mean summer concentration of total phosphate was 44 microgram P/L. This decreased to 29 microgram P/L in the first summer and 23 microgram P/L the second summer after the treatment. Total N decreased from 0.68 mg N/L before the treatment to 0.32 mg N/L the first summer after treatment. The phosphate loading was not reduced, hence it can be concluded that the fish removal caused the more oligotrophic conditions. (Author's abstract)
W91-03782

WHOLE-LAKE FOOD-WEB MANIPULATION AS A MEANS TO STUDY COMMUNITY INTERACTIONS IN A SMALL ECOSYSTEM.
Water Board of Utrecht (Netherlands).
For primary bibliographic entry see Field 2H.
W91-03783

FIRST ATTEMPT TO APPLY WHOLE-LAKE FOOD-WEB MANIPULATION ON A LARGE SCALE IN THE NETHERLANDS.
Water Board of Utrecht (Netherlands).
E. van Donk, M. P. Grimm, R. D. Gulati, P. G. M. Heuts, and W. A. de Kloet.
Hydrobiologia HYDRB8, Vol. 200/201, p 291-301, August 27, 1990. 3 fig, 6 tab, 34 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Food chains, *Lake restoration, *Limnology, *Netherlands, *Water quality control, Biomass, Cyanophyta, Daphnia, Eutrophic lakes, Fish management, Lake Breukeleveen, Light, Loosdrecht Lakes, Macrophytes, Phosphorus, Pike, Submerged plants, Transparency, Turbidity, Zooplankton.

Lake Breukeleveen (180 ha, mean depth 1.45 m), a compartment of the eutrophic Loosdrecht Lakes system (The Netherlands), was selected to study the effects of whole-lake food web manipulation on a large scale. In Lake Loosdrecht (dominated by filamentous cyanobacteria), water management measures taken from 1970-1984 (sewerage systems, dephosphorization) have reduced the external P load from 1.2 g/sq m/yr to 0.35 g/sq m/yr. The water transparency (Secchi depth about 30 cm) has not improved. The aim of the food web manipulation in Lake Breukeleveen was not only to improve the light climate of the lake, but to study if the successful effects observed in lakes of a few ha in size could be upscaled. In March 1989 the standing crop of planktivorous and benthivorous fish populations was reduced by intensive fishery, from about 150 kg/ha to about 57 kg/ha. The lake was made inaccessible to fish migrating from other lakes and it was stocked with large-sized daphnids and 0+ pike. However, water transparency did not increase in the following summer and autumn 1989, which is in contrast to the great improvement in light conditions observed elsewhere in smaller lakes. The main explanations for the negative outcome in Lake Breukeleveen are: (1) the rapid increase of the planktivorous fish biomass and carnivorous cladocerans, predating on the zooplankton community; (2) suppression of the large daphnids by the high concentrations of filamentous cyanobacteria; and (3) high turbidity of the lake due to resuspension of bottom material induced by wind, unlike in smaller lakes, and consequently the inability of submerged macrophytes to develop and stabilize the system. (Author's abstract)
W91-03784

IS REDUCTION OF THE BENTHIVOROUS FISH AN IMPORTANT CAUSE OF HIGH TRANSPARENCY FOLLOWING BIOMANIPULATION IN SHALLOW LAKES.
Rijksinstituut voor Zuivering van Afvalwater, Leylstad (Netherlands).
For primary bibliographic entry see Field 2H.
W91-03785

EARLY RESPONSES OF PLANKTON AND TURBIDITY TO BIOMANIPULATION IN A SHALLOW WATER PRAIRIE LAKE.
North Dakota State Univ., Fargo. Dept. of Zoology.
M. A. Hanson, and M. G. Butler.
Hydrobiologia HYDRB8, Vol. 200/201, p 317-327, August 27, 1990. 6 fig, 1 tab, 37 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Fish management, *Lake restoration, *Limnology, *Minnesota, *Transparency, Bosmina, Chydorus, Crustaceans, Daphnia, Diatoms, Eutrophic lakes, Food chains, Lake Christina, Lake management, Macrophytes, Phosphorus, Seasonal distribution, Submerged plants, Turbidity, Zooplankton.

The effect of fish removal was evaluated in the shallow, eutrophic Lake Christina, Minnesota. Fish were removed in October. By late May of the following year, the cladoceran community had shifted from small-bodied Bosmina and Chydorous (less than 100/L) to larger Daphnia (over 100/L). During the periods of peak daphnid abundance (late May-June), chlorophyll-a concentrations and edible diatoms were reduced and water transparency improved dramatically. Total P was not lowered significantly during this period. Although this clear-water phase was short-lived (May, June, and early July), it corresponded to the critical period of plant growth and permitted dramatic increases in submerged macrophytes. (Author's abstract)
W91-03786

EFFECTS OF PLANKTIVOROUS FISH MASS MORTALITY ON THE PLANKTON COMMUNITY OF LAKE MENDOTA, WISCONSIN: IMPLICATIONS FOR BIOMANIPULATION.
Wisconsin Univ.-Madison. Center for Limnology.
For primary bibliographic entry see Field 2H.
W91-03787

EFFECTS OF PLANKTIVORE ABUNDANCE ON CHLOROPHYLL-A AND SECCHI DEPTH.
York Univ., North York (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-03788

THREE YEARS OF EXPERIENCE IN BIOMANIPULATING A SMALL EUTROPHIC LAKE: LAGO DI CANDIA (NORTHERN ITALY).
Istituto Italiano di Idrobiologia, Pallanza (Italy).
G. Giussani, R. de Bernardi, and T. Ruffoni.
Hydrobiologia HYDRB8, Vol. 200/201, p 357-366, August 27, 1990. 6 fig, 1 tab, 28 ref. EEC Grant CEE-CNR-EV4V-0129-I.

Descriptors: *Biocontrol, *Biomanipulation, *Bioremediation, *Eutrophic lakes, *Italy, *Lake restoration, *Limnology, *Water quality control, Bass, Biomass, Lago di Candia, Nonpoint pollution sources, Phytoplankton, Pike, Precipitation, Rudd, Runoff, Transparency, Water pollution sources.

Since the diversion of the municipal sewage of the small town of Candia (northern Italy), runoff and precipitation have been the sole contributors of nutrients to Lago di Candia. The fish population is characterized mainly by rudd (Scardinius erythrophthalmus) overstocking and by a low density of large-mouth bass (Micropterus salmoides) and pike (Esox lucius). During 1986 about 12 tons of rudd (1-2 yr old) were removed from the lake. Considering 1986 as a 'control year,' average Secchi disc transparency improved from 2.3 m in 1986 to 3.3 m in 1988. Phytoplankton biovolume decreased from 114 to 58 cu mm/L, but zooplankton biovolume increased from 8 to 11.5 cu mm/L. The results achieved show that a gradual biomanipulation treatment can have a satisfactory outcome, and it has the advantage of not producing catastrophic situations either in the biotic or in the abiotic compartments of the lake. (See also W91-03795) (Author's abstract)
W91-03790

ENGINEERING AND BIOLOGICAL APPROACHES TO THE RESTORATION FROM EUTROPHICATION OF SHALLOW LAKES IN WHICH AQUATIC PLANT COMMUNITIES ARE IMPORTANT COMPONENTS.
Liverpool Univ. (England). Dept. of Environmental and Evolutionary Biology.
B. Moss.
Hydrobiologia HYDRB8, Vol. 200/201, p 367-377, August 27, 1990. 4 fig, 59 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Bioremediation, *Eutrophic lakes, *Lake restoration, *Limnology, *Water quality control, Aquatic plants, Crustaceans, Ecosystems, England, Fish, Food chains, Norfolk Broads, Nutrients, Refuges, Zooplankton.

Engineering approaches to lake restoration (nutrient removal, sediment pumping, hypolimnion oxygenation, alum treatments) may be most appropriate to deep lakes where the aim of restoration from eutrophication is simply to reduce the production and crop of one component, the phytoplankton. These approaches do not always give the desired results because the nutrient loading may be reduced only to a limited extent. There are additional problems in shallow lakes where change of state between community dominance (aquatic plants versus plankton) is wanted. Each community has powerful buffering mechanisms and biomanipulation may be essential to switch one state to another even with considerable nutrient reduction. For the phytoplankton-dominated community the buffers include the advantages of early growth, lower diffusion pathways for CO2, overhead shading, and an absence of large cladoceran grazers. Open-water shallow environments provide no refuges against predation for the large Cladocera, which are both the most efficient grazers and the most favored prey for fish. Restoration of aquatic plants may require provision of refuges for grazers. There are two types of refuges: open and closed. Open refuges resemble the architecture of a plant bed, but without a barrier to fish. Closed refuges (cages) provide a barrier to fish, but not to small invertebrates. Closed refuges seem likely to be much more successful in restoration of the Norfolk Broads (England). (See also W91-03792) (Rochester-PTT)
W91-03791

POTENTIAL OF ARTIFICIAL REFUGIA FOR MAINTAINING A COMMUNITY OF LARGE-BODIED CLADOCERA AGAINST FISH PREDATION IN A SHALLOW EUTROPHIC LAKE.
University of East Anglia, Norwich (England). School of Environmental Sciences.
K. Irvine, B. Moss, and J. Stansfield.
Hydrobiologia HYDRB8, Vol. 200/201, p 379-389, August 27, 1990. 5 fig, 14 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Bioremediation, *Eutrophic lakes, *Lake restoration, *Limnology, *Refuges, Crustaceans, Daphnia, Ecosystems, England, Fish, Food chains, Hoveton Great Broad, Norfolk Broads, Shallow water, Zooplankton.

The Norfolk Broads are a series of shallow lakes that are highly eutrophic and typified by dense populations of phytoplankton and an absence of submerged aquatic plants. The zooplankton community is subject to intense predation pressure by young fish and is dominated by small-bodied organisms, which have a low potential for reducing phytoplankton populations through grazing. Various designs and densities of artificial refugia for zooplankton against fish predation were established in Hoveton Great Broad in order to enhance populations of large-bodied Cladocera. Initially some of the refuges contained higher densities and larger individuals of Daphnia and Ceriodaphnia than the surrounding open water. However, towards the end of the first season and throughout the subsequent 2 yr, population densities and size structure were similar both within and outside the refuges, although there was still evidence of enhanced body-size of Daphnia within the refuges

compared with the open water. The provision of habitat structures designed as refugia from fish predation did not enhance large-bodied cladoceran populations enough to promote this restoration strategy as feasible for eutrophic and shallow lakes. (See also W91-03791) (Author's abstract)
W91-03792

CAN MACROPHYTES BE USEFUL IN BIOMANIPULATION OF LAKES: THE LAKE ZWEMLUST EXAMPLE.
Warsaw Univ. (Poland). Dept. of Hydrobiology.
T. Ozimek, R. D. Gulati, and E. van Donk.
Hydrobiologia HYDRB8, Vol. 200/201, p 399-407, August 27, 1990. 7 fig, 3 tab, 36 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Lake restoration, *Limnology, *Macrophytes, *Netherlands, *Submerged plants, *Transparency, *Water quality control, Chara, Chlorophyta, Elodea, Lake Zwemlust, Limiting nutrients, Nitrogen, Phytoplankton.

Lake Zwemlust (1.5 ha, mean depth 1.5 m) has been the object of an extensive limnological study since its biomanipulation involving planktivorous fish (bream) in March 1987 and emptying of the lake. In the summer of 1987, the Secchi depth increased to the lake bottom (2.5 m), compared with about 30 cm in previous summers. The reaction of submerged macrophytes to improving underwater light climate was rapid. In summer 1987, besides the introduced Chara globularis, 5 species of submerged macrophytes occurred and colonized 10% of the lake area. In 1988 and 1989, new species did not appear, but the area colonized by macrophytes increased by 7 and 10 times, respectively. Elodea nuttallii was dominant among the macrophytes and Mougeotia among the filamentous green algae. Their abundance contributed to transient N-limitation of phytoplankton causing a persistent clear water phase in 1988 and 1989, unlike in 1987 when zooplankton grazing contributed chiefly to the water clarity. Laboratory bioassays on macrophytes confirmed nitrogen limitation. (Author's abstract)
W91-03794

BIOMANIPULATION OF LAGO DI CANDIA (NORTHERN ITALY): A THREE-YEAR EXPERIENCE OF AQUATIC MACROPHYTE MANAGEMENT.
Istituto Italiano di Idrobiologia, Pallanza (Italy).
G. Galanti, P. Guilizzonni, and V. Libera.
Hydrobiologia HYDRB8, Vol. 200/201, p 409-417, August 27, 1990. 3 fig, 1 tab, 23 ref. EEC Environmental Research Program Contract CEE-CNR-EV4V-0120-1.

Descriptors: *Aquatic plants, *Biocontrol, *Biomanipulation, *Bioremediation, *Eutrophic lakes, *Lake restoration, *Limnology, *Water pollution control, Biomass, Food chains, Italy, Lago di Candia, Nitrogen, Organic matter, Oxygen, Phosphorus removal, Phytoplankton, Rudd, Transparency, Water chestnut, Zooplankton.

A long-term experimental aquatic plant management program has been in progress since 1985 in the eutrophic Lago di Candia (northern Italy). In 1986, 7.7 ha of water chestnut (Trapa natans L.) were harvested; 8.2 ha were harvested in 1988 and 11.0 ha in 1988, removing 334, 290, and 418 tons, respectively, of fresh plant material from the lake. This annual harvesting of about 50% of the total water chestnut cover resulted in the removal from the lake of about 70 kg/yr of P, a significant portion of the annual external loading, which derives mainly from runoff and precipitation. In addition, up to 38 tons/yr of organic matter and 1 ton/yr of N were removed. First results of the effect of harvesting on Secchi-disc transparency, oxygen, total P, phytoplankton, and zooplankton are reported. The reduction of zooplanktivorous fish increased the biovolume of the zooplankton community by about 40%. Consequently, the phytoplankton biomass decreased by 50%, whereas the Secchi-disc transparency during the critical summer period (July-October) increased by 30%. These results can be ascribed both to the removal of 12 tons of rudd (Scardinius erythrophthalmus) and to the increased intensity of predation on zooplanktivorous fish as a consequence of the removal of Trapa. No significant changes in oxygen concentration were observed, although comparing the current situation with data of 1979 and 1982, when markedly anoxic conditions and the presence of H2S were observed, shows the present situation to be a considerable improvement. No other macrophyte species became abundant after harvesting before Trapa natans took over again each year. In only a few areas did Ceratophyllum demersum increase in density as a result of dispersion of fragments derived from the harvesting operation. No short-term detrimental effects such as algal blooms or nutrient recycling were observed after the macrophyte harvesting. Biomanipulation of aquatic plants in Lago di Candia appears to be valuable in controlling eutrophication.. (See also W91-03790) (Rochester-PTT)
W91-03795

IMPACT OF MECHANICAL DEWEEDING ON DAL LAKE ECOSYSTEM.
Kashmir Univ., Srinagar (India). Centre of Research for Development.
D. P. Zutshi, and A. Ticku.
Hydrobiologia HYDRB8, Vol. 200/201, p 419-426, August 27, 1990. 2 fig, 4 tab, 13 ref.

Descriptors: *Aquatic plants, *Aquatic weed control, *Biomanipulation, *Eutrophic lakes, *Lake restoration, *Limnology, *Water quality control, Bioremediation, Chlorophyta, Conductivity, Dal Lake, Diatoms, Fish, India, Kashmir, Macrophytes, Nitrogen, Oxygen, Phosphorus, Recreation, Rotifers, Tourism.

The accelerated nutrient enrichment of Dal Lake, Kashmir, has augmented the production of aquatic vegetation to the point where many recreational activities have been severely impaired. Mechanical deweeding was introduced in the lake in 1986 as a way of providing relief from nuisance conditions. The effects of large-scale vegetation removal were assessed in relation to water quality, plankton population, macrophytes, and fish. Electrical conductivity, dissolved oxygen, total P concentration, and nitrate-N concentration changed significantly immediately after deweeding. Phytoplankton species that increased after deweeding included: Amphora ovalis, Cymbella cistula, and Cosmarium sp.; the rotifers Anuraeoposis fissa, Brachionus calcyciflorus, and Monostyla bulla also increased. No visible improvements in the Dal Lake environment have been observed although mechanical harvesting has been in operation for the last three years. This is mainly because harvesting operations are not being carried out on a definite schedule. Selective deweeding should occur during the height of the tourist season. The possibility of introducing biological control measures should be assessed. (Rochester-PTT)
W91-03796

PROPOSALS FOR MACROPHYTE RESTORATION IN EUTROPHIC COASTAL LAGOONS.
Barcelona Univ. (Spain). Dept. de Ecologia.
F. A. Comin, M. Menendez, and J. R. Lucena.
Hydrobiologia HYDRB8, Vol. 200/201, p 427-436, August 27, 1990. 6 fig, 8 tab, 35 ref. CICYT-Spain PAC84-16-C02-02 and EEC Contract EV4V-0132-E, TT.

Descriptors: *Aquatic plants, *Biomanipulation, *Coastal areas, *Eutrophic lakes, *Lagoons, *Lake restoration, *Macrophytes, Agricultural runoff, Encanizada Lagoon, Light, Mediterranean Sea, Nonpoint pollution sources, Particulate matter, Phytoplankton, Potamogeton, Rice, Salinity, Spain, Tancada Lagoon, Turbidity, Water pollution sources, Widgeongrass.

Based on the comparison of environmental requirements for Ruppia cirrhosa and Potamogeton pectinatus growth, macrophyte versus phytoplankton biomass and production features, and differences in hydrological and nutrient balances between Tancada lagoon (Spain, on the Mediterranean Sea, where macrophytes from dense beds) and Encanizada lagoon (with no macrophytes at all), several proposals for macrophyte restoration are presented. The highest efficiency of R. cirrhosa takes place at high irradiance and it grows over a wide range of salinity. P. pectinatus is better adapted to lower light intensity and salinity than Ruppia. R. cirrhosa transplanted from Tancada to Encanizada was successful in enclosures, where light availability increased, but not in open water were light extinction coefficient was 0.032/cm. Phytoplankton biomass (0.11-2.15 g C/sq m) is much lower than macrophyte biomass (16-200 g C/sq m/yr) in Tancada lagoon. However, phytoplankton production (165 g C/sq m/yr in Tancada, 480 g C/sq m/yr in Encanizada) is the same order of magnitude as macrophyte production (244-467 g C/sq m/yr). Turnover rates are 0.3-0.9/day for phytoplankton and 1.2-2.5/yr for macrophytes. Phytoplankton and inorganic particles are responsible for high turbidity of the water in Encanizada lagoon. Phytoplankton blooms in Encanizada lagoon are supported by high freshwater inflows from rice field drains from May to November. The seawater discharge/freshwater discharge ratios are, respectively, 0.24 and 0.48, which denote a higher seawater influence in Tancada than in Encanizada lagoon. Decreasing freshwater inputs to Encanizada lagoon both in May and November, thus allowing greater inputs of seawater, is proposed as the most effective way to restore this eutrophic coastal lagoon. (Author's abstract)
W91-03797

ZEBRA MUSSELS (DREISSENA POLYMORPHA): A NEW PERSPECTIVE FOR WATER QUALITY MANAGEMENT.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
H. H. Reeders, and A. Bij de Vaate.
Hydrobiologia HYDRB8, Vol. 200/201, p 437-450, August 27, 1990. 9 fig, 1 tab, 41 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Bioremediation, *Limnology, *Mussels, *Netherlands, In situ tests, Lake Wolderwijd, Phytoplankton, Suspended matter, Temperature effects.

In the evaluation of the role of lake restoration programs, in situ measurements of the filtration rate of the freshwater mussel Dreissena polymorpha were performed in Lake Wolderwijd, The Netherlands. The filtration rate depends mainly on the suspended matter content of the water, and shows an inverse exponential relationship with this factor. The filtration activity is temperature indifferent between approx. 5 and 20 C. At low temperatures the filtration rate drops abruptly; at high temperatures a gradual inhibition occurs. The filtration rate shows a sigmoidal relation with the length of the mussel. The largest D. polymorpha have a diminished filtration rate compared with animals of smaller size. This might be a degenerative feature of the oldest mussels. In Lake Wolderwijd a population density of 675 mussels per sq m is required to compensate phytoplankton growth by grazing. Manipulation of the size of the population can be executed by adding suitable substrates for the mussel. (Author's abstract)
W91-03798

SHOALS OF DREISSENA POLYMORPHA AS A BIO-PROCESSOR OF SESTON.
Nicholas Copernicus Univ. of Torun (Poland). Inst. of Biology.
R. Wisniewski.
Hydrobiologia HYDRB8, Vol. 200/201, p 451-458, August 27, 1990. 6 fig, 2 tab, 25 ref.

Descriptors: *Biomanipulation, *Bioremediation, *Lake restoration, *Limnology, *Mussels, *Seston, Animal behavior, Lake Druzno, Lake Parteczyny, Lake management, Poland, Suspended sediments.

Mussels of Dreissena polymorpha were collected from the mesotrophic Lake Parteczyny (Poland), where the species occurs in the form of a narrow, but very dense, shoal. Size-sorted mussels were allowed to colonize plastic plates in the laboratory. The plates were then transported to the shallow, eutrophic Lake Druzno, where D. polymorpha has been absent in recent years. A set of plates were exposed in lake water to which a fine fraction of

sediment was added. The resulting concentration of suspended matter was slightly higher than that found during intensive sediment resuspension. During the first 10-30 min of exposure to suspension mussels kept their valves closed, but after this time they continued filtration. The results showed that the relatively high concentration of sediment added to lake seston does not affect clearance capacity of suspension in D. polymorpha and even enhanced it. It is suggested that collection of plates colonized by D. polymorpha can be useful in the bioremediation of shallow lakes, rich in phytoplankton, with muddy bottom deposits that restrict the natural occurrence of the mussel. (Rochester-PTT)
W91-03799

HYDROPHYTE-MACROINVERTEBRATE INTERACTIONS IN ZWEMLUST, A LAKE UNDERGOING BIOMANIPULATION.
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
R. Kornijow, R. D. Gulati, and E. van Donk.
Hydrobiologia HYDRB8, Vol. 200/201, p 467-474, August 27, 1990. 4 fig, 2 tab, 30 ref.

Descriptors: *Aquatic plants, *Biocontrol, *Biomanipulation, *Bioremediation, *Lake restoration, *Limnology, *Macroinvertebrates, *Macrophytes, *Netherlands, Algae, Cycling nutrients, Food chains, Lake Zwemlust, Lake management.

In two years after biomanipulation of Lake Zwemlust (The Netherlands), macrophytes (helophytes, elodeids) and filamentous algae developed luxuriantly in the lake. They influenced the structure of macroinvertebrate communities inhabiting them. Macrophytes and algae, by changing environmental and trophic conditions, also affected the composition of the macrobenthos. Vascular plants served as an important source of food for zoobenthos and phytofauna, mainly after they were decomposed. Filamentous algae were consumed alive by many animals. Invertebrates appeared to be important as a potential nutrient source for hydrophytes. (Author's abstract)
W91-03801

MULTIPLICITY OF STABLE STATES IN FRESHWATER SYSTEMS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
For primary bibliographic entry see Field 2H.
W91-03802

QUANTIFYING THE FOOD WEBS OF LAKE BLEISWIJKSE ZOOM AND LAKE ZWEMLUST.
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 2H.
W91-03803

BIOMANIPULATION ADDITIONAL TO NUTRIENT CONTROL FOR RESTORATION OF SHALLOW LAKES IN THE NETHERLANDS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
S. H. Hosper, and E. Jagtman.
Hydrobiologia HYDRB8, Vol. 200/201, p 523-534, August 27, 1990. 3 fig, 4 tab, 38 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Lake restoration, *Limnology, *Netherlands, *Water quality control, Aquatic plants, Bream, Eutrophic lakes, Fisheries, Food chains, Macrophytes, Roach, Shallow water, Submerged plants, Transparency, Turbidity, Zooplankton.

Eutrophication control is one of the major environmental policy issues in The Netherlands. As a result of international action programs, the average P loading of freshwater systems should decrease by 50% between 1985 and 1995. However, in many cases the restoration of water quality requires additional measures. Recovery is hampered by the structure and functioning of the present food chain. The feeding behavior of the dominant fish in Dutch lakes, bream and roach, tends to impose a homeostasis on the system, resisting restoration of water quality. In shallow lakes, biomanipulation, including drastic reduction of fish stocks, may induce a shift from a stable 'turbid-water state' to a stable 'clear-water state.' Two questions relevant to assessment of the potential of biomanipulation for the restoration of a particular lake are discussed: (1) is drastic reduction of fish-stocks feasible and (2) will a shift occur from 'turbid' to 'clear' after the fish reduction. The increase in water clarity following fish reduction largely depends on the increase in the density of the Daphnia population and the contribution of benthivorous fish to the resuspension of sediments. A 'turbid' to 'clear' shift may be expected if the total biomass of planktivorous and benthivorous fish is reduced to levels < 50 kg/ha. The stability of the achieved clear-water state depends largely on the development of submerged macrophytes in the lake and on the level of nutrient loading. It is tentatively concluded that a stable clear-water state may be expected at initial total-P concentrations < 0.10 mg/l. Because the water managers of The Netherlands have no fishing rights, they must cooperate with anglers and commercial fishermen to apply biomanipulation as a tool for water management. (Author's abstract)
W91-03804

BIOMANIPULATION DEVELOPMENT IN NORWAY.
Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway).
A. Langeland.
Hydrobiologia HYDRB8, Vol. 200/201, p 535-540, August 27, 1990. 1 fig, 2 tab, 21 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Fish management, *Lake management, *Lake restoration, *Norway, *Water quality control, Algae, Biomass, Chlorophyta, Cyanophyta, Ecosystems, Fish, Lake Langvatn, Phytoplankton, Rotifers, Water chemistry, Zooplankton.

Since 1974 several studies have been carried out in Norway to investigate the interactions between planktivorous fish, zooplankton, phytoplankton, and water chemistry. Since 1978 a long-term national research program has been conducted by the Norwegian Council for Scientific and Industrial Research. In this program several whole-lake manipulations of the fish stocks were performed to test hypotheses about trophic interactions. It was predicted that manipulations of planktivorous fish populations might improve water quality in lakes undergoing eutrophication. Two examples illustrate the results achieved. First, results of the whole-lake fertilization experiment conducted from 1974-1978 at Lake Langvatn revealed the importance of top-down effects in the lake ecosystem. When cladocerans dominated, the zooplankton community was able to maintain a more or less constant phytoplankton biomass and a rather low phytoplankton production even when nutrient levels were increased. During years with rotifer dominance, algal biomass and productivity increased, despite the low amounts of added nutrients. The second experiment, which was performed in the eutrophic Lake Haugatjern, included total elimination of the fish population with rotenone in late 1980. This was followed by a four-fold decrease in algal biomass. The species composition changed from the dominance of large-sized Anabaena flos-aquae and Staurastrum luetkemeulleri to smaller, fast-growing species and gelatinous green algae. Although the potential benefits of biomanipulation are clear, use of the technique is a challenge for fishery biologists and managers because knowledge is insufficient concerning how to control the density of fish stocks. Increased energy transfer to fish also may improve the recreational fishery. (Rochester-PTT)
W91-03805

REVIEW: LIMNOLOGICAL MANAGEMENT AND BIOMANIPULATION IN THE LONDON RESERVOIRS.
Royal Holloway and Bedford New Coll., Egham (England). Dept. of Biology.
A. Duncan.
Hydrobiologia HYDRB8, Vol. 200/201, p 541-548, August 27, 1990. 4 fig, 25 ref.

Descriptors: *Biocontrol, *Biomanipulation, *England, *Lake restoration, *Limnology, *Reservoir operation, *Reservoirs, *Water quality control, Algae, Biomass, Ecosystems, Fish, London, Transparency, Zooplankton.

Low algal biomasses and high water transparencies are a feature of the storage reservoirs that supply most of London's treated water. This results from knowledgeable limnological management and biomanipulation and despite the eutrophic nature of the River Thames with its high nutrients (7 g N/cu m, 1 g P/cu m) and particulate organic carbon (2 g C/cu m). Built-in possibilities of jetting input water are managed to prevent stratification, to ensure isothermy, to mix chemicals and plankton vertically and horizontally, and to manipulate the mixed-depth of the algal populations such that their potential for biomass growth is reduced by light-energy limitation. Spring algal growth is delayed and the spring peak is reduced and curtailed by the grazing impact of considerable biomasses of large-bodied daphnid populations (Daphnia magna, pulicaria, and hyalina) whose development also is supported by the continuous input of high crops of riverine algae. The existence of a large-bodied daphnid zooplankton in the reservoirs is associated with low levels of fish predation since the late 1960s. Variations in the intensity and nature of this vertebrate predation during the period 1968-1988 are illustrated by the changes that have occurred in the relationship between the phytoplankton and zooplankton biomasses of the April-May-June quarter of the year. This example of the London reservoirs shows that biomanipulation of deep water bodies has bottom-up as well as top-down effects. (Author's abstract)
W91-03806

POTENTIAL FOR BIOMANIPULATION USING FRY COMMUNITIES IN A LOWLAND RESERVOIR: CONCORDANCE BETWEEN WATER QUALITY AND OPTIMAL RECRUITMENT.
Lodz Univ. (Poland). Inst. of Environmental Biology.
M. Zalewski, B. Brewinska-Zaras, P. Frankiewicz, and S. Kalinowski.
Hydrobiologia HYDRB8, Vol. 200/201, p 549-556, August 27, 1990. 8 fig, 27 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Lake restoration, *Limnology, *Poland, *Reservoir operation, *Reservoirs, *Water quality control, Animal populations, Carp, Crustaceans, Daphnia, Fish management, Monitoring, Perch, Phytoplankton, Reproduction, Slejow Reservoir.

The fry community in Slejow Reservoir, central Poland, a temperate lowland reservoir, was monitored for 7 yr. The variation in reproductive success of the dominant perch and cyprinids was correlated with the variation of the water level. During summer the main food of perch was Daphnia. In the year with the highest density of perch, a decline in the density of cladocerans and in the percentage of Daphnia eaten was observed. This resulted in low stomach fullness and poor fry growth. Simultaneously, the amount of phytoplankton increased. An optimal recruitment curve was found for maintaining water quality with optimal recruitment of fish stocks, assuming that a high rate of fry growth is essential for survival during winter. Regulation of fry density can be achieved by manipulation of water levels during the reproductive and early ontogeny periods. (Author's abstract)
W91-03807

RESTORATION OF SHALLOW EUTROPHIC LAKES, AND THE ROLE OF NORTHERN PIKE, AQUATIC VEGETATION, AND NUTRIENT CONCENTRATION.
Witteveen and Bos, Deventer (Netherlands).
M. P. Grimm, and J. J. G. M. Backx.
Hydrobiologia HYDRB8, Vol. 200/201, p 557-566, August 27, 1990. 5 fig, 5 tab, 37 ref.

Descriptors: *Aquatic vegetation, *Biocontrol, *Biomanipulation, *Eutrophic lakes, *Fish man-

agement, *Lake restoration, *Limnology, *Netherlands, *Water pollution treatment, Biomass, Ecosystems, Phosphorus, Pike, Predation, Shallow water, Water quality.

The feasibility of biomanipulation is related particularly to reducing the production and recruitment of planktivorous fish stocks. For assessing the level of predation needed to suppress planktivorous fish stocks, the relation between fish production and biomass, on one hand, and nutrient concentration on the other were analyzed based on data obtained from several years of investigation at various sites in The Netherlands. The carrying capacity of shallow lakes in terms of biomass is related to the total phosphorus concentration and the nature of the lake bottom substrate. The production of planktivorous fish was 60-80% of the maximum carrying capacity. Aquatic vegetation and northern pike appear to be effective tools for maintaining water quality, but they are limited by the maximum nutrient concentration aquatic vegetation can sustain. (Author's abstract)
W91-03808

EFFECTS OF PLANKTIVOROUS FISHES ON THE PLANKTON COMMUNITY IN A EUTROPHIC LAKE.
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
For primary bibliographic entry see Field 2H.
W91-03809

EXPERIMENTAL STUDY OF THE IMPACTS OF PLANKTIVOROUS FISHES ON PLANKTON COMMUNITY AND EUTROPHICATION OF A TROPICAL BRAZILIAN RESERVOIR.
Companhia de Agua e Esgotos de Brasilia (Brazil). Secao de Estudos de Poluicao Hidrica.
F. L. R. M. Starling, and A. J. A. Rocha.
Hydrobiologia HYDRB8, Vol. 200/201, p 581-591, August 27, 1990. 4 fig, 2 tab, 36 ref.

Descriptors: *Algal control, *Biocontrol, *Biomanipulation, *Brazil, *Eutrophic lakes, *Lake restoration, *Limnology, *Water quality control, Bluegills, Carp, Cyanophyta, Eutrophication, Fish management, Food chains, Paranoa Reservoir, Phytoplankton, Reservoir operation, Rotifers, Tilapia.

The impacts of three facultative planktivorous fishes, Congo tilapia (Tilapia rendalli), bluegill (Lepomis macrochirus), and tambaqui (Colossoma macropomum), and an obligate planktivorous fish, silver carp (Hypophthalmichthys molitrix), on the plankton community and water quality of Paranoa Reservoir (Brazil), a typical eutrophic reservoir, were examined using both selective grazing experiments in the laboratory and an enclosure experiment. The first two species inhabit this reservoir and the remaining two are recommended for introduction. The field experiment was performed in 10 limnocorrals of 2 cu m each and lasted 5 wk. During the enclosure experiment, silver carp suppressed copepod nauplii, cladocerans and rotifers while the presence of tilapia and bluegill was associated with increased rotifer density. The dominant blue-green alga, Cylindrospermopsis raciborskii (98% of phytoplankton biomass) was enhanced in the presence of bluegill, tilapia, and tambaqui, but reduced in the presence of silver carp. This impact on plankton is in agreement with the results of the laboratory feeding trials. The control of the undesirable alga C. raciborskii by silver carp grazing appears to be a promising management tool based on the present results. (Author's abstract)
W91-03810

SOME POSITIVE AND NEGATIVE EFFECTS OF STOCKING WHITEFISH ON THE ECOSYSTEM REDEVELOPMENT OF HJARBAEK FJORD, DENMARK.
Viborg Amtskommune (Denmark). Environmental Dept.
K. Rasmussen.
Hydrobiologia HYDRB8, Vol. 200/201, p 593-602, August 27, 1990. 7 fig, 1 tab, 14 ref.

Descriptors: *Biocontrol, *Biomanipulation, *Denmark, *Fish management, *Fjords, *Limnology, *Water quality control, *Whitefish, Benthos, Eutrophic lakes, Fish stocking, Hjarbaek Fjord, Midges, Plankton.

In 1984 the County of Viborg (Denmark) introduced a large-scale program to improve the water quality in Hjarbaek Fjord, a freshwater fjord cut off from the sea in 1964. Measures were taken to reduce the discharges of nutrients from various sources. To reduce the nuisance of chironomids a large release of whitefish (Coregonus lavaretus L.) was incorporated into the program. The effects of these remediation efforts on the fish, benthos, and plankton communities were studied during a period of 5 yr. The whitefish established a self-reproducing population with a very good growth rate, and may have created quantitative and qualitative changes in the plankton community. Observed changes in the benthos community also may be related to predation by whitefish. The study did not confirm that whitefish could actually control the population of chironomids. The stocking of whitefish created an exploitable fishery of valuable species in the hypertrophic Hjarbaek Fjord. (Author's abstract)
W91-03811

ZOOPLANKTON IMPACTS ON CHLOROPHYLL AND TRANSPARENCY IN ONONDAGA LAKE, NEW YORK.
Michigan Technological Univ., Houghton. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2H.
W91-03812

REVIEW OF IMMISCIBLE FLUIDS IN THE SUBSURFACE: PROPERTIES, MODELS, CHARACTERIZATION AND REMEDIATION.
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W91-03847

STORM WATER MANAGEMENT MODEL FOR URBAN AREAS IN KUWAIT.
Kuwait Univ., Safat. Dept. of Civil Engineering.
N. A. Zaghloul, and A.-R. M. Al-Shurbaji.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 563-575, August 1990. 8 fig, 3 tab, 14 ref.

Descriptors: *Computer models, *Kuwait, *Storm runoff, *Storm water management, *Urban runoff, Computers, Flood hydrographs, Mathematical analysis, Mathematical models, Storm sewers, Urban drainage, Urban hydrology.

A comprehensive study was conducted to implement the Storm Water Management Model (SWMM) for urban areas in Kuwait. The updated version of the model designed to run on an IBM Personal Computer and compatibles was utilized. Urban runoff simulation in arid areas by the SWMM model is a powerful and efficient tool in designing drainage systems and as such, a viable replacement of the commonly used rational method. It was found that only the streets and paved areas that are hydraulically connected to the drainage system contribute to runoff. Fine and coarse discretization approaches were used in the study. The difference between the hydrographs simulated by the two approaches were relatively small. The performance of the existing drainage system and the accuracy of the design method used were tested using a 25-year storm. The result of the simulation revealed that the storm sewers were oversized by factors ranging from 1.2 to 3.6. The SWMM model was used to estimate the storm water runoff volume collected from all urbanized areas in Kuwait City. The annual expected harvested runoff water was found to be significant; however, the quality of runoff water needs to be assessed before a decision is made on its reuse. (Author's abstract)
W91-03852

PREDICTION, VALIDATION, MONITORING, AND MITIGATION OF ANTHROPOGENIC EFFECTS UPON NATURAL SYSTEMS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5C.
W91-03871

BACTERIAL CONTAMINATION AND REMEDIATION MEASURES AT MARINA DEL REY, CALIFORNIA, U.S.A.
Los Angeles County Dept. of Beaches and Harbors, CA.
For primary bibliographic entry see Field 5B.
W91-03872

BINATIONAL MANAGEMENT OF HAZARDOUS WASTE: THE MAQUILADORA INDUSTRY AT THE US-MEXICO BORDER.
California Univ., Los Angeles. School of Public Health.
D. M. Perry, R. Sanchez, W. H. Glaze, and M. Mazari.
Environmental Management EMNGDC, Vol. 14, No. 4, p 441-450, 1990. 8 fig, 1 tab, 29 ref. California Department of Health Services Contract No. 88-T0370.

Descriptors: *Hazardous wastes, *Industrial wastes, *International agreements, *Mexico, *United States, *Waste management, *Water pollution control, *Water pollution sources, Environmental policy, Legislation, Maquiladora, Path of pollutants, Public health, Volatile organic compounds.

Foreign-owned industry in the form of assembly plants, termed maquiladora, has become very important in Mexico to the extent that it represents the second largest source of foreign exchange and is a valuable source for employment and regional development. The economic prosperity gained from the rapid growth of the maquiladora industry has been accompanied by increased environmental and human health risks associated with generation of hazardous waste. Diversification of industry has resulted in the predomination of those sectors that likely use hazardous substances. The Mexicali-Calexico border region was selected to demonstrate the potential for environmental and health risks associated with the generation of hazardous waste. Estimates for the generation of hazardous waste were obtained from 34 maquiladora plants in Mexicali, represented by the electronic and electrical equipment and parts, mechanical and transportation equipment, and toys and sporting equipment centers. Repeated detection of volatile organic compounds in the New River at the US-Mexico border suggests that hazardous waste from the printed circuit board industry in Mexicali is not being disposed of in a proper manner. Potential adverse health effects, such as carcinogenic and mutagenic responses associated with detectable volatiles, are discussed. US and Mexico national legislation and the binational environmental agreement were examined for their adequacy to ensure proper management of hazardous waste generated by the maquiladora industry. Environmental policy options are presented that focus on: (1) increased environmental accountability of US parent companies for their maquiladora assembly plants in Mexico; and (2) more integration between US Customs and border states with the EPA to improve the binational management of hazardous waste generated by the maquiladora industry. (Author's abstract)
W91-03875

HEAVY METAL ACCUMULATION BY BARNACLES AND ITS IMPLICATIONS FOR THEIR USE AS BIOLOGICAL MONITORS.
Victoria Univ. of Manchester (England). Dept. of Environmental Biology.
For primary bibliographic entry see Field 5A.
W91-03886

SALINE WATER DISPOSAL OPTIONS IN THE MURRAY BASIN.
Rural Water Commission of Victoria, Armidale (Australia). Investigations Branch.
For primary bibliographic entry see Field 3C.
W91-03891

IS BROADSCALE REVEGETATION ECONOMIC AND PRACTICAL AS A GROUNDWATER AND SALINITY MANAGEMENT TOOL IN THE MURRAY-DARLING BASIN.
La Trobe Univ., Bundoora (Australia). School of Agriculture.
For primary bibliographic entry see Field 4C.
W91-03895

ASPECTS OF STRATIGRAPHY AND STRUCTURE IN RELATION TO THE WOOLPUNDA GROUNDWATER INTERCEPTION SCHEME, MURRAY BASIN, SOUTH AUSTRALIA.
South Australian Dept. of Mines and Energy, Adelaide.
For primary bibliographic entry see Field 2F.
W91-03896

EVALUATION OF AQUIFER BEHAVIOR AND CHARACTERISTICS IN THE SINGRAULI COALFIELD, CENTRAL INDIA.
Indian School of Mines, Dhanbad. Dept. of Applied Geology.
For primary bibliographic entry see Field 2F.
W91-03914

COLUMN STUDIES ON METHANOTROPHIC DEGRADATION OF TRICHLOROETHENE AND 1,2-DICHLOROETHANE.
Sonnenschein Nath and Rosenthal, Washington, DC.
N. A. Lanzarone, and P. L. McCarty.
Ground Water GRWAAP, Vol. 28, No. 6, p 910-919, November/December 1990. 12 fig, 2 tab, 30 ref. Grant CR-81220.

Descriptors: *Aliphatic hydrocarbons, *Biodegradation, *Bioremediation, *Cleanup, *Dichloroethane, *Groundwater pollution, *Halogenated hydrocarbons, *Methane bacteria, *Trichloroethene, *Water pollution treatment, Biotransformation, Ion exchange, Propane, Sand aquifers, Soil columns.

The potential for and variables affecting enhanced aerobic biodegradation of carbon-14-labeled trichloroethene (TCE) and 1,2-dichloroethane (1,2-DCA) were evaluated using laboratory columns packed with fully-saturated sandy aquifer material. The column fluids were exchanged weekly to simulate the growth of native microorganisms capable of biotransforming halogenated aliphatics. The exchange solutions for seven columns, one of which served as a control, contained dissolved oxygen as the electron acceptor. The electron donor for another column was dissolved propane, while the remaining five columns were fed varying concentrations of dissolved methane. Propane was not consumed, and TCE degradation did not occur in this column. However, methane was utilized in other columns, and the resulting stimulated populations mineralized both TCE and 1,2-DCA to CO2. Little or no TCE degradation occurred when the methane concentration was 4.5 mg/L, but did when the methane was reduced to 1.5 mg/L. TCE degradation was greatest when either a low methane concentration (1.5 mg/L) or an alternating pulse of methane with oxygen one week followed by oxygen only the next was used. Nutrient supplements did not conclusively enhance TCE degradation. When TCE addition was stopped and methanotrophic bacteria stimulation was continued, half of the carbon-14 from previously sorbed TCE that was subsequently eluted by exchange was present as nonvolatile compounds and CO2, and the other half as TCE. Although the results are site-specific, they do suggest that the addition of methane and oxygen to water circulated through a groundwater system to remove TCE by aboveground treatment can, in some cases, result in a doubling of the rate of removal and effect mineralization of about one-half of the TCE removed. (Author's abstract)
W91-03916

SELECTION OF SURFACTANTS FOR THE REMOVAL OF PETROLEUM PRODUCTS FROM SHALLOW SANDY AQUIFERS.
General Motors Research Labs., Warren, MI. Environmental Science Dept.
M. S. Abdul, T. L. Gibson, and D. N. Rai.
Ground Water GRWAAP, Vol. 28, No. 6, p 920-926, November/December 1990. 1 fig, 7 tab, 11 ref.

Descriptors: *Cleanup, *Groundwater pollution, *Hydrocarbons, *Soil contamination, *Surfactants, *Water pollution treatment, Alcohols, Colloids, Detergents, Dispersion, Nonionic surfactants, Phenols, Sand, Sand aquifers, Soil columns, Solubility, Sulfates, Sulfonates, Turbidity.

Soil and groundwater contamination by petroleum products, such as gasoline and oils, is widespread. A laboratory study was conducted to evaluate the relative suitability of 10 commercial surfactants for washing residual levels of automatic transmission fluid (ATF) from sandy material. The surfactants included at least one example for each of four main groups of commercial surfactants: (1) ethoxylated alcohols (nonionic), (2) ethoxylated nonylphenols (nonionic), (3) sulfates (anionic), and (4) sulfonates (anionic). Several properties of aqueous solutions of the surfactants (0.00001 to 5.0% v/v) were measured and used in evaluating their suitability. The extent of dispersion of soil colloids was measured as the turbidity (in formazin turbidity units, FTU) of soil/surfactant solution mixtures. The detergency of the surfactant solutions and the extent to which they solubilized the ATF were measured. The critical micelle concentration, which ranged from 0.05 to 5.0 percent, was measured and used to select the aqueous concentration of the surfactants in washing experiments. The amount of ATF removed from the sand ranged from about 23% by washing with water to more than 80% by washing with ethoxylated alcohol surfactants. ATF was best removed from the soil by washing with a 0.5% aqueous solution of either alkoxylated alcohol ether, ethoxylated alcohol, or nonylphenol ether sulfate. An ethoxylated alcohol surfactant was selected for scale-up laboratory and field tests because this surfactant caused low soil-colloid dispersion and high ATF dispersion and solubilization, and was effective in washing ATF from the soil. (Author's abstract)
W91-03917

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WATER-RESOURCES PROGRAMS AND HYDROLOGIC-INFORMATION NEEDS, MARION COUNTY, INDIANA, 1987.
Geological Survey, Indianapolis, IN. Water Resources Div.
R. F. Duwelius.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-159, 1990. 24p, 6 fig, 47 ref.

Descriptors: *Data acquisition, *Indiana, Groundwater, Interagency cooperation, Surface water, Water quality, Water resources organizations, Water use.

Water resources are abundant in Marion County, Indiana, and have been developed for public and industrial supply, energy generation, irrigation, and recreation. The largest water withdrawals are from surface water, and the two largest water uses are public supply and cooling water for electrical-generating plants. Water-resources programs in the county are carried out by Federal, State and local agencies to address issues of surface and groundwater availability and quality. The programs of each agency are related to the functions and goals of the agency. Although each agency has specific information needs to fulfill its functions, sometimes these needs overlap, and there are times when the same hydrologic information benefits all. Overlapping information needs and activities create opportunities for interagency coordination and cooperation. Such cooperation could lead to a savings of dollars spent on water-resources programs and could assure an improved understanding of the water resources of the county. Representatives from four agencies--the Indiana Department of Environmental Management, the Indiana Department of Natural Resources, the Indianapolis Department of Public Works, and the U.S. Geological Survey--met four times in 1987 to describe their own water-resources programs, to identify hydrologic-information needs, and to contact other agencies with related programs. This report presents the interagency findings and is intended to further communication among water resource agencies by identifying current programs and common needs for hydrologic information. Hydrologic information needs identified by the agency representatives include more precise methods for determining the volume of water withdrawals and for determining the volume of industrial and municipal discharges to surface water. Maps of flood-prone areas need to be updated as more of the county is developed. Improved aquifer maps of the inter-till aquifers are needed, and additional observation wells are needed in the inter-till and bedrock aquifers. Finally, immediate access to instantaneous precipitation data is needed to assess flooding potential. (USGS)
W91-02967

DEVELOPMENT OF SYSTEMS.
Michigan State Univ., East Lansing. Inst. of Water Research.
For primary bibliographic entry see Field 7C.
W91-02989

ROLE OF ENVIRONMENTAL MODELING IN THE DECISION-MAKING PROCESS.
For primary bibliographic entry see Field 5G.
W91-02996

WATER: LAWS AND MANAGEMENT.
For primary bibliographic entry see Field 6E.
W91-03032

COST SHARING: IT'S IMPACT ON WATER RESOURCES DEVELOPMENT.
Military Academy, West Point, NY. Dept. of Electrical Engineering.
For primary bibliographic entry see Field 6C.
W91-03034

REGIONAL WATER MANAGEMENT AGENCY INVOLVEMENT IN LOCAL GOVERNMENT COMPREHENSIVE PLANNING.
Southwest Florida Water Management District, Brooksville.
R. W. Frahm, and R. A. Christianson.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 1B-1--1B-10, 2 fig, 3 ref.

Descriptors: *Florida, *Land use, *Local governments, *Regional planning, *Water management, *Water resources management, Decision making, Evaluation, Information exchange, Management planning, Public policy, Southwest Florida Water Management District.

The Southwest Florida Water Management District (SWFWMD) has broad responsibilities for the management of water resources over a region that includes all or part of 16 counties. In response to the growth management legislation adopted by the state of Florida in 1984 and 1985, each of the 97 local governments within the SWFWMD is required to prepare a comprehensive plan. These local planning efforts represent a unique opportunity to enhance water resources protection through the coordination of land and water management. Local land use and planning decisions impact water resources significantly, especially in the context of the rapid growth currently taking place in the SWFWMD to strengthen intergovernmental coordination and improve water resource management. The four primary elements of this program include information and technical assistance, policy guidance, comprehensive plan review and comment, and follow-up assistance to aid in the implementation of local plans. (See also W91-03032) (Author's abstract)
W91-03036

Group 6A—Techniques Of Planning

WATER MANAGEMENT PLANNING: A PERSPECTIVE FROM THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT.
Southwest Florida Water Management District, Brooksville.
R. S. Owen, and H. D. Levine.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 1B-11--1B-19, 2 exhibits.

Descriptors: *Florida, *Management planning, *Southwest Florida Water Management District, *Water management, *Water resources management, Decision making, Information exchange, Public policy, Public utility districts, Regulations.

Planning initiatives at the Southwest Florida Water Management District include both formal and informal efforts and practices. Different efforts are identified with particular emphasis given to the development of strategic planning and how it may serve to consolidate budget and program planning within the District. Several strategic planning goals are presented: (1) data collection and analysis which is comprised of efforts to improve and expand data collection and analysis efforts at the District to insure that the governing board and staff can make well informed decisions; (2) regulation, which is a goal to continue programs and initiatives which enable the District to meet its statutory charges (provided in Chapter 373, F.S.), including regulation of water resources in the District; (3) water conservation, with regard to a continuation and expansion of programs which encourage the conservation and protection of water and water-related resources; (4) coordination, by continuing to develop and support existing programs which promote activities with other state and local agencies, the private sector and concerned citizens of the District; and (5) organizational development, which is a commitment to reviewing and modifying (if necessary) the infrastructure of the agency to ensure the quality of the services provided to the constituency of the District. (See also W91-03032) (Lantz-PTT)
W91-03037

MANAGING WATER RESOURCES BY INTEGRATING PLANNING: NEW JERSEY'S STATE PLAN.
New Jersey Dept. of the Treasury, Trenton. Office of State Planning.
For primary bibliographic entry see Field 6C.
W91-03038

RESPONSE TO THE ALABAMA ENVIRONMENTAL PROTECTION PLAN.
Water Cycle Concepts, Inc., Auburn, AL.
J. C. Warman, and D. H. Block.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 1B-35--1B-41, 2 ref.

Descriptors: *Alabama, *Environmental policy, *Environmental protection, *Legislation, *Water management, Coastal zone management, Economic aspects, Hazardous wastes, Land use, Regulations, State jurisdiction, Waste disposal, Water resources management.

The Alabama Legislature adopted a joint resolution in February 1986 establishing a 24-member Alabama Environmental Planning Council for the State of Alabama. The council members were selected to represent all geographic areas of the State and diverse segments of society. The council was organized into task forces that included: air quality, land use, coastal zone/marine resources, solid and hazardous waste, and water resources, to address the major environmental issues facing the State. The council's objective was to write a plan that balances the need to protect Alabama's environmental resources with the State's desire to continue economic growth and development. Organization of the plan includes the establishment of broad environmental goals, actions aimed at achieving the objectives, measures by which to gage the degree of progress toward each goal, and possible consequences of inaction. Early in 1989, the Plan was submitted through the Director of the Alabama Department of Environmental Management to the Governor and the Legislature. A description of comments made at these and public meetings is provided in this paper. (See also W91-03032) (Author's abstract)
W91-03039

COMPREHENSIVE WATER SHORTAGE PLANNING IN THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT.
Southwest Florida Water Management District, Brooksville.
D. Brandes.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 1B-43--1B-47.

Descriptors: *Florida, *Southwest Florida Water Management District, *Water conservation, *Water deficit, *Water management, *Water resources management, *Water supply, Drought, Economic aspects, Maintenance, Water demand, Water resources development.

Drought is often the presumed reason for a water shortage, however it should not be regarded as the exclusive cause of shortfalls in water supply. Other factors that may be responsible for water shortage include: distribution system failure, inadequate production or treatment capacity, pollution of supply sources, and excessive water use. Local water shortages may also result from inadequate planning and development of supply sources or treatment and storage facilities. These inadequacies can be caused by rapid increases in demand, or a lack of development and maintenance of supply capability. Rainfall variability only exacerbates these conditions. Water shortage planning must take into account this wide variety of circumstances which can produce shortages. This approach would recognize the diverse and complex causes of water shortages, and focus on actions to prevent, forestall, and minimize shortages as well as to mitigate their impact when they do occur. Long-term water conservation measures, reduction in demand, regulatory and economic measures, and enhancing supply are possible solutions to the water demand crisis. (See also W91-03032) (Lantz-PTT)
W91-03040

ROLE OF PLANNING IN RESOLVING WATER POLICY DISPUTES.
Montana Dept. of Natural Resources and Conservation, Helena. Water Resources Div.
M. J. McKinney.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 2B-17--2B-29, 2 fig, 33 ref.

Descriptors: *Legal aspects, *Management planning, *Project planning, *Public policy, *Water management, *Water resources development, *Water resources management, Competing use, Decision making, Water use.

In the arid West, the development and implementation of water policy often results in disputes among water users, resource managers, and policy makers. Several approaches exist to resolve these disputes, including administrative appeals, litigation and political action. Another, rarely used method for resolving water policy disputes is planning. A collaborative, consensus-building approach to water resources planning and dispute resolution offers many benefits. By including affected interests in actively determining the outcome of a dispute or a potentially controversial situation, these groups have a stake in the final decision and in seeing that it is implemented. This should avoid the costly and time consuming outcomes of unmanaged conflicts, such as administrative appeals, litigation and political action. This approach also encourages the participating individuals and groups to focus on specific water management issues rather than assuming adversarial positions which leave little room for pursuing mutually acceptable solutions. Other benefits include: the concentration of diverse perspectives and interests; the cooperative and systematic analysis of technical information; the formation of more pragmatic, equitable and mutually acceptable goals and alternatives; and the improvement of relationships among diverse, often competing water user groups, resource management agencies, and policy makers. Finally, this approach may be used to resolve other natural resource disputes and potentially controversial issues. (See also W91-03032) (Lantz-PTT)
W91-03042

POLICY EDUCATION TO BUILD LOCAL CAPACITY TO MANAGE THE RISK OF GROUNDWATER CONTAMINATION.
Cornell Univ., Ithaca, NY. Resource Economics.
For primary bibliographic entry see Field 5G.
W91-03043

WATER USE PERMITTING IN FLORIDA: AN EFFECTIVE PROGRAM FOR ALLOCATING WATER.
Saint Johns River Water Management District, Palatka, FL. Dept. of Resource Management.
For primary bibliographic entry see Field 6D.
W91-03054

IMPLEMENTATION OF AN OPERATIONAL GEOGRAPHIC INFORMATION SYSTEM FOR MULTIPURPOSE WATERSHED MANAGEMENT.
Salem State Coll., MA. Digital Geography Lab.
For primary bibliographic entry see Field 7C.
W91-03068

AMERICAN RIVER AND AUBURN DAM: AN EXAMPLE OF THE NEW WATER POLICY.
California State Univ., Sacramento. Dept. of Economics.
K. Calandri.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 12A-27--12A-32, 10 ref.

Descriptors: *American River, *Auburn Dam, *Public policy, *Water policy, *Water resources development, Dams, Decision making, Flood control, Public participation, Water supply development.

In 1965 the construction of Auburn Dam, California was authorized by Congress to provide a multipurpose dam on the American River for water, power, and flood control. In the following 25 years, the dam has not been built, and the need for this dam has been questioned despite the continuing increases in the demand for water, power, and flood control. Highlighted in this paper are the changing views of water usage (economic, as well as technical and legal innovations) over the last 25 years in order to determine the best way to provide for the increasing needs of the region and to ensure the environmental protection and instream uses for the water. The new views of the Bureau of Reclamation and the federal government as to cost sharing, dry dams, as well as the more efficient use of existing supplies have lead the author to believe that the correct decision over the construction of the dam will be made in the near future. In the new legal framework with the recognition of states rights, fisheries and downstream users, such as the Delta, and lower American River, will help achieve the needed equity in the water system. With the new tools, however, regardless of what happens with the Auburn unit, the decisions made will be better than those that were made 20-25 years ago. (See also W91-03032) (Lantz-PTT)
W91-03079

STRINGFELLOW HAZARDOUS WASTE SITE: COMPUTERIZED DATA MANAGEMENT.
CH2M Hill, Santa Ana, CA.
For primary bibliographic entry see Field 7C.
W91-03080

SILVICULTURE BEST MANAGEMENT PRACTICES-A COMPREHENSIVE ASSESSMENT.
Florida Div. of Forestry, Tallahassee.
For primary bibliographic entry see Field 5G.
W91-03083

INTERBASIN WATER TRANSFERS: A MANAGEMENT APPROACH FOR PHOENIX'S WATER FUTURE.
Montgomery (James M.) Consulting Engineers, Inc., Pasadena, CA.
R. C. Siemak.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 11B-3--11B-18, 7 fig, 2 tab.

Descriptors: *Arizona, *Interbasin transfers, *Phoenix, *Water management, *Water resources development, *Water resources management, Agricultural water, Financial aspects, Groundwater quality, Groundwater resources, McMullen Valley, Project planning.

To meet the City's future water needs, Phoenix investigated the feasibility of the purchase of 14,000 acres in the McMullen Valley (an agricultural area 80 miles west of Phoenix), the retirement of the land from production, and the exportation of the underlying groundwater to Phoenix. The evaluation included assessing the groundwater characteristics of the basin, determining facility requirements, estimating project costs, developing methods of conserving the existing groundwater supply in the early years of the project, and investigating the socio-economic impacts of the purchase on the Valley's residents and county government. Based on the evaluation of the technical and socio-economic aspects of the project, the development of the McMullen Valley for exportation of groundwater to the City of Phoenix is economically feasible. The study area has over 6 million acre-feet (AF) of good-to-excellent quality groundwater available. An annual exportation of 30,000 AF/yr is possible without severely impacting groundwater levels or well extraction production. The present agricultural economy within the McMullen Valley is declining and is expected to continue in a downward trend. Thus, a water conservation plan that includes retirement of farm lands would have a minimal impact on the area's agricultural economy. Loss of tax revenue may be mitigated by an in-lieu tax payment program. Other mitigation programs have been proposed to aid the McMullen Valley Community. (See also W91-03032) (Lantz-PTT)
W91-03085

WATER-RESOURCES DEVELOPMENT ALTERNATIVES FOR THE MISSISSIPPI ALLUVIAL PLAIN IN EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
G. L. Mahon, J. E. Terry, and R. C. Peralta.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 11B-29--11B-43, 6 fig, 2 tab, 15 ref.

Descriptors: *Alternative planning, *Arkansas, *Mississippi-Missouri River Basin, *Water resources development, *Water resources management, Aquifers, Federal jurisdiction, Groundwater resources, Hydrologic models, Model studies, State jurisdiction.

Effective management of the water resources of the Mississippi Alluvial Plain in eastern Arkansas involves understanding the nature of existing problems, estimating total water demands, predicting how much of the total demand can be provided by the underlying aquifer and available surface water sources, and deducing how much water must come from alternate sources. Various Federal and State agencies have cooperatively provided hydrologic information for the area to evaluate water resources development alternatives insuring that: (1) the use of water from the aquifer be maximized while maintaining a minimum of 20 feet of saturated thickness, (2) the use of surface water be maximized where it is currently available, and (3) alternate sources of water (surplus surface water) be identified for use in deficit areas. Water resources development alternatives are being evaluated by using digital groundwater flow and optimization models. The optimization model is used to maximize withdrawals from the aquifer and from available surface water sources, while maintaining a minimum saturated thickness in the aquifer. The validity of predictions in both the flow and optimization models depends on the accuracy of historic and projected water use. Optimization model by-products include estimates of unmet water use demands and the location of surplus surface water that would be available for transport to and utilization in water deficient areas. (See also W91-03032) (Author's abstract)
W91-03087

PROMOTING REGIONAL WATER SUPPLY DEVELOPMENT: A CASE STUDY FROM SOUTHWEST FLORIDA.
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 6E.
W91-03088

PLANNING TOOL FOR WATER CONSERVATION.
Brown and Caldwell, Tampa, FL.
J. Salgaonkar.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 13B-5--13-B-11, 1 fig, 1 tab, 5 ref.

Descriptors: *Computer programs, *Cost-benefit analysis, *Water conservation, *Water resources management, *Water use, Management planning, Southwest Florida Water Management District.

An easy to use spreadsheet program was developed to evaluate total watershed savings and the relative cost-effectiveness of various water conservation measures. The program can be used with commercially available software such as LOTUS 1-2-3 and Symphony. When utility specific information is inserted into specific cells the formulas imbedded in the program calculate the cost-benefit ratios and total water savings over the planning period. For the measures analyzed for the Southwest Florida Water Management District achievable water savings ranged from less than 1% up to as much as 15% of the projected usage. This reduction in water usage will help extend supplies, decrease wastewater flows, reduce energy consumption and stabilize the demands of rapid population growth. A rigorous cost-benefit analysis provides the following advantages: (1) it provides data needed to plan for future growth; (2) it supports the budget/planning process required to implement new conservation programs; (3) it gives the agency staff and its board of directors a sound basis for implementing the needed water conservation measures to achieve the projected water savings; and (4) it demonstrates to the public that the water agency has thoroughly investigated water conservation options before approving any new capital projects to accommodate new growth. (See also W91-03032) (Lantz-PTT)
W91-03091

GENERALIZED MODEL OF THE REQUIRED STORAGE CAPACITY.
Sarajevo Univ. (Yugoslavia). Inst. of Water Resources Engineering.
For primary bibliographic entry see Field 4A.
W91-03546

SECOND CONFERENCE ON THE MANAGEMENT OF THE ILLINOIS RIVER SYSTEM: THE 1990S AND BEYOND.
Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. 199p. Edited by Holly Korab.

Descriptors: *Conferences, *Illinois, *Illinois River, *Water resources development, *Water resources management, *Watershed management, Federal jurisdiction, Local governments, Management planning, Resources management, State jurisdiction, Water quality.

The Illinois River Watershed has been the focus of public concern and countless research studies for decades. In April 1987, approximately 200 people gathered in Peoria, Illinois for the First Conference on the Management of the Illinois River System. Here, the participants discussed problems of the Illinois River System, indicated priorities, and identified ways to manage a solution. Since this time, a great deal of progress has taken place throughout the Illinois River Watershed. This second conference was held to provide an open public forum for discussion of program thrusts, actions, and solutions since the first conference and promote continuing public awareness and action. The papers presented at this conference and presented in these proceedings, fall into three broad categories (Illinois State Water Plan Task Force; Local Initiatives; and The Federal Perspective), and discuss topics ranging from the 'Water Quality Impacts of Illinois River Commercial Navigation' to 'Long-Term Resources Monitoring on the Illinois River. (See W91-03609 thru W91-03632) (Lantz-PTT)
W91-03608

ILLINOIS DEPARTMENT OF CONSERVATION'S CHANGING ROLE IN THE ILLINOIS RIVER BASIN.
Illinois Dept. of Conservation, Springfield.
For primary bibliographic entry see Field 6E.
W91-03609

WATERWAYS--THEIR RECREATIONAL POTENTIAL.
Heartland Water Resources Council, Peoria, IL.
B. Noble.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 36-40.

Descriptors: *Illinois, *Illinois River, *Recreation, *Water resources management, Land use, Resources management, Social aspects, State jurisdiction, Water use.

In Peoria, the Illinois River has the potential for becoming the focal point of the community. The two expansive lakes of the Illinois River provide not only visual enhancement, but also help to solve the aquatic recreational needs of people throughout central Illinois. Throughout history, the Illinois River has always been an important migration route for ducks, rivaling and actually exceeding the Mississippi flyway to earn the reputation as the choice duck hunting area in the US. The Peoria District, with the aid of the Forest Park Foundation and Federal and State matching funds through the State of Illinois Department of Conservation (DOC), has preserved over 4.2 linear miles of riverfront in the City of Peoria and Village of Peoria Heights. A nature preserve, Galena Marina, and Detweiller, as well as the development of a river front park and garden in conjunction with the City and the Private sector, as well as a shoreline golf course and other park and open space opportunities, are available for public access. The Peoria Park District, in conjunction with the City of Peoria and the Detweiller Trust as well as the DOC are working together in the development of a hiking/jogging/biking trail now in the initial stage of construction. This trail, envisioned to be a connecting link between the existing Rock Island trail and East Peoria, Morton and Pekin has become a reality. The Peoria side of the trail has a potential length of 48 miles. This planned trail will parallel the river corridor for a portion of its length due to local governmental efforts in acquiring the former railroad switching yards and other riverfront lands previously owned or leased to the private sector. (See also W91-03608) (Lantz-PTT)
W91-03612

UPDATE OF TRI-COUNTY RIVERFRONT PLAN.
Scruggs and Hammond, Inc., East Peoria, IL.
L. D. Luebbe.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 91-95.

Group 6A—Techniques Of Planning

Descriptors: *Illinois, *Resources management, *Urban areas, *Water resources management, Land use, Long-term planning, Peoria, Recreation, Water resources development.

Several progress observations are presented comparing present development and public interest with those of 20 years ago. The area of public interest has grown significantly since 1968. Today considerable public access facilities have been created through land acquired or transferred for recreational use. River Basin development is now of greater concern, as well as floodplain zoning. In 1968, tributary erosion control was emphasized by keeping channel tributaries clear of vegetation. Today there are programs to revegetate streambanks to prevent erosion, thereby helping to prevent the loss of farmland. The development of a regional bikeway and jogging trail connecting the communities of Pekin, East Peoria and Peoria is now in varying stages of construction. It is believed that such a project will provide greater exposure of the waterfront to the citizenry. (See also W91-03608) (Lantz-PTT)
W91-03620

ILLINOIS RIVER AND PEORIA LAKES: IT'S TIME TO ACT.
Caterpillar Tractor Co., Peoria, IL.
M. Reuter, H. W. Holling, and R. W. Frazee.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 99-105.

Descriptors: *Erosion control, *Illinois, *Illinois River, *Peoria Lakes, *Water resources management, Dredging, Economic aspects, Lake sediments, Management planning, Public policy, Sedimentation, Watershed management.

In June 1988, the Heartland Water Resources Council of Central Illinois (HWRCI) was formed to manage the issue of saving the Illinois River and Peoria Lakes from sedimentation. A number of studies have documented the river's loss of volume (77% since 1903) and other changes. The HWRCI is attempting to build an awareness of the sedimentation problem and broaden the base of support for the challenge to keep soil on the land and manage the sediment already in the Illinois River and Peoria Lakes. Causes are varied, but the two critical sources of erosion mentioned include crop land which slopes less than 5%, and streambanks. The solution presented is multidimensional but not conclusive: selective dredging, construction of Islands for a sediment depository and improved wildlife habitat, and enhanced erosion controls on streambanks and farmlands. Some of these projects could begin within two years and may cost close to $200 million. (See also W91-03608) (Lantz-PTT)
W91-03621

STREAM BANK STABILIZATION AND THE ILLINOIS RIVER SOIL CONSERVATION TASK FORCE.
Illinois River Soil Conservation Task Force, Eureka, IL.
For primary bibliographic entry see Field 4D.
W91-03623

PLANNING FOR THE FUTURE OF NAVIGATION ON THE ILLINOIS WATERWAY.
Army Engineer District, Rock Island, IL.
C. R. Smith, P. D. Soyke, and M. A . Cockerill.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 160-167, 1 tab, 4 ref.

Descriptors: *Illinois, *Illinois River, *Management planning, *Navigation, *Water resources management, Public participation, Public policy.

Selected management challenges and potential solutions to assure the future of the Illinois Waterway System are addressed, with emphasis placed on the role of the US Army Corps of Engineers within the context of a three-point management approach for executing navigation responsibilities. The existing condition is described, primarily in economic and environmental terms, and key issues and objectives are identified. The future will be approached within a strategic planning framework which integrates the concerns of all levels of government, the public and the numerous organizations and constituencies who share jurisdictions or interests on the Illinois Waterway System. In order to accomplish the studies, the Corps will begin to collect, compile, and evaluate the engineering, economic, and environmental data necessary to make sound management decisions. The reconnaissance study is scheduled to begin in November 1989, and, depending upon funding availability, is scheduled to be completed in April of 1991, at an estimated cost of $400,000. Federal and non-federal partners recognize that physical, economic, social, and commercial, and environmental conditions and needs have evolved since the Illinois Waterway was placed into operation in 1933 as a 90-ft channel project. Capacity, safety, operational efficiency, cost-effectiveness, and environmental compatibility issues must remain at the forefront of current capital investment planning and decision making. (See also W91-03608) (Author's abstract)
W91-03629

ILLINOIS RIVER AND THE U.S. CORP OF ENGINEERS.
Army Engineer District, Rock Island, IL.
J. R. Brown.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 175-180.

Descriptors: *Illinois, *Illinois River, *Mississippi River, *Water resources management, Environmental protection, Long-term planning, Monitoring, Navigation, Recreation, River systems, Upper Mississippi River Environmental Ma, Water quality.

The Illinois River and its tributaries, as a part of the Upper Mississippi River System, is a nationally recognized commercial and recreational boating navigation system with a complex ecosystem which needs to be protected. As such, the Illinois Waterway is a part of the Upper Mississippi River Environmental Management Program (UMR-EMP). The UMR-EMP is a unique project implemented by the Corp in cooperation with interagency groups including: the Fish and Wildlife Interagency Committee (FWIC); the River Resources Coordinating Team (RRCT); the On-Site Inspection Team (OSIT); and the River Industry Action Committee (RIAC). The project has no definitive cost-benefit ratio requirement. The EMP resulted from the GREAT River Studies begun in the 1972 to deal with the problems of sedimentation and dredged material placement. The EMP consists of five basic program elements: Habitat Rehabilitation and Enhancement Projects, Long-Term Resource Monitoring, Study of Impact of Recreation, Traffic Monitoring Study, and Recreation Projects. The Corp recognizes that the navigation pools, side channels, and backwaters of the Illinois Waterway are components of its complex ecosystem, and our Habitat Rehabilitation projects undertaken on a cost sharing basis with other Federal and State agencies will help provide nesting, food, and cover for fish and wildlife. (See also W91-03608) (Lantz-PTT)
W91-03632

TANK IRRIGATION IN SEMI-ARID TROPICAL INDIA: ECONOMIC EVALUATION AND ALTERNATIVES FOR IMPROVEMENT.
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
For primary bibliographic entry see Field 3F.
W91-03648

EFFICIENT USE OF WATER IN IRRIGATION: PRINCIPLES AND PRACTICES FOR IMPROVING IRRIGATION IN ARID AND SEMIARID REGIONS.
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
For primary bibliographic entry see Field 3F.
W91-03651

MANAGING CANAL IRRIGATION: PRACTICAL ANALYSIS FROM SOUTH ASIA.
Sussex Univ., Brighton (England). Inst. of Development Studies.
For primary bibliographic entry see Field 3F.
W91-03655

IMPACT OF RISK AND PLANNING HORIZONS ON THE SELECTION OF SOIL CONSERVATION MANAGEMENT SYSTEMS.
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4D.
W91-03716

DEVELOPMENT OF AN INTERDISCIPLINARY PLANNING MODEL FOR WATER AND FISHERY MANAGEMENT.
New Mexico State Univ., Las Cruces. Dept. of Fishery and Wildlife Sciences
R. A. Cole, F. A. Ward, T. J. Ward, and R. M. Wilson.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 597-609, August 1990. 9 fig, 2 tab, 13 ref.

Descriptors: *Computer models, *Fish management, *Lake fisheries, *Limnology, *Management planning, *Model studies, *Primary productivity, *Reservoir fisheries, *Water resources management, Biomass, Fish conservation, Licensing, Mathematical models, Nutrients, Sport fishing.

An interdisciplinary model was developed that analyzes the effects of resource management decisions on New Mexico fishery production, yield, sportfishing effort and economic benefit to anglers. The model recreates river flows and materials transported through reservoirs and their tailwaters from 1974 through 1987. Solar radiation, water temperature, phosphorus, nitrogen, suspended solids, and water exchange rates determine primary production. Organic loads from watershed sources, added to primary production, form a trophic base for sportfish forage. Fish production is partitioned into biomass and growth of each age class in sportfish and forage fish groups by differential responses to food type, light, water level fluctuation and predation. Fish biomass, with angler population distribution and site condition, contributes to determining angler effort and economic benefits. Model users can vary and analyze water level and quality, stocking, fishing regulations, site access, site facilities, and site entry fees. The model (on floppy disks with a user manual) is available for operation on MS DOS compatible computers with a hard disk. (Author's abstract)
W91-03855

ENVIRONMENTAL IMPACT ASSESSMENT IN THE PEOPLE'S REPUBLIC OF CHINA.
Wisconsin Univ.-Green Bay. Coll. of Environmental Sciences.
For primary bibliographic entry see Field 6E.
W91-03874

INTEGRATING FORAGE, WILDLIFE, WATER, AND FISH PROJECTIONS WITH TIMBER PROJECTIONS AT THE REGIONAL LEVEL: A CASE STUDY IN SOUTHERN UNITED STATES.
Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
For primary bibliographic entry see Field 4C.
W91-03877

6B. Evaluation Process

WATER-RESOURCES PROGRAMS AND HYDROLOGIC-INFORMATION NEEDS, MARION COUNTY, INDIANA, 1987.
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 6A.
W91-02967

DEVELOPMENT OF DECISION AIDS.
D. J. Lawrence.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 25-27.

Descriptors: *Agriculture, *Conservation, *Decision making, *Information exchange, *Nonpoint pollution sources, *Soil conservation, *Water conservation, *Water pollution control, *Water quality control, Computer programs, Databases, Information systems, Land use, Resources management.

The role of the Soil Conservation Service (SCS) has, and continues to be, assisting farmers and ranchers with making decisions about soil and water conservation. SCS has initiated several efforts to bring conservation planning procedures in line with current agricultural realities. To meet the decision maker's demand for more quantified information, SCS undertook an assessment of the tools (computer programs, procedures, worksheets, etc.) available for estimating the effects of conservation on a broad range of resources, including: soil, water, air, plant, animal, and human. Delivering information to SCS field staffs is a key link between the research community and landusers; application of expert systems in delivery of new technology needs to be assessed. The interdisciplinary assessment group recommended many development needs, including conservation practice and effects on water quality, plant ability to cycle nutrients and pesticides, fate of water and chemicals in the vadose zone, sediment yield procedures for fields and watersheds, economic effects of water quality, and evaluation of current water quality conditions. The development of new decision aids for a broad range of resource concerns needs to be undertaken immediately. Although the most difficult software and database developmental issue can be that of identifying a project slate, the Tools Assessment and Development Report provides the agency with a subjective guide to developing decision aids, and therefore it can assist in the allocation of limited software development funds. The development of these new decision aids will require increased awareness of producer information needs; improved partnerships with the research community; and innovative ways of transferring the new conservation effects information. (See also W91-02985) (Fish-PTT)
W91-02991

POLICY ANALYSIS, AGRICULTURE, AND WATER QUALITY.
For primary bibliographic entry see Field 5G.
W91-02995

EPA'S CEEPES PROJECT: DESCRIPTION AND DATA NEEDS.
For primary bibliographic entry see Field 5G.
W91-02997

ANALYZING NATIONAL FARM CONSERVATION POLICY IN A NATIONAL GIS.
Center for Resource Innovations, Washington, DC.
M. S. Maizel, and K. Chan.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 91-94, 6 ref.

Descriptors: *Agriculture, *Conservation, *Farm management, *Geographic information systems, *Nonpoint pollution sources, *Resources development, *Water pollution control, Databases, Environmental policy, Government supports, Groundwater pollution, Management planning.

The Conservation Title of the 1985 Farm Bill together with proposals for the 1990 Farm Bill promise wider interest on the part of Congress in conservation policies to protect the nation's agricultural and related natural resources. The need to assess current provisions comprehensively and design new approaches to the sustainability of farm and farm-dependent resources is thus also a growing concern. The idea of 'targeting' resource regions using geographic information systems (GIS) with special policy provisions is a potential option. The Center for Resource Innovations together with the Harvard Laboratory for Computer Graphics and Spatial Analysis has been analyzing proposals for the 1990 Farm Bill which might lead to ground and surface water resources protection, enhancement and protection of endangered species and other wildlife habitats and other ecologically sensitive resources. The National Resources Inventory (NRI) of the Soil Conservation Service, U.S. Department of Agriculture is periodically-conducted assessment of the status, use, and potential of 1.5 billion of the nation's nonfederal rural lands. To these databases, EPA's REACH FILE has been overlaid to draw relationships between the NRI polygons on a watershed basis. This database has been used to assess the potential for multiple benefits of the Conservation Title of the 1985 Farm Bill and to assess the potential for groundwater and surface water contamination from farm practices. More and better geological information is needed, as well as finer delineation of specific climate, cropping systems, cover and practices and other information are needed for cause/effect analyses for groundwater vulnerability. (See also W91-02985) (Fish-PTT)
W91-03003

C AND SF PROJECT: ADAPTING A WATER RESOURCES PROJECT TO CHANGING PRIORITIES.
Army Engineer District, Jacksonville, FL.
S. J. Appelbaum.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 2A-13--2A-20, 9 ref.

Descriptors: *Central and Southern Florida Project, *Flood control, *Florida, *Management planning, *Regulated flow, *Water management, *Water resources management, Evaluation, Kissimmee Lake, Kissimmee River, Lake Okeechobee, Public policy, Water quality.

The Central and Southern Florida (C and SF) Project was conceived in 1947 by the US Corp of Engineers to provide flood protection and water control for central and southern Florida. While many of the project works have been constructed, development of the project continues today. Conditions and water resources priorities in the area are vastly different today. Population growth in central and south Florida has increased tremendously in the past 40 years. Awareness and understanding of the complex and fragile ecosystem of central and southern Florida have also increased in the years since the project was originally formulated, although Federal planning procedures for water resources projects and fiscal constraints have sometimes impeded this process. As part of the C and SF project, the upper Kissimmee lakes were regulated and the lower Kissimmee River was channelized. Restoration of the Kissimmee has been proposed as one of the strategies to improve water quality of Lake Okeechobee. (See also W91-03032) (Lantz-PTT)
W91-03035

INCREASING THE VALUE OF TECHNICAL DATA FOR MAKING GROUNDWATER POLICY DECISIONS.
North Carolina State Univ., Raleigh. Dept. of Economics.
For primary bibliographic entry see Field 7B.
W91-03075

AMERICAN RIVER AND AUBURN DAM: AN EXAMPLE OF THE NEW WATER POLICY.
California State Univ., Sacramento. Dept. of Economics.
For primary bibliographic entry see Field 6A.
W91-03079

EVALUATING THE IMPLEMENTATION AND EFFECTIVENESS OF BASIN PLANS IN KING COUNTY, WASHINGTON.
King County Surface Water Management Div., Seattle, WA.
D. Hendrickson.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p I4B-I--I4B-14, 7 tab.

Descriptors: *King County, *Performance evaluation, *Surface water, *Washington, *Water resources management, Compliance, Evaluation, Water management, Water plans, Watershed management.

In 1987, King County, Washington evaluated the implementation and effectiveness of five major comprehensive watershed plans completed over the previous decade. The project had two major findings. First, most of the recommendations in the plans have not been implemented. The percentage of all recommended solutions, structural and nonstructural, that have been implemented, ranges from 17% ten years after plan completion to 36% after 6 years. The reasons identified for poor implementation include: insufficient funding and staff; no established implementation procedures; unclear recommendations; and unassigned responsibility for implementation. Second, some of the solutions that were implemented have not performed as predicted. Reasons for this include: inaccurate or outdated design assumptions; insufficient maintenance of structural solutions; and poor enforcement of regulatory solutions. The project recommended numerous improvements in King County's new Surface Water Management Program to correct these past problems. Recommendations addressed four general themes: (1) basin plans should be living documents that can be routinely modified in response to new information or changed conditions; (2) specific staff should be accountable for plan implementation; (3) institutional changes are needed to ensure better regulatory compliance; and (4) budget and scheduling decisions should not compromise the quality of plan analyses. (See also W91-03032) (Author's abstract)
W91-03093

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES. VOLUME III.
For primary bibliographic entry see Field 2F.
W91-03178

SECONDARY ECONOMIC IMPACT OF ACID DEPOSITION CONTROL LEGISLATION IN SIX COAL PRODUCING STATES.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5G.
W91-03220

COST AND TECHNOLOGY DOCUMENT ON DRINKING WATER TREATMENT FOR LOW RANGE COSTS: ESTIMATED LOW RANGE COSTS FOR THE REMOVAL OF INORGANICS, RADIONUCLIDES, AND CORROSION RELATED CONTAMINANTS FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5F.
W91-03221

1988 NEEDS SURVEY REPORT TO CONGRESS: ASSESSMENT OF NEEDED PUBLICLY OWNED WASTEWATER TREATMENT FACILITIES IN THE UNITED STATES.
Environmental Protection Agency, Washington,

DC. Office of Municipal Pollution Control.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-189633. Price codes: A03 in paper copy, A01 in microfiche. Report no. 430/09-89-001, February 1989. 70 p, 6 fig, 4 tab, 4 append. Contract no. 68-03-3476.

Descriptors: *Capital costs, *Clean Water Act, *Economic evaluation, *Municipal wastewater, *Wastewater facilities, Cost analysis, Participating funds, Public health, Secondary wastewater treatment, Sewer systems, Water quality.

The Environmental Protection Agency (EPA) has compiled a detailed estimate of the capital costs to build publicly owned municipal wastewater treatment facilities to comply with the requirements of the Clean Water Act. The 1988 Needs Survey focuses on construction grant eligible category of need, rather than the expanded State Revolving Fund eligibilities under the 1987 Amendments to the Clean Water Act. EPA's needs estimates include those for which a water quality or public health problem could be documented in accordance with specific criteria established in the 1986 Survey. The needs for documented facilities are: $83.5 billion to satisfy all categories of need for the design year (2008) population, and $67.9 billion to satisfy all categories of need for the current (1988) population. Compared to previous Surveys, the overall change is small which suggests that grant-eligible needs are beginning to stabilize. A total of 15,591 treatment facilities are operating in 1988, and 17,374 facilities will be in operation when all documented needs are met. Eighty-eight percent of existing treatment facilities currently provide secondary treatment or better. When design year needs are met, nearly all treatment facilities will provide secondary treatment or better. Over 1,100 collection systems have combined sewer systems. Of these, 328 have documented needs in the 1988 Survey, totaling $16.4 billion to correct combined sewer overflow problems. (Fish-PTT)
W91-03232

LONG-TERM EVALUATION OF WETLAND CREATION PROJECTS.
Hampshire Coll., Amherst, MA. School of Natural Science.
For primary bibliographic entry see Field 2H.
W91-03267

OPTIONS TO BE CONSIDERED IN PREPARATION AND EVALUATION OF MITIGATION PLANS.
Environmental Protection Agency, Atlanta, GA. Region IV.
W. L. Kruczynski.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 555-570, 1 fig, 1 tab, 3 ref.

Descriptors: *Alternative planning, *Artificial wetlands, *Water resources management, *Wetland restoration, *Wetlands, Compensation, Environmental engineering, Environmental impact, Evaluation, Monitoring, Project planning, Water law, Water resources development.

Consideration of compensatory mitigation should be confined to projects which comply with the Environmental Protection Agency's Section 404(b)(1) Guidelines. The complexity of designing a successful mitigation plan is due to specific characteristics of many types of wetlands and the many options available at mitigation sites. The types of compensatory mitigation, in order of preference, are: restoration, creation, enhancement, exchange. Preservation should only be considered when the ecological benefits of preservation greatly outweigh the environmental losses of an unavoidable filling activity. A methodology based upon rating of the options has been developed to aid in the selection of an acceptable mitigation plan. In general, on-site, in-kind, up-front mitigation is the preferred option. However, other options may be acceptable based on availability of sites, plant material, and other variables. The proposed methodology should be used as a guide and not as the only criterion in decision making. Monitoring of mitigation sites is essential to demonstrate creation of functional wetland systems. The specific issues which should be explicitly addressed during the permit review process to improve the prospects of successful compensatory mitigation of wetland losses for projects which otherwise comply with the Section 404 Guidelines are: slopes and gradients, soils, plant material, hydrology, monitoring, timing, location, and community type. (See also W91-03244) (Author's abstract)
W91-03272

HOW TO GET THE PUBLIC BEHIND WATER RECLAMATION.
Los Angeles County Sanitation District, CA.
J. Haworth.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 81-87.

Descriptors: *Public opinion, *Reclaimed water, *Wastewater treatment, *Water reuse, *Water shortage, *Water treatment, Economic aspects, Marketing, Public policy, Water resources management.

The public is very interested in water reclamation but is equally concerned about the risks. Since Los Angeles County is located in a semiarid desert there will always be a water shortage here. The public is aware that they are in a dry area. They are aware that they need water and they want their local water agency to supply it. To ensure public acceptance it is necessary to run a clean and open organization. Violations must be minimized. Spilled sewage is not helpful to the image of an agency that is supposed to be producing safe, reliable, reclaimed water. Seemingly peripheral things like odor are not helpful. The industry must present a classy face and a classy image for the public to see, in everything that is done including brochures and annual reports. It is important to be visible and available, especially when there is a problem. In good times take advantage of the lull in the bad times. Unfortunately, newspapers do not come out with headlines that read, 'Sewage Treatment Plant Ran Swell Yesterday'. The public will never know that a plant is running well unless someone tells them. With water reclamation there is a need for marketing. Wastewater agencies need allies who know what the agencies do, understand it, and think it is good. The worst ally is an uninformed ally. To develop informed allies it is necessary to spread accurate information. This can be done through tours, presentations, school programs and career days. In conclusion it is important for agencies to have good communication with the public, to build informed citizen allies, and to have credibility. (See also W91-03273) (Agostine-PTT)
W91-03283

WATER REUSE PLANS AND ASSISTANCE PROGRAMS.
San Diego County Water Authority, CA.
P. M. MacLaggan.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 107-117. 5 fig.

Descriptors: *California, *Financing, *Planning, *Reclaimed water, *Wastewater treatment, *Water resources institutes, *Water resources management, *Water reuse, *Water treatment, Economic aspects, Legal aspects, Management planning, Regulations.

The first step in the planning of water reuse programs is to establish a regional coordinator. The water authority acts as the regional coordinator in San Diego County. The next step, which brings together all the key players, is the formation of a reclamation advisory committee. In San Diego County the Water Authority Reclamation Advisory Committee (WARAC) is comprised of representatives from each entity and meets monthly. WARAC is subdivided into committees that are looking at water reuse activities on a drainage basin-wide basis. Additionally, there is a subcommittee looking at policy and financing issues. All reclamation matters are passed through the WARAC to the Water Authority Board of Directors for consideration. Probably the most important step in developing a regional water reuse program is to look at local issues related to institutional relationships, project implementation, operation, financing, pricing, and revenue distribution. In addition to institutional arrangements there is the need for regulatory support. Political support is also an important aspect of reclamation planning. It is necessary to have the support of federal, state, and local politicians for programs to go forward. Funding can come in three steps: planning, design, and construction. At the planning level the water authority of San Diego County provides under its Water Reclamation Technical Assistance Program, 50 percent of the planning funding when matched by the local participant. There are two existing financial mechanisms available for the design and construction funds. There is also a program for funding during the operational phase which has been established by the Metropolitan Water District of southern California. A model reclamation ordinance is being prepared which is expected to be adopted throughout the region. The ordinance will provide master planning in each of the agencies, mandatory use requirements, dual piping provisions, and elimination of brine discharges from home water softeners. (See also W91-03273) (Agostine-PTT)
W91-03286

COOPERATIVE AGREEMENT ON SETTLEMENT AND RESOURCE SYSTEMS ANALYSIS. PROCEEDINGS TO THE CONFERENCE ON THE AFRICAN EXPERIENCE WITH RIVER BASIN DEVELOPMENT: ACHIEVEMENTS TO DATE, THE ROLE OF INSTITUTIONS, AND STRATEGIES FOR THE FUTURE. HELD IN EASTON, MARYLAND ON MAY 24-27, 1988.
Clark Univ., Worcester, MA.
R. Perritt.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-105628/AS. Price codes: AO3 in paper copy, AO1 in microfiche. Report No. AID-PN-ABB-954. May 1988. 46p. SARSA Cooperative Agreement No. DAN-1135-A-00-4068-00. Prepared in cooperation with Institute for Development Anthropology, Binghamton, NY.

Descriptors: *Africa, *River basin development, *Water resources development, *Water resources management, *Watershed management, International commissions, Planning.

Guidelines for improved river basin planning were developed at a conference of more than 50 international specialists. Participants reviewed achievements and problems of river basin development to date and proposed future strategies. A major theme of the conference was the importance of defining a planning process appropriate for the unique characteristics of African river basins. The conference supported environmentally sound water controls that can interact with local systems, such as surface and groundwater storage. The report also summarizes workshop recommendations on the following issues: the strengths and weaknesses of regional river basin institutions; the role of local organizations; the need for trained personnel; and the importance of research to improve river basin development. The report includes a French summary of the conference proceedings. (Author's abstract)
W91-03585

GREAT LAKES: LIVING WITH NORTH AMERICA'S INLAND WATERS.
For primary bibliographic entry see Field 2H.
W91-03672

GREAT LAKES INSTITUTIONS AND THE POLICY PROCESS: ISSUES IN INTERSTATE AND INTERNATIONAL RESOURCE MANAGEMENT.
Great Lakes Commission, Ann Arbor, MI.

M. J. Donahue.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 1-10, 17 ref.

Descriptors: *Great Lakes, *Lake management, *Regional planning, *Water policy, *Water resources management, Canada, Governmental interrelations, Lake basins, Policy making, Political aspects, Water pollution control, Water quality management, Watershed management.

As a shared, multi-purpose resource, the Great Lakes are extensively used and managed at every level from municipalities to the international arena. A complex array of federal, state, provincial, local, and regional entities collectively defines the Great Lakes 'institutional ecosystem.' An understanding of the various roles, responsibilities and interrelationships within this 'ecosystem' is critical to sound policy development. Major uses of the Great Lakes include water supply, industry, transportation, recreation and tourism, power production, commercial and sport fishery, and waterfront development. Regional organizations play a pivotal role in Great Lakes Basin management by coordinating all other levels of government, and there are a multitude of issues that defy solution by political jurisdiction and must therefore be addressed in regional forum, such as water quality (point source pollution, nonpoint source pollution, in-place pollutants, airborne pollutants, and landfill and groundwater pollution), hazardous water management, fish contamination, and lake water levels. The Great Lakes deserve stature as a global laboratory for scientific inquiry and institutional analysis. In essence, the Great Lakes region is a composite of the whole array of socioeconomic, political, and environmental characteristics and issues that one might find in any water-based region, it is advisable to focus future research and policy attention to comparative analyses and technical exchange between various regions. (See also W91-03672) (Fish-PTT)
W91-03673

GREAT LAKES RESEARCH NEEDS AND HOW TO MEET THEM.
Michigan Dept. of Natural Resources, Lansing. Office of the Great Lakes.
K. E. Vigmostad, T. Anderson, and T. D. Martin.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 11-20, 2 ref.

Descriptors: *Environmental policy, *Great Lakes, *Hydrologic data, *Lake management, *Research, *Research priorities, *Water policy, *Water resources management, Canada, Ecosystems, Freshwater, Habitats, Natural resources, Surveys, Water quality management.

The Laurentian Great Lakes form the largest freshwater lake system in the world. These Lakes hold 95% of the nation's surface freshwater reserves and 20% of the world's. The Lakes contribute directly to the ecological and socioeconomic wellbeing of 37 million basin residents. Pressing water quality and quantity problems point to the gaps in research and information upon which to base sound public policy decisions. From a frontline, state-agency perspective, sound management depends on solid information about the Lakes, which requires quality research. Furthermore, ecosystem management demands ecosystem-oriented research. Based on the findings of a 75-member international team and an Office of the Great Lakes survey of universities and colleges, foundations, private nonprofit organizations, and state agencies, it is indicated that basic Great Lakes research needs include: sediment cores, budgets for the basic life chemicals, interactions between lake physics, food webs, and biological productivity. Specific jurisdictional research areas were identified as: chemical transport and fate; continental and global processes; critical habitat protection and resource inventory; ecological processes and population dynamics; health of Great Lakes fish and birds; human health impact of toxicants; institutional arrangements and facilities; monitoring; open lake and shoreline physical processes; social, economic, and political issues; water levels; and water quality. By providing adequate, protected sources of funding and by coordinating research activities into a common effort, a research climate can be developed which fosters and enables cutting-edge, ecosystem-oriented research of value to all of the large lakes of the world. (See also W91-03672) (Fish-PTT)
W91-03674

REMEDIAL ACTION PLANS: A GREAT LAKES PROGRAM WHOSE TIME HAS COME.
International Joint Commission-United States and Canada, Windsor (Ontario).
J. H. Hartig.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 45-51, 1 fig, 1 tab, 7 ref.

Descriptors: *Great Lakes, *Lake management, *Lake restoration, *Water policy, *Water pollution control, *Water resources management, Canada, Environmental impact, Environmental policy, Evaluation, Governmental interrelations, Management planning, Ontario, Political aspects, Public participation, Site remediation.

Forty-two Areas of Concern have been identified in the Great Lakes Ecosystem where general or specific objectives of the Great Lakes Water Quality Agreement are not met and such failure has caused or is likely to cause impairment of beneficial use or of the area's ability to support aquatic life. Although some Areas of Concern still exhibit bacterial pollution and eutrophication, the major problem here today is toxic substances contamination (e.g., 41 of the 42 Areas of Concern have toxic substances contamination). In 1985, the eight Great Lakes states and the province of Ontario committed themselves to developing a remedial action plan (RAP) to restore beneficial uses in each Area of Concern within their political boundaries. RAPs must not only identify specific measures necessary to control existing sources of pollution, abate environmental contamination (e.g., contaminated sediments) and restore beneficial uses, but must present timetables for implementation of remedial actions to be able to measure progress. Three primary reasons why this RAP program is different from previous initiatives include: public participation (commitment to generate and sustain broad community support); strategic planning (identifying when specific actions will be taken in the future to resolve the problems); and evaluating and tracking progress (IJC) will evaluate RAPs for adequacy and biennially track implementation progress). (See also W91-03672) (Author's abstract)
W91-03677

LAKE SUPERIOR'S HIGH WATER LEVEL AND DAMAGES: A DELICATE BALANCE.
Minnesota Dept. of Natural Resources, St. Paul.
O. Sium, P. Otterson, and D. Retka.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 111-115, 1 fig, 1 tab, 5 ref.

Descriptors: *Great Lakes, *Lake Superior, *Lake management, *Minnesota, *Water level fluctuations, *Water resources management, Erosion, Flood damage, Interagency cooperation, Lake shores, Land use, Management planning, Shore protection, Zoning.

Minnesota's Northshore damage survey was done as a result of the high water levels in Lake Superior during 1985-1986. Massive erosion and structural damages began to occur when Lake Superior's water level exceeded elevation 602.2 feet International Great Lakes Datum 1955. Damages due to the 1985-1986 period were estimated at about $77 million in Minnesota. Shoreland development, shipping, and recreational activities have been consistent with the International Joint Commission's operating plan to manage Lake Superior's water levels between elevations 600.5 and 602.0. Because Minnesota's Northshore is a unique resource, the Northshore Management Board, consisting if representatives of each unit of government along the Shore with the exception of Duluth, was formed to develop a land use management plan for the North Shore. The plan will be the basis for the adoption of improved local zoning controls which will conserve natural resources, protect water quality and lessen damage to future development due to flooding, wave action, seepage, and erosion. (See also W91-03672) (Author's abstract)
W91-03684

REVIEW OF PUBLIC PARTICIPATION IN THE GREAT LAKES WATER QUALITY AGREEMENT.
League of Women Voters of Michigan, Brighton.
C. Y. Swinehart.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 137-147, 19 ref.

Descriptors: *Great Lakes, *International commissions, *Lake management, *Public participation, *Water quality management, *Water resources management, Canada, Governmental interrelations, Management planning, United States, Water resources development.

The Great Lakes Water Quality Agreement expresses the commitment of the U.S. and Canada to improve and preserve the quality of the world's largest fresh water ecosystem: the Great Lakes-St. Lawrence River. Despite considerable obstacles of distance, expense, different political/legal systems and culture, citizens of both countries have played an ongoing and increasingly significant part in the development, implementation, and improvement of the agreement. Public involvement has evolved from citizen's demands for international studies that resulted in the original binational commitment of 1972, through their increasingly active monitoring of agreement implementation, to the participation of public interest groups in the governments' 1987 review and modification of the 1987 review and modification of the 1978 agreement. Some options for future participation include: creation of a citizen advisory committee for the International Joint Commission (IJC); citizen appointments to the agreement's boards and committees; full participation in the development, monitoring, and implementation of remedial action plans for Great Lakes areas of concern; more direct and public communication in IJC biennial meetings on Great Lakes water quality; greater outreach by governments and the IJC to citizens in future reviews and negotiations of agreements. The acceptance and implementation of these and other opportunities depends on the imagination, initiative, and willingness of citizens, the U.S. and Canadian governments and the IJC. (See also W91-03672) (Fish-PTT)
W91-03687

MANAGEMENT APPROACHES WITHIN THE 1987 US/CANADA GREAT LAKES WATER QUALITY AGREEMENT.
Environmental Protection Agency, Chicago, IL. Great Lakes National Program Office.
K. Fuller.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 149-153.

Descriptors: *Environmental protection, *Governmental interrelations, *Great Lakes, *Lake management, *Water quality management, *Water resources management, Canada, Clean Water Act, Ecosystems, Interagency cooperation, International commissions, United States, Water pollution management, Water quality standards.

Two major events occurred during 1987 that will change management approaches to environmental quality in the Great Lakes. Section 118 of the Clean Water Act now specifically recognizes the U.S./Canada Agreement and sets its purpose, 'to achieve goals embodied in the Great Lakes Water Quality Agreement.' The second event was the

signing of amendments to the Agreement by the U.S. and Canada following a year-long review. The new management themes provided by the amendment consist of five elements: (1) accountability for taking action has been strengthened by calling for reports by specific dates and clarified in terms of the responsibilities of the federal governments, states, and the International Joint Commission; (2) a process is specified for sorting out the hundreds of chemicals of concern in the Lakes for the purpose of setting ambient objectives (criteria); (3) the two countries are to consult at least every two years to establish or modify ambient objectives, including ecosystem objectives; (4) the remedial action plans are called for to address designated geographic 'areas of concern'--hard core polluted areas where beneficial uses have not yet been fully restored; and (5) Lake Management Plans are called for to address 'critical pollutants,' to be designated by the federal governments. These new provisions will allow all concerned to understand the problems and keep score on progress being made. (See also W91-03672) (Author's abstract)
W91-03688

SIGNIFICANCE OF GIS AND REMOTE SENSING TECHNOLOGY IN GREAT LAKES MONITORING AND RESOURCE MANAGEMENT.
Wisconsin Univ.-Madison. Environmental Remote Sensing Center.
For primary bibliographic entry see Field 7B.
W91-03689

GROUND WATER RECHARGE: DEMONSTRATION PROGRAM AND POLICY ISSUES.
Bureau of Reclamation, Denver, CO.
B. P. Glenn.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 123-131, 1 fig.

Descriptors: *Artificial recharge, *Demonstration programs, *Groundwater management, *Groundwater recharge, *Nonpoint pollution sources, *Water policy, *Water resources management, Arizona, California, Colorado, Idaho, Interagency cooperation, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, Project planning, South Dakota, Texas, Utah, Washington, Water pollution control, Wyoming.

The High Plains States Groundwater Demonstration Program Act (Act) of 1983 directs the Secretary of the Interior, acting through the Bureau of Reclamation, to engage in a special study of the potential for groundwater recharge in the High Plains States (Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming) and other Reclamation Act States (Arizona, California, Idaho, Montana, Nevada, North Dakota, Oregon, Utah, and Washington). The Program is being carried out in two phases. Phase I was the planning, development, and site selection phase, and Phase II is the design, construction, operation, and evaluation phase. The legislation established a two-year period for Phase I and a five-year period for Phase II. The Phase II plan will contain not less than 21 demonstration sites, located in areas having a declining water table, an available surface water supply, and a high probability of physical, chemical, and economic feasibility for recharge of the groundwater reservoir. The program will emphasize recharge orientation, local supplies, nonstructural aspects, institutional and legal aspects, and uniqueness. Project proposals were submitted, evaluated, and selected based on technical merit, environmental clearance requirements, requirements of the Act, and cost ceiling constraints. Policy issues which will be addressed during the study include the identification of the beneficiaries of groundwater recharge, allocation of costs, and integration into existing Federal Projects. Groundwater protection is emerging as an important issue in the program. (See also W91-03704) (Fish-PTT)
W91-03718

CREATING SUCCESSFUL PROGRAMS: THE INNOVATIVE TOUCH.
Weston (Roy F.), Inc., Washington, DC.
For primary bibliographic entry see Field 5G.
W91-03720

BIRTH OF A MEGAPROJECT: POLITICAL ECONOMY OF FLOOD CONTROL IN BANGLADESH.
Massachusetts Univ., Amherst. Dept. of Economics.
For primary bibliographic entry see Field 4B.
W91-03873

IS BROADSCALE REVEGETATION ECONOMIC AND PRACTICAL AS A GROUNDWATER AND SALINITY MANAGEMENT TOOL IN THE MURRAY-DARLING BASIN.
La Trobe Univ., Bundoora (Australia). School of Agriculture.
For primary bibliographic entry see Field 4C.
W91-03895

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ECONOMIC ANALYSIS OF PROPOSED AMENDMENTS TO WATER POLLUTION REGULATIONS PHOSPHORUS DISCHARGES R87-6.
Blaser, Zeni and Co., Springfield, IL.
For primary bibliographic entry see Field 5G.
W91-03022

ECONOMIC ANALYSIS OF PROPOSED SITE SPECIFIC CHANGES TO WATER QUALITY REGULATIONS AFFECTING BORDEN CHEMICAL COMPANY.
Booker Associates, Inc., St. Louis, MO.
For primary bibliographic entry see Field 5G.
W91-03023

TECHNOLOGIES AND COSTS FOR THE REMOVAL OF SYNTHETIC ORGANIC CHEMICALS FROM POTABLE WATER SUPPLIES.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
For primary bibliographic entry see Field 5F.
W91-03029

COST SHARING: IT'S IMPACT ON WATER RESOURCES DEVELOPMENT.
Military Academy, West Point, NY. Dept. of Electrical Engineering.
G. E. Galloway.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 2A-1--2A-9, 2 fig, 2 tab, 14 ref.

Descriptors: *Cost sharing, *Water management, *Water resources development, Community development, Construction costs, Cost-benefit analysis, Costs, Feasibility studies, Federal jurisdiction, Local governments, Project planning.

The 1986 Water Resources Development Act, imposed on the water resources development programs of the US Army Corp of Engineers, increased requirements for local sponsors of water projects to share in the funding of both feasibility studies and project construction. This approach, on the drawing board for nearly ten years, was expected to significantly alter the pattern of water resources development. The first three years of experience under the Act are examined in this paper, as well as its predecessor activities not initiated because of a failure to obtain the needed cost sharing agreements. General conclusions are drawn concerning the possible long-term impacts of the fiscal driven criteria for project activity. Among the conclusions are: (1) limited funding through the Federal government for spending in the water resources arena go further when combined with contributions from local sponsors; (2) demonstrated willingness to pay by sponsors, for participation in planning and project construction, stands as evidence that the benefit cost ratio established for the project is in fact correct; and (3) the greater focus on insuring fiscal responsibility in project development is also improving the quality of management of these projects with attendant savings and benefits for the Federal government. (See also W91-03032) (Lantz-PTT)
W91-03034

MANAGING WATER RESOURCES BY INTEGRATING PLANNING: NEW JERSEY'S STATE PLAN.
New Jersey Dept. of the Treasury, Trenton Office of State Planning.
R. A. Kull.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 1B-21--1B-33, 2 fig, 3 tab, 4 ref.

Descriptors: *Costs, *Management planning, *New Jersey, *Water management, *Water resources management, Classification, Economic aspects, Evaluation, Financial feasibility, Public policy, State jurisdiction, Water resources development.

Continued population and employment growth in New Jersey is approaching the existing capacity of water resources to sustain future development. Technological responses to enhance this capacity are available, but at substantial increases in public utility and service costs. The ability to finance these costs is limited; future development must be made more efficient to ensure optimum use of infrastructure and the protection of natural resources. The management of development, currently shared among numerous functional State agencies, general county and municipal governments, and special districts must be better coordinated. New Jersey's new State Planning Act provides a mechanism to integrate planning. A State Development and Redevelopment Plan now being prepared includes statewide policies for planning and development; a regional design system specifying a hierarchy of community types based on infrastructure and resource capacities; a 'tier' system classifying areas of the state based on common issue and characteristics; a 'cross-acceptance' process for refining the Plan prior to adoption, by building consensus across all levels of government; and a monitoring process to measure the Plan's effectiveness. (See also W91-03032) (Author's abstract)
W91-03038

COST OF WASTEWATER RECLAMATION.
HYA Consulting Engineers, Arcadia, CA.
M. G. Hoover.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 55-64. 5 tab, 6 ref.

Descriptors: *California, *Cost analysis, *Reclaimed water, *Wastewater treatment, *Water reuse, *Water treatment, Economic aspects, Irrigation, Waste disposal, Water resources management.

Wastewater can no longer be treated to a high level of purity for disposal and non-beneficial uses, such as deep ocean discharges. The beneficial use of reclaimed water as a water resource, particularly for irrigation, and the offsetting costs for importing, avoiding water system expansion, and developing wastewater disposal systems can make reclamation practical, economical, and efficient. The cost components of reclaimed water need not be complicated but should include the detail of a number of cost elements based upon reasonable assumptions. Using the example of costs from other agencies, particularly the Irvine Ranch Water District, it is evident that reclaimed water when viewed from the position of water resource management can be as asset with a favorable cost to benefit ratio. When considered a water source and compared to the avoided costs of imported water and expanded potable water systems, it becomes an even more attractive argument. In costing reclaimed water, consideration of the following is essential: (1) listing cost centers and elements; (2) consideration of funding sources; (3) adoption of a

pricing philosophy based on the market and the value of the reclaimed water; (4) involvement of the end users; (5) utilization of the experience and 'learning curve' of other agencies. Water reclamation is a program. The program includes a series of projects, public relations, education and training. It involves dedication and commitment. Implementation of water reclamation is an essential part of managing water resources. (See also W91-03273) (Author's abstract)
W91-03281

FINANCING RECLAMATION PROJECTS.
South Coast Water District, Laguna Beach, CA.
R. C. Miller.
IN: Symposium III. Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 65-80.

Descriptors: *California, *Financing, *Reclaimed water, *Wastewater treatment, *Water reuse, *Water treatment, Economic aspects, Legal aspects, Legislation.

The basic provisions of the financing alternatives available to most public agencies is outlined. The discussion is general in nature and does not include all of the details involved in each of the financing options. The information is sufficient to make a conceptual decision on the approach to financing a given project. Once a decision is made, a financing consultant can provide the specifics on any proposed financing, including recommendations on timing, structure, term, call features, reserve funds, ratings, insurance provisions, and similar technical features. Among the options outlined are (1) Mello-Roos Community Facilities Act of 1982, (2) Special Assessment bond financing, (3) Improvement Act of 1911-Assessment Proceedings, (4) Improvement Act of 1911-Bonds, (5) Municipal Improvement Act of 1913, (6) Improvement Bond Act of 1915, (7) Revenue bonds, (8) General obligation bonds, (9) Lease-revenue securities, and (10) Short-term debt instruments. Floating rate securities are suggested as a way to reduce annual financing costs. A brief outline of municipal bond insurance is also given. (See also W91-03273) (Agostine-PTT)
W91-03282

WATER POLLUTION ABATEMENT EXPENDITURES IN THE WISCONSIN PAPER INDUSTRY.
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5G.
W91-03589

EFFLUENT FEES: POLICY CONSIDERATIONS ON A SOURCE OF REVENUE FOR INFRASTRUCTURE FINANCING.
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5G.
W91-03592

REVENUE SOURCES FOR RIVER MANAGEMENT.
Illinois Univ., Urbana.
W. D. Seitz.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 139-144, 2 ref.

Descriptors: *Economic aspects, *Illinois, *Illinois River, *Rivers, *Taxes, *Water resources management, Financing, Licenses.

Traditional sources of revenue will not be adequate to implement land and water measures necessary to manage the Illinois River. An analysis of alternative sources of revenue and the approximate revenue potential, based on an earlier analysis of revenue sources for lake management, is presented. Recreational license surcharges, users fees for demarcated recreational sites, marine fuel taxes, excise taxes of recreational equipment, potable water surcharges, special tax assessments on property, and assessments on polluters, are among the alternatives explored. Some of these alternatives appear to be applicable at the local level, but may require special provisions such as the formation of a new management institution equivalent in this context to the special taxing district. State (or Federal) involvement is likely to be required to deal with the problems in major river systems such as Illinois. New institutional structures such as those developed to manage the Columbia River may merit attention. (See also W91-03608) (Author's abstract)
W91-03625

CROPPING STRATEGIES FOR EFFICIENT USE OF WATER AND NITROGEN: INTRODUCTION.
Georgia Agricultural Experiment Stations, Griffin.
For primary bibliographic entry see Field 3F.
W91-03634

MULTIPLE CROPPING FOR EFFICIENT USE OF WATER AND NITROGEN.
Georgia Coastal Plain Experiment Station, Tifton.
For primary bibliographic entry see Field 3F.
W91-03635

6D. Water Demand

WATER WITHDRAWAL AND USE IN MARYLAND, 1986.
Geological Survey, Towson, MD. Water Resources Div.
J. C. Wheeler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-714, 1990. 30p, 7 fig, 12 tab, 23 ref, append.

Descriptors: *Maryland, *Pumpage, *Water use, Agricultural water, Aquaculture water, Domestic water, Hydroelectric power, Industrial water, Irrigation water, Mining water, Public water supply, Surface water, Thermoelectric power.

During 1986, about 1,460 million gallons per day of freshwater was withdrawn from the surface-, and groundwater resources of Maryland. In addition, more than 6,240 million gallons per day of saline surface water was withdrawn and used primarily for cooling purposes in the generation of electricity. Most freshwater withdrawals (84%) were from surface water sources and were withdrawn and used in the Potomac drainage basin, whereas most groundwater was withdrawn and used in the Upper Chesapeake drainage basin. The Potomac Group aquifers provided the most groundwater (56 million gallons per day). Ten water use categories comprise the major demands on the surface and groundwater resources of the State: public supply, domestic, commercial, industrial, mining, thermoelectric power generation, hydroelectric power generation, agricultural (non-irrigation), irrigation, and aquaculture. Public-supply systems withdrew the most water in the State (801 million gallon/day) for use by residents, commercial establishments, and industries. Baltimore City had the largest public-supply use in 1986 (about 151 million gallons/day). (USGS)
W91-02960

LESSONS LEARNED WHILE DEVELOPING PICS DATABASE.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 7C.
W91-03048

WATER USE REGULATION FOR THE '90'S - THE SOUTHWEST FLORIDA EXPERIENCE.
Southwest Florida Water Management District, Brooksville. Resource Regulation Dept.
K. A. Weber, and C. F. Harper.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 3B-1--3B-8, 1 fig, 11 ref.

Descriptors: *Florida, *Groundwater management, *Regulations, *Selective withdrawal, *Southwest Florida Water Management District, *Water law, *Water management, *Water use, Land use, Saline water intrusion, Water demand, Water resources development, Water resources management.

The State of Florida has one of the most comprehensive water management programs in the nation, with Water Management Districts encompassing the entire state. Each District is charged with a multitude of water management functions, including the regulation of water use. The Southwest Florida Water Management District (SWFMD) was the first in the state to regulate water withdrawals, in 1969. Recently the District has revised their water use rules with the aim of updating them based on an expanded knowledge of the District's hydrology, advances in technology, and the present and future demands imposed on the resource by the rapid growth of the region. These newly revised rules and procedures strike a balance between the optimum use of the water resources and their protection. These rules and procedures address the evaluation of reasonable water use, and withdrawal impacts on surface water bodies, wetlands, saltwater intrusion, inducement of pollution, existing water users and land use, and other water use problems. These rules were developed to manage limited water resources in the face of tremendous growth, and may serve as a model for other areas facing similar challenges. (See also W91-03032) (Author's abstract)
W91-03052

WATER USE PERMITTING IN FLORIDA: AN EFFECTIVE PROGRAM FOR ALLOCATING WATER.
Saint Johns River Water Management District, Palatka, FL. Dept. of Resource Management.
J. C. Elledge.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 4B-17--4B-28, 2 fig, 11 ref.

Descriptors: *Florida, *Groundwater management, *Regulations, *Water allocation, *Water districts, *Water management, *Water resources management, *Water use, Case studies, Consumptive Use Program, Potable water, St Johns River, Urbanization, Water demand.

Rapid growth in Florida has resulted in increased demands on natural resources, including surface and groundwater supplies. The significant increase in population has been concentrated in coastal areas which have limited local potable water supplies. As a result, 5 regional Water Management Water Districts, along with the Consumptive Use Permitting Program (CUP) have been established. The Districts were intended to be an administrative forum for the resolution of conflicts between competing users. The CUP program has several other goals: to ensure reasonable use of water; to protect the environment and the water supply; and to promote conservation. The CUP program has accomplished all of its established goals. Case studies are presented which focus on the effectiveness of the CUP program at the St. Johns River Water Management District. (See also W91-03032) (Lantz-PTT)
W91-03054

ECONOMIC EFFICIENCY AND INSTITUTIONAL CHANGE IN WATER ALLOCATION: THE 1987 HAWAII WATER CODE.
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 6E.
W91-03057

WATER-RESOURCES DEVELOPMENT ALTERNATIVES FOR THE MISSISSIPPI ALLUVIAL PLAIN IN EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.

Group 6D—Water Demand

For primary bibliographic entry see Field 6A.
W91-03087

REASSESSING ESTIMATES OF GREAT LAKES CONSUMPTIVE USES AND IMPACTS.
Corps of Engineers, Chicago, IL. North Central Div.
D. J. Leonard, and R. Manam.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 33-44, 10 fig, 2 tab, 11 ref.

Descriptors: *Consumptive use, *Environmental impact, *Great Lakes, *Lake management, *Water policy, *Water resources management, Canada, Estimating, Interagency cooperation, Projections, Water use.

Several studies in the last decade have produced varying estimates of consumptive uses of Great Lakes waters. There are significant differences between the 1975 base year data developed by the U.S. Geological Survey (USGS) and the data used by the International Joint Commission's (IJC's) International Great Lakes Diversions and Consumptive Uses Study Board. The projected estimates of the Study Board were compared with the revised estimates generated by the IJC and the USGS as part of IJC's Reference Study of 1981, and new water-use data were compiled by the USGS for the years 1980 and 1985. Consumptive water use, the portion of water withdrawal that is not returned to the Great Lakes system, is expected to be five times greater in 2035 than it was in 1975. Consumptive use is estimated to increase from 7% of total withdrawals in 1975 to 15% in 2035. Manufacturing consumed 53% of the total consumptive use in 1975, with municipal consumption at 16%, and the power industry at 10%. These three sectors accounted for 80% of the water consumed in 1975 and may increase to 92% in 2035. Based on the 1980 and 1985 consumptive use data developed by the USGS the rate of consumptive use increase is estimated to be 218.4 cfs/year, which is higher than the IJC (1985) value of 115.6 cfs/year. A possible range of projected values for consumptive use for the year 2000 is between 4500 and 6500 cfs. Current plans are to undertake a detailed study to reevaluate the projection methods and the significance of consumptive use impacts during drought situations. (See also W91-03672) (Fish-PTT)
W91-03676

RECREATIONAL BEACH ENVIRONMENT: PERCEPTIONAL DIFFERENCE OF USERS, EMPLOYEES, AND THE PUBLIC.
State Univ. of New York Coll. at Cortland. Dept. of Recreation and Leisure Studies.
R. B. Buerger, J. F. Palmer, and T. A. More.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 269-278, 3 tab, 16 ref. NOAA U.S. Department of Commerce, Sea Grant College, New York Sea Grant Institute Grant No. NA81AAD00027.

Descriptors: *Beaches, *Great Lakes, *Lake Ontario, *Lake management, *Public opinion, *Recreation, *Surveys, *Water resources management, Economic aspects, Lake shores, New York, Public participation, Social aspects.

A study was performed to investigate what attributes beach users, those employed at the beach and the general public, perceive as important in the coastal recreation environment. During the summer of 1982, 300 beach users and 99 beach employees at three New York State park beaches along the southeast shore of Lake Ontario were personally interviewed. Beach users and beach employees were asked to evaluate 20 beach attributes based on their own personal perception. In 1984, 52 randomly selected City of Oswego (lake shore community near test beaches) residents (public) evaluated the same 20 beach attributes using a mail questionnaire. A comparison of the beach user and public responses showed a significant difference in perception of the beach attributes 'low cost of entrance' (important for public), 'opportunity to see wildlife' (public), and 'rules and regulations' (public). Moderately significant differences were indicated for the attributes 'socializing at the beach' (public), 'weather' (user), and 'people who work at the beach' (public). All demographic variables were significantly different between beach users and the public except for the variable 'income.' The results of this study indicate that beach users are not a cross-section of the public social strata but do have similar economic resources at their disposal. Also, the two groups perceive the beach environment differently specifically in terms of how people at the beach should be managed. Beach employees' own perceptions of the beach were not similar to either group and should not be used alone to make decisions about how to manage recreational use at the beach. (See also W91-03672) (Author's abstract)
W91-03701

EXCURSION, CRUISE AND PASSENGER FERRY SERVICES ON THE GREAT LAKES AND ST. LAWRENCE RIVER.
Great Lakes Commission, Ann Arbor, MI.
S. J. Thorp.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 285-294, 7 ref.

Descriptors: *Great Lakes, *Lake management, *Recreation, *Tourism, *Water resources management, Boating, Economic aspects, Navigable waters, Ships, Travel.

Passenger vessel activity on the Great Lakes and St. Lawrence River is undergoing a renaissance. At present, several million people take these excursions and ferry trips during the navigation season. In addition, several hundred thousand passengers, with their vehicles, board ferries each year. In 1987, large liner cruises on the lower St. Lawrence River set a modern-day passenger record. However, passenger movement by vessel mode is substantially less than what it was when immigrants boarded boats for westward destinations and millions of travelers embarked on trips during the famed 'Resort Era' in the early twentieth century. The upswing in patronage reflects the general increase in tourism and outdoor recreation activity in North America and the Great Lakes Region. An increasing number of excursion firms own or manage other complementary businesses and several are subsidiaries themselves. Another trend is broader geographic dispersion by independent firms and multiple service locations for individual companies. In the wake of this current interest, feasibility studies and marketing surveys have been completed indicating substantial demand for multi-day cruise service for the Great Lakes and St. Lawrence System. New opportunities for market growth and attention to efficient operations will guide future profitability. The overnight cruise sector has rediscovered the St. Lawrence River and may be on the verge of coming back to the Great Lakes. (See also W91-03672) (Author's abstract)
W91-03703

6E. Water Law and Institutions

WATER QUALITY INITIATIVE OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.
For primary bibliographic entry see Field 5G.
W91-02986

WATER: LAWS AND MANAGEMENT.
Contributed Papers and Abstracts for the Conference held September 17-22, 1989, Tampa, Florida. American Water Resources Association, Bethesda, Maryland, 1989. 820p.

Descriptors: *Conferences, *Groundwater management, *Legal aspects, *Legislation, *Water law, *Water management, *Water resources development, *Water resources management, Databases, Environmental protection, Regulations, Water supply development, Wetlands.

These proceedings present papers from the conference which have been divided into 28 sections. (1) National water policy; (2) Regional water resources management; (3) Comprehensive water resource planning; (4) Water resources policies studies; (5) Water resources information management and data sharing; (6) Water resources database design and utilization; (7) National water quality assessment programs; (8) Wetland management techniques; (9) Water regulations in Florida; (10) State's water rights; (11) Water use regulations and allocations; (12) Reclaimed water panel discussion; (13) Water quality treatment studies; (14) Water quality treatment criteria; (15) Hydrologic data measurements and models; (16) GIS as a tool for water resources management; (17) Groundwater management issues; (18) Groundwater management protection; (19) Water resources education; (20) Management tools for water resources management programs; (21) Flood water management; (22) Project management; (23) Hydrologic modeling of water quality impacts; (24) Environmental management; (25) Water supply management-I; (26) Water supply management-II; (27) Water use management; and (28) Basin planning and watershed management. (See W91-03033 thru W91-03096) (Lantz-PTT)
W91-03032

TWO STATES, TWO POLICIES: WETLANDS AND MINING IN ALASKA AND PENNSYLVANIA.
Pennsylvania State Univ., University Park. Graduate School.
E. G. M. Meij, L. K. Davis, and R. P. Brooks.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 1A-5--1A-13, 1 tab, 20 ref.

Descriptors: *Alaska, *Clean Water Act, *Legal aspects, *Mining, *Pennsylvania, *Water law, *Water management, *Water pollution control, *Wetlands, Economic aspects, Environmental protection, Federal jurisdiction, Public policy, State jurisdiction.

The Clean Water Act provides guidelines for wetland protection on a national basis in the absence of a comprehensive national policy for wetlands protection. Implementation of the Clean Water Act by the Corp of Engineers, the EPA, and state environmental agencies has resulted in regional variations in wetland management and protection. Without clear national standards for wetlands protection, these agencies determine regional wetlands policies during the permitting process. Industry-specific permit decisions further fragment the wetland protection inherent in the Clean Water Act. The emergence of regional policies is demonstrated with examples of coal mining in Pennsylvania and gold mining in Alaska. The organizational structure of the state and federal agencies which administer mining permits in these two states contribute to regional variation in wetlands protection. Regional variations also arise from differences in economic base, degree of development, percentage of wetlands in private versus public ownership, availability of a wetland inventory, and physiography. In Pennsylvania where wetlands are scarce, the population density is high, the economy is diversified, and most mining takes place on private lands, the state has developed strict regulations to protect wetlands. In Alaska where wetlands are abundant, the population density is very low, the economy depends heavily on the natural resource base, and mining takes place predominantly on public lands, national regulations such as the Clean Water Act are relied upon for wetland protection. (See also W91-03032) (Author's abstract)
W91-03033

WATER MANAGEMENT PLANNING: A PERSPECTIVE FROM THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT.
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 6A.
W91-03037

RESPONSE TO THE ALABAMA ENVIRONMENTAL PROTECTION PLAN.
Water Cycle Concepts, Inc., Auburn, AL.
For primary bibliographic entry see Field 6A.
W91-03039

OVERCOMING INSTITUTIONAL BARRIERS AND CONSTRAINTS TO WATER QUALITY MANAGEMENT.
University of Tennessee, Planning Research Center, Knoxville, TN.
For primary bibliographic entry see Field 5G.
W91-03041

ROLE OF PLANNING IN RESOLVING WATER POLICY DISPUTES.
Montana Dept. of Natural Resources and Conservation, Helena. Water Resources Div.
For primary bibliographic entry see Field 6A.
W91-03042

MANAGING GROUNDWATER IN TEXAS: THE CHANGING PACE OF REGULATION.
Texas Tech Univ., Lubbock. Dept. of Geography.
For primary bibliographic entry see Field 4B.
W91-03053

STATE WATER ALLOCATION LAW: ITS TRADITIONAL AND EMERGING ROLES.
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.
W. E. Cox.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 5B-3--5B-9, 6 ref. USGS Grant No. 14-08-0001-G1481.

Descriptors: *Water allocation, *Water demand, *Water law, *Water management, Competing use, Legal aspects, Legislation, State jurisdiction, Water use.

Water allocation laws are a fundamental component of the institutional framework for state water resources management. The definition of property interests is essential to water use and development. The basic function of water law is to facilitate the application of water to those uses which best contribute to social welfare. Although this function remains the same, the types of conflicts that must be resolved vary over time in response to changing views of the public interest. A traditional role of water law has been the resolution of conflict among competing offstream water uses. This function continues to be important, but increasing offstream use has required the recognition of a second function of water law: the protection of environmental conditions dependent on instream flow. Another increasingly important role is the resolution of interjurisdictional political conflicts arising over water transfer. Water law has not functioned well in this area. Weaknesses in resolving interjurisdictional conflict indicate the need for further evolution, if water law is to continue to serve its intended function effectively. (See also W91-03032) (Author's abstract)
W91-03055

ECONOMIC EFFICIENCY AND INSTITUTIONAL CHANGE IN WATER ALLOCATION: THE 1987 HAWAII WATER CODE.
Hawaii Univ., Honolulu. Water Resources Research Center.
J. E. T. Moncur.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 5B-23--5B-30, 19 ref.

Descriptors: *Economic aspects, *Hawaii, *Institutional constraints, *Legislation, *Water allocation, *Water management, *Water resources management, Legal aspects, Regulations, State jurisdiction, Water resources development, Water transfer.

In response to a 1978 constitutional amendment, Hawaii's 1987 legislature enacted a State Water Code. The code establishes a regulatory and administrative mechanism, but leaves almost completely up to its new Commission on Water Resources Management the crucial matter of criteria and institutional framework for assignment, and especially transfer, of water rights. The emergent institutional framework will largely determine the economic efficiency of water use in Hawaii, in conventional uses as well as in maintaining water quality and aesthetic values. With potable ground and surface water sources all but exhausted in some parts of the state, the conventional supply augmentation approach to satisfying water demand means developing expensive desalination. The alternative, demand management, requires attention to the means of obtaining and transferring the right to use water. An examination of the economic efficiency of the institutions emerging from implementation of the code is presented, including the possibilities for water marketing. (See also W91-03032) (Author's abstract)
W91-03057

ANTIDEGRADATION: A NEW LEVEL OF WATER QUALITY CONTROL. THE COLORADO EXPERIENCE.
Vranesh and Raisch, Boulder, CO.
For primary bibliographic entry see Field 5G.
W91-03062

DESIGN AND LEGALITY OF AN INNOVATIVE APPROACH TO NONPOINT SOURCE CONTROL.
Environmental Defense Fund, New York.
For primary bibliographic entry see Field 5G.
W91-03063

STATE WATER QUALITY LAWS AND PROGRAMS TO CONTROL NONPOINT SOURCE POLLUTION FROM FOREST LANDS IN THE SOUTH.
Georgia Univ., Athens. School of Forest Resources.
For primary bibliographic entry see Field 5G.
W91-03064

LEGAL ISSUES IN SURFACE WATER AND GROUNDWATER HAZARDOUS SUBSTANCES CONTAMINATION CASES.
Huey, Guilday, Kuersteiner and Tucker, Tallahassee, FL.
For primary bibliographic entry see Field 5G.
W91-03069

STATE AND LOCAL GROUND-WATER PROGRAMS RELATED TO WELLHEAD PROTECTION.
Environmental Protection Agency, Washington, DC. Office of Ground-Water Protection.
For primary bibliographic entry see Field 4B.
W91-03070

EFFECTIVE ENVIRONMENTAL ACTION: THE CASE OF THE WEKIVA RIVER.
Saint Johns River Water Management District, Palatka, FL. Dept. of Water Resources.
N. S. Whitney, and J. C. Elledge.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 9B-13--9B-22, 1 fig, 7 ref.

Descriptors: *Environmental protection, *Florida, *Public participation, *Regulations, *Wekiva River, Case studies, Environmental policy, Legislation.

Tools that are needed to accomplish legislative acts in favor of conservation of natural resources include technical support, organization, persistence and an effective spokesperson. The citizen or group endeavoring to change the system in favor of environmental legislation must establish credibility and build support for the desired changes. In the recent case of the Wekiva River Protection Act, the Friends of the Wekiva River (FOWR), a central Florida environmental group, demonstrated that well organized and persistent groups can accomplish meaningful improvements to resource protection regulations. FOWR accomplished this by building support in the press and the affected agencies. This case may provide a model for further environmental action initiatives. (See also W91-03032) (Lantz-PTT)
W91-03073

INFORMATION: THE MOST UN-MANAGED RESOURCE IN WATER MANAGEMENT.
QUAD Data Corp., Tallahassee, FL.
For primary bibliographic entry see Field 7C.
W91-03074

NONTRIBUTARY GROUND WATER AS A MUNICIPAL SUPPLY IN THE DENVER METROPOLITAN AREA.
Denver Water Dept., CO.
For primary bibliographic entry see Field 4B.
W91-03086

PROMOTING REGIONAL WATER SUPPLY DEVELOPMENT: A CASE STUDY FROM SOUTHWEST FLORIDA.
Southwest Florida Water Management District, Brooksville.
D. W. Meinhart.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 12B-1--12B-10, 2 fig, 1 tab, 4 ref.

Descriptors: *Florida, *Public relations, *Water resources development, *Water resources management, *Water supply development, Case studies, Legislation, Public policy, Southwest Florida Water Management Distr, Water management.

The regional water supply development concept in southwest Florida was born out of the Tampa Bay-area water supply problems of the 1960's and 1970's. During this period, competition for a finite resource was heightened by rapid population growth. Accordingly, legislation was enacted which allowed regional water supply authorities to be created for the purpose of developing, storing, and supplying water across governmental boundaries. This legislation also directed Florida's five water management districts to assist water supply authorities meet demands in a manner giving priority to conservation and the reduction of environmental impacts associated with excessive or improper withdrawals of water from concentrated areas. In the Southwest Florida Water Management District (SWFWMD), three multi-jurisdictional water supply authorities are in varying stages of operation and fiscal maturity. The SWFWMD has been actively involved in promoting the development of each authority. At the staff level, assistance has been provided primarily through the planning process. At the policy level, assistance has been provided through the utilization of ad valorem tax revenues and land acquisition programs. Future promotion of the regional concept by the SWFWMD is expected to be directed toward supply development and dependability, reuse, and conservation. (See also W91-03032) (Author's abstract)
W91-03088

MANAGING GOVERNMENT REGULATION AND PUBLIC PERCEPTION OF BIOTECHNOLOGY FIELD TESTS: A CASE STUDY.
BioTechnica Agriculture, Inc., Cambridge, MA.
For primary bibliographic entry see Field 5G.
W91-03111

GROUNDWATER POLLUTION PROTECTION: A MULTIDISCIPLINARY ACTION TO BE LED BY A PRACTISING HYDROGEOLOGIST AND BACKED UP BY AN ENFORCEMENT OF LAW.
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 5G.
W91-03193

DEVELOPING A STATE WELLHEAD PROTECTION PROGRAM: A USER'S GUIDE TO

ASSIST STATE AGENCIES UNDER THE SAFE DRINKING WATER ACT.
Environmental Protection Agency, Washington, DC. Office of Ground-Water Protection.
For primary bibliographic entry see Field 5F.
W91-03222

ECONOMIC IMPACT STUDY OF PROPOSED AMENDMENTS TO ILLINOIS ADMINISTRATIVE CODE 604.203 AND 605.104 OF SUBTITLE F PUBLIC WATER SUPPLIES (TRIHALOMETHANES) R84-12.
Blaser, Zeni and Co., Springfield, IL.
W. L. Blaser, J. R. McQuown, W. H. Hallenbeck, D. J. Goodwin, and W. R. Rickert.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB89-152706. Price codes: A09 in paper copy, A01 in microfiche. Report no. ILENR/RE-EA-89/02, January 1989. 187 p, 36 tab, 33 ref, 7 append. Contract no. EA 49.

Descriptors: *Administrative regulations, *Drinking water, *Economic impact, *Illinois, *Trihalomethanes, *Water quality standards, *Water treatment, Chlorination, Cost-benefit analysis, Monitoring, Public health, Surface water, Water pollution control, Water quality control, Water supply.

In October of 1982, the Illinois Pollution Control Board (IPCB), conforming to federal regulations, adopted a regulatory program to protect individuals from trihalomethanes (THMs) in drinking water. The program included establishing a maximum allowable concentration of 0.10 mg/L, and further provided for a systematic monitoring program. A study was performed to provide the IPCB with economic, public health and ancillary information to assist its members in deciding whether to adopt a rule which would apply current Maximum Contaminant Level (MCL) standards for total THM to surface-connected water supplies with populations of fewer than 10,000 individuals. The public water supplies which would be affected by the proposed regulation were identified, classified, and described. The IPCB proposal provided for the use of a one-sample maximum trihalomethane potential test annually to determine which supplies should follow a monitoring program to test four samples for each quarter. The IEPA proposal suggests a single-sample total THM test instead, and would cost $18,050 less than the IPCB proposal. Strategies for controlling THMs to comply with the MCL of 0.10 mg/L fall into three categories: (1) reducing precursors before chlorination, (2) use of disinfectants that generate fewer THMs, and (3) reducing THMs after they are formed. The principal costs of health effects (based on ingestion of drinking water) of the proposed THM rule are health care costs and loss of income from early death. Dollar-denominated costs of the proposed THM program exceed the dollar-denominated benefits. (Fish-PTT)
W91-03231

SUSQUEHANNA RIVER BASIN COMMISSION 1989 ANNUAL REPORT.
Susquehanna River Basin Commission, Harrisburg, PA.
Susquehanna River Basin Commission, Harrisburg, PA. 1990. 0 p. 17 fig, 3 tab.

Descriptors: *Interstate commissions, *River basins, *Susquehanna River, *Water resources management, *Watershed management, Administrative regulations, Fish management, Flood plain management, Gages, Groundwater management, Hydroelectric power, Maryland, New York, Pennsylvania, Selective withdrawal, Water use.

The Susquehanna River Basin Commission was created by the states of New York and Maryland, the Commonwealth of Pennsylvania, and the United States to manage the water resources of the Susquehanna River Basin. During 1989, a total of 96 projects were reviewed by the Commission. Several project review items that deserve special mention are: Groundwater Withdrawal Regulation Enforcement; Consumptive Water Use Survey; Debris Management; Amended Regulations; Water Allocations--Yellow Breeches and Conodoguinet Watersheds; Dock Street Dam Hydroelectric Project; and Migratory Fish Restoration. In 1984-85, the Commission proposed upgrading the flood forecast and warning system in the Susquehanna River Basin, to improve flood forecasts within the Susquehanna River Basin. The work accomplished to date includes: installation or upgrading raingages and streamgages, installation of a new computer, additional staff, construction of two radio transmission towers, and improvements to weather radar display and staff capabilities. During 1989, a significant amount of construction work was completed on the Cowanesque Water Storage Project in Tioga County, Pennsylvania: intake tower modifications and access road relocation, slope modification, fish and wildlife mitigation, recreation modifications, and reservoir cleaning. The Commission continues to implement the plan developed in 1985 to monitor suspended sediment and nutrient loadings in the Susquehanna River. Other noteworthy projects are: Information Requests, and SRBC In-House Computer System. (Fish-PTT)
W91-03243

MITIGATION AND THE SECTION 404 PROGRAM: A PERSPECTIVE.
Environmental Protection Agency, Atlanta, GA. Region IV.
W. L. Kruczynski.
IN: Wetland Creation and Restoration: The Status of the Science. Island Press, Covelo, California. 1990. p 549-554, 10 ref.

Descriptors: *Alternative planning, *Water law, *Water resources management, *Wetland restoration, *Wetlands, Compensation, Environmental engineering, Environmental impact, Governmental interrelations, Interagency cooperation, Project planning, Water resources development.

Although the basic language of Section 404 of the Federal Water Pollution Control Act Amendments of 1972 has not changed substantially since the program's inception, the program has evolved through revisions in U.S. Army Corps of Engineers (Corps) Regulations and Environmental Protection Agency (EPA) Guidelines, and the judicial history of wetland case law. Compensatory replacement mitigation appeared early in the program as an attempt to replace loss of wetlands, at least on paper. It appeared in projects for which federal commenting agencies chose not to dispute issuance of a Corps permit. The EPA and the Corps are currently negotiating a joint mitigation policy, but there remains a difference of opinion between the agencies concerning how mitigation should be considered in the permitting process. It is the EPA's position that the presumption that there are alternatives to the destruction of wetlands cannot be overcome by the applicant's promise to create new wetlands. However, compensatory replacement mitigation may be appropriate for projects for which there are no practicable alternatives and all appropriate and practicable minimization has been required. There are three categories of proposed projects, those for which impacts are: (1) significant regardless of proposed mitigation, (2) significant unless sufficiently offset by mitigation, and (3) not significant. Consideration of the role of compensatory mitigation for projects which are not immediately rejected from further consideration because of the magnitude of the environmental losses must be made on a case-by-case basis. (See also W91-03244) (Author's abstract)
W91-03271

WHAT COMMUNITY LEADERS HAVE TO DO TO MAKE RECLAMATION HAPPEN.
San Diego County Water Authority, CA.
D. Mason.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 19-23.

Descriptors: *Legal aspects, *Policy making, *Public participation, *Reclaimed water, *Water reuse, Economic aspects, Marketing, Public policy, Water policy.

The private citizen committee member and board member can play a role in water reclamation. The water districts must talk to their customers and become marketing people. To make reclamation work it is necessary to find out what the customers' needs are and to take the time to understand the market. It will be necessary to invest time and money into the program. Traditionally the water business solved problems through regulation. With water reclamation, it is suggested that along with the 'stick' the customers must be offered the 'carrot'. When rules and regulations become an obstacle, it is necessary to look beyond them to challenge the criteria and the decision makers. Challenge is the basis on which rule and regulation is built. If the challenge is proper accept it; if not change it. People can change it and that is an elected official's role. People can go before their political leaders, whether they represent a Regional Water Quality Control Board or the state board. Everyone can become involved in water reclamation. People must change from being involved to being committed. (See also W91-03273) (Agostine-PTT)
W91-03276

REGULATIONS THAT ENCOURAGE RECLAMATION.
G. Arant.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p 25-31.

Descriptors: *California, *Legal aspects, *Reclaimed water, *Regulations, *Wastewater management, *Water reuse, Economic aspects, Public policy, Water policy, Water resources management.

The regulations affecting reclamation are there to fill a primary function: protection of water quality and public health and safety. Region IX's comprehensive water quality control plan report which established the water quality standards and objectives for the region's eleven hydrologic basins and fifty-four subunits was adopted in 1975. Three years later in 1978, the regional board amended basin plans for nineteen coastal subunits, removing all water quality objectives and clearing the way for reclamation projects in those areas. Recently the regional board adopted revised basin objectives for the Salt Creek basin which will allow the use of reclaimed water on developments within the service area of the Otay Municipal Water District. Each new basin plan study and application for amendments will be evaluated on its own merits by the regional board. The regulations have not really changed to encourage reclamation. Economic, political, and sociological factors have converged to bring water reclamation to the forefront in water resource planning. These factors have added new interests and momentum to making reclamation happen here and now. This momentum will drive through the regulatory road blocks, constraints, or hurdles which have continually, and most times unfairly, been cited as the reason why San Diego region and many others have not yet met the full reclamation potential. Another sociopolitical event which has significantly pushed the scale in favor of reclamation has been the virtual demise of the U.S. EPA 301(h) waiver process, which allowed for reducing treatment levels for ocean discharge. Finding beneficial uses for reclaimed water will ease the pressure to expand coastal treatment facilities, lessen land and ocean outfalls, encourage the development of more cost effective inland treatment facilities, as well as provide a new source of revenue for the sewering agency. (See also W91-03273) (Agostine-PTT)
W91-03277

STATE LEGISLATURE'S VIEW OF RECLAMATION.
M. Dillon.
IN: Symposium III, Association of Water Reclamation Agencies, October 13-14, 1988. Water Reclamation: Here, Now...and How. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 1990. p

33-40.

Descriptors: *California, *Legislation, *Political constraints, *Reclaimed water, *State jurisdiction, *Water reuse, Legal aspects, Political aspects, Water shortage.

Water reclamation is only one of hundreds of issues before the state legislature. Issues generally surface in one of several ways. They may surface because of a crisis. An issue may surface from people with special interests. A third way is from legislators who may take a keen interest in an issue. A fourth way is from state departments themselves, like the State Water Resources Control Board (SWRCB) or the Department of Water Resources. The staff to one of the key senate committees of the state legislature feels that water reclamation is not the solution to the water problems. On the assembly side there is a stronger interest. Legislators from areas where there is not a water shortage such as northern California show less interest than those from areas such as southern California which is experiencing water shortages. State agencies have generally tried to convince the legislature and the governor that water reclamation will go a long way toward solving some of the water problems. The most consistent champion of water reclamation in Sacramento has been the State Water Resources Control Board. The board has been the sponsor of the Clean Water Bond Act since 1970. For the future it is anticipated that most legislators will have little interest in water reclamation, and without a crisis it will probably continue to be a nonissue before the legislature. It is incumbent upon everyone in water reclamation to educate every senator and assemblyman as to the need for water reclamation, what is currently being done and why their help is needed. It is important to get the legislators out to see water reclamation projects. (See also W91-03273) (Agostine-PTT)
W91-03278

ILLINOIS DEPARTMENT OF CONSERVATION'S CHANGING ROLE IN THE ILLINOIS RIVER BASIN.
Illinois Dept. of Conservation, Springfield.
J. W. Comerio.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 15-18.

Descriptors: *Illinois, *Illinois River Basin, *State jurisdiction, *Water resources management, *Watershed management, Conservation, Environmental protection, Institutions, Public policy, Recreation, Resources management, Water resources institutes.

The Illinois Water Department (IWD) traditionally has been viewed as a natural resource conservation and recreation provision agency, with little impact on the state's economy. However, the relationship between the Illinois tourism industry and the state's quality of life is becoming more obvious. A $120 million park and conservation program, known as PCII, was appropriated to improve tourism. PCII includes expansion of overnight accommodations at department sites with several possible new public-private joint ventures if economically warranted; development of visitor centers and visitor information facilities; development of swimming pools and beaches; campground expansion and the addition of shower buildings; development of day use facilities and trails; and basic infrastructure improvements. The IWD has also made some internal changes to strengthen its economic development role. The Office of Resource Marketing and Education has been formed to better promote conservation sites, facilities, and programs. Tourism is one of the state's fastest growing industries and a vital part of Illinois' economic development. (See also W91-03608) (Lantz-PTT)
W91-03609

ILLINOIS RIVER SOIL CONSERVATION TASK FORCE.
For primary bibliographic entry see Field 4D.
W91-03622

STREAM BANK STABILIZATION AND THE ILLINOIS RIVER SOIL CONSERVATION TASK FORCE.
Illinois River Soil Conservation Task Force, Eureka, IL.
For primary bibliographic entry see Field 4D.
W91-03623

ILLINOIS RIVER COALITION/FATHER MARQUETTE COMPACT.
Caterpillar Tractor Co., Peoria, IL.
H. Holling.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 145-146.

Descriptors: *Illinois, *Illinois River, *Public participation, *Water resources institutes, *Water resources management, Economical aspects, Local governments, Public policy.

The Illinois River Coalition/Father Marquette Compact (IRC/FMC) was formed in February 1988 to serve the advocacy objective on a regional basis. The coalition was incorporated by interested citizens from Jersey, Peoria, Tazewell, Marshall, and LaSalle counties. Meetings were established to begin a dialogue among those who want to save the water resource. The meeting format consists of status reports on significant river related matters and a discussion of strategies for gathering maximum support from governmental authorities. There is no budget and the IRC/FMC functions with a volunteer staff. Progress in generating ongoing regional discussions and consensus building has been slow. However, experience to date indicates that the concept of a system wide advocacy committee is valid and can work. The work program for the next three months calls for three to four regional meetings, publication of a newsletter, and heightened acceptance of cooperation and communication aimed at saving the Illinois River. (See also W91-03608) (Lantz-PTT)
W91-03626

COMPARISON OF COMMERCIAL-COMMODITY AND RECREATIONAL USE OF THE ILLINOIS RIVER SYSTEM: THE CASE OF THE ILLINOIS AND MICHIGAN NATIONAL HERITAGE CANAL CORRIDOR.
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
R. J. Burdge, and R. A. Robertson.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 150-155, 2 tab.

Descriptors: *Case studies, *Illinois, *Illinois River, *Recreation, *Water use, Canals, Competing use, Federal jurisdiction, Legislation, River systems, Surveys, Water resources development.

A substantial portion of the US population lives within a short drive of one of 18 major river corridors. These corridors represent the closest opportunity for the 'wilderness' recreation experience that millions of urban residents ever have. With the support of the Illinois congressional delegation, community and environmental groups convinced Congress to designate the Illinois River Corridor as a National Heritage Corridor. The stated purpose of the Illinois and Michigan National Corridor is to 'retain, enhance and interpret, for the benefit and inspiration of present and future generations, the cultural, historical, natural, recreational and economic resources of the corridor, where feasible, consistent with economic growth'. Besides inventorying the historical, archaeological, biological, geological and recreational resources of the corridor, the impacts of commercial and industrial activity on recreation use in the Upper Illinois Waterway are studied. This study includes the relationships among the many diverse and competing uses of the Upper Illinois Waterway and provides information that can be used by planners, managers and politicians interested in developing commercial/industrial developments near existing recreation areas. Interviews with recreation site visitors and managers as well as state and federal planners were conducted to identify the kinds of problems that corridor visitors encounter when using this industrial/commercial area for recreation. (See also W91-03608) (Lantz-PTT)
W91-03628

USEPA PERSPECTIVE ON NONPOINT POLLUTION CONTROL AND WETLANDS FUNCTION.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5G.
W91-03631

STATE GROUNDWATER PROTECTION POLICIES: A LEGISLATOR'S GUIDE.
National Conference of State Legislatures, Denver, CO.
For primary bibliographic entry see Field 5G.
W91-03657

WATER AND THE ENVIRONMENT: THE IMPLEMENTATION OF EUROPEAN COMMUNITY DIRECTIVES ON POLLUTION CAUSED BY CERTAIN DANGEROUS SUBSTANCES DISCHARGED INTO THE AQUATIC ENVIRONMENT.
Department of the Environment, Cardiff (Wales). Welsh Office.
For primary bibliographic entry see Field 5G.
W91-03661

AGENDA FOR THE MANAGEMENT OF THE GREAT LAKES ON A LONG TERM ECOSYSTEM BASIS.
Cornell Univ., Ithaca, NY.
L. B. Dworsky, and D. J. Allee.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 21-32, 3 fig, 1 tab, 9 ref.

Descriptors: *Environmental protection, *Governmental interrelations, *Great Lakes, *Lake management, *Water policy, *Water resources management, Canada, Ecosystems, Education, Environmental policy, Institutions, Management planning, Regulations.

The 1909 Boundary Water Treaty between the United States and Great Britain has been acknowledged as a most successful binational agreement. The International Joint Commission (IJC) has dealt with 130 conflicts. Usually only responding to references from the two governments, in January 1985 the IJC issued a unique unrequested Advisory. The Advisory urged that the Great Lakes be managed on ecosystem basis, including values beyond water quality. Three seminar reports at Cornell University tested the feasibility of such an approach. The first report refers to citations and identifies and discusses the principal issues that would confront the two governments (The United States and Canada) in considering longer-term action for management of the Great Lakes Ecosystem. The second report aims to provide further aid and stimulus to the governments to initiate in-depth discussions. The third report suggests feasible tasks involving the implementation of ecosystem-derived plans and programs. Clearly the knowledge resources are available for a meaningful start to an ecosystem-based management process. But implementation requires greatly expanded understanding by those involved in each issue. An expanded role for the IJC could be a key in facilitating this step to institutional capacity building. (See also W91-03672) (Author's abstract)
W91-03675

FLUCTUATING GREAT LAKES WATER LEVELS: EXPECTATIONS AND THE IJC.
International Joint Commission-United States and Canada, Ottawa (Ontario).
M. Clamen.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 75-81, 11 ref.

Descriptors: *Governmental interrelations, *Great Lakes, *International commissions, *Lake management, *Water level fluctuations, *Water resources management, Canada, Coastal zone management, Interagency cooperation, Lake shores, Regulations, Shore protection.

The shared history of the Great Lakes is at an important juncture. Although water levels have fluctuated widely in the last several decades, in 1986 all lakes, except Lake Ontario, established new 20th century record highs. Considerable shoreline flooding, erosion, and associated coastal zone problems resulted as well as public demands for action. Solutions that have been considered previously include: further lake level regulation, interbasin diversion modification, shoreline protection works, and modifications of shoreline practices. This issue is of central concern to the International Joint Commission (IJC) because of its responsibility in regulating the outflow from Lakes Superior and Ontario, and because of previous IJC studies on this subject over the past twenty years. In August 1986 the Governments of the United States and Canada agreed to request the Commission to examine and report upon methods of alleviating the adverse consequences of water level fluctuations, including the high water level crisis of 1986. The IJC believes the current study calls for a more comprehensive and far-reaching investigation than has been accomplished in response to any of the previous requests by Governments. (See also W91-03672) (Author's abstract)
W91-03680

GREAT LAKES WATER RESOURCES MANAGEMENT.
Corps of Engineers, Chicago, IL. North Central Div.
M. J. Todd, and J. W. Kangas.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 93-102, 3 tab, 14 ref.

Descriptors: *Governmental interrelations, *Great Lakes, *Lake management, *Water level fluctuations, *Water resources management, Channels, Computer models, Erosion, Flood damage, Flooding, Forecasting, Hydrologic budget, International commissions, Lake shores, Meteorological data collection, Precipitation, Regulations, Shore protection, Storms.

Excessive Great Lakes basin precipitation resulted in 1985-87 levels which broke all previous record high levels for all months and all lakes, except Lake Ontario. It caused considerable flooding and erosion damage along many reaches of the 5,000 miles of U.S. Great Lakes shoreline. Approximately 1,000 miles are subject to significant flooding and 500 miles are subject to severe erosion. Most of the damage occurs during periods of storm activity. The U.S. shoreland damages in 1972-76 were estimated to be about $200 million and the estimates for 1985-87, although not yet fully assessed, are expected to be somewhat higher, about $285 million. Limited outflow capacities of Great Lakes outlet channels cannot accommodate the high water supplies recently experienced. Complete regulation of the Great Lakes has been found in previous studies to be engineeringly feasible, but economically unjustified. Such measures are currently being reevaluated on a comprehensive basis by the International Joint Commission under a new Great Lakes Levels Reference Study. There are several innovative measures being investigated to partially alleviate current and future damages. Improvements of the U.S. Army Corps of Engineers' computer and mapping facilities, the real-time hydrometeorological data collection network system, and forecasting techniques are part of the measures being considered at this time. Many of these measures will use state-of-the-art models and data systems. Additionally, it is intended to explore and implement computer simulation models to better determine the hydrologic and hydrodynamic behavior of the lakes and the connecting channels and better manage this resource. (See also W91-03672) (Author's abstract)
W91-03682

UNITED STATES NONPOINT SOURCE PHOSPHORUS REDUCTION EFFORT.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5G.
W91-03691

NONPOINT POLLUTION: 1988-POLICY, ECONOMY, MANAGEMENT, AND APPROPRIATE TECHNOLOGY.
For primary bibliographic entry see Field 5G.
W91-03704

FEDERAL ENVIRONMENTAL LEGISLATIVE PROCESS.
Colorado State Univ., Fort Collins.
H. P. Caulfield.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 1-8, 10 ref.

Descriptors: *Environmental policy, *Federal jurisdiction, *Legislation, *Nonpoint pollution sources, *Political constraints, *Water pollution control, *Water pollution sources, *Water resources management, Agricultural chemicals, Decision making, Drinking water, Groundwater pollution, Public health, Water policy.

A conceptual framework of politics is often the result of many systems analyses prepared from the perspective of several scientific disciplines, presenting single or multiple conclusions or conclusions specifying possible political/environmental tradeoffs. The processes of legislative decision are identified as ideological adherence; bargaining, resulting in compromise; and vote trading. One particular concern of the Environmental Movement is the actual and potential degradation of groundwater from seepage of fertilizers and pesticides in rural areas affecting on-farm and rural community groundwater supplies utilized as drinking water. This public problem was considered hypothetically for possible solution by federal environmental legislation. The involvement of several forms of ideological adherence (maintenance of human health, economic well-being and progress, maintenance of the 'family farm,' and Creative or New Federalism) provide the basic standpoints from which bargaining among their adherents can occur. The main issue areas in which bargaining would appear to be needed include: health effects of agricultural chemicals in drinking water, groundwater pollution, federal taxes on agricultural chemicals, alternative drinking water sources, and distribution of federal tax revenues to provide needed subsidies. It was concluded that interest groups and legislators outside the agricultural community who identify ideologically with environmental health concerns generally could increase the likelihood of a major legislative breakthrough. The possible need for tradeoffs between decreased agricultural production and a decrease in groundwater pollution would appear to present a complex and far-reaching problem. (See also W91-03704) (Fish-PTT)
W91-03705

GROUNDWATER QUALITY: THE ROLE OF AGRICULTURAL POLITICS AND POLICY.
Iowa Univ., Iowa City. Dept. of Geography.
R. S. Roberts, and D. R. Lighthall.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 9-21, 2 fig, 1 tab, 26 ref.

Descriptors: *Agriculture, *Groundwater pollution, *Groundwater quality, *Iowa, *Nonpoint pollution sources, *Political aspects, *Water policy, *Water pollution sources, *Water resources management, Agricultural chemicals, Environmental policy, Farming, Government supports, Profit, Regulations, Water pollution control, Water quality control.

The growing problem of nonpoint-source groundwater contamination from agricultural chemicals has been conceptualized as a historical outcome of the production environment of capitalist agriculture in the Midwest. Alternative policy responses to contamination, such as the voluntary adoption of Best Management Practices, cross-compliance, site-specific regulation of chemical application, and taxation of synthetic chemicals were evaluated on the basis of their interrelationships with this institutional structure. Analysis of Iowa's policy response to contamination reveals a contradiction between intensified regulation of chemical use and the imperatives facing farmers seeking profits in competitive markets. As a result, a long-term solution of the problem will hinge on the development of profitable alternatives to current production technologies and a concomitant reorientation of the public sector research agenda. Considerable insight into possible avenues for groundwater quality protection policy can be gained by analyzing policy options for their political significance. The debate over particularities of governmental level or policy tools, however, risks masking a more fundamental point: any solution to nonpoint-source contamination of water supplies requires a comprehensive understanding of the source of contamination and the structural forces that determine its occurrence. (See also W91-03704) (Author's abstract)
W91-03706

GROUND WATER POLICY OF USDA.
Department of Agriculture, Washington, DC.
R. W. Long.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 23-27.

Descriptors: *Administrative agencies, *Agricultural chemicals, *Agriculture, *Groundwater, *Nonpoint pollution sources, *Water policy, *Water pollution control, *Water pollution sources, Conservation, Crop production, Drinking water, Environmental impact statement, Farming, Governmental interrelations, Public health, Research priorities, Water resources management.

The use of agricultural chemicals, especially pesticides and nutrients, has become widespread in the U.S. over the past three or four decades, causing increasing problems of nonpoint source contamination of drinking water supplies. While acknowledging the importance of environmental and health concerns, U.S. Department of Agriculture (USDA) policy continues to support the prudent use of agricultural chemicals in production agriculture. The USDA believes that voluntary solutions to natural resource problems is the best route to lasting progress. One of its greatest challenges is to improve coordination among its own programs and cooperation among its own agencies. Some of the actions that the USDA has undertaken recently include: placing additional emphasis on control of nonpoint source water pollution; coordinating an approach between the Soil Conservation Service and the Extension Service (two USDA agencies) for advising farmers and ranchers on practices that involve the use of agricultural chemicals; implementing the conservation provisions of the 1985 farm bill, which removes marginal land from production and promotes conservation on other farmland; extensive human health risk assessments in environmental impact statements where pesticide use is proposed; formation of a USDA Working Group on Agricultural Chemicals and the Environment; research priority on groundwater quality; and implementation of educational on-farm demonstrations designed to move new technology quickly to production agriculture. Over the next several years, the USDA will continue to strengthen the

policies recently set in place. (See also W91-03704) (Fish-PTT)
W91-03707

ECONOMIC IMPLICATIONS OF THE FOOD SECURITY ACT OF 1985'S DISCRETIONARY ENVIRONMENTAL PROVISIONS.
Economic Research Service, Washington, DC.
C. W. Ogg, and M. O. Ribaudo.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 49-56, 2 fig, 1 tab, 22 ref.

Descriptors: *Agriculture, *Conservation, *Economic aspects, *Environmental policy, *Legislation, *Nonpoint pollution sources, *Water policy, *Water pollution control, *Water resources management, Agricultural chemicals, Cost-benefit analysis, Cropland, Erosion, Erosion control, Groundwater mining, Irrigation, Riparian vegetation, Saline water, Surface-groundwater relations, Water quality management, Watershed management.

Erosion and crop surplus concerns in Congress led to inclusion of the Conservation Title in the Food Security Act of 1985, which established the Conservation Reserve Program (CRP). Although the CRP retired only highly erodible cropland in its first two years, other environmental problem cropland could gain CRP eligibility at the discretion of the Secretary of Agriculture. Stream buffers, which became eligible in 1988, are expected to provide much higher water quality benefits per acre than highly erodible acres. Enrolling saline, irrigated cropland would, however, produce higher off-site benefits only in certain river basins. Addressing groundwater mining through the CRP would result in much lower off-site benefits per acre than highly erodible acres currently enrolled. CRP rental payments for both surface and groundwater irrigated cropland would also be relatively high. The recent CRP changes and proposals being considered by Congress are increasingly focused on local water quality problems and can increase the overall environmental benefits from the program. Additional changes under consideration could in some instances also increase these benefits, but would affect other CRP program objectives, such as supply reductions and program costs. Only wet croplands appear to offer substantive potential for expanding the CRP unless program costs per acre enrolled are allowed to increase. (See also W91-03704) (Fish-PTT)
W91-03710

NONPOINT POLLUTION POLICIES AND POLITICS: THE ROLE OF ECONOMIC INCENTIVES.
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W91-03711

INSTITUTION-SENSITIVE APPROACH TO THE USE OF ECONOMIC INSTRUMENTS FOR NONPOINT SOURCE WATER POLLUTION CONTROL.
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W91-03712

ECONOMICS OF SILVICULTURAL BEST MANAGEMENT PRACTICES.
Forest Service, Atlanta, GA.
For primary bibliographic entry see Field 5G.
W91-03713

EQUITY AND EFFICIENCY ASPECTS OF ALTERNATE STORMWATER MANAGEMENT FINANCING SYSTEMS.
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W91-03714

REVENUE SOURCES FOR NONPOINT SOURCE POLLUTION ABATEMENT: AN ECONOMIC ANALYSIS.
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W91-03715

NONPOINT SOURCE REGULATION--A WATERSHED APPROACH.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 4D.
W91-03717

IMPLEMENTATION OF THE NEBRASKA NITRATE CONTROL LEGISLATION.
Nebraska Natural Resources Commission, Lincoln.
D. Williamson.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 133-139, 8 ref.

Descriptors: *Environmental policy, *Groundwater management, *Legislation, *Nebraska, *Nitrates, *Nonpoint pollution sources, *Water pollution control, *Water pollution sources, *Water resources management, Agricultural chemicals, Farming, Fertilizers, Governmental interrelations, Irrigation wells, Soil analysis, Water analysis, Water policy, Water quality standards.

Nebraska is considered unique in the methods chosen to manage groundwater. Strong local groundwater quality management controls can be exercised by the 24 natural resources districts. These districts cover the entire state. The state provides oversight, and in event of lack of action on the part of a local district, the state can step in and require remedial and preventative action. The Central Platte Natural Resources District (CPNRD) is the first in the state to develop Special Protection Areas to control nonpoint source pollution of the aquifer. Nitrate concentrations in groundwater in many parts of the District now exceed the standard of 10 mg/L as nitrate-nitrogen. The District has applied phased protection areas: Phase I areas are those with the least pollution (0 to 12.5 mg/L nitrate) and the lowest level of control (producer inventories); Phase III areas have the highest rate of pollution (greater than or equal to 20.1 mg/L nitrate) and the most stringent controls (banning of fall and winter fertilizer application, groundwater supply management areas). The Phase II protection area now covers 440,000 acres and includes approximately 5,000 irrigation wells. Average nitrate concentrations in this area range from 12.6 to 20 mg/L. In addition to Phase I measures, Phase II farmers are required to attend irrigation and fertilizer management classes, and an annual water analysis is also required for each irrigation well as well as an annual deep soils analysis for each field, and farmers are required to submit annual reports. At this point, it appears that the NRDs and the Nebraska Department of Environmental Control are developing a good working relationship to help assure an effective water quality management program. (See also W91-03704) (Fish-PTT)
W91-03719

INTEGRATED RESOURCE MANAGEMENT: REGION V'S NONPOINT SOURCE CONTROL AND CLEAN LAKES PROGRAM.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5G.
W91-03721

SOUTHEASTERN MINNESOTA COOPERATES TO DEVELOP AN INNOVATIVE APPROACH TO NONPOINT POLLUTION.
Zumbro/Root River Water Quality Task Force, Minnesota.
P. K. B. Hunt, A. C. Persons, M. Lundberg, and G. Isberg.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 155-163, 1 fig, 8 ref.

Descriptors: *Governmental interrelations, *Management planning, *Minnesota, *Nonpoint pollution sources, *Water pollution control, *Water resources management, Comprehensive planning, Groundwater management, Interagency cooperation, Karst, Land resources, Political aspects, Water policy, Water quality management.

Southeastern Minnesota is very susceptible to erosion and has karst topography that is subject to groundwater contamination. The Minnesota Legislature recently enacted the Comprehensive Local Water Management Act. This legislation authorized the counties to address the issue of water and related land resources through local management. Nine counties in southeastern Minnesota in conjunction with state and federal agencies have joined together to address all water issues that transcend political boundaries. To date 80 percent of those issues are nonpoint in nature. This coalition of counties has recognized politics as an obstacle to the abatement of nonpoint pollution and have therefore developed strategies to address this vital issue. The nine counties have formed a regional task force as well as individual county committees to delineate and prioritize the issues, primarily involving water quality. Each county will have a comprehensive water management plan, but the plan will be coordinated with the contiguous counties. Case studies from two of the nine counties highlight the local organizational structure and water management planning efforts and issues. This water management planning program truly represents an intergovernmental approach to water resource planning and properly balances state and regional concerns with local issues. The water management plan will not be static and will be updated on a routine basis. (See also W91-03704) (Author's abstract)
W91-03722

INTEGRATED EXPERIENCE--THE MILWAUKEE RIVER EAST-WEST BRANCH WATERSHED RESOURCE MANAGEMENT PLAN.
Wisconsin Dept. of Natural Resources, Milwaukee.
For primary bibliographic entry see Field 4D.
W91-03723

STORMWATER PERMITS--A POINT SOURCE UMBRELLA FOR NONPOINT POLLUTION PROBLEMS.
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-03724

STORMWATER NONPOINT SOURCE POLLUTION CONTROL.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5G.
W91-03725

MARYLAND'S STORMWATER MANAGEMENT PROGRAM.
Maryland Dept. of the Environment, Annapolis. Sediment and Stormwater Div.
For primary bibliographic entry see Field 5G.
W91-03726

NEW STRATEGIES IN URBAN DRAINAGE AND STORMWATER POLLUTION CONTROL IN SWITZERLAND.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
V. Krejci.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p

203-211, 3 fig, 1 tab, 20 ref.

Descriptors: *Nonpoint pollution sources, *Storm water management, *Switzerland, *Urban drainage, *Water pollution control, Environmental impact, Management planning, Wastewater disposal, Wastewater treatment, Water policy, Water pollution sources, Water pollution treatment, Water resources management.

The new strategies in urban drainage and storm water pollution control are based on a better understanding of the entire system: the source of storm water and of the pollution-transport-transfer-treatment-manifestation and consequences in receiving waters and in groundwater. Similar to the existing water pollution control strategy for dry weather situations, it appears that in the future, urban drainage and storm water pollution control strategy will be more related to specifically-identified problems rather than giving general design recipes. This control strategy is supported by the new proposal of the Swiss Law for Water Pollution Control and especially by the revision of guidelines for the Master Plan of Urban Drainage. The most important change is the global consideration of quantity and quality aspects in planning, design, operation, and rehabilitation of urban drainage. Unfortunately, significant progress in the interpretation of observed pollution loads and their impact on the ecological state of receiving waters is not in sight. However, there are still possibilities for improving storm water pollution control without exact understanding of the ecological impact of urban runoff in general: (1) by changing from rapid and complete collection of wastewater from urban areas towards slow transport with a consistent separation of polluted and unpolluted wastewater and by infiltrating a high fraction of 'unpolluted' storm water runoff, there can be a significant reduction of discharged pollution; and (2) with the help of modern technical tools such as mathematical modeling, electronic and computer process control, planning, design, and operation of urban drainage can be significantly improved. (See also W91-03704) (Author's abstract)
W91-03727

IRRIGATION-INDUCED WATER QUALITY PROBLEMS: POLICY IMPLICATIONS OF DOI RECONNAISSANCE STUDY RESULTS.
National Irrigation Water Quality Program, Washington, DC.
For primary bibliographic entry see Field 5B.
W91-03735

IDENTIFYING AND MEASURING POTENTIAL CONFLICT IN WATER INSTITUTIONS.
Florida Univ., Gainesville. Dept. of Food and Resource Economics.
G. D. Lynne, J. W. Milon, and M. E. Wilson.
Water Resources Bulletin WARBAQ, Vol. 26, No. 4, p 669-676, August 1990. 1 tab, 18 ref.

Descriptors: *Administrative agencies, *Administrative regulations, *Institutional constraints, *Institutions, *Water allocation, Behavior, Case studies, Economic aspects, Florida, Social aspects, Water demand, Water supply.

Scarcity combined with differences in values, beliefs and attitudes can lead to behavior differences and conflicts over water. An index for measuring potential conflict using survey information about water attitudes and beliefs of individuals in three groups in a Florida case study (of the Southwest Florida Water Management District) was developed. The index was developed around the concepts of water scarcity, the role of water resources in producing end-state values such as economic growth and higher income, the equity of water distribution, and instrumental value dimensions such as responsibility, rationality and competency. This index suggests the extent to which individuals in different groups have diverging beliefs and attitudes. The index helps in assessing the current capability of the institution to reduce conflict. The results suggest that the current institution is effective, but changes may help to streamline the consumptive-use permitting process, to improve educational programs, and to seek improved institutional arrangements to reduce future conflict over economic uses of water. (Hoskin-PTT)
W91-03861

ENVIRONMENTAL IMPACT ASSESSMENT IN THE PEOPLE'S REPUBLIC OF CHINA.
Wisconsin Univ.-Green Bay. Coll. of Environmental Sciences.
R. B. Wenger, W. Huadong, and M. Xiaoying.
Environmental Management EMNGDC, Vol. 14, No. 4, p 429-439, 1990. 2 fig, 45 ref.

Descriptors: *China, *Environmental impact statement, *Environmental policy, *Environmental protection, *Resources management, Decision making, Management planning, Political aspects, Project planning, Social aspects.

Environmental impact assessment (EIA) procedures have been in existence in the People's Republic of China over the last decade. The impetus for China's introduction of EIA was provided by the Environmental Protection Law of the People's Republic of China, adopted by the Fifth National People's Congress in 1979. The EIA process, which is administrative and not statutorily mandated, has been applied primarily to construction projects. Four stages are typically involved in an EIA investigation: design of the investigation, evaluation of background environmental quality, prediction of environmental impacts, and an assessment and analysis of the environmental impacts. A variety of approaches are used for predicting and analyzing environmental impacts, ranging from ad hoc methods to fairly sophisticated mathematical models. The results of the EIA investigation are compiled in an environmental impact statement, which is used as the basis for decision making by personnel in environmental protection departments. The EIA process does not include provisions for citizen notification or involvement. Views differ concerning the effectiveness of the EIA program in protecting China's natural, social, and cultural environments. Some hold that the EIA program has brought about improvement in environmental protection, while critics contend that the program has had little effect in the prevention of pollution. Most observers seem to feel that the program should be continued and improved. A major avenue for improvement is to place the evaluation of a particular project in a regional context. (Author's abstract)
W91-03874

BINATIONAL MANAGEMENT OF HAZARDOUS WASTE: THE MAQUILADORA INDUSTRY AT THE US-MEXICO BORDER.
California Univ., Los Angeles. School of Public Health.
For primary bibliographic entry see Field 5G.
W91-03875

6F. Nonstructural Alternatives

SITE SELECTION MODEL FOR ACQUISITION OF WATER RESOURCE LANDS: A GIS APPLICATION.
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 7C.
W91-03067

MODEL FOR QUANTIFYING INCENTIVE PAYMENTS FOR SOIL CONSERVATION IN CROPPING REGIONS SUBJECT TO WATER EROSION.
La Trobe Univ., Bundoora (Australia). School of Agriculture.
For primary bibliographic entry see Field 4D.
W91-03140

SPECIAL FLOOD HAZARD EVALUATION REPORT: CANASERAGA CREEK, TOWN OF GROVE, ALLEGANY COUNTY, NEW YORK.
Army Engineer District, Buffalo, NY.
Available from the National Technical Information Service, Springfield, Virginia 22161, as AD-A210 303. Price codes: A03 in paper copy, A01 in microfiche. Final report, May 1989. 19 p, 1 fig, 3 tab, 7 ref, 4 plates.

Descriptors: *Flood forecasting, *Flood hazard, *Flood peak, *Flood plain management, *Land use, *New York, *Nonstructural alternatives, Computer programs, Hydrographs, Hydrologic data, Regression analysis.

Knowledge of potential floods and flood hazards is important in land use planning. An investigation was performed to determine the potential flood situation along a portion of Canaseraga Creek within the town of Grove, New York. No historical flood records exist and the stream is ungaged within the study area so flooding is not well documented. Hydrologic analyses were carried out to establish the 100-year peak discharges for Canaseraga Creek, using a regional regression equation and a computerized method that is capable of developing runoff hydrographs, routing hydrographs through channel reaches and reservoirs, and combining or separating hydrographs at confluences. Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the 100-year recurrence interval. Both structural and nonstructural tools are used for achieving desired future flood plain conditions. There are three basic strategies which may be applied individually or in combination: (1) modifying the susceptibility to flood damage and disruption, (2) modifying the floods themselves, and (3) modifying (reducing) the adverse impacts of floods on the individual and the community. Information developed for this study will furnish a suitable basis for the adoption of land use controls to guide flood plain development. (Fish-PTT)
W91-03225

SUSQUEHANNA RIVER BASIN COMMISSION 1989 ANNUAL REPORT.
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 6E.
W91-03243

6G. Ecologic Impact Of Water Development

EVALUATION OF FARMING SYSTEMS.
Agricultural Research Service, Lincoln, NE.
For primary bibliographic entry see Field 4C.
W91-02990

EFFECTIVE ENVIRONMENTAL ACTION: THE CASE OF THE WEKIVA RIVER.
Saint Johns River Water Management District, Palatka, FL. Dept. of Water Resources.
For primary bibliographic entry see Field 6E.
W91-03073

DESERT ENCROACHMENT IN EGYPT'S NILE VALLEY.
Minya Univ. (Egypt). Soil Science Dept.
For primary bibliographic entry see Field 2G.
W91-03120

EFFECTS OF GRAZING AND TRAMPLING ON SOIL DETERIORATION AROUND RECENTLY DRILLED WATER HOLES IN THE SAHELIAN ZONE.
Office de la Recherche Scientifique et Technique Outre-Mer, Abidjan (Ivory Coast).
For primary bibliographic entry see Field 4C.
W91-03122

IMPACT: AN EXPERT SYSTEM FOR ENVIRONMENTAL IMPACT ASSESSMENT.
Westinghouse Savannah River Co., Aiken,SC.
C. Loehle, and R. Osteen.
Available from the National Technical Information Service, Springfield, Virginia 22161, as DE89-010748. Price codes: A03 in paper copy, A01 in

microfiche. Report no. DP-MS--88-236, April 1989. 21 p, 2 fig, 1 tab, 25 ref, append. Contract no. DE-AC09-76SR00001.

Descriptors: *Computer models, *Computer programs, *Environmental impact, *Expert systems, *Model studies, Construction, Databases, Environmental policy, Land management, Land use, South Carolina.

Environmental assessment has become a routine part of the planning process for major development projects and land management activities, particularly within the federal government. An expert system screening tool provides the following advantages: (1) provides a standard, public procedure for all projects; (2) contains a complete list of environmental issues; (3) only requires data relevant to the proposed activity; and (4) acts as a training tool and source of expertise for novices. The model, developed at the Savannah River Site in South Carolina, is of the regulatory type, and is named IMPACT. It is designed to be a screening tool for construction projects and activities relative to compliance with NEPA (National Environmental Policy Act). It checks for a suite of possible environmental problems that might be caused by the activity. Activity types include well drilling, road construction, facility construction and operation, power line installation, and similar activities. Environmental issues include air and water emissions, sediment loading to streams, and groundwater contamination. Testing was carried out in stages. Feedback from potential users of the preliminary design and prototype led to redesign. The second stage prototype contained all goal functionality in the menus, but not all items were implemented and no report was generated. This testing was followed by development of the complete system. (Fish-PTT)
W91-03240

MODELLING THE EFFECTS OF PROPOSED PUMPING FROM THE TAMBRAPARNI RIVER BASIN, TAMILNADU, INDIA.
V.O.C. Coll., Tuticorin (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-03323

SALT MARSH MITIGATION: AN EXAMPLE OF THE PROCESS OF BALANCING MOSQUITO CONTROL, NATURAL RESOURCE, AND DEVELOPMENT INTERESTS.
Indian River Mosquito Control District, Vero Beach, FL.
P. D. O'Bryan, D. B. Carlson, and R. G. Gilmore.
Florida Scientist FLSCAQ, Vol. 53, No. 3, p 189-203, Summer 1990. 4 fig, 2 tab, 17 ref.

Descriptors: *Coastal marshes, *Florida, *Indian River Lagoon, *Land development, *Management planning, *Marsh management, *Mosquitoes, *Salt marshes, *Wetlands, Administrative agencies, Environmental effects, Mosquito control, Natural resources, Permits, Pine Island, Reservoirs, Salinity, Turbidity, Water quality monitoring, Wildlife habitats.

A Rotational Impoundment Management (RIM) plan was accepted by federal, state and local permitting agencies as mitigation for wetlands impacted during development of a riverfront subdivision at Indian River Impoundment number 6 (Pine Island, 129.5 ha). The developer submitted separate permit applications to the Florida Department of Environmental Regulation, St. John's River Water Management District, and Indian River County, each of which have jurisdiction for dredge and fill projects in salt marshes. Impoundment number 6 was seasonally re-integrated to the Indian River lagoon through culverts installed in the dike and water levels were carefully controlled with a permanent electric pump. Limited biological monitoring, as required by the permits, indicated that the impoundment responded positively to RIM. Fish and macrocrustacean sampling indicated increased species utilization of the marsh after re-connection to the estuary, and no negative effects on avian populations were observed during the dredging, filling and management activities. Salinity, turbidity, and temperature trends were comparable in the lagoon and in the impoundment. At no time during the closed period were permit regulations exceeded for salinity (>40 ppt), temperature (>35 C), or turbidity (>29 NTU over background). The project was considered to be beneficial to the private land owner, the local mosquito control district, and natural resource interests. (MacKeen-PTT)
W91-03441

COOPERATIVE AGREEMENT ON SETTLEMENT AND RESOURCE SYSTEMS ANALYSIS. PROCEEDINGS TO THE CONFERENCE ON THE AFRICAN EXPERIENCE WITH RIVER BASIN DEVELOPMENT: ACHIEVEMENTS TO DATE, THE ROLE OF INSTITUTIONS, AND STRATEGIES FOR THE FUTURE. HELD IN EASTON, MARYLAND ON MAY 24-27, 1988.
Clark Univ., Worcester, MA.
For primary bibliographic entry see Field 6B.
W91-03585

WATER QUALITY IMPACTS OF ILLINOIS RIVER COMMERCIAL NAVIGATION.
Illinois State Water Survey, Peoria. Water Quality Section.
For primary bibliographic entry see Field 5G.
W91-03610

WATERWAYS--THEIR RECREATIONAL POTENTIAL.
Heartland Water Resources Council, Peoria, IL.
For primary bibliographic entry see Field 6A.
W91-03612

COMMENTS FOR ILLINOIS RIVER CONFERENCE PEORIA, OCTOBER 3-4, 1989.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5G.
W91-03613

ENVIRONMENTAL MANAGEMENT PROGRAM PROPOSALS: THE ILLINOIS BASIN.
Illinois State Dept. of Transportation, Springfield.
For primary bibliographic entry see Field 5G.
W91-03618

ILLINOIS RIVER BASIN: LIFEBLOOD OF OUR STATE.
Illinois Dept. of Energy and Natural Resources, Springfield.
K. A. Witter.
IN: Second Conference on the Management of the Illinois River System: The 1990s and Beyond. Proceedings of the Conference held October 3-4, 1989 in Peoria, Illinois. University of Illinois Water Resources Center Special Report No. 18, 1989. p 81-90.

Descriptors: *Ecological effects, *Illinois, *Illinois River Basin, *Water resources management, Economic aspects, Ecosystems, Fisheries, Illinois River, Lakes, Land use, Navigation, Recreation, Watershed management, Wildlife.

The Illinois River is 273 miles long, and the River Basin occupies about half of the land area of Illinois. The present-day Illinois River is a remnant of a much larger Mississippi River which carved out the Illinois Valley. The waterways of the Illinois River Basin carry 60% of the State's annual commodities tonnage. In addition to serving economic and commercial needs, the Illinois River also serves as the source for public water supply systems through a vast region of the state. The River is also home to a variety of fish populations, and side channels and backwaters serve as nurseries and spawning areas. In recent years as many as 375 bald eagles have been counted annually, representing about 3% of the total wintering population of bald eagles in the lower 48 states. In addition to fishing and hunting, the activities of boating, water skiing, hiking, and camping and the pleasures of the scenic and historic sites and parks along the river draw thousands of visitors to the banks of the Illinois each year. The most serious consequence to the health and welfare of the Illinois River is the problem of sedimentation. Although sedimentation has been a natural process through the ages, increased row-cropping and the construction of hydraulic structures has exacerbated the problem throughout the river basin. Sedimentation has been responsible for the disappearance of entire backwater lakes, and it has changed many portions of the river from lake-like expanses to narrow incised channels. Many of the backwater and bottomland lakes should no longer be called lakes; they are now really broad, shallow wetlands. In an effort to save these endangered lakes, the State Water Survey has developed some low-cost methods to restore aquatic vegetation. Scientists have also erected a breakwater in Peoria Lake to protect the planting area and to prevent further sedimentation. The new vegetation acts as a nursery for young bluegill, channel catfish, and bass, and actual numbers of fish have quadrupled since testing began. (See also W91-03608) (Lantz-PTT)
W91-03619

GEOLOGY FOR ENVIRONMENTAL PLANNING IN MONROE COUNTY, INDIANA.
Indiana Geological Survey, Bloomington.
E. J. Hartke, and H. H. Gray.
Available from the Publications Section, Indiana Geological Survey, 611 North Walnut Grove, Bloomington, IN 47405. Price: $6.00. Indiana Geological Survey Special Report 47, Environmental Study 21, 1989. 38p, 13 fig, 1 tab, 1 plate, 36 ref.

Descriptors: *Baseline studies, *Environmental protection, *Geology, *Indiana, *Land use, *Regional planning, *Water resources management, Geologic formations, Landfills, Minerals, Monroe County, Site selection, Water resources.

Monroe County, in south-central Indiana about 35 mi south of Indianapolis, is one of the most rapidly growing counties in Indiana. According to records maintained by the Indiana University gaging station, the average annual precipitation is about 44 in, which is spread relatively evenly throughout the year. Much spring and summer rain falls during thunderstorms, some of which bring damaging winds. Seasonal snowfall averages about 8 in per year, but much more may fall during a severe winter. Rapid growth in population (> 20% increase from 1972 to 1984) is placing great pressures on both agricultural and woodland resources. In addition, part of the county landscape has been effectively removed from beneficial use through crushed-stone and dimension-stone quarrying. The report is designed to present general information to planners, government officials, and the public to assist them in the orderly development and use of the natural mineral resources of Monroe County. It is not a definitive, detailed work but is a preliminary estimate of the land use suitability and mineral resources of the county. For example, the maps are approximations and the boundaries shown on them are gradational, but in nearly all areas more detailed information is available at the Indiana Geological Survey. Data sources for this study include field investigation, augur borings, seismic surveys, oil-and water-well logs, and published and unpublished reports. Information is presented concerning: mineral resources, water resources, disturbed areas, sanitary landfill suitability, septic system suitability, gas storage, natural features, and geologic hazards. (Lantz-PTT)
W91-03646

REASSESSING ESTIMATES OF GREAT LAKES CONSUMPTIVE USES AND IMPACTS.
Corps of Engineers, Chicago, IL. North Central Div.
For primary bibliographic entry see Field 6D.
W91-03676

CHICAGO AND ITS LAKEFRONT: LIVING ON THE EDGE.
Chicago Shoreline Protection Commission, IL.
H. L. Henderson, and N. Pansic.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 65-73, 4 fig, 2 tab.

Descriptors: *Chicago, *Environmental impact, *Great Lakes, *Lake management, *Lake shores, *Shore protection, *Water resources management, Cost-benefit analysis, Financial feasibility, History, Jurisdiction, Legal aspects, Metropolitan water management, Recreation, Social aspects, Urban planning, Water level, Water policy.

The deteriorating condition of Chicago's lakefront, as well as an assessment of potential remedial and enhancement measures, has been the subject of a year-long study by the Chicago Shoreline Protection Commission. This highly-developed, 30-mile stretch of urban shoreline is a key resource which contributes greatly to the quality of life of the residents of the largest metropolitan area on the Great Lakes. While the technical challenge of shore protection may be fairly well understood, Chicago's lakefront represents a complex mix of historical, jurisdictional, financial, legal, and social issues. These real-world issues must be taken into account if long-term shoreline protection is to be achieved in Chicago. The history of Chicago's lakefront begins in 1833, when a harbor and pier were constructed which started sediment erosion and accumulation patterns. The present shoreline was created between the world wars through sediment and debris fill activities, and is currently used for open parkland, harbors, beaches, private residences, and private industry. Steadily rising lake levels is a current cause for concern for protection of the shoreline as a public resource. Other technical issues which need to be addressed are: definition of 'normal' lake levels, wave climate, preference of 'hard' or 'soft' measures, and cost-effectiveness of designs. Fiscal constraints, funding priorities, governmental interrelations, and legal issues of shoreline ownership and development must all be considered in preservation and maintenance actions to be undertaken at Chicago's lakefront region. (See also W91-03672) (Fish-PTT)
W91-03679

ONTARIO HYDRO IMPACTS ON THE GREAT LAKES--AND VICE VERSA.
Ontario Hydro, Toronto.
C. W. Stevens.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 117-127, 6 fig, 3 ref.

Descriptors: *Diversion, *Great Lakes, *Hydroelectric plants, *Lake management, *Water level fluctuations, *Water resources management, Flood damage, Flow control, Hydrologic budget.

One important use of the water in the Great lakes system is the generation of electricity. As a major producer of electricity, Ontario Hydro a crown corporation owned by the atzens of Ontario has a vital stake in the future management of the Great Lakes system. Ontario Hydro diverts water into the Great Lakes system, and operates generating stations fed by the Welland Canal. Ontario Hydro, in conjunction with the New York Power Authority, operates generating stations on the St. Lawrence and on the Niagara River. Ontario Hydro operations have raised the levels of the Great Lakes by no more than 3 inches. When this increase is measured against storm surges of up to 8 feet, long-term variations of 5 feet, and record high levels of 3 feet above normal, the impact of the operations on flood damage is not significant. Closure of the diversions would slightly lower the lakes. However, the magnitude of this benefit in reducing flood damage would be no benefit because of the long time period required for the effect of changes to move through the system. The operation of the International Niagara River Control Structure does not appear to affect the discharge from Lake Erie. Hydroelectric generating stations are designed to use the most dependable flow in a river. As such, the stations on the Great Lakes system cannot use the extra water available during periods of high lake level. The excess water is spilled. The potential benefit of trying to remove Ontario Hydro impacts on the Great Lakes system by closing the diversions is far exceeded by the potential cost, both economic and environmental. (See also W91-03672) (Fish-PTT)
W91-03685

EFFECTS ON U.S. WATER RESOURCES OF AGRICULTURAL CHEMICALS AND RUNOFF: MAGNITUDE, EXTENT, AND ECONOMIC CONSEQUENCES.
Economic Research Service, Washington, DC.
S. R. Crutchfield.
IN: Nonpoint Pollution: 1988-Policy, Economy, Management, and Appropriate Technology. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 39-47, 9 ref.

Descriptors: *Agricultural chemicals, *Agricultural runoff, *Economic aspects, *Environmental effects, *Nonpoint pollution sources, *Water policy, *Water pollution control, *Water resources management, Environmental impact, Farm wastes, Groundwater pollution, Legislation, Nitrates, Pesticides, Public health, Surface-groundwater relations, Water pollution sources, Watershed management.

Agricultural nonpoint source pollution is a serious problem for U.S. water resources: the impact on water quality from agricultural residuals is broad in scope and geographically extensive. The primary problem is surface water and groundwater contamination by agricultural chemicals through leaching, rainwater runoff, or soil erosion. A recent study of groundwater in the U.S. estimated that about 1,400 counties (of 3,000 studied) showed the potential for either nitrate contamination, pesticide contamination, or both. Another study of freshwater systems showed that 48 of 90 watersheds were found to have excessive levels of nutrients or sediment caused by agriculture. For most types of water pollution, especially chronic conditions like excessive levels of nutrients and high concentrations of pesticides and other farm chemicals, the most significant coastal effects are usually found in estuaries and bays. The degradation of water quality from agricultural residuals results in an economic cost of several billion dollars annually. Three principal costs of groundwater contamination are health impacts, informational costs, and remedial costs. The social costs of human exposure to chemicals in groundwater are not yet known. A variety of federal, state, and local laws provide a legal or administrative basis for addressing the problem of agricultural nonpoint source pollution of surface and groundwater. Programs and policies to manage and control the impact of agriculture on U.S. water resources encompass many objectives and must involve tradeoffs among conflicting needs; the goals of environmental protection and enhancement of water quality may at times conflict with other social goals such as ensuring profitable food and fiber production. (See also W91-03704) (Fish-PTT)
W91-03709

BIODIVERSITY LOSS IN THE TEMPERATE ZONE: DECLINE OF THE NATIVE FISH FAUNA OF CALIFORNIA.
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
P. B. Moyle, and J. E. Williams.
Conservation Biology, Vol. 4, No. 3, p 275-284, September 1990. 2 fig, 3 tab, 32 ref, append.

Descriptors: *California, *Ecological effects, *Environmental impact, *Fish populations, *Species diversity, Ecosystems, Fish establishment, Habitats, Stress, Water resources development.

In proportion to the entire fauna, loss of species may be as great in temperate regions as in tropical regions. To test the validity of this statement an investigation was conducted concerning the status of the native fish fauna of California, using a methodology that quantifies expert knowledge. Of 113 native taxa, 6% are extinct, 12% are officially listed as threatened or endangered, 6% deserve immediate listing, 17% may need listing soon, 22% show declining populations but are not yet in serious trouble, and 36% appear to be secure. Much of the faunal decline has taken place in recent years; it has included unexpectedly rapid declines of once abundant species. Fish taxa in serious trouble are most likely to be: (1) endemic to California, (2) restricted to small areas, (3) occupants of just one drainage basin, (4) part of a fish assemblage of less than 5 species, and (5) found in isolated springs, warm water streams, or big rivers. Water diversions and introduced species, acting in concert, seem to be the principal causes of the decline of the native fauna, although other types of habitat degradation have contributed as well. The situation in California with its high degree of endemism (60%), may be regarded as extreme but fish faunas in other temperate regions show signs of being nearly as stressed. It is likely that the situation with fish reflects a more general decline in the biota of temperate regions of the world. (Author's abstract)
W91-03870

COLLAPSE OF RIPARIAN POPLAR FORESTS DOWNSTREAM FROM DAMS IN WESTERN PRAIRIES: PROBABLE CAUSES AND PROSPECTS FOR MITIGATION.
Lethbridge Univ. (Alberta). Dept. of Biological Sciences.
S. B. Rood, and J. M. Mahoney.
Environmental Management EMNGDC, Vol. 14, No. 4, p 451-464, 1990. 4 fig, 2 tab, 54 ref.

Descriptors: *Dam effects, *Ecological effects, *Environmental policy, *Poplar trees, *Riparian vegetation, Alberta, Arizona, Colorado, Drought, Flooding, Forests, Land use, North Dakota, Restoration, Streamflow, Water resources development, Wyoming.

The riparian poplar forests of the western prairies are endangered as a result of the damming and diversion of rivers in this region. Recent reports have described substantial declines of riparian poplar forests downstream from dams in Alberta, Montana, North Dakota, Wyoming, Colorado, and Arizona. Forest and hydrological conditions are analyzed to clarify the causes of downstream forest decline. Dams were found to contribute to forest failure by: (1) reducing downstream flows; and/or (2) altering flow patterns to attenuate spring flooding and/or stabilize summer flows. Reduced flows are reported to induce drought stress, which is particularly lethal to seedlings and very old poplars. The artificial moderation of spring flooding may inhibit the formation of seedbeds essential for seeding replenishment. Increased river valley development involving cattle grazing, agricultural clearing and direct harvesting of trees also contributes to forest failure. Potential methods of mitigating the impacts of dams on downstream forests include downstream flow schedules that: (1) retain occasional spring flooding, (2) taper off rather than abruptly drop downstream flow, and (3) provide adequate flows throughout the summer. Poplar forest stabilization and recovery can be further promoted by fencing to protect trees from livestock grazing and trampling, or artificial site preparation such as cultivation or scarification to encourage poplar regeneration. (Author's abstract)
W91-03876

SALINE SEEPAGE AND LAND DEGRADATION--A NEW SOUTH WALES PERSPECTIVE.
Soil Conservation Service of New South Wales, Sydney (Australia).
For primary bibliographic entry see Field 5B.
W91-03893

7. RESOURCES DATA

7A. Network Design

CONSIDERATIONS FOR DATA COLLECTION TO SUPPORT SIMULATION ANALYSES IN THE SATURATED ZONE.
D. W. Pollock.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 43-44.

Descriptors: *Groundwater data, *Hydrologic data collections, *Hydrologic models, *Model studies, *Nonpoint pollution sources, *Water pol-

lution control, Data requirements, Simulation analysis.

Simulation has been an integral part of groundwater science for over half a century. Models are useful because they provide a systematic framework for integrating and evaluating the effects of the many interacting processes that control the behavior of groundwater systems. A critical point has been reached where a careful look must be taken at the capabilities of models and the relation between simulation, data collection, and the objectives that drive groundwater studies. Successful studies involve an iterative approach to problem-solving that consists of: (1) definition of the problem and objectives, (2) development of a conceptual model, or set of working hypotheses about how the groundwater system functions, (3) an analysis of existing data, (4) collection of new data that is appropriate to address the problem, (5) further analysis, often based around simulation, and (6) re-evaluation of conceptual models and the possible need for additional data and analysis. This type of iterative approach requires that the collection of hydrogeologic data be interwoven with and inseparable from the analysis of the problem. Data collection programs designed without specific objectives in mind often fail to meet the needs of specific problems when they arise. (See also W91-02985) (Fish-PTT)
W91-02994

40 CFR 265 INTERIM STATUS INDICATOR-EVALUATION GROUND-WATER MONITORING PLAN FOR THE 216-B-63 TRENCH.
Battelle Pacific Northwest Labs., Richland, WA.
B. N. Bjornstad, and S. Dudziak.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-012583. Price codes: A07 in paper copy, A01 in microfiche. Report No. PNL-6862, March 1989. 140p, 15 fig, 12 tab, 50 ref, 3 append.

Descriptors: *Groundwater quality, *Hanford Site, *Hazardous wastes, *Monitoring, *Monitoring wells, *Network design, *Project planning, Groundwater pollution, Leaching, Path of pollutants, Washington.

An outline of a groundwater monitoring plan for the 216-B-63 trench located in the northeast corner of the 200 East Area on the Hanford Site in southeastern Washington State is presented. It was determined that hazardous materials (corrosives) were disposed of into the trench during past operations. Installation of an interim-status groundwater monitoring system is required to determine whether hazardous chemicals are leaching to the groundwater from beneath the trench. This document summarizes the existing data that are available from near the 216-8-63 trench and presents a plan to determine the extent of groundwater contamination, if any, derived from the trench. The plan calls for the installation of four new monitoring wells located near the west end of the trench. These wells will be used to monitor groundwater levels and water quality immediately adjacent to the trench. Two existing Resource Conservation and Recovery Act monitoring wells, which are located near the trench and hydraulically upgradient of it, will be used as background wells. (Lantz-PTT)
W91-03024

MINIMUM SET OF DATA ELEMENTS FOR GROUND WATER.
Environmental Protection Agency, Washington, DC. Information Management and Services Div.
M. Zenon, N. Dee, and C. Miller.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 3A-5--3A-15, 4 tab, 2 ref.

Descriptors: *Data requirements, *Data storage and retrieval, *Databases, *Groundwater resources, *Information systems, *Network design, Water management, Geohydrology, Information exchange, Springs, Wells.

The EPA is considering the adoption of a policy which requires the creation and maintenance of a consistent collection of groundwater data based on a minimum set of data elements. The set of data elements was selected by a work group made up of representatives from EPA, other Federal agencies and the States. The set is characterized by elements that are needed to: communicate groundwater data across programs; facilitate accessing data from automated information systems other than one's own; provide, to the users, a road map for finding other related material; and, provide a link between water quality and well location information. The set consists of 22 elements, including geographic descriptors, well/spring descriptors and sample descriptors. Individual programs can add elements to this base to meet their special program needs: EPA encourages the groundwater community to adopt this minimum set as the collection of a consistent set of data elements will lead to more efficient management and sharing of data across the groundwater community, and ultimately to better decision-making. (See also W91-03032) (Author's abstract)
W91-03044

GROUND WATER MODELING ANALYSIS FOR A CONTAMINATED WATER-SUPPLY WELL FIELD IN INDIANA.
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 2F.
W91-03081

GEOHYDROLOGICAL DATA ACQUISITION: SOME IMPERATIVES.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-03188

GROUND WATER MONITORING AT WELLHEAD PROTECTION AREAS.
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-03447

METHODS DEVELOPMENT AND IMPLEMENTATION FOR THE NATIONAL PESTICIDE SURVEY.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W91-03507

SAMPLING ERRORS FOR RAINGAUGE-DERIVED MEAN AREAL DAILY AND MONTHLY RAINFALL.
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 2B.
W91-03746

7B. Data Acquisition

RESULTS OF QUALIFICATION TESTS ON WATER-LEVEL SENSING INSTRUMENTS, 1987.
Geological Survey, Stennis Space Center, MS. Water Resources Div.
T. E. Olive.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-397, 1990. 37p, 8 fig, 11 tab, 9 ref, append. Project no. WD954.

Descriptors: *Data acquisition, *Instrumentation, *Performance evaluation, *Water level, *Water measurement, Procurement, Qualified products list, Test facilities.

The U.S. Geological Survey's Hydrologic Instrumentation Facility at the Stennis Space Center, Mississippi, conducts qualification tests on water level sensing instruments. Instrument systems, which meet or exceed the Survey's minimum performance requirements, are placed on the Survey's Qualified Products List. The qualification tests conducted in 1987 added two instrument systems to the Survey's Qualified Products List. One system met requirements for use at a daily-discharge station, and the other system met requirements for a special-case station. The report is prepared for users of hydrologic instruments. The report provides a list of instrument features, describes the instrument systems, summarizes test procedures, and presents test results for the two instrument systems that met the Survey's minimum performance standards for the 1987 round of qualification tests. (USGS)
W91-02966

WATER-RESOURCES PROGRAMS AND HYDROLOGIC-INFORMATION NEEDS, MARION COUNTY, INDIANA, 1987.
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 6A.
W91-02967

QADATA USER'S MANUAL: AN INTERACTIVE COMPUTER PROGRAM FOR THE RETRIEVAL AND ANALYSIS OF THE RESULTS FROM THE EXTERNAL BLIND SAMPLE QUALITY-ASSURANCE PROJECT OF THE U.S. GEOLOGICAL SURVEY.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-02981

SAN FRANCISCO CENTRAL BAY SUSPENDED SEDIMENT MOVEMENT. REPORT 1: SUMMER CONDITION DATA COLLECTION PROGRAM AND NUMERICAL MODEL VERIFICATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2J.
W91-03010

MAPPING RIPARIAN/WETLAND HABITATS OF THE NEZ PERCE NATIONAL FOREST. A COOPERATIVE APPROACH.
Fish and Wildlife Service, Portland, OR.
B. V. Harrison, and G. F. Kellogg.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 6A-15--6A-23, 1 fig, 16 ref.

Descriptors: *Data acquisition, *Mapping, *Nez Perce National Forest, *Riparian land, *Water management, *Water resources management, *Wetlands, Classification, Economic aspects, Interagency cooperation, Riparian waters, Surveys, Water resources data.

The US Forest Service has a long standing policy to recognize the unique values of riparian areas (riparian ecosystems, aquatic ecosystems, wetlands and flood plains) and to manage these areas in relation to various legally mandated requirements. The Nez Perce National Forest decided to inventory all riparian areas with the Forest in order to facilitate the management of activities which could potentially impact these riparian and wetland resources. After consulting with the US Fish and Wildlife Service's (USFWS) National Wetlands Inventory program, the Nez Perce decided to map all riparian/wetland resources in the Forest using the USFWS's wetland classification system. A cooperative agreement was struck when the Nez Perce and National Wetlands Inventory decided to fund different phases of the inventory independently. Wetland maps depicting riparian/wetland location, shape and type were prepared for the entire Forest. This cooperative effort resulted in reduced inventory costs for both agencies. (See also W91-03032) (Author's abstract)
W91-03050

METHOD FOR COMPUTING SHEETFLOW RUNOFF FOR FLAT SLOPES.
South Florida Water Management District, West Palm Beach. Dept. of Resource Management.

R. S. Tomasello, and N. L. Garrido.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 9A-5--9A-12, 4 fig, 4 ref.

Descriptors: *Data interpretation, *Flood routing, *Florida, *Model studies, *Rainfall-runoff relationships, *Routing, *Runoff, *Sheet flow, Computer models, Hydrologic models, Runoff rates, Surface runoff, Water resources management.

Where specific basin discharge criteria have not been developed, the South Florida Water Management District's (SFWMD) surface water management program requires post development design discharges to be less than or equal to the predevelopment runoff rates. An accurate means of estimating the design storm predevelopment runoff rate is important to the water management system design, and to the integrity of the receiving waters. An over estimate of predevelopment runoff rates may lead to basin flooding problems. On the other hand, an underestimate may lead to an expensive overdesign of the water management system and the loss of developable land. Traditional hydrologic runoff methods generally do not provide good results for routing in very flat basins, particularly where back water effects and tailwater conditions are important. Natural systems incorporating wetland sloughs and heads are examples of such systems. The SHEET2D model has been developed which provides the user with the ability to dynamically route excess rainfall as overland flow through flat areas, including wetlands. The model utilizes hydrologic methods to compute the excess rainfall and uses hydraulic/hydrodynamic computations for the overland routing. The results of model verifications, particularly in wetland areas, are presented. The SHEET2D model and its upfront program will offer a user friendly environment to SFWMD permitting engineers and reviewers to apply a more sophisticated methodology for flood routing design storms in sheetflow conditions. The SHEET2D model employs the dynamic equations allowing for accurate physical simulations of water movement in the flat slope conditions not available through traditional hydrologic methods. (See also W91-03032) (Lantz-PTT)
W91-03065

INCREASING THE VALUE OF TECHNICAL DATA FOR MAKING GROUNDWATER POLICY DECISIONS.
North Carolina State Univ., Raleigh. Dept. of Economics.
L. E. Danielson, G. Meij, and C. W. Abdalla.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 10B-15--10B-22, 10 ref.

Descriptors: *Data acquisition, *Groundwater management, *Groundwater resources, *Water resources data, *Water resources management, Decision making, Interagency cooperation, Local governments, Public policy, State jurisdiction.

Water quality program funding is heavily oriented toward collection of data and research and development activities, especially in the early stages of issue development. Making data available to policy makers in a useful form and in a timely manner increases the value of the information. Ways to increase the value of technical groundwater data are considered. Coordination between policy makers and data collection agencies increases the value of the technical data and improves policy decision making. It is difficult for federal agencies to determine specific data and information needs at state and local levels. It is also more difficult for local decision makers to access and interpret technical data than for agencies and individuals generating the data. Increasing cooperation between agencies is seen as the key to providing the ability to make sound groundwater policy decisions. (See also W91-03032) (Lantz-PTT)
W91-03075

MONITORING POPULATIONS OF 4-CHLOROBIPHENYL-DEGRADING BACTERIA IN SOIL AND LAKE WATER MICROCOSMS USING COLONY HYBRIDIZATION.
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 5G.
W91-03114

USE OF SOIL SPECTRAL PROPERTIES FOR MONITORING SOIL EROSION.
Maryland Univ., College Park. Dept. of Agronomy.
R. A. Weissmiller, G. E. Van Scoyoc, S. E. Pazar, K. Latz, and M. F. Baumgardner.
IN: Soil Erosion and Conservation. Soil Conservation Society of America, Ankeny, Iowa. 1985. p 119-127, 6 fig, 2 tab, 13 ref.

Descriptors: *Monitoring, *Remote sensing, *Soil erosion, *Soil physical properties, *Soil spectral properties, Indiana, Iron oxides, Satellite technology, Soil classification, Soil conservation.

The universal soil loss equation has proved useful for predicting erosion and planning conservation. To reduce staggering topsoil losses and to maintain agricultural productivity, methods must be developed to assess, delineate, and monitor soil erosion rapidly and accurately. Remote sensing techniques, such as black and white aerial photography have been used in soil survey work for years. More recently, Landsat satellite data have been used as an aid in soil survey for both small-scale and more detailed inventories. While working in the midwestern United States to develop digital analysis techniques for using Landsat multispectral scanner (MSS) data to aid in the soil survey effort, researchers found that these techniques also offered a potential means of quantitatively surveying and measuring areas of severely eroded soils. Several workers have used spectral qualities of soils to distinguish and classify eroded surface soils in parts of Indiana. As iron oxide content increases and organic matter content decreases with increased severity of erosion, reflectance properties of soils change. However, severely eroded soils show decreased reflectance, so that the highest reflectance may not represent the most severely eroded soils. The capability to detect severely eroded soils while preparing a soil inventory of Jasper County, Indiana, was a significant breakthrough in the use of digital analysis of Landsat MSS data to assess degradation of land resources. (See also W91-03117) (Rochester-PTT)
W91-03128

DESIGN AND CONSTRUCTION CONSIDERATIONS FOR SEDIMENT SAMPLING OF STREAMFLOWS.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2J.
W91-03130

PROGRESS AND PROSPECTS IN ENVIRONMENTAL ISOTOPE HYDROLOGY.
Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
For primary bibliographic entry see Field 2F.
W91-03180

EXPLORATION OF FRACTURED ZONES BY RADON DETERMINATION IN THE SOIL.
For primary bibliographic entry see Field 2G.
W91-03181

GEOHYDROLOGICAL DATA ACQUISITION: SOME IMPERATIVES.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-03188

STRUCTURE OF TROPICAL CYCLONES AND SURROUNDING REGIONS AS DETERMINED FROM OLS AND SSM/I IMAGERY ANALYSIS.
Air Force Geophysics Lab., Hanscom AFB, MA.
For primary bibliographic entry see Field 2B.
W91-03226

40 CFR 265 INTERIM-STATUS GROUNDWATER MONITORING PLAN FOR THE 2101-M POND.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5A.
W91-03238

SEQUENTIAL PRECIPITATION SAMPLERS: A LITERATURE REVIEW.
Nebraska Univ. at Omaha. Dept. of Chemistry.
For primary bibliographic entry see Field 2B.
W91-03294

INTERCOMPARISON OF CONTINUOUS FLOW, AND AUTOMATICALLY SEGMENTING RAINWATER COLLECTION METHODS FOR DETERMINING PRECIPITATION CONDUCTIVITY AND PH.
Nebraska Univ. at Omaha. Dept. of Chemistry.
For primary bibliographic entry see Field 2B.
W91-03295

DETERMINATION OF ANISOTROPIC PERMEABILITY OF AN UNCONFINED AQUIFER IN EGYPT USING PUMPING TEST DATA OF A PARTIALLY PENETRATING WELL.
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
M. Shahin.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Proceedings of an International Workshop held February 28-March 4, 1989. This is Volume 2 of a 3 Volume Set. A. A. Balkema, Brookfield, Vermont. 1989. p 569-579, 7 fig, 7 ref.

Descriptors: *Aquifer testing, *Aquifers, *Egypt, *Groundwater movement, *Pumping tests, *Wells, Anisotropy, Comparison studies, Mathematical models, Nile Delta, Performance evaluation, Permeability.

Wells installed for pumping groundwater in Egypt have short screens that do not penetrate the full thickness of the aquifer. Consequently, the results obtained from pumping tests often are considered uncertain because field conditions generally do not agree with the assumptions of the traditional analysis. The vertical component of groundwater flow to a pumped well partially penetrating an aquifer should be considered in the analysis and not ignored. A pumped well at Abu-Shalaby (Nile Delta) was employed for some tests of recent techniques for analyzing pumping test data, in which anisotropy of the aquifer is considered. The results were compared to those obtained with traditional methods. Methods based on the grain-size distribution of the aquifer material are too empirical. Unless proper constants are used, the results could be misleading. The methods based on the anisotropy of the aquifer material, where both horizontal and vertical permeabilities are considered, seem to give more realistic and satisfactory results. The two steady-state methods (RIGW/IWACO and a similar one with a different type curve), in which the drawdown is measured in one in vertical section and in the other in a horizontal section, give almost the same values, especially for the horizontal permeability the horizontal permeability. The unsteady-state method give slightly high values for the horizontal permeability and the vertical permeabilit. To overcome the differences among the various methods, the use of average results from all the methods should be used. (See also W91-03311) (Rochester-PTT)
W91-03318

SELECTING EFFECTIVE METHODS FOR GROUNDWATER PROSPECTING AND EXPLORATION IN MEKONG DELTA.
General Department of Mine and Geology, S. R. Vietnam.
For primary bibliographic entry see Field 2F.
W91-03333

CASE STUDY OF INTEGRATED EXPLORATION PRACTICE FOR SHALLOW FRESH WATER AQUIFERS IN SOUTHERN PARTS OF RAMNAD DISTRICT (TECHNOLOGY MISSION PROJECT).
AFPRO GIT Unit III, Coimbatore.
For primary bibliographic entry see Field 2F.
W91-03351

DETERMINATION OF URANIUM IN AN ANALYTICAL CHEMISTRY LABORATORY.
Environmental Monitoring Systems Lab., Las Vegas, NV.
C. K. Liu, R. W. Holloway, and J. Akridge.
IN: Radon, Radium and Uranium in Drinking Water. Lewis Publishers, Inc., Chelsea, Michigan. 1990. p 165-171. 8 ref.

Descriptors: *Analytical techniques, *Chemical analysis, *Laboratory methods, *Pollutant identification, *Radioactivity techniques, *Radiochemical analysis, *Radioisotopes, *Uranium, *Water analysis, Alpha spectroscopy, Drinking water, Fluorometry, Quantitative analysis, Resins, Spectroscopy, Water quality standards.

Three methods for the analysis of uranium in water are commonly used by laboratories involved in measuring radioactivity in the environment: (1) alpha spectroscopy, (2) radiochemical separation and total alpha particle counting, and (3) fluorometry. Of these, the fluorometric method measures the total mass of uranium and not the uranium radioactivity. The radioactivity of uranium must be inferred from this measurement, based on some assumption concerning the ratio of U-234 to U-238. Because this ratio may be highly variable in natural water, the fluorometric method will often be less accurate than the other two methods in assessing the radioactivity of uranium in water. This is especially true in cases where most of the radioactivity is due to U-234 rather than U-238. For those laboratories unable to acquire alpha spectroscopy instruments, the radiochemical separation/alpha particle counting method is an acceptable alternative. However, the need to estimate the chemical recovery in this method is a weakness of some importance. The most suitable method for the measurement of uranium in drinking water is the method using alpha spectroscopy. This allows the accurate measurement of the alpha activity of each isotope of uranium. There are a number of different purification schemes that will produce pure samples in a form that can be counted by alpha spectroscopy. One of the most popular methods is the use of ion exchange resins. Based on the analytical merits of alpha spectroscopy it should be the method of choice for the measurement of uranium in drinking water. (See also W91-03366) (Agostine-PTT)
W91-03376

SETTING UP A LABORATORY FOR RADON IN WATER MEASUREMENTS.
Maine Univ. at Orono. Dept. of Physics and Astronomy.
For primary bibliographic entry see Field 5A.
W91-03378

ANALYTICAL METHODOLOGY FOR RADIUM IN FOOD AND WATER.
Food and Drug Administration, Winchester, MA. Winchester Engineering and Analytical Center.
For primary bibliographic entry see Field 5A.
W91-03379

PRECONCENTRATION OF IRON BY COMPLEXATION AND ULTRAFILTRATION.
Turin Univ. (Italy). Dipt. di Chimica Analitica.
C. Sarzanini, P. Masse, E. Mentasti, and A. Verdier.
Separation Science and Technology SSTEDS, Vol. 25, No. 6, p 729-737, May 1990. 4 tab, 18 ref.

Descriptors: *Chemical analysis, *Iron, *Pollutant identification, *Ultrafiltration, *Water analysis, Hydrogen ion concentration, Ion exchange, Polyelectrolytes.

The effect of a cationic polyelectrolyte (Multifloc C563, Protex) on the formation of complexes of iron and 1,2-dihydroxybenzene-3,5-disulfonic acid (Tiron) and the behavior of such complexes in ultrafiltration experiments were investigated. Discontinuous ultrafiltration experiments were performed with neutral membranes, and metal-ligand, ligand C563, and metal-ligand-C563 systems. The first set of experiments was performed to evaluate the efficiency of ultrafiltration with respect to the stoichiometry of the iron-Tiron complexes (Fe-T, Fe-T2, and Fe-T3). At pH 2 there was a release of the complex and a poor recovery of iron (46%). At pH 9, the larger steric hindrance provided a greater interaction with the membrane and a higher recovery of iron (77%). The presence of polyelectrolyte improved iron retention, so that 50 and 95% of Fe(III) was recovered at pH 2 and 9, respectively. Because the concentration of polyelectrolyte in the permeate and in the retentate may become a limiting parameter, ultrafiltrations were performed to evaluate its behavior. The permeate and retentate concentrations of polyelectrolyte were the same in the corresponding fractions for all the conditions considered and did not significantly affect the ultrafiltration performance. The present preconcentration method may be useful for reducing the detection limits of heavy metals, reducing matrix interference in instrumental determinations, and removing toxic metals from polluted waters. (Geiger-PTT)
W91-03411

INSENSITIVITY OF REMOTE SENSING TO WATER-LOGGING IN LOW-CAPILLARITY SOILS.
Punjab State Council for Science and Technology, Chandigarh (India).
K. P. Singh.
Current Science CUSCAM, Vol. 59, No. 9, p 464-465, 1990. 7 ref.

Descriptors: *Capillarity, *India, *Landsat images, *Remote sensing, *Soil water, *Waterlogging, Field tests, Flood plains, Land reclamation, Mapping, Monitoring, Project planning.

Use of Landsat data has been reported widely for monitoring waterlogging patterns. Examples of various case studies indicate that such techniques, though extremely useful, should essentially be used in conjunction with field data. It is demonstrated that in certain cases, although the area may be waterlogged, Landsat images may not register any signatures. Such observations when interpreted without the aid of field data lead to deceptive results and wrong planning and execution of schemes in the field for reclamation of waterlogged areas. Examples from the alluvial tracts of Punjab State, India, highlight the importance of such data. Waterlogged areas generally appear to have different spectral signatures on Landsat images due to the increased moisture content in the topsoils. Waterlogged areas can be picked up by Landsat and Thematic Mapper data if the capillary rise in the soils is high and the topsoil zone is near saturation. Field visits have proved that even though an area is waterlogged, it may not appear on Landsat and TM data products. Recommended measures include construction of new surface, link, and subsurface drains; lining of canals and distributaries; introduction of vertical drainage, afforestation measures, etc. and aim to decrease the inflow components and increase the outflow components in the groundwater system. (Fish-PTT)
W91-03418

MEMBRANE/GAS CHROMATOGRAPHIC SYSTEM FOR AUTOMATED EXTRACTION AND DETERMINATION OF TRACE ORGANICS IN AQUEOUS SAMPLES.
Dow Chemical Co., Midland, MI. Analytical Labs.
For primary bibliographic entry see Field 5A.
W91-03436

FIELD METHODS FOR MEASUREMENT OF GROUND WATER REDOX CHEMICAL PARAMETERS.
Geological Survey, Denver, CO. Geologic Div.
K. Walton-Day, D. L. Macalady, M. H. Brooks, and V. T. Tate.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 4, p 81-89, Fall 1990. 5 fig, 2 tab, 40 ref.

Descriptors: *Analytical methods, *Geochemistry, *Groundwater chemistry, *Oxidation-reduction potential, *Water analysis, *Water chemistry, *Water sampling, Cape Cod, Colorado, Field tests, Groundwater pollution, Ion-selective electrodes, Massachusetts, Tennessee Park, Water quality monitoring.

An inexpensive, versatile, and portable system for rapid field determinations of redox potentials, pH, conductivity, ferrous and total iron, nitrite, specific conductance, dissolved oxygen, and temperature of groundwater is described. Three airtight flow-through cells were designed and constructed to permit flow of groundwater into and through the cells with minimal infiltration of atmospheric gases into the samples. The electrode flow-through cell permits simultaneous use of up to four electrodes. The ampoule flow-through cell is used for commercially available colorimetric analyses for many dissolved constituents. The sample collection cell is designed to provide samples that are unaffected by outgassing and contact with atmospheric gases. A portable mounting scheme facilitates routine sampling of multiple wells. Analytical determinations in the field were generally performed with commercially available ampoules, prepared analytical kits, or standard field instruments. The field apparatus and associated analyses were applied to two field sites. Analysis of a shallow sand and gravel aquifer contaminated with treated sewage on Cape Cod, Massachusetts indicated detectable levels of dissolved oxygen in all samples except those containing ferrous iron. The findings support the hypotheses of denitrification and Nernstian response of platinum electrodes. The second site, a subalpine wetland in Tennessee Park near Leadville, Colorado, receives input from a stream contaminated with acid mine drainage. The wide range of iron, oxygen, and sulfide concentrations, despite the close proximity of the wells, is evidence of the pervasive chemical heterogeneity of the aquifer with respect to redox-sensitive aqueous species. It is concluded that the field methods described provide the means for rapid and reliable analyses of groundwater geochemical parameters. (MacKeen-PTT)
W91-03444

COMPLEMENTARY INVESTIGATIVE TECHNIQUES FOR SITE ASSESSMENT WITH LOW-LEVEL CONTAMINANTS.
Science Applications International Corp., Golden, CO. Environmental Remediation Div.
For primary bibliographic entry see Field 5G.
W91-03445

SOIL-GAS SURVEYING FOR SUBSURFACE GASOLINE CONTAMINATION USING TOTAL ORGANIC VAPOR DETECTION INSTRUMENTS: PART II. FIELD EXPERIMENTATION.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5A.
W91-03448

DEVELOPMENT AND APPLICATION OF A TECHNIQUE FOR ESTIMATING NUTRIENT DEFICIENCY IN SOFT SEDIMENTS.
Montana State Univ., Bozeman. Dept. of Biology.
W. K. Dodds, and J. C. Priscu.
Hydrobiologia HYDRB8, Vol. 203, No. 1/2, p 93-97, September 14, 1990. 2 fig, 19 ref.

Descriptors: *Analytical techniques, *Diffusion, *Enrichment, *Lake sediments, *Limiting nutrients, *Limnology, *Nutrient concentrations, *Sediment analysis, *Sediment sampler, Benthic environment, Estimating, Nitrates, Nitrogen, Oligotrophic lakes, Oxygen, Phosphates, Phosphorus, Photosynthesis, Primary productivity, Water sampling.

A diffusion enrichment technique has been developed which allows for chemical enrichment of soft surficial and shallow subsurface sediments and subsequent measurement of O2 production. The sediment is enriched by inserting a perforated tube containing dialysis tubing filled with a nutrient/agar mixture. O2 production by surficial sediment is measured using an inverted, translucent, polyethylene chamber over the sediment. The inside of the chamber contains a collapsible bag connected to the water outside the chamber. When water overlying the sediment is withdrawn from a sampling port, it is displaced with water from outside the chamber, thus preventing contamination of water samples with pore water from below. The technique was tested by enriching near-shore sediments in a large oligotrophic lake with inorganic N and P. NH4(+) additions significantly stimulated benthic primary production as measured by O2 production, whereas enrichment with PO4(-3) had no effect. (Author's abstract)
W91-03499

DYNAMIC PARTITIONING OF ORGANIC CHEMICALS IN REGIONAL ENVIRONMENTS: A MULTIMEDIA SCREENING-LEVEL MODELING APPROACH.
California Univ., Los Angeles. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W91-03510

EIGHT-MONTH SAMPLE OF MARINE STRATOCUMULUS CLOUD FRACTION, ALBEDO, AND INTEGRATED LIQUID WATER.
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W91-03524

CANCER RISK ASSESSMENT: IMPORTANCE OF IDENTIFYING MECHANISMS OF ACTION.
Washington State Univ., Pullman. Coll. of Pharmacy.
R. J. Bull.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 10, p 57-60, October 1990. 2 tab, 16 ref.

Descriptors: *Carcinogens, *Drinking water, *Mathematical models, *Public health, *Risk assessment, *Water treatment, Contaminants, Health aspects, Public policy, Water quality standards.

The goal of risk assessment is to estimate the likelihood of adverse human health effects that could result from exposure to potentially hazardous substances or activities. The process by which regulatory standards are established for drinking water contaminants is based on extrapolating animal toxicity data to humans using a standard mathematical model. The assumptions and judgements involved introduce a relatively high degree of uncertainty and conservativeness into both the qualitative and quantitative aspects of the process. The practical effect is that standards developed under the current regulatory process are based on inflated estimates of the actual calculated risks. Setting standards based on knowledge of specific mechanisms of carcinogenicity would decrease the uncertainty involved in risk assessment. If the process were to take into account the carcinogenic mechanisms of specific contaminants rather than treat all contaminants the same, the resulting standards could differ by orders of magnitude. Understanding these specific mechanisms of carcinogenicity is necessary for arriving at the most appropriate mathematical construct for calculating more rational standards. (Mertz-PTT)
W91-03529

SATELLITE DATA TRANSMISSION AND HYDROLOGICAL FORECASTING IN THE FIGHT AGAINST ONCHOCERCIASIS IN WEST AFRICA.
Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Abidjan (Ivory Coast). Centre ORSTOM d'Adiopodoume.
E. Servat, J.-M. Lapetite, J.-C. Bader, and J.-F. Boyer.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 187-198, September 1990. 5 fig, 9 ref.

Descriptors: *Data transmission, *Flow discharge, *Human diseases, *Hydrologic data, *Public health, *River forecasting, *Satellite technology, *West Africa, Computer programs, Data acquisition, Insecticide application, Surface water data, Water level.

Onchocerciasis, or river blindness, is an endemic disease which causes great hardship in west Africa. Within the World Health Organization's Onchocerciasis Control Program (WHO/OCP), reliable data on the discharge of the watercourses have been obtained by using remote satellite transmission. These data are necessary to calculate how much insecticide should be introduced into the rivers. The hydrological platform consists of a system for measuring water level using a pressure sensor powered by a solar panel and a battery. Measurements are made every 30 min and transmitted by satellite to a reception station. The technique offers several advantages: (1) guaranteed access to data in all seasons; (2) transmission of the water levels almost in real-time; (3) more reliable data than that from river gauges; and (4) rapid and simple centralization of the data. Implementation of the system has resulted in improved efficiency of treatment and in the reduction of OCP costs. Software for forecasting the discharge over different time intervals was developed to improve the efficiency of the system. Satellite transmission of hydrologic data is recommended for other applications, including flood warning systems and management of national hydrologic networks. (MacKeen-PTT)
W91-03548

METHODS FOR THE DETERMINATION OF ORGANIC COMPOUNDS IN DRINKING WATER.
Environmental Monitoring Systems Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W91-03580

EVALUATION OF TREND DETECTION TECHNIQUES FOR USE IN WATER QUALITY MONITORING PROGRAMS.
Colorado State Univ., Fort Collins.
J. C. Loftis, R. C. Ward, R. D. Phillips, and C. H. Taylor.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-100058/AS. Price codes: AO7 in paper copy, AO1 in microfiche. Report No. EPA/600/3-89/037. March 1989. 150p, 58 fig, 25 tab, 20 ref, 2 append. EPA Cooperative Agreement CR813997.

Descriptors: *Acid rain, *Data processing, *Monitoring, *Statistical analysis, *Water quality, *Water quality trends, Analysis of covariance, Distribution, Kendall tests, Monte Carlo method, Seasonal variation, Serial correlation, t-Test.

Information goals for a long-term water quality monitoring program, to measure the impacts due to acid precipitation, were developed using the Acid Precipitation Act of 1980 (PL 96-294, Title VII) as a basis. These broad information goals were refined to obtain statistical hypotheses for which statistical tests could be employed as part of a data analysis plan. Seven statistical tests were identified as capable of providing the desired information regarding trends in individual systems--analysis of covariance (ANOCOV); modified t-test; Kendall-tau following removal of seasonal means; seasonal Kendall (SK); seasonal Kendall with serial correlation correction; ANOCOV on ranks; and modified 't' on ranks. The tests were evaluated under various conditions (i.e., distribution shape, seasonality and serial correlation) in order to determine how well they might perform as part of a data analysis plan. A Monte Carlo simulation approach was used to evaluate the tests. For annual sampling, the Kendall-tau (also known as the Mann-Kendall) test is recommended. For seasonal sampling, the Seasonal Kendall or analysis of covariance (ANOCOV) on ranks tests are recommended. (Author's abstract)
W91-03584

SEDIMENT QUALITY VALUES REFINEMENT: VOLUME 1 - DATA APPENDICES, 1988 UPDATE AND EVALUATION OF PUGET SOUND AET.
PTI Environmental Services, Bellevue, WA.
For primary bibliographic entry see Field 5A.
W91-03599

CASE STUDY EVALUATION OF SATELLITE-DERIVED RAINFALL ESTIMATES AND THEIR APPLICATION TO NUMERICAL MODEL PRECIPITATION FORECAST VERIFICATION.
National Weather Service Forecast Office, Milwaukee, WI.
For primary bibliographic entry see Field 2B.
W91-03600

BOREHOLE GEOPHYSICS APPLIED TO GROUND-WATER INVESTIGATIONS.
For primary bibliographic entry see Field 2F.
W91-03653

PROCEEDINGS OF THE SIXTH CORPS CHEMISTS MEETING, 16-17 MAY 1989.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5A.
W91-03659

CONDITIONABILITY, FILTERABILITY, SETTLEABILITY AND SOLIDS CONTENT OF SLUDGES 1984 (A COMPENDIUM OF METHODS AND TESTS): METHODS FOR THE EXAMINATION OF WATERS AND ASSOCIATED MATERIALS.
For primary bibliographic entry see Field 5D.
W91-03662

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY.
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-03663

SIGNIFICANCE OF GIS AND REMOTE SENSING TECHNOLOGY IN GREAT LAKES MONITORING AND RESOURCE MANAGEMENT.
Wisconsin Univ.-Madison. Environmental Remote Sensing Center.
J. R. Vande Castle, R. G. Lathrop, and T. M. Lillesand.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 155-161, 3 fig, 1 tab, 7 ref.

Descriptors: *Geographic information systems, *Great Lakes, *Lake management, *Remote sensing, *Water quality management, *Water resources data, *Water resources management, Flow rates, Landsat images, Mapping, Spatial distribution, Temperature gradient, Water pollution sources, Water quality.

Great Lakes monitoring and resource management strategies require input from increasingly diverse and complex data sources. Conventional information such as population statistics, land use records and field sampling data need to be merged with more contemporary sources of information. Timely management decisions require up-to-date information including point source, real-time temperature or flow rate data, to space-based image maps of wetlands, temperature patterns or water quality parameters. Remotely-sensed data provide information covering a wide range of spatial and temporal scales. Systems such as Landsat-TM and SPOT-HRV can provide information with a spatial resolution of 30 to 10 m respectively, while sys-

tems such as NOAA-AVHRR can provide near real-time information at a spatial resolution of 1.1 km on a daily basis, limited only by cloud cover. Future systems such as SeaWiFS on Landsat-6 will be able to provide real-time wide-field multispectral data in conjunction with the Enhanced Thematic Mapper. The Geographic Information System (GIS) concept provides the framework to organize these complex and unstandardized data into spatial information. A GIS allows information, whether it is map-based, point source, or image-based to be located in space and/or time as a layer of information within a common database. The database can be updated or queried at any point and used for specific tasks such as flow rate analysis, diffusion rates and residence times. These derived data can then be included as additional layers within the database to provide information for management decisions of Great Lakes resources. See also W91-03672) (Author's abstract)
W91-03689

GEOPHYSICAL DETERMINATION OF LAKEBED SEDIMENT HYDRAULIC PROPERTIES.
Wisconsin Univ.-Milwaukee. Dept. of Geosciences.
C. J. Hero, and R. W. Taylor.
IN: The Great Lakes: Living with North America's Inland Waters. Proceedings of a Symposium. American Water Resources Association, Bethesda, Maryland. 1988. p 163-171, 6 fig, 24 ref.

Descriptors: *Geophysical methods, *Great Lakes, Lake management, *Water quality management, Water resources management, Aquitards, Conductance, Electrical properties, Geohydrology, Hydraulic conductivity, Hydraulic properties, Lake sediments, Resistivity, Surface-groundwater relations, Water resources data.

The use of geophysical techniques to characterize hydrogeologic systems is of great interest to investigators who study systems that cover large areas, such as the determination of the interactions between the Great Lakes and the adjacent aquifers. These interactions are strongly dependent on the hydraulic properties of the lakebed sediments. Direct measurement of the hydraulic properties of the lakebed sediments of large lakes is costly, when often possible, thus the use of geophysical techniques is necessary. A number of geoelectrical methods have been proposed or used for the characterization of the hydrogeologic properties of aquifers, but the lakebed sediments are aquitards. These generally contain at least some clay, which limits or eliminates the usefulness of some of those methods, particularly the use of formation factor. Consequently, the longitudinal conductance method has been successfully utilized to provide hydrogeologic information essential for the determination of water fluxes between aquifers and lakes. The success of the longitudinal conductance technique does not preclude the existence of even more effective methods. Hydraulic conductivity and electrical resistivity show similar relationships with the percent clay in the sediment, thus direct application of electrical resistivity, through use of iterative inversion, shows promise for the future. (See also W91-03672) (Author's abstract)
W91-03690

RESULTS OF FIFTEEN YEARS OF CONTINUOUS MONITORING OF WATER QUALITY IN THE RUHR RIVER HEAVILY AFFECTED BY RESIDUAL POINT AND NONPOINT POLLUTION.
Ruhrverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-03733

ESTIMATION OF DIFFUSE INPUTS TO A COASTAL SEA: SOLUTION TO AN INVERSE MODELLING PROBLEM.
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 2L.
W91-03817

DETECTION OF INITIAL EFFECTS OF POLLUTION ON MARINE BENTHOS: AN EXAMPLE FROM THE EKOFISK AND ELDFISK OILFIELDS, NORTH SEA.
Oslo Univ. (Norway). Inst. of Marine Biology.
For primary bibliographic entry see Field 5C.
W91-03837

DAM SAFETY: AN EVALUATION OF SOME PROCEDURES FOR DESIGN FLOOD ESTIMATION.
Salford Univ. (England). Dept. of Civil Engineering.
I. D. Cluckie, and M. L. Pessoa.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 5, p 547-569, October 1990. 7 fig, 2 tab, 44 ref.

Descriptors: *Dam stability, *Design floods, *Hydraulic properties, *Probable maximum precipitation, *Rainfall intensity, *Storm water, *Streamflow forecasting, England, Probable maximum flood, Radar, Statistical analysis, Stocks Reservoir, Unit hydrographs.

A number of aspects can be related to the estimation of dam design floods. A new approach to this estimation of probable maximum precipitation (PMP) takes advantage of the spatial variability of precipitation using radar-derived distributed rainfall measurements. Procedures which utilize storm transposition and storm maximization are introduced and the unit hydrograph method is employed to estimate the probable maximum flood. These results are compared with those obtained by the application of both Wakeby and generalized extreme value (GEV) distributions, these statistical functions being fitted by the method of probability weighted moments (PWMs) and used for both at-site and regional analyses. In addition, a case study is presented in which the techniques were applied to the Stocks Reservoir in the northwest of England. The following conclusions were drawn from the study: (1) the Wakeby distribution is widely recognized as a probability distribution which can deal with samples originating from a wide variety of formative processes; (2) the use of PWMs removes much of the subjectivity (apart from the treatment of outliers) of techniques; (3) the Wakeby/PWM method requires a larger database to provide reasonable, unbiased estimation of parameters then the GEV/PWM method; (4) the Wakeby distribution is more sensitive to outliers and short record length sites and shows a tendency to produce higher estimates than the GEV distribution, particularly for return periods > 500 years; (5) at-site estimation of a very extreme event, such as 10,000 year flood, using typically available record lengths is nothing more than a well-informed guess; (6) the results produced using the RADMAX procedures and employing the UK Flood Studies Report unit hydrograph method were comparable to those obtained with other techniques; and (7) radar calibration (presently performed in real time using a limited number of rain gages by the UK Meteorological Office) is a crucial element when considering the utilization of the radar data archive in such studies. (Hoskin-PTT)
W91-03845

SINGLE-DOPPLER OBSERVATIONS OF A WEST AFRICAN SQUALL LINE ON 27-28 MAY 1981 DURING COPT 81: KINEMATICS, THERMODYNAMICS AND WATER BUDGET.
Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
F. Roux, and S. Ju.
Monthly Weather Review MWREAB, Vol. 118, No. 9, p 1826-1854, September 1990. 22 fig, 3 tab, 52 ref, 2 append.

Descriptors: *Atmospheric physics, *Ivory Coast, *Meteorology, *Precipitation, *Remote sensing, *Squalls, *Storms, Condensation, Evaporation, Hydrologic budget, Mathematical analysis, Mathematical models, Radar.

A large and intense West African squall line was observed during the night of 27/28 May 1981 at Korhogo (along the north of Ivory Coast) during the COPT 81 experiment. Unfortunately, as only single-Doppler radar data are available, it is not possible to obtain detailed information on the small scale structure of the leading convective region. Taking advantage of the apparent stationarity of the mesoscale features, a new processing method (referred to as ABCD) has been developed for a combined processing of 12 successive conical scans, allowing deduction of three-dimensional wind and reflectivity fields in a domain of 260 x 60 x 15 cubic km, with resolutions of 20 km in the horizontal and 500 m in the vertical. The deduced circulation displays classical characteristics of trailing stratiform parts of mesoscale convective systems, with a mesoscale updraft above 4 km, a mesoscale downdraft below, and a relative rear-to-front flow of moderate intensity in the midlevels; all these features are slightly more intense than on 22 and 23-24 June 1981. Because of the propagation of the squall line in a direction slightly different from that of the environmental winds, the velocity component parallel to the line is relatively important. Pressure and temperature fields retrieved from an improved analysis of the momentum equation and of the thermodynamic equation show a warming due to condensation in the mesoscale updraft, cooling due to evaporation below, hydrostatic low pressure in the midlevels and high pressure near the surface. The vertical component of vorticity is weak and correlated with the horizontal divergence, while there is an anticorrelation between the shearing deformation and the horizontal divergence. The cross-line component of vorticity is weak compared with the along-line component. The baroclinic generation due to the horizontal buoyancy gradient is the dominant term in the budget of the along-line component of vorticity. However, the influence of the three-dimensional effects through the shearing-tilting term are also important. The water budget provides values of the different components relatively similar to those obtained in previous studies, with, however, a larger condensation rate due to the more important upward motions. (Author's abstract)
W91-03851

WINTER SHORT-PULSE RADAR STUDIES ON THE TANANA RIVER, ALASKA.
Cold Regions Research and Engineering Lab., Hanover, NH.
A. J. Delaney, S. A. Arcone, and E. F. Chacho.
Arctic ATICAB, Vol. 43, No. 3, p 244-250, September 1990. 8 fig, 24 ref.

Descriptors: *Alaska, *Data acquisition, *Frost, *Frozen ground, *Radar, *Remote sensing, *River channels, *Tanana River, Aerial photography, Channels, Fairbanks, Ice thickness, River ice, Soil horizons, Subarctic zone, Surveys.

Subsurface profiles were obtained during airborne and surface short-pulse radar surveys along a winter roadway over the Tanana River, near Fairbanks, Alaska. The roadway crossed ice covered channels and intervening frozen channel bars. The airborne profiles were intended for ice thickness profiling but also revealed sporadic reflections from a deeper horizon beneath the bars. Later profiling from the surface recorded these deeper reflecting horizons in detail, and they were found to correspond with the base of seasonal frost, measured in drill holes. The sediments immediately beneath the frozen material were saturated and represented the top of a seasonally variable groundwater table confined and controlled by frost penetration. The profiles made from the surface also revealed reflections from the bottom of the ice and the channel bottom. However, no significant reflections were observed beneath the channel bottom; reflections from sloping horizons above and below the base of the frost in the bar may indicate alluvial bedding patterns in these deposits. Eleven holes were drilled along the roadway to determine ice thickness, water and frost depth, and the depths to the river ice alluvium contact. Wide angle reflection and refraction soundings were also made to determine electrical properties of materials and to verify depth interpretations from echo times. These observations indicate that the airborne technique provides an effective method of locating unfrozen channels and measuring the depth of frost penetration beneath the bars. The surface surveys revealed additional data on sedimentary structure. (Author's abstract)
W91-03868

Group 7B—Data Acquisition

USE OF FIELD-FLOW FRACTIONATION TO STUDY POLLUTANT-COLLOID INTERACTIONS.
Monash Univ., Clayton (Australia). Water Studies Centre.
For primary bibliographic entry see Field 5B.
W91-03879

CHARACTERIZATION AND ASSAY CONDITIONS FOR USE OF ACHE ACTIVITY FROM SEVERAL MARINE SPECIES IN POLLUTION MONITORING.
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes. Lab. Effets Biologiques des Nuisances.
For primary bibliographic entry see Field 5A.
W91-03885

DETERMINATION OF RADON IN WATER BY ARGON PURGING AND ALPHA COUNTING WITH A PROPORTIONAL COUNTER.
Ecole Polytechnique, Montreal (Quebec).
L. Zikovsky, and N. Roireau.
International Journal of Radiation Applications & Instrumentation. A, Appl. Radiation & Isotopes ARISEF, Vol. 41, No. 7, p 679-681, 1990. 2 fig, 1 tab, 11 ref.

Descriptors: *Analytical methods, *Analytical techniques, *Data acquisition, *Drinking water, *Pollutant identification, *Radon, *Water analysis, *Well water, Carcinogens, Detection limits, Domestic water, Municipal water, Public utility districts, Radioactivity, Toxicity, Water quality.

Radon (222Rn) is a naturally occurring inert gas which diffuses from geological strata into ground water. When well water is used for domestic purposes such as drinking and washing, the radon release constitutes a potential source of radioactivity in indoor air. It has been estimated that over a period of 70 years, between 2000 and 40,000 lung cancer fatalities have been caused by the inhalation of natural radon released from U. S. public water supplies. Due to the highly toxic nature of radon it is important to be able to measure small concentrations of radon in water in a relatively simple way. This report describes the development of a new method of radon determination in water by purging with argon and counting in a proportional counter. The detection limit associated with this new method was calculated to be 0.02 Bq/L. The detection limit could be further reduced by increasing the volume of the sample or the counting time. The separation method used in this technique is reasonably fast and the detector was insensitive to beta emitters such as 85Kr. The analytical technique developed for the detection of radon is relatively simple, fast, very sensitive, and interference-free. The gas handling equipment can be assembled quite easily in any laboratory. The only drawbacks of the method were the 'memory effect' and the waiting period between measurements. (Korn-PTT)
W91-03888

APPLICATION OF LANDSAT THEMATIC MAPPING TO GEOLOGY AND SALINITY IN THE MURRAY BASIN.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
R. Johnston, and J. Kamprad.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 363-366, 1990. 6 fig, 2 tab, 4 ref.

Descriptors: *Australia, *Data interpretation, *Flow discharge, *Geohydrology, *Landsat images, *Mapping, *Murray-Darling River Basin, *Remote sensing, *Saline groundwater, Aeolian deposits, Field tests, Seepage, Vegetation.

In hydrological and geological studies in the Murray Basin in southeastern Australia, composite images derived from Landsat Thematic Mapper (TM) digital data enable excellent delineation of both ancient and active groundwater discharge zones, including strong zoning within active salinas. Differentiation of aeolian deposits, including lunettes, is possible only where there are distinctive vegetation associations. Landsat TM images can also be used, in conjunction with field checking, to detect areas where saline seepage zones are developing. The uncorrected TM data can be used as a guide to the extent of salinization and the evaporite mineral assemblages present within the salinas, providing the ephemeral nature of these is taken into consideration. The technique is applicable over the entire Murray Basin, but caution must be exercised when comparing scenes from different areas, as color differences between scenes recorded on different dates may result during processing of the data. This emphasizes the need for field checking each scene, and comparising pixel data for apparently similar areas in different scenes. The investigation demonstrates that Landsat TM has the potential for significant application to salinity studies in this environment, however, more advanced processing techniques than those applied should be investigated. (Fish-PTT)
W91-03907

DEVICE FOR IN SITU DETERMINATION OF GEOCHEMICAL TRANSPORT PARAMETERS: 2. BIOCHEMICAL REACTIONS.
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
R. W. Gillham, R. C. Starr, and D. J. Miller.
Ground Water GRWAAP, Vol. 28, No. 6, p 858-862, November/December 1990. 3 fig, 12 ref. Ontario Ministry of the Environment and NSERC Operating Grant No. 6414.

Descriptors: *Geochemistry, *Groundwater pollution, *In situ tests, *Instrumentation, *Measuring instruments, *Path of pollutants, Aquifer testing, Biodegradation, Chemical reactions, Data acquisition, Denitrification, Field tests, Groundwater data, Groundwater quality, Water chemistry.

Chemical and biological reaction rates are required for estimating migration rates of many reactive contaminants in groundwater, and as input data for mathematical models. Reaction rates must be measured, and depend on environmental conditions that are often difficult to duplicate in the laboratory. In situ rate measurements minimize the difficulties of controlling environmental variables such as temperature, pH, Eh, dissolved oxygen, solution and solid phase composition, and bacterial population. An instrument has been developed which isolates a 1.9-liter portion of an aquifer for in situ biochemical rate measurement. The device has been used successfully to measure the rate of reactions involving inorganic and organic contaminants in sandy aquifers. Two applications of the device, measurement of denitrification rates and rates of biodegradation of benzene, were examined, and the results show good agreement with results from previous studies. The in situ microcosm (ISM) is simple in design and is reasonably easy to operate. The method has a major advantage over large-scale injection tests in that it requires much less time and much less equipment. Furthermore, the test zone is isolated from the natural advective and dispersive processes in the aquifer, and thus the results are more easily interpreted; this can be a disadvantage if one wishes to study interactions of the degradation, advective, and dispersive processes. Though some degree of physical disturbance will occur during installation of the ISM, the chemical integrity of the test zone should be preserved. This is a major advantage over most laboratory test procedures. (Author's abstract)
W91-03909

DETERMINATION OF SPECIFIC STORAGE BY MEASUREMENT OF AQUIFER COMPRESSION NEAR A PUMPING WELL.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2F.
W91-03911

EFFECT OF SENSOR ERROR ON INTERPRETATION OF LONG-TERM WATER-LEVEL DATA.
Geological Survey, Denver, CO.
D. O. Rosenberry.
Ground Water GRWAAP, Vol. 28, No. 6, p 927-936, November/December 1990. 7 fig, 4 tab, 12 ref.

Descriptors: *Error analysis, *Instrumentation, *Measuring instruments, *Sensors, *Water level fluctuations, *Water level recorders, *Water measurement, Data storage and retrieval, Digital computers, Electrical equipment, Errors, Groundwater level, Monitoring wells, Nebraska, New Hampshire, Potentiometers, Strain gages.

Submersible strain-gage pressure transducers and potentiometer-float systems were used to monitor water-level fluctuations in wells. Use of uncorrected data from six pressure transducers at a site in New Hampshire would have caused an incorrect interpretation of the vertical hydraulic-head distribution. Seven potentiometer-float systems at a site in Nebraska provided data that indicated a slight attenuation of water-level fluctuations, which likely caused some small fluctuations to go unobserved. Digital data loggers were used at both sites to scan the sensors and calculate hourly and daily average values of water levels in the wells. Check measurements using a chalked steel tape were made weekly at the New Hampshire site and monthly at the Nebraska site. Comparisons of recorded data with check measurements indicated values measured by pressure transducers over periods of weeks to months were irregularly larger or smaller than the check measurement. This error was attributed to a drift of the zero reference point of the sensor, and was unpredictable. Values obtained by potentiometer-float systems lagged the water-level change indicated by the check measurements. The lag was attributed to the sum of the mechanical friction of the moving parts of the monitoring system. This error was somewhat constant and predictable. The average absolute error of six submersible pressure transducers that were in operation for 15 months was 0.098 foot. The average absolute error of seven potentiometer-float systems that were operated for 17 months was 0.027 foot. (Author's abstract)
W91-03918

7C. Evaluation, Processing and Publication

POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND DURING SEPTEMBER 1988.
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, D. C. Andreasen, S. E. Curtin, and J. C. Wheeler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4040, 1990. 1p, 1 fig.

Descriptors: *Coastal plains, *Confined aquifers, *Magothy Aquifer, *Maps, *Maryland, *Potentiometric level, Cone of depression, Groundwater level, Maryland Coastal Plain, Wells.

A map showing the potentiometric surface of the Magothy aquifer in southern Maryland during the fall of 1988 was prepared from water-level measurements in 83 observation wells. The potentiometric surface was highest near the northwest boundary and outcrop area of the aquifer in topographically high locations of Anne Arundel and Prince Georges Counties. The hydraulic gradient in the study area was generally southeastward or toward the centers of three cones of depression that have developed in response to pumping stresses. These cones formed around well fields in the Annapolis, Waldorf, and Chalk Point areas. The potentiometric surface of the Magothy aquifer was more than 40 ft below sea level in parts of the Waldorf and Chalk Point areas. (USGS)
W91-02962

GEOHYDROLOGY AND NUMERICAL MODEL ANALYSIS OF GROUND-WATER FLOW IN THE PULLMAN-MOSCOW AREA, WASHINGTON AND IDAHO.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02970

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO.
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-02972

MAP OF MEAN ANNUAL RUNOFF FOR THE NORTHEASTERN, SOUTHEASTERN, AND MID-ATLANTIC UNITED STATES, WATER YEARS 1951-80.
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02973

SIMULATION OF GROUND-WATER FLOW IN THE MISSISSIPPI RIVER VALLEY ALLUVIAL AQUIFER IN EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02976

LARGE SPRINGS IN THE VALLEY AND RIDGE PROVINCE IN TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
E. F. Hollyday, and M. A. Smith.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4205, 1990. 9p, 2 fig, 1 tab, 5 ref.

Descriptors: *Aquifer systems, *Data collections, *Flow duration, *Groundwater resources, *Hydrologic data, *Springs, *Tennessee, *Valley and Ridge province, *Water resources data, Discharge measurement, Maps, Statistical analysis.

Approximately 2,700 miscellaneous discharge measurements for 171 large springs in 28 counties of East Tennessee, predominantly within the Valley and Ridge physiographic province, were analyzed statistically and results tabulated to summarize data useful to the Appalachian Valleys-Piedmont Regional Aquifer System Analysis study. The number of measurements at each spring ranged from 1 to 65. Information from each spring includes station numbers, latitude, longitude, spring name and where data are sufficient, an estimate of the mean discharge and the discharge exceeded by 75%, 50%, and 25% of the miscellaneous measurements. Data are referenced to locations on a 1:1,000,000-scale map. The highest mean spring discharge was 32.2 cu ft/sec (14,5000 gallons/min). (USGS)
W91-02979

STRUCTURE AND APPLICATION OF AN INTERFACE PROGRAM BETWEEN A GEOGRAPHIC-INFORMATION SYSTEM AND A GROUNDWATER FLOW MODEL.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-02980

QADATA USER'S MANUAL: AN INTERACTIVE COMPUTER PROGRAM FOR THE RETRIEVAL AND ANALYSIS OF THE RESULTS FROM THE EXTERNAL BLIND SAMPLE QUALITY-ASSURANCE PROJECT OF THE U.S. GEOLOGICAL SURVEY.
Geological Survey, Denver, CO. Water Resources Div.
K. J. Lucey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-162, 1990. 53p, 2 fig, 3 tab, 13 ref.

Descriptors: *Computer programs, *Quality assurance, *Water analysis, Information retrieval, Quality control, Statistics.

The U.S. Geological Survey conducts an external blind sample quality assurance project for its National Water Quality Laboratory in Denver, Colorado, based on the analysis of reference water samples. Reference samples containing selected inorganic and nutrient constituents are disguised as environmental samples at the Survey's office in Ocala, Florida, and are sent periodically through other Survey offices to the laboratory. The results of this blind sample project indicate the quality of analytical data produced by the laboratory. This report provides instructions on the use of QADATA, an interactive, menu-driven program that allows users to retrieve the results of the blind sample quality-assurance project. The QADATA program, which is available on the U.S. Geological Survey's national computer network, accesses a blind sample data base that contains more than 50,000 determinations from the last five water years for approximately 40 constituents at various concentrations. The data can be retrieved from the database for any user-defined time period and for any or all available constituents. After the user defines the retrieval, the program prepares statistical tables, control charts, and precision plots and generates a report which can be transferred to the user's office through the computer network. A discussion of the interpretation of the program output is also included. This quality assurance information will permit users to document the quality of the analytical results received from the laboratory. The blind sample data is entered into the database within weeks after being produced by the laboratory and can be retrieved to meet the needs of specific projects or programs. (USGS)
W91-02981

DEVELOPMENT OF SYSTEMS.
Michigan State Univ., East Lansing. Inst. of Water Research.
J. F. Bartholic.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 15-22, 1 fig.

Descriptors: *Agriculture, *Geographic information systems, *Hydrologic models, *Information systems, *Nonpoint pollution sources, *Water pollution control, *Watershed management, Data processing, Decision making, Evaluation, Systematics, Technology transfer.

When studying a complex set of interactions (as in an agricultural watershed), some sort of organizing scheme is crucial to study human impacts and evaluate alternatives. A systems approach involves an effort to systematize the physical and biological system and the social process of using highly technical information as a basis for facilitating planning and management at the watershed and farm level. Further, the system should allow for predictions of impacts and potential improvements should a wide array of improved practices be implemented. The most important physical and biological processes occurring must be linked from a process standpoint, taking into account agronomic practices at the land surface, with emphasis on understanding the linkages between submodels within the total system. In the process of transferring this technical knowledge to a social system, the economic, motivational, institutional, time, and education requirements that must be impacted for changes to occur in the way individuals and farmers handle their portion of the larger landscape must be considered. Spatial information systems, with the capability of overlaying spatial information (soils, land use, etc.) and associated tabular data, are available. These generally are referred to as geographic information systems (GIS), useful in providing a structure for tieing together spatial information for models and predictions, and facilitating a general pathway for technology transfer, technical assistance, and feedback from the end-users. Once spatial information is in the system, the layers or the layers' attributes can be mathematically handled through process or statistical models. The overall elements of a total system leading to local implementation starts with process models, requiring systemization and regionalization. A strong, highly focused, systematic approach to integrate the process models is essential, including: operationalization; needs assessment and data needs; environmental/economic impacts; social adaptive process; decisions made and investments; and feedback. (See also W91-02985) (Fish-PTT)
W91-02989

SURFACE WATER QUALITY MODELS.
For primary bibliographic entry see Field 5G.
W91-02993

ROLE OF ENVIRONMENTAL MODELING IN THE DECISION-MAKING PROCESS.
For primary bibliographic entry see Field 5G.
W91-02996

EPA'S CEEPES PROJECT: DESCRIPTION AND DATA NEEDS.
For primary bibliographic entry see Field 5G.
W91-02997

SOIL CONSERVATION SERVICE CLIMATIC DATA ACCESS FACILITY.
Soil Conservation Service, Washington, DC. Resources Inventory Div.
B. A. Shafer.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 61-62.

Descriptors: *Agriculture, *Climatic data, *Data storage and retrieval, *Hydrologic data collections, *Nonpoint pollution sources, *Resources management, *Water pollution control, Hydrologic cycle, Management planning, Soil conservation.

Reliable, readily accessible climatic data are essential for planning and implementing resource management systems. Climate parameters are the driving forces in the processes associated with the hydrologic cycle, soil erosion, and plant growth. They are thus key to any concerted effort aimed at addressing water quality and quantity issues in the agricultural environment. An interdisciplinary task force was commissioned to study alternative means to correct the deficiency of the Soil Conservation Service to acquire, manage, interpret, and effectively use climate data in its operations. The recommendation of that task force was to create a Climate Data Access Facility (CDAF) to serve as the primary focal point for intra-agency climate data access. It is not the intent of CDAF to duplicate databases and services that can more efficiently be obtained elsewhere; only those data that are required to support operational programs or that are frequently used will be kept online for interactive retrieval. The CDAF cannot fulfill its intended purpose without a national network of support personnel. A small dedicated staff will operate the CDAF, augmented by climatic liaisons at technical centers. (See also W91-02985) (Fish-PTT)
W91-02998

SOCIO-ECONOMIC DATA RELATING TO THE WATER QUALITY INITIATIVE.
Economic Research Service, Washington, DC. Resources and Technology Div.
For primary bibliographic entry see Field 5G.
W91-02999

DEVELOPMENT OF THE NATIONAL RESOURCES INVENTORY.
Soil Conservation Service, Washington, DC.
J. J. Goebel, and B. A. Shafer.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 69-71, 3 ref.

Descriptors: *Agriculture, *Data collections, *Natural resources, *Nonpoint pollution sources, *Resources management, *Water pollution control, *Water resources data, Conservation, Environmental policy, Governmental interrelations, Land use, Water sampling.

The U.S. Department of Agriculture's Soil Conservation Service (SCS) has conducted periodic inventories of the nation's soil, water, and related resources for over 50 years. The National Resources Inventory (NRI) produces estimates of non-federal land cover and use, rates of sheet, rill, and wind erosion, conservation treatment needs, the extent of highly erodible cropland, and many other resource characteristics and related soil properties, based upon data collected at scientifically-selected random sample sites located in all U.S. counties. The 1987 NRI updated selected 1982 NRI data items for a subsample of 1982 NRI sample sites; it was specifically designed to detect significant 5-year trends in the condition of the nation's natural resources. Sufficient data were collected from a statistically-selected sample to allow for analysis of resource conditions at the state level. For the 1987 NRI, data were collected for nearly 1 million sample sites. The NRI is the federal government's principal source of information on the status, condition, and trend of soil, water, and related resources on the nation's non-federal lands. NRI data serve a wide range of purposes, among them: monitoring trends, helping formulate state and national policy, appraising progress of conservation programs, providing information to agency management, and aiding in research and modeling efforts. The 1987 NRI data are being made available in many forms: a USDA statistical bulletin, a computerized system available at Iowa State University, and through SCS state offices. (See also W91-02985) (Fish-PTT)
W91-03000

SOLID-EARTH SCIENCE DATA BASES.
Geological Survey, Reston, VA.
J. C. Matti, and J. M. McNeal.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 73-84.

Descriptors: *Agricultural chemicals, *Databases, *Geologic mapping, *Mapping, *Nonpoint pollution sources, *Path of pollutants, *Water pollution control, Baseline studies, Geochemistry, Geophysical methods.

A variety of solid-earth map-based databases are available to facilitate research and planning in the agricultural arena. Solid-earth maps provide a framework for a host of different topical investigations, such as determination of non-point sources of agricultural chemicals. The various solid-earth map types can be grouped into three major categories: geologic maps, geochemical maps, and geophysical maps. A geologic map contains both descriptive information (physical properties, three-dimensional geometry, relative age relations, and origin of material and structures) and an interpretive model. Geochemical maps provide statistically reliable geochemical baseline against which potentially unusual samples may be judged; provide a basis for judging future geochemical changes; and provide a basis for estimating geochemical processes. Geophysical maps are integrated with other maps in addressing environmentally oriented problems, using: ground-penetrating radar, remote sensing, electromagnetic induction, complex resistivity, well-logging, and magnetic, seismic, radiometric, gravity, and borehole techniques. When used in combination, the mapping techniques provide a powerful analytical package for portraying the surface and subsurface geologic framework of an area or region. (See also W91-02985) (Fish-PTT)
W91-03001

ANALYZING NATIONAL FARM CONSERVATION POLICY IN A NATIONAL GIS.
Center for Resource Innovations, Washington, DC.
For primary bibliographic entry see Field 6B.
W91-03003

GEOLOGIC MAPPING FOR PROTECTION OF GROUNDWATER RESOURCES.
D. P. McKenna.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 99-100, 4 ref.

Descriptors: *Agricultural chemicals, *Geologic mapping, *Groundwater pollution, *Groundwater resources, *Nonpoint pollution sources, *Path of pollutants, *Water pollution control, Aquifer systems, Geohydrology, Geologic control, Groundwater movement, Mapping, Soil properties.

Accurate prediction of the vulnerability of groundwater resources to contamination from agricultural chemicals is one of the most important environmental issues facing farmers, water users, and state and federal agencies. Aquifer vulnerability to agricultural chemical contamination is a function of soil properties and hydrogeologic conditions. While it is recognized that the character of earth materials influences the fate of contaminants, geology (the study of the earth) is not viewed as playing an important role in addressing the issue of agricultural chemical contamination of groundwater (or surface water) resources. However, an approach to three-dimensional geologic mapping has been developed that is material-oriented and designed to produce geologic information that can be directly interpreted for specific uses. The first product of this approach is a stack-unit map which provides information on geologic materials to a given depth over specified areas. Once the basic geologic framework has been established and the materials characterized, the presence and distribution of aquifers can be predicted. Application of basic hydrologic concepts on water movement and contaminant transport allows for predictions of the rate and direction of groundwater flow and the vulnerability of underlying aquifers to contamination. An accelerated program should be developed to assess the geohydrology in the most vulnerable areas is necessary for state and federal agencies to accurately target educational and monitoring programs, and potentially to implement pesticide use regulations. (See also W91-02985) (Fish-PTT)
W91-03005

STATE DATA BASE CAPABILITIES, WISCONSIN.
Wisconsin Univ.-Madison. Dept. of Agricultural Engineering.
G. D. Bubenzer.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 101-103.

Descriptors: *Databases, *Governmental interrelations, *Groundwater pollution, *Nonpoint pollution sources, *Water pollution control, *Water resources management, *Wisconsin, Data collections, Data quality control, Data storage and retrieval, State jurisdiction, Water quality.

The Wisconsin Comprehensive Ground Water Protection Act was signed into law in May, 1984. The act expanded Wisconsin's legal, organizational, and financial capacity for controlling groundwater pollution. The groundwater program evolving as a result of this act has five major components: Standards, Regulations, Monitoring and Data Management, Research, and Coordination. In order to help insure coordination between the various agencies, the Ground Water Coordinating Council was created to advise and assist state agencies in the coordination of non-regulatory programs and to exchange information related to groundwater. Databases related to water quality are currently available within several state and local database systems. Unfortunately, until very recently little was done to coordinate the collection of the data and development of the data bases. Evaluation of the quality of the data in existing data banks is needed in order to insure that interpretations based on the data are factual. Wisconsin agencies are moving toward a uniform system of reporting water quality data. This system should encourage uniform documentation of sampling procedures and environmental conditions that may be contributing to groundwater contamination, and facilitate transfer of data between databases and increase the utilization of data by researchers and regulators. The greatest need is to provide assurance that data entered into the databases have been collected with sufficient quality control to insure reliability. (See also W91-02985) (Fish-PTT)
W91-03006

STATE OF MINNESOTA DATA BASE CAPABILITIES.
Minnesota Dept. of Agriculture, St. Paul.
J. W. Hines.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 105-107.

Descriptors: *Agricultural chemicals, *Databases, *Geographic information systems, *Mapping, *Minnesota, *Nonpoint pollution sources, *Water pollution control, Computer programs, Fertilizers, Groundwater management, Monitoring, Pesticides, Water quality, Water resources management.

There are two major database systems in Minnesota, both of which are housed at the Minnesota State Planning Agency's Land Management Information Center (LMIC). This organization is charged with the compilation of data on natural resources of the state. Both groundwater quality and quantity as well as geological and geographical information are included in the systems. The first database contains data and information compiled in raster format for use with the state geographic information system (GIS). Each data point represents a 40-acre grid cell and corresponds to a color number for mapping purposes. Second generation databases will be digitized from 7.5 minute quadrant and compiled on a 100-meter grid, solving some resolution problems. The second of the major sources of data available in Minnesota is being compiled as part of the Ground Water Data Clearinghouse. This database is still in the developmental stage and may appear quite different when it is complete. The database is menu-driven for user-friendly interfacing. The CWI database will contain substantial information, including long-term (four years, to date) water quality monitoring data on pesticide and nitrate-nitrogen concentrations from the Minnesota Department of Agriculture's monitoring programs. Each well in the database may have data on more than 31 agricultural chemicals. The number of wells and number of analytes is constantly expanding, but will be updated periodically for database completeness. (See also W91-02985) (Fish-PTT)
W91-03007

STATE DATABASE CAPABILITIES: THE MICHIGAN EXPERIENCE.
Michigan State Univ., East Lansing. Dept. of Resource Development.
B. E. Vieux.
IN: Information Exchange on Models and Data Needs Relating to the Impact of Agricultural Practices on Water Quality: Workshop Proceedings. U.S. Geological Survey, Reston, Virginia. 1990. p 109-111.

Descriptors: *Databases, *Mapping, *Michigan, *Nonpoint pollution sources, *Water pollution control, *Water resources management, Computer models, Data collections, Geographic information systems, Remote sensing, Soil surveys, State jurisdiction.

A considerable amount of data has been gathered concerning the location of land and water resources in the state of Michigan. By capturing original data sets, the information content is maintained regardless of end uses which are many and varied. For example, modern soil surveys are digitized in a vector/polygon format ensuring that the original detail of the mapping is preserved. Interpretations of these maps are left to the user and not stored as part of the database nor is any grid cell or raster format used in the database which may degrade the resolution and information content of the data. The types of maps that are available to a varying degree of completion for the 83 counties in

Michigan under the categories of the Michigan Resource Information System (MIRIS) map sets and the Great Lakes Information System map sets. Efforts to provide access to the MIRIS database are under way through the Center for Remote Sensing, Michigan State University. Potential applications and uses of digital databases should offer insight into gaps in database information. Interpretations of reasonable values must be supplied to the model or the data must be collected and added to the database. Model and geographic information system integration can guide database development and quality-assurance/quality-control. Agricultural impacts on land and water resources can be assessed and minimized using this technology only through cooperation of the data gatherers at state and federal agencies, and researchers both in government and at universities. (See also W91-02985) (Fish-PTT)
W91-03008

NATIONAL WATER INFORMATION SYSTEM USER'S MANUAL. VOLUME 2, CHAPTER 4. GROUND-WATER SITE INVENTORY SYSTEM.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Federal Center, Bldg. 810, Box 25425, Denver, Colorado 80225. USGS Open-File Report No. 89-587. 227 p, 16 fig.

Descriptors: *Data storage and retrieval, *Databases, *Groundwater data, *Hydrologic data collections, *Manuals, *National Water Information System, Computers, Information exchange, Networks.

The Groundwater Site Inventory (GWSI) System is a groundwater data storage and retrieval system that is part of the National Water Information System (NWIS) developed by the US Geological Survey (USGS). The NWIS is a distributed water database in which data can be processed over a network of minicomputers at the USGS offices throughout the United States. This system comprises the Automated Data Processing System, the GWSI System, the Quality of Water System, and the Water-Use Data System. The GWSI provides for entering new sites, updating existing sites within the local database, (WATSTORE), which is the national data base. In addition, the GWSI System provides for retrieving and displaying groundwater and surface water data stored in the local database. Finally, the GWSI System provides for routine maintenance of the local and national data files. This manual contains instructions for users of the System and discusses the general operating procedures for the programs found within the main menu. (Author's abstract)
W91-03013

GEOCHEMICAL COMPUTER CODES: A REVIEW, FINAL REPORT.
K. Andersson.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-617981. Price codes: A06 in paper copy, A01 in microfiche. Report No. NP-87/86, August 1987. 109 p, 30 fig, 9 tab, 44 ref, append.

Descriptors: *Computer programs, *Data interpretation, *Data processing, *Geochemistry, Chemical interactions, Chemical speciation, Comparison studies, Equilibrium.

Since the 1960's a large number of geochemical computer codes for various applications have been published. A large number of these codes address groundwater, lake water and sea water. Most of the computer codes treat equilibrium conditions, although some codes are available with a kinetic capability. Some of the codes solve equilibrium and transport equations simultaneously and require a large computer capacity. Three code intercomparisons were found in the literature which indicate that there are many geochemical codes available for geochemical calculations. These intercomparisons show that: speciation for major components works well for most codes; speciation of minor components give larger deviations; the databases are the main sources of discrepancy; many of the codes have poor documentation and it is difficult for a user to set up a problem; many problem formulations may cause codes to fail to converge. 'Good' starting estimates may be necessary for convergence; the choice of activity coefficient calculation method may be important to the result at higher ionic strengths (above 0.5); some codes cannot treat all the problems set up in the intercomparisons (eg, adsorption and precipitation under certain conditions); in codes where adsorption is included, a large number of different algorithms are used. These have different advantages and disadvantages, but it is difficult to set up an algorithm that covers both variations in pH and concentration, and where the input parameters are easily available; and, in the complicated test case of fly ash leaching, performed within the EPRI intercomparison, large differences between experimental and calculated data as well as between data calculated by the two codes compared were observed. This is attributed to mathematical differences in the codes, database differences and to the fact that equilibrium may not have been attained in the experiment. (Lantz-PTT)
W91-03027

AQUIFER PROPERTIES DATABASE.
Illinois State Water Survey Div., Champaign.
K. J. Hlinka, S. J. Cravens, and R. C. Kohlhase.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 4A-5--4A-11, 3 fig, 1 tab, 4 ref.

Descriptors: *Aquifer characteristics, *Aquifers, *Databases, *Groundwater data, *Hydrologic data collections, *Illinois, *Water management, *Water resources data, Data storage and retrieval, Geohydrology, Information exchange.

The Groundwater Section of the Illinois State Water Survey (ISWS) has collected information on more than 4,500 well and aquifer production tests conducted throughout Illinois since the early 1920's. This information has been compiled into a useable, computerized database that tabulates more than 22 aquifer property and well informational fields. The database is continually updated by the ISWS and used by ISWS staff as well as consultants, engineers, geologists, and hydrologists in research, design, and planning projects. This information has practical significance for site-specific and regional planning applications. The availability of extensive, statewide aquifer property data within a single database promises to be a powerful tool for future investigations. However, it is still important to maintain the original field data from which the aquifer properties database was created and to use it in combination with this computerized information. (See also W91-03032) (Lantz-PTT)
W91-03046

HYDROLOGIC DATA BASE MODEL.
South Florida Water Management District, West Palm Beach.
B. R. Turcotte.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 4A-13--4A-22, 5 fig, 8 ref.

Descriptors: *Data storage and retrieval, *Databases, *Florida, *Hydrologic data, *Model studies, *Network design, *Water management, *Water resources data, Data interpretation, Hydrologic data collections, South Florida Water Management District.

The South Florida Water Management District operates and maintains a corporate hydrologic database, DBHYDRO, for the region within and near the district boundaries which ranges from the Orlando area to beyond Key West. DBHYDRO allows easy access to over 35,000 station years of data collected at over 6500 stations in and around the SFWMD. DBHYDRO has been in production since late 1985. Subsequently, objectives have changed and limitations in the original database logic have been recognized. Changes in the South Florida Water Management District's (SFWMD) computer hardware and operating system have required the reimplimentation of the SFWMD's hydrologic database. The SFWMD's new hydrologic database design starts with a data model which incorporates concepts of entity-relationship (E-R) modeling. E-R modeling is a tool used to organize and represent relationships by making use of consistent graphic notation. Describing relationships in their most fundamental form affords maximum generality for database design, and is hardware and software independent. (See also W91-03032) (Lantz-PTT)
W91-03047

LESSONS LEARNED WHILE DEVELOPING PICS DATABASE.
Illinois State Water Survey Div., Champaign.
J. R. Kirk, and D. M. Woller.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 4A-23--4A-29, 5 fig.

Descriptors: *Data storage and retrieval, *Databases, *Hydrologic data, *Illinois, *Public-Industrial-Commercial Survey dat, *Water management, *Water resources data, *Water use, Computer programs, Water resources development.

The organization of capabilities of the Public-Industrial-Commercial Survey (PICS) database of the Illinois Water Inventory Program (IWIP), and its interaction with the geographic information system (GIS), is presented. The IWIP was initiated in 1978 as an effort to bring together the diverse collection of water resource information in the State of Illinois and to document the states water use. The PICS database, developed within this program, is a site specific database that contains information about high-capacity wells or intake points. It utilizes a standard query language relational database management system to store and retrieve information. A number of apparent lessons were learned with the development of the PICS database. One of the most important is the need for a unique identifier for use with each data record. When possible, cross-referenced names, other identification numbers, and historical information should be included in the database so that other data can be utilized in combination with this information. The simplest way to accomplish this is to let the computer generate a unique ID code, either random or sequential, and never reuse this ID. Verification of data should be of major concern in developing a database. In addition, several other observations were made: (1) extra effort must be taken in designing a database to meet management objectives and goals; (2) care should be taken in terms of data decentralization; (3) avoid the use of special extensions in computer program languages in order to make applications transferable; and (4) GIS system compatible coordinates should be used for local reference. (See also W91-03032) (Lantz-PTT)
W91-03048

SITE SELECTION MODEL FOR ACQUISITION OF WATER RESOURCE LANDS: A GIS APPLICATION.
Southwest Florida Water Management District, Brooksville.
R. Christianson.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 10A-5--10A-18, 4 fig, 1 tab, 4 ref.

Descriptors: *Data interpretation, *Florida, *Geographic information systems, *Model studies, *Site selection, *Water resources development, *Water resources management, Flood plains, Information exchange, Maps, Potable water, Vegetation.

A computer-based Geographic Information System application has been designed to identify lands within the 10,000 sq mile Southwest Florida Water Management District most critical for acquisition for the protection of water resources. This model combines over 30 layers (maps) of information through techniques such as overlaying, buffering, and the development of map themes through solving analytic equations. These layers include parameters such as flood plains, land cover, location of potable water supply sources, population, and topography. Model results are expressed in maps targeting lands for various combi-

nations of flood protection, water supply protection, natural systems protection, and management and acquisition concerns. (See also W91-03032) (Author's abstract)
W91-03067

IMPLEMENTATION OF AN OPERATIONAL GEOGRAPHIC INFORMATION SYSTEM FOR MULTIPURPOSE WATERSHED MANAGEMENT.
Salem State Coll., MA. Digital Geography Lab.
W. L. Hamilton, K. Barnes, B. Bishop, and W. Lingsch.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 10A-19--10A-24, 1 ref.

Descriptors: *Geographic information systems, *Information systems, *Quabbin Reservoir, *Water resources management, Boston, Information exchange, Water management, Water resources development, Water supply.

Management operations on the Quabbin Watershed in Massachusetts are being supported with a Geographic Information System (GIS). The Quabbin Reservoir is managed by the Metropolitan District Commission (MDC) to supply the Boston Metropolitan area with water. MDC's management goals for Quabbin are: (1) to increase water yields and maintain water quality; and (2) to protect and enhance its natural and cultural values. All activities within the watershed must serve these goals, and the Quabbin resource managers are using GIS as a tool to help ensure compliance. Quabbin's GIS is setup according to the expressed needs of the managers, so as to compliment and augment their current operations. Moreover, GIS is project specific rather than generic. Its implementation is incremental and integrated, for individual GIS are developed for specific management units. These are subsequently linked with the inclusion of additional contiguous management units. This reduces the time required for the system to become operational. Furthermore, managers have greater flexibility in realizing the GIS potentials and limitations, including hardware limitations. (See also W91-03032) (Author's abstract)
W91-03068

INFORMATION: THE MOST UN-MANAGED RESOURCE IN WATER MANAGEMENT.
QUAD Data Corp., Tallahassee, FL.
D. W. McEwen.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 10B-3--10B-12.

Descriptors: *Florida, *Information management, *Information systems, *Water resources management, Data storage and retrieval, Databases, Water resources data.

Florida is committed to managing growth and preserving a certain quality of life for future and present generations. As the population and the economy grows, problems will escalate and become more critical. Effective information management will become increasingly important. Current management of information is somewhat haphazard compared to management of other vital resources. Data elements are frequently not defined or structured consistently between organizational units. While adequate for first time use of data, subsequent use is generally too cumbersome and labor intensive. Databases are rarely documented. The lack of a cohesive organizational plan and a lack of leadership contribute to this situation. It appears that the most beneficial action for the State to take in the immediate future is as follows: (1) Create a state-wide information locator system which would contain information about the data sets and contact people; (2) Require every agency to create and maintain a comprehensive data dictionary; (3) Coordinate the creation of state-wide data element definitions and encourage every agency to become compatible; (4) Establish data transfer procedures and the telecommunications infrastructure to make data transfer easy and practical; (5) Develop a uniform methodology for calculating reimbursement costs for information retrieval and preparation services; (6) For the foreseeable future, have users simply locate the information and retrieve what they need from the source; (7) Encourage the private sector to provide value added services regarding the timely retrieval, reformatting, and conversion of selected data for the end user; and (8) Address the reluctance of state agencies and employees to use value added services. (See also W91-03032) (Lantz-PTT)
W91-03074

STRINGFELLOW HAZARDOUS WASTE SITE: COMPUTERIZED DATA MANAGEMENT.
CH2M Hill, Santa Ana, CA.
S. K. Gupta, U. P. Singh, and R. Gupta.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 13A-1--13A-10, 10 fig, 5 ref. EPA Contract No. 68-01-7251.

Descriptors: *Cleanup, *Computer programs, *Data interpretation, *Hazardous waste disposal, *Waste disposal, *Waste management, *Water pollution treatment, California, Data storage and retrieval, Databases, Economic aspects, Geohydrology, Hazardous wastes, Model studies, Riverside.

The Stringfellow Hazardous Waste site, a former (1956-1972) 17-acre Class I industrial liquid waste disposal facility, is approximately 5 miles northwest of Riverside, California. At this site, millions of gallons of organic and inorganic liquid industrial waste were deposited in unlined ponds. These wastes have contaminated soils and groundwater under the site, and the contaminant plume has migrated toward the Glen Avon Community. EPA has marked this as California's topmost priority hazardous waste site for cleanup under the federal Superfund program. This study presents: (1) the need for computerized data processing; (2) physiographic features of the site; (3) partial geohydrological information of the site; (4) processing of the contaminant distribution data; and (5) development of a preliminary three dimensional finite element conceptual model of the site. The database at a given hazardous waste site is one of the most important components of the project. At a fraction of the cost of field and laboratory investigations, computerized data processing using geographic information systems and custom made software, as initiated at the Stringfellow site, maximizes efficient interpretation, use, and storage of the database. It also facilitates the generation of maps in required scale, the production of composite maps of different coverage (relevant information), and the generation of input files for analysis. (See also W91-03032) (Lantz-PTT)
W91-03080

MODELING THE HYDROLOGIC IMPACTS OF PHOSPHATE MINING AND RECLAMATION IN CENTRAL FLORIDA.
Bromwell and Carrier, Inc., Lakeland, FL.
For primary bibliographic entry see Field 4C.
W91-03082

PLANNING TOOL FOR WATER CONSERVATION.
Brown and Caldwell, Tampa, FL.
For primary bibliographic entry see Field 6A.
W91-03091

STOCHASTIC SIMULATION OF GULLY NETWORKS ON ERODED LAND.
Tokyo Univ. (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 2J.
W91-03133

SEDIMENT YIELD MODELING OF ROADWAYS.
New Mexico State Univ., Las Cruces. Dept. of Civil, Agricultural and Geological Engineering.
For primary bibliographic entry see Field 2J.
W91-03134

ADJUSTING THE UNIVERSAL SOIL LOSS EQUATION FOR USE IN WESTERN EUROPE.
Faculte des Sciences Agronomiques de l'Etat, Gembloux (Belgium).
For primary bibliographic entry see Field 2J.
W91-03136

PHYSICAL COMPONENTS OF THE EPIC MODEL.
Agricultural Research Service, Temple, TX. Grassland, Soil and Water Research Lab.
For primary bibliographic entry see Field 2J.
W91-03138

EFFECTIVENESS OF EI30 AS AN EROSIVITY INDEX IN HAWAII.
Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Sciences.
For primary bibliographic entry see Field 2J.
W91-03146

MODIFYING THE UNIVERSAL SOIL LOSS EQUATION FOR FOREST LAND.
Forest Service, Atlanta, GA.
For primary bibliographic entry see Field 2J.
W91-03156

RESEARCH ON THE UNIVERSAL SOIL LOSS EQUATION IN INDIA.
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
For primary bibliographic entry see Field 2J.
W91-03157

APPLICABILITY OF THE UNIVERSAL SOIL LOSS EQUATION (USLE) AND MODIFIED USLE IN HAWAII.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 2J.
W91-03158

EXPERIMENTALLY DERIVED MODIFICATION OF THE USLE.
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2J.
W91-03159

NEW MATHEMATICAL MODEL OF SOIL EROSION AND DEPOSITION PROCESSES WITH APPLICATIONS TO FIELD DATA.
Griffith Univ., Nathan (Australia).
For primary bibliographic entry see Field 2J.
W91-03162

EXPERIMENTAL MODEL OF EVALUATING SOIL EROSION ON A SINGLE-RAINSTORM BASIS.
Istituto Sperimentale per lo Studio e la Difesa del Suolo, Florence (Italy).
For primary bibliographic entry see Field 2J.
W91-03163

HYDROGEOLOGICAL PARAMETER ESTIMATION TECHNIQUES: LOCAL TEST, MODEL FITTING, STOCHASTIC METHODS, AND THE USE OF TRACERS.
Paris-4 Univ. (France).
For primary bibliographic entry see Field 2F.
W91-03183

STOCHASTIC SPATIAL PREDICTION OF HYDROGEOLOGIC PARAMETERS: ROLE OF CROSS-VALIDATION IN KRIGINGS.
National Geophysical Research Inst., Hyderabad (India).
S. Ahmed, and C. P. Gupta.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume III. Proceedings of an International Workshop held February 23-March 4, 1989. A. A. Balkema, Rotterdam. 1989. p 77-90, 3 fig, 14 ref.

Descriptors: *Developing countries, *Hydrologic models, *Kriging, *Model studies, *Parametric hydrology, *Water resources development, Analytical methods, Geohydrology, Groundwater management, Hydrologic data, Stochastic hydrology, Stochastic models, Water resources management.

Stochastic treatment of spatial processes has been realized mainly with the theory of regionalized variables and it is now being used quite extensively in many fields of earth science as well as other sciences. The main handicap in applying kriging to hydrogeological problems is the scarcity and sparsity of observed data. However, a few modifications and additions to the existing techniques permit utilization of hydrogeological data successfully in spatial prediction of aquifer parameters. The use of several properties of a system together in estimation has proven to be useful both physically and mathematically. Cross-validation is most useful when there are less data, as in the case of hydrogeologic parameters. It is found that cross-validation checks ambiguous structural models, decides the appropriate range, and selects the suitable combination of the additional information. Cross-validation may be employed in deciding the best external drift function when there are more than two types of additional information. Even in the method of kriging with an external drift, a conditional variogram which is a combination of several variograms and cross-variograms should be used, but practical examples show that a modified variogram of the main variable through cross-validation can be easily utilized for estimation. An important role of cross-validation is to sort the unreliable data out which are called outliers in geostatistical language. (See also W91-03178) (Author's abstract)
W91-03184

GEOHYDROLOGICAL DATA BASE FOR WATER MANAGEMENT.
Jawaharlal Nehru Technological Univ., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-03189

3-D STOCHASTIC DISCRETE FRACTURE NETWORK MODEL FOR SIMULATING FLOW AND TRANSPORT THROUGH FRACTURED MEDIA.
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 2F.
W91-03190

NEW APPROACH TO TRACER TRANSPORT ANALYSIS: FROM FRACTURE SYSTEMS TO STRONGLY HETEROGENEOUS POROUS MEDIA.
California Univ., Berkeley. Earth Sciences Div.
For primary bibliographic entry see Field 2F.
W91-03191

MODELLING OF ENERGY FORESTRY: GROWTH, WATER RELATIONS AND ECONOMICS.
For primary bibliographic entry see Field 2I.
W91-03198

SIMULATED WATER BALANCE OF A WILLOW STAND ON CLAY SOIL.
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Soil Sciences.
For primary bibliographic entry see Field 2I.
W91-03202

RIVER MEANDERING.
For primary bibliographic entry see Field 2E.
W91-03203

USER'S GUIDE FOR THE UPDATED SMITH-FEDDES MODEL.
Arvin/Calspan Advanced Technology Center, Buffalo, NY.
For primary bibliographic entry see Field 2B.
W91-03228

ADIRONDACK WATERSHED DATA BASE: ATTRIBUTE AND MAPPING INFORMATION FOR REGIONAL ACIDIC DEPOSITION STUDIES.
Oak Ridge National Lab., TN. Environmental Sciences Div.
A. E. Rosen, R. J. Olson, G. K. Gruendling, D. J. Bogucki, and J. L. Malanchuk.
Available from the National Technical Information Service, Springfield, Virginia 22161, as DE89-005682. Price codes: A11 in paper copy, A01 in microfiche. Report no. ORNL/TM--10144, December 1988. 245 p, 43 fig, 4 tab, 37 ref, 3 append. Contract no. DE-AC05-84OR21400.

Descriptors: *Acid rain, *Acid rain effects, *Databases, *Geographic information systems, *Mapping, *Watershed management, Adirondacks, Data interpretation, Environmental protection, Model studies, New York.

The Adirondack Watershed Data Base (AWDB) provides a means to study various watershed attributes that may contribute to increased acidification of Adirondack surface waters, and is a valuable resource for the study of other ecological phenomena. The AWDB consists of digital watershed boundaries and digital geographic data (topography, soils, land cover, etc.), stored within a geographic information system, and watershed/lake attribute data stored in a data management system for 463 Adirondack headwater lakes. Attributes include watershed morphology, physiography, bedrock, soils, land cover, wetlands, disturbances (e.g. cabins, fire, and logging), beaver activity, precipitation, and atmospheric deposition. Over 600 variables are available for each watershed. These data can be combined with water chemistry data and fish community status for regional-scale examinations of watershed attributes that may account for variability and change in water chemistry and fish populations in the Adirondacks. (Fish-PTT)
W91-03234

IMPACT: AN EXPERT SYSTEM FOR ENVIRONMENTAL IMPACT ASSESSMENT.
Westinghouse Savannah River Co., Aiken,SC.
For primary bibliographic entry see Field 6G.
W91-03240

VARIANCES AND COVARIANCES OF THE MAXIMUM ENTROPY ESTIMATORS FOR THE PEARSON TYPE-3 DISTRIBUTION.
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and V. T. V. Nguyen.
Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 4, p 590-596, August 1990. 7 tab, 17 ref, append. Natural Sciences and Engineering Research Council of Canada Grant A6833.

Descriptors: *Entropy, *Flood forecasting, *Flood frequency, *Mathematical studies, *Parameter estimation, *Probability distribution, *Statistical analysis, Data interpretation, Monte Carlo method, Sampling, Simulation analysis.

Although the method of maximum entropy appears to be promising in fitting the Pearson type-3 distribution in flood probability analysis, the sampling properties of the estimators have not been available. The formulas needed for computing the variances and covariances of the parameter estimators and the variance of the T-year event are provided. All needed formulas are derived analytically and related computation schemes are described. Through applications of the developed technique to actual and simulated data, it was found that the efficiency of the method of maximum entropy may be slightly improved when the biased sample variance is used instead of the unbiased one. Simulated results indicate that this procedure can provide good estimated values for the percent standard error, hence for the variance of the T-year event. (Author's abstract)
W91-03308

KNOWLEDGE-BASED EXPERT SYSTEM FOR FLOOD FREQUENCY ANALYSIS.
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
K. C. A. Chow, and W. E. Watt.
Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 4, p 597-609, August 1990. 8 fig, 4 tab, 12 ref.

Descriptors: *Data interpretation, *Expert systems, *Flood forecasting, *Flood frequency, *Probability distribution, Canada, Performance evaluation, Simulation analysis, Statistical analysis, Uncertainty.

Single-station flood frequency analysis is an important element in hydrotechnical planning and design. In Canada, no single statistical distribution has been specified for floods: hence, the conventional approach is to select a distribution based on its fit to the observed sample. This selection is not straightforward owing to typically short record lengths and attendant sampling error, magnified influence of apparent outliers, and limited evidence of two populations. Nevertheless, experienced analysts confidently select a distribution for a station based only on a few heuristics. A knowledge-based expert system has been developed to emulate these expert heuristics. It can perform data analyses, suggest an appropriate distribution, detect outliers, and provide means to justify a design flood on physical grounds. If the sample is too small to give reliable quantile estimates, the system performs a Bayesian analysis to combine regional information with station-specific data. The system was calibrated and tested for 52 stations across Canada. Its performance was evaluated by comparing the distributions selected by experts with those given by the developed system. The results indicated that the system can perform at an expert level in the task of selecting distributions. (Author's abstract)
W91-03309

OVERVIEW OF FLOW SIMULATION MODELS IN FRACTURED AQUIFERS.
Indian Inst. of Science, Bangalore.
For primary bibliographic entry see Field 2F.
W91-03312

NONDEFEATIST DERIVATION OF FINITE DIFFERENCE SCHEMES.
Roorkee Univ. (India). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W91-03313

HYDROGEOLOGY OF THE MIDDLE CHELIFF BASIN (ALGERIA): SIMULATION OF GROUNDWATER FLOWS.
Neuchatel Univ. (Switzerland). Center of Hydrology.
For primary bibliographic entry see Field 2F.
W91-03314

GROUNDWATER BASIN SIMULATION OF MAHI RIGHT BANK CANAL COMMAND AREA, GUJARAT, INDIA.
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
For primary bibliographic entry see Field 2F.
W91-03319

SIMULATION OF REGIONAL HYDRODYNAMICS IN THE NEYVELI AQUIFER.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-03321

GROUNDWATER QUALITY MONITORING: STATISTICAL MODELING.
Kakatiya Inst. of Tech. and Science, Warangal (India).
For primary bibliographic entry see Field 4C.
W91-03338

ANALYSIS OF BREAKTHROUGH CURVES FOR ASSESSING MOVEMENT OF CONTAMINANTS.
Central Soil Salinity Research Inst., Karnal (India).
For primary bihliographic entry see Field 5B.
W91-03340

DISPERSION OF POLLUTANTS IN POROUS MEDIA FLOW ONE-DIMENSIONAL APPROACH.
College of Engineering, Poona (India).
For primary bibliographic entry see Field 5B.
W9I-03341

SINGLE-PHASE/TWO-PHASES NUMERICAL MODEL USING NESTED SQUARE MESHES.
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 2F.
W91-03343

CLIMATIC CLASSIFICATION FOR QUEENSLAND USING MULTIVARIATE STATISTICAL TECHNIQUES.
Jaffna Univ. (Sri Lanka). Dept. of Geography.
For primary bibliographic entry see Field 2B.
W91-03395

THEORETICALLY DERIVED DISTRIBUTION FOR ANNUAL RAINFALL TOTALS.
For primary bibliographic entry see Field 2B.
W91-03398

RATIONAL APPROACH FOR MODIFYING ROTATIONAL WATER DELIVERY SCHEDULE.
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 3F.
W91-03422

PUMP TEST ANALYSIS OF LEAKY AQUIFER.
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-03423

OBSERVABILITY OF SURFACE IRRIGATION ADVANCE.
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W91-03424

ESTIMATION OF SURFACE IRRIGATION PARAMETERS.
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W91-03425

SELF-ADAPTIVE CONTROL OF SURFACE IRRIGATION ADVANCE.
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W91-03426

USING SOIL AND METEOROLOGIC DATA BASES IN UNSATURATED ZONE MODELING OF PESTICIDES.
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5B.
W91-03446

USE OF COOPERATIVE WEATHER STATION DATA IN CONTEMPORARY CLIMATE RESEARCH.
Illinois State Water Survey Div., Champaign Climate and Meteorology Section.
For primary bibliographic entry see Field 2B
W91-03503

USE OF PARAMETER TRANSFORMATIONS IN NONLINEAR, DISCRETE FLOOD EVENT MODELS.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2E.
W91-03542

DEFINITION OF GROUNDWATER FLOW PATTERNS BY ENVIRONMENTAL TRACERS IN THE MULTIPLE AQUIFER SYSTEM OF SOUTHERN ARAVA VALLEY, ISRAEL.
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
For primary bibliographic entry see Field 2F.
W91-03556

COMPARATIVE EVALUATION OF THE ESTIMATORS OF THE LOG PEARSON TYPE (LP) 3 DISTRIBUTION.
Saint Johns River Water Management District, Palatka, FL. Dept. of Surface Water Programs.
D. V. Rao.
Journal of Hydrology JHYDA7, Vol. 117, No. 1/4, p 369-374, September 1990. 3 tab, 9 ref.

Descriptors: *Data interpretation, *Data processing, *Flood forecasting, *Statistical analysis, *Streamflow forecasting, *Surface water data, Estimating equations, Log distribution, Log transformations, Mathematical analysis, Mixed moments method.

A variation of the mixed moments method for fitting the log Pearson type 3 (LP3) distribution is discussed. Quantiles are the combined expression of the distribution parameters and are of primary interest in design calculations. Three estimation methods (RLMO, MXM1, and MXM3) were compared in a study of the bias and root mean square errors (RMSE) for eight LP3 population cases of the 200-yr maximum event. Among the three methods examined, RLMO estimates had a markedly high bias, whereas MXM1 had, in general, the lowest bias. Minor differences were seen in RMSE; however, overall, MXM1 had the lowest RMSE. Applying criteria for robust estimates, MXM1 was superior to RLMO and MXM3 methods. It is concluded that the MXM1 method possesses the most desirable statistical properties as a fitting method for LP3, compared with other available methods. (MacKeen-PTT)
W91-03557

ADVANCED UTILITY SIMULATION MODEL, ANALYTICAL DOCUMENTATION, STATE LEVEL MODEL (VERSION 1.0).
Illinois Univ. at Urbana-Champaign. Coll. of Engineering.
J. J. Stukel.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-161772/AS. Price codes: A25 in paper copy, AO1 in microfiche. Report No. EPA/600/8-88/071a. January 1989. 578p, 66 fig, 133 tab, 233 ref, 5 append. EPA Cooperative Agreement CR808514.

Descriptors: *Acid rain, *Air pollution, *Electric power industry, *Model studies, *Nitrogen oxides, *Simulation models, *Sulfur dioxide, *Water pollution sources, Chemistry of precipitation, Costs, Forecasting models, United States.

The report is one of 11 in a series describing the initial development of the Advanced Utility Simulation Model (AUSM) by the Universities Research Group on Energy (URGE) and its continued development by the Science Applications International Corporation (SAIC) research team. The AUSM is one of four stationary source emission and control cost forecasting models developed by EPA for the National Acid Precipitation Assessment Program (NAPAP). The AUSM projects air pollution emissions (SO2 and NOx), generating technology types and costs of operation, and combinations of fuels and emission control technologies to simultaneously meet electric demand and emission constraints on a least cost basis for each year through 2010. Thirteen electric demand regions are simulated, and output is provided for each of the 48 contiguous states. The initial version of AUSM, Version 1.0, was delivered by URGE in November 1984 and August 1985. Further development of the AUSM by SAIC between 1985 and 1988 has resulted in the development of Versions 2.0 and 3.0. Reports describing these revisions by SAIC to the initial Version 1.0 of AUSM are also part of this series. (Author's abstract)
W91-03581

SEDIMENT QUALITY VALUES REFINEMENT: VOLUME I. 1988 UPDATE AND EVALUATION OF PUGET SOUND AET (APPARENT EFFECTS THRESHOLD).
PTI Environmental Services, Bellevue, WA.
For primary bibliographic entry see Field 5C.
W91-03583

EVALUATION OF TREND DETECTION TECHNIQUES FOR USE IN WATER QUALITY MONITORING PROGRAMS.
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 7B.
W91-03584

CASE STUDY EVALUATION OF SATELLITE-DERIVED RAINFALL ESTIMATES AND THEIR APPLICATION TO NUMERICAL MODEL PRECIPITATION FORECAST VERIFICATION.
National Weather Service Forecast Office, Milwaukee, WI.
For primary bibliographic entry see Field 2B.
W91-03600

GROUND WATER POLLUTION TRANSPORT: MODEL STUDIES (JAN 75-MAR 89).
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W91-03604

INTRODUCTION TO MODELING OF TRANSPORT PHENOMENA IN POROUS MEDIA.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-03654

DETERMINATION OF AN UPPER LIMIT DESIGN RAINSTORM FOR THE COLORADO RIVER BASIN ABOVE HOOVER DAM.
Morrison-Knudsen Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 2B.
W91-03664

MAJOR GEOHYDROLOGIC UNITS IN AND ADJACENT TO THE OZARK PLATEAUS PROVINCE, MISSOURI, ARKANSAS, KANSAS AND OKLAHOMA--SPRINGFIELD PLATEAU AQUIFER.
Geological Survey, Rolla, MO. Water Resources Div.
J. L. Imes.
Available from Books and Open File Reports Section, USGS Box 25425, Denver, CO 80225. USGS Hydrologic Investigations Atlas HA-711-G, 1990. 3p, 3 maps, 6 ref.

Descriptors: *Arkansas, *Geohydrology, *Groundwater budget, *Kansas, *Maps, *Missouri, *Oklahoma, *Springfield Plateau Aquifer, Aquifer systems, Groundwater quality, Groundwater yield, Hydraulic conductivity, Hydrologic data collections, Regional Aquifer System Analysis, Saline-freshwater interfaces, Stratigraphy.

An investigation of the geohydrologic system in the Ozark Plateaus province has been made as part of the Central Midwest Regional Aquifer-System Analysis, a major study that encompasses parts of 10 states. The stratigraphic relationships among the primary geohydrologic units in the Ozark Plateaus province are discussed in Chapter A of this Hydro-

logic Investigation Atlas series, which focuses on one of those geohydrologic units, the Springfield Plateau aquifer. The Springfield Plateau aquifer, widely used in the south-western part of the Ozark Plateaus province as a source for domestic-, and stock-water, is a sequence of Mississippian Plateaus aquifer system. To the west and south, the Springfield Plateau aquifer thickens abruptly at the edge of the Salem Plateau and at the edge of small, isolated outcrops of stratigraphically lower geohydrologic units, then maintains a relative uniform thickness of 100 to 400 ft throughout the Ozark Plateaus province. The aquifer gradually thickens to the northwest and is missing in the Springfield Plateau in Johnson, Henry, and St. Clair Counties, Missouri. Along the perimeter of the Ozark Plateaus province, the potentiometric surface of geologic units that comprise the Springfield Plateau aquifer is greatly affected by topography. In west-central Missouri and eastern Kansas, where the Springfield Plateau aquifer crops out in about one-third of the Ozark Plateaus province, the aquifer's freshwater to the west of the Ozark Plateaus province is depicted by 1,000 and 2,000 mg/L dissolved solids. Little hydrologic data are available for the Springfield Plateau aquifer in northern Arkansas. In Ste. Genevieve County, Missouri, the hydraulic gradient in geohydrologic units stratigraphically equivalent to the Springfield Plateau aquifer is northeast toward the Mississippi River where groundwater discharges from the rocks. A saline water and freshwater transition zone extending southeast through St. Louis County indicates the mixing zone between the freshwater flow system in the Ozark Plateaus province and a saline water flow system to the northeast. (See W91-03666 thru W91-03668) (Lantz-PTT)
W91-03665

MAJOR GEOHYDROLOGIC UNITS IN AND ADJACENT TO THE OZARK PLATEAUS PROVINCE, MISSOURI, ARKANSAS, KANSAS, AND OKLAHOMA--WESTERN INTERIOR PLAINS CONFINING SYSTEM.
Geological Survey, Rolla, MO. Water Resources Div.
J. L. Imes.
Available from Books and Open File Reports Section, USGS Box 25425, Denver, CO 80225. USGS Hydrologic Investigations Atlas HA-711-H, 1990. 3p, 3 maps, 7 ref.

Descriptors: *Arkansas, *Geohydrology, *Groundwater budget, *Kansas, *Maps, *Missouri, *Oklahoma, *Western Interior Plains Confining Syste, Aquifer systems, Aquifers, Confined aquifers, Groundwater quality, Groundwater resources, Groundwater yield, Hydraulic conductivity, Hydrologic data collections, Regional Aquifer System Analysis, Stratigraphy.

An investigation of the geohydrolgoic system in the Ozark Plateaus province, has been made as part of the Central Midwest Regional Aquifer-System Analysis, a major study that encompasses parts of 10 States. The stratigraphic relationship among the primary geohydrologic units in the Ozark Plateaus province is discussed in Chapter A of this Hydrologic Investigations Atlas. This chapter focuses on the Western Interior Plains confining system, geohydrologic unit that confines the western and southern edges of the Ozark Plateaus aquifer system. The Western Interior Plains confining system is an extremely thick (as much as 20,000 ft) and areally extensive geohydrologic unit that extends from the Rocky Mountains to western Missouri and northern Arkansas. Confining layers usually, but not always, contain significant quantities of shale, a relatively impermeable material. Within the thick Western Interior Plains confining system, many formations of younger geologic age than those that are present along the boundaries of the Ozark Plateaus province exist. Because the Western Interior Plains confining system is a thick, complex sequence of interbedded permeable sandstone and limestone layers and large, relatively impermeable shale layers, the distribution of hydraulic heads within the confining system varies both vertically and laterally. Movement of groundwater through the confining system is slow and complex. Groundwater levels in the upland areas tend to be as much as 100 ft lower than the average land-surface altitude. In the northwestern part of the Ozarks, groundwater in the weathered surface layer of the confining system primarily moves toward the Missouri and Marais des Cygnes River valleys. Well recovery tests on 14 wells located near the border of the Ozark Plateaus in southwestern Missouri show a range of yields from 1 to 40 gallons per minute. Generally, well yields tended to decrease from east to west in this area. The dissolved solids concentrations of water in the Western Interior Plains confining system increases to the west, generally exceeding 100,000 mg/L at the west edge of the map area. (See also W91-03665, W91-03667, and W91-03668) (Lantz-PTT)
W91-03666

MAJOR GEOHYDROLOGIC UNITS IN AND ADJACENT TO THE OZARK PLATEAUS PROVINCE, MISSOURI, ARKANSAS, KANSAS, AND OKLAHOMA--ST. FRANCOIS AQUIFER.
Geological Survey, Rolla, MO. Water Resources Div.
J. L. Imes.
Available from Books and Open File Reports Section, USGS Box 25425, Denver, CO 80225. USGS Hydrologic Investigations Atlas HA-711-C, 1990. 2p, 3 maps, 3 ref.

Descriptors: *Arkansas, *Geohydrology, *Groundwater budget, *Kansas, *Maps, *Missouri, *Oklahoma, *St Francois Aquifer, Aquifers, Groundwater quality, Groundwater resources, Groundwater yield, Hydraulic conductivity, Hydrologic data collections, Regional Aquifer System Analysis, Sediments, Stratigraphy.

An investigation of the geohydrologic system in the Ozark Plateau province has been made as part of the Central Midwest Regional Aquifer-System Analysis, a major study of the regional aquifer system in parts of 10 States. Because a large quantity of fresh groundwater is available in aquifers underlying the Ozark Plateaus province, a subregional project has been established to study the geohydrologic units of this area in more detail than is practical in the regional study. The stratigraphic relationship among the primary geohydrologic units in the Ozark Plateaus province is discussed in Chapter A of this Hydrologic Investigations Atlas series. The chapter focuses on the St. Francois aquifer, a geohydrologic unit within the Ozark Plateaus aquifer system underlying the Ozark Plateaus province. The St. Francois aquifer is thickest ($>$ 1,000 ft) in the eastern part of the Ozark Plateaus province near the Mississippi Alluvial Plain. The aquifer generally is between 300 and 500 ft thick immediately west and southwest of the St. Francois Mountains and $<$ 300 ft thick in the western southwestern, and southern parts of the province. The sediments that form the St. Francois aquifer are conformable with less permeable sediments of the overlying Davis Formation. Lamotte Sandstone and Bonneterre Dolomite form the St. Francois aquifer in the eastern two-thirds of the province. The Lamotte generally is a well-sorted sandstone with some silt, locally grading into arkose and conglomerate. Estimates of hydraulic conductivity in the immediate vicinity of the St. Francois Mountains, using specific capacity data, range from 0.0001 ft/sec to 0.000001 ft/sec and tend to decrease away from the mountains. The St. Francois aquifer is used as a source of water primarily at its outcrop area in the St. Francois Mountains. Water quality in this region is adequate for most uses, and dissolved solids concentrations range from about 220 to 450 mg/L. Those wells that are open to a significant thickness of Lamotte Sandstone usually have yields ranging from 100 to 500 gal/min. Depth to water in the outcrop area ranges from ground level to about 150 ft. (See also W91-03665, W91-03666, and W91-03668) (Lantz-PTT)
W91-03667

MAJOR GEOHYDROLOGIC UNITS IN AND ADJACENT TO THE OZARK PLATEAUS PROVINCE, MISSOURI, ARKANSAS, KANSAS, AND OKLAHOMA.
Geological Survey, Rolla, MO. Water Resources Div.
J. L. Imes.
Available from Books and Open File Reports Section, USGS Box 25425, Denver, CO 80225. USGS Hydrologic Investigations Atlas HA-711-A, 1990. 1p, 2 fig, 1 map, 5 ref.

Descriptors: *Aquifer systems, *Arkansas, *Geohydrology, *Kansas, *Maps, *Missouri, *Oklahoma, *Ozark Plateau, Hydrologic data collections, Ozark Aquifer, Regional Aquifer System Analysis, Springfield Plateau Aquifer, St Francois Aquifer, Stratigraphy.

An investigation of the geohydrologic system in the Ozark Plateaus province has been made as part of the Central Midwest Regional Aquifer-System Analysis, a major study of the regional aquifer system in parts of 10 states. The stratigraphic and geologic relationships among the primary geohydrologic units in and adjacent to the Ozark Plateaus is depicted in this atlas (Chapter A). This is the first of a series of chapters (A-H) that includes maps of the altitude of the top, thickness, potentiometric surface, and percentage-of-shale content of individual geohydrologic units. The geohydrologic system in and adjacent to the Ozark Plateaus province can be divided into eight major regional units on the basis of relative rock permeability and well yields. These geohydrologic units consist of geologic units ranging in age from Precambrian (igneous and metamorphic rocks) to Quaternary (alluvial deposits). Five of the units, the St. Francois aquifer, St. Francois confining unit, Ozark aquifer, Ozark aquifer system (stratigraphic column). The approximate location of the boundary of the mainly freshwater Ozark Plateaus aquifer system has been identified using potentiometric-head and dissolved solids concentration data from the system's component geohydrologic units. Geohydrologic units that comprise the Ozark Plateaus aquifer system crop out in a concentric pattern centered on the St. Francois Mountains. The three lowest geohydrologic units crop out only in the immediate vicinity of the St. Francois Mountains. The Ozark aquifer is the largest aquifer, both in areas of outcrop and thickness, and the most important source of freshwater in the Ozark Plateaus. The geohydrologic section, which trends across the Ozark Plateaus province from west to east, passing through the St. Francois Mountains, depicts the stratigraphic position and relative thicknesses of the units. The geohydrologic units in and adjacent to the Ozark Plateaus province are: (1) basement confining unit (Chapter B); (2) St. Francois aquifer (Chapter C); (3) St. Francois confining unit (Chapter D); (4) Ozark aquifer (Chapter E); (5) Ozark confining unit (Chapter F); (6) Springfield Plateau aquifer (Chapter G); (7) Western Interior Plains confining system (Chapter H); and (8) Post-Paleozoic sediments. (See also W91-03665 thru W91-03667)
W91-03668

HYDROGEOLOGY OF THE GALLUP SANDSTONE IN THE SAN JUAN STRUCTURAL BASIN, NEW MEXICO, COLORADO, ARIZONA AND UTAH.
Geological Survey, Albuquerque, NM. Water Resources Div.
J. M. Kernodle, G. W. Levings, S. D. Craigg, and W. L. Dam.
Available from Books and Open Files Reports Section, USGS Box 25425, Denver, CO 80225. USGS Hydrologic Investigations Atlas HA-720-H, 1989. 2p, 14 fig, 3 tab, 31 ref.

Descriptors: *Arizona, *Colorado, *Gallup Sandstone, *Geohydrology, *Groundwater resources, *Maps, *New Mexico, *Utah, Dissolved solids, Groundwater budget, Groundwater quality, Hardness, Hydrologic data collections, Natural gas, Oil fields, Regional Aquifer System Analysis, Sulfates, Water quality.

This report is one in a series resulting from the USGS's Regional Aquifer-System Analysis (RASA) study of the San Juan structural basin that began in October 1984. The purposes of the study are to: (1) define and evaluate the aquifer system; (2) assess the effects of past, present, and potential groundwater use on aquifers and streams; and (3) determine the availability and quality of ground-

water. The Gallup Sandstone is one of the primary water-bearing units in the regional aquifer system. Water wells generally are near the western and southern margins of the basin. Oil and gas test holes have penetrated the Gallup Sandstone near the northeast edge of the main body. Water is produced in several of these oil or gas fields as a secondary product or for reinjection in secondary recovery and repressurization projects. Water in the Gallup Sandstone occurs under both water table and artesian conditions. Recharge to the aquifer is from infiltration of precipitation and streamflow on outcrops and from vertical leakage of water through confining beds. The reported or measured discharge from 32 water wells completed in the Gallup Sandstone ranges from 1 to 645 gal/min (gpm) and the median is 40 gpm. The specific capacity of 13 of these wells ranges from 0.12 to 2.10 gpm/ft of drawdown and the median is 0.46 gpm/ft of drawdown. Physical and chemical data used to describe the quality of water in the Gallup Sandstone are available for 1948 to 1986. The concentrations of dissolved sulfate exceeded the secondary drinking water standard of 250 mg/L in 48 of 77 samples; the median value is greater than the standard. Concentrations of dissolved chloride generally are small; however, in one sample chloride exceeded the standard of 250 mg/L. The concentration of dissolved solids in water the Gallup Sandstone ranged from 210 to 6,000 mg/L. Water from the Gallup generally is hard to very hard; 39% of the samples were classified as very hard. (Lantz-PTT)
W91-03669

POTENTIAL FOR AQUIFER COMPACTION, LAND SUBSIDENCE, AND EARTH FISSURES IN AVRA VALLEY, PIMA AND PINAL COUNTIES, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
S. R. Anderson.
Available from Books and Open File Reports Section, USGS Box 25425, Denver, CO 80225. USGS Hydrologic Investigations Atlas HA-718, 1989. 3p, 9 fig, 56 ref.

Descriptors: *Aquifer characteristics, *Arizona, *Avra Valley, *Compaction, *Groundwater mining, *Groundwater resources, *Maps, *Subsidence, Aquifers, Geohydrology, Geologic fissures, Geologic fractures, Groundwater level, Groundwater recharge, Hydrologic data collections, Water level.

Avra Valley is a large north-trending alluvial basin about 15 mi west of Tucson in Pima and Pinal Counties, Arizona. Two major ephemeral streams, the Santa Cruz River and Brawley Wash, drain the area. These streams and their tributaries provide a source of recharge to an extensive alluvial aquifer that underlies the valley floor. The aquifer consists of interbedded gravel, sand, silt, and clay and contains a vast quantity of groundwater. Aquifer compaction, land subsidence, and earth fissures can severely damage or affect the functional capability of manmade features. Aquifer compaction may damage wells, differential land subsidence may adversely affect structures such as sewers and irrigation water supply systems that are dependent on gravity for their operation, and fissures may damage engineered structures. In addition, compaction and subsidence can seriously reduce the groundwater storage capacity of the aquifer, and fissures may provide a direct path for the rapid movement of contaminants from the land surface to the aquifer. Damage that results from compaction, subsidence, and fissuring has occurred in the Eloy-Picacho area northwest of Avra Valley. Survey data indicate that 120 sq mi subsided about 7 to 12.5 ft from 1952 to 1977. Many earth fissures have opened in this area; the fissures commonly are more than 1,000 ft long and generally surround areas of large water level decline and subsidence. This report describes geohydrologic characteristics of Avra Valley that may contribute to potential aquifer compaction, land subsidence, and earth fissures. The quantitative evaluation of potential land subsidence in this report is presented as an interim land-use and water-use planning tool pending acquisition and study of additional data. The evaluation also assumes that water level declines in the aquifer will continue. Socio-economic factors that may reduce groundwater withdrawals, and thus the potential for compaction and subsidence in Avra Valley, were not evaluated. These factors include the effects of the 1980 Arizona Ground-Water Management Act that regulates withdrawals of groundwater in major agricultural areas, the importation of Colorado River water by the Central Arizona Project, and the probable increased reuse and reclamation of sewage effluent. (Lantz-PTT)
W91-03670

HYDROLOGIC CHARACTERISTICS OF SOILS IN THE HIGH PLAINS, NORTHERN GREAT PLAINS, AND CENTRAL TEXAS CARBONATES REGIONAL AQUIFER SYSTEMS.
Geological Survey, Lincoln, NE. Water Resources Div.
J. T. Dugan, R. D. Hobbs, and L. A. Ihm.
Available from Books and Open File Reports Section, USGS Box 25425, Denver, CO 80225. USGS Hydrologic Investigation Atlas HA-714, 1990. 1p, 2 tab, 1 map, 33 ref.

Descriptors: *Aquifer systems, *Maps, *Soil properties, *Soil water, *Texas, Carbonates, Classification, Hydrologic data collections, Permeability, Regional aquifers, Seasonal variation, Slopes, Soil moisture retention, Soil profiles, Water table.

Certain physical characteristics of soils; namely, permeability, available water capacity, slope, and thickness, have a measurable effect on the hydrologic responses of soils in the High Plains, Northern Great Plains, and Central Texas Carbonates Regional Aquifer systems. The study, which includes all or parts of 11 States, describes the relation between the hydrologic characteristics of the soils and those environmental factors that affect the development and distribution of the soils. In addition to providing a quantitative basis for evaluating the hydrologic responses of the soils, the methodology serves as a tool for consolidating the soil groups of the study area into a more manageable number. The 161 soil mapping units identified in the study area are consolidated into 39 hydrologic soil groups and range of values are presented for: (1) average permeability of the soil profile; (2) average available water capacity of the soil; and (3) average maximum slope. Additionally, the depth to seasonal high water table is indicated as $>$ or $<$ 6 ft and thickness of the soil profiles as $>$ or $<$ 60 inches. The spatial patterns of the soils classified according to their quantifiable hydrologic characteristics will serve as an integral component in the analysis of actual evapotranspiration, consumptive irrigation requirements, and potential groundwater recharge of the study area. (Lantz-PTT)
W91-03671

MODELING NONPOINT POLLUTION AT THE WATERSHED LEVEL WITH THE AID OF A GEOGRAPHIC INFORMATION SYSTEM.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
For primary bibliographic entry see Field 4D.
W91-03734

BIAS IN LOG-TRANSFORMED FREQUENCY DISTRIBUTIONS.
Proctor and Redfern Group, Toronto (Ontario).
B. G. Wilson, B. J. Adams, and B. W. Karney.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 19-37, October 1990. 5 fig, 2 tab, 22 ref.

Descriptors: *Data interpretation, *Flood forecasting, *Flood frequency, *Frequency distribution, *Hydrologic data, *Mathematical equations, *Numerical analysis, *Statistics, Monte Carlo method, Parametric hydrology, Simulation analysis, Wave height.

Estimates of the parameters of frequency distributions are often derived from the logarithms of a series of measured data rather than from the original series itself. This is common practice, for example, in estimating flood frequencies from measured streamflow data, extreme wave frequencies from wave height data, as well as in many other contexts. This procedure leads to biased estimates of the moments and quantiles of the frequency distribution in arithmetic space. This bias is the result of the nonlinear inverse transformation process. The case of the two parameter lognormal distribution was examined in detail and analytical expressions for the bias was derived. The bias introduced by the logarithmic transformation is dependent on the sample size and the population parameters. The derived analytical expressions for bias agree with the results of a series of Monte Carlo simulations. (Author's abstract)
W91-03738

SLIDING MAXIMA.
Agricultural Univ., Wageningen (Netherlands). Dept. of Mathematics.
M. A. J. van Montfort.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 77-85, October 1990. 2 tab, 11 ref.

Descriptors: *Data interpretation, *Mathematical studies, *Numerical analysis, *Statics, *Time series analysis, Estimating equations, Hydrologic data collections, Probable maximum precipitation, Statistical analysis.

The statistics of extremes play an important role in quantitative hydrology. In practice, the distribution of maxima in time periods of a specified length and a sliding starting point is often required, e.g. the maximum precipitation amount in January in a sliding period of 24 hours, while data of observation days only are available. The notation 'A-maxima' is used for maxima in a time period with sliding starting point, where A is an abbreviation of arbitrary or any. 'F-maxima' refer to fixed starting points. Inference on A-maxima is usually based on F-maxima and a partly empirical factor (the 'Hershfield coefficient'); the problem is how to use F-maxima for inference on A-maxima. The distribution of a maximum in a time interval of fixed length with a sliding starting point was estimated from maxima over periods with fixed starting points. Special attention was paid to a specific quantile of the distribution of A-maxima; the 0.98-quantile, related to a return period of 50 years, was chosen for a data set of 58 years. The results were related to estimations based on F-maxima. Support was found for the Hershfield coefficient, but knowledge of this coefficient or continuous recording is not a prerequisite. (Fish-PTT)
W91-03741

SIMULATION OF SALTWATER INTRUSION IN THE NORTHERN GUAM LENS USING A MICROCOMPUTER.
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2F.
W91-03742

STOCHASTIC MODEL OF THE INTERNAL STRUCTURE OF CONVECTIVE PRECIPITATION IN TIME AT A RAINGAUGE SITE.
Universidad Politecnica de Valencia (Spain). Dept. of Hydraulic and Environmental Engineering.
For primary bibliographic entry see Field 2B.
W91-03744

ASSESSING HYDROLOGIC MODEL NONLINEARITY USING RESPONSE SURFACE PLOTS.
Newcastle Univ. (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W91-03745

SAMPLING ERRORS FOR RAINGAUGE-DERIVED MEAN AREAL DAILY AND MONTHLY RAINFALL.
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 2B.
W91-03746

PARAMETER TRANSFERABILITY FOR A DAILY RAINFALL DISAGGREGATION MODEL.
National Weather Service, Johnson City, NY.
For primary bibliographic entry see Field 2B.
W91-03749

ESTIMATION OF THE HYDRAULIC PARAMETERS OF THE RIO-MAIOR AQUIFER IN PORTUGAL BY USING STOCHASTIC INVERSE MODELING.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-03752

TRANSPORT IN HETEROGENEOUS POROUS FORMATIONS: 1. TIME-DEPENDENT CONVECTIVE DISPERSION.
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
J. Valiantzas, and C. Thirriot.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 311-327, October 1990. 10 fig, 17 ref.

Descriptors: *Convection, *Dispersion, *Groundwater movement, *Model studies, *Porous media, *Solute transport, *Stochastic models, Analysis of variance, Correlation analysis, Dispersion coefficient, Flow velocity, Heterogeneity, Hydraulic conductivity, Numerical analysis, Probabilistic process, Seepage, Statistical analysis.

A stochastic Lagrangian model was used to obtain the time evolution of the convective dispersion coefficient in heterogeneous porous formations. By using a probabilistic approach, the correlation of Lagrangian velocities was related to the spatial correlation of the Eulerian velocities. This model is an extension of those previously developed. The statistical parameters of the seepage velocity field were related to the heterogeneous structure using Monte Carlo numerical simulations. In addition, Monte Carlo simulations of the convective transport of a tracer in two-dimensional and three-dimensional heterogeneous domains were obtained. Three different types of correlation functions of the random conductivity field were examined. The investigation of the generated velocity field leads to the conclusion that the statistical characteristics of the velocity field are independent of the particular form of correlation of conductivities examined. Variances depend essentially on the standard deviation of the log conductivities while the correlation function depends only on the integral scale of the conductivity field. The comparison of numerical with theoretical results is favorable. (See also W91-03755) (Fish-PTT)
W91-03755

TRANSPORT IN HETEROGENEOUS POROUS FORMATIONS: 2. TIME-DEPENDENT DOUBLE DISPERSION.
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
J. Valiantzas, and C. Thirriot.
Journal of Hydrology JHYDA7, Vol. 118, No. 1/4, p 329-342, October 1990. 9 fig, 15 ref, append.

Descriptors: *Convection, *Dispersion, *Groundwater movement, *Model studies, *Porous media, Correlation analysis, Darcys law, Dispersion coefficient, Energy transfer, Flow velocity, Heterogeneity, Hydraulic conductivity, Mass transfer, Numerical analysis, Probabilistic process, Spatial distribution, Stochastic models.

The analysis of the mechanisms governing the phenomenon of dispersion in porous media, which is directly related to mass and energy transfer, is common subject of research. The global effect of the local dispersion on the pure convective fluctuations has been studied, using two-dimensional and three-dimensional theory for field-scale time evolution of the effective dispersion in heterogeneous porous media. A probabilistic approach was used to obtain the time correlation of Lagrangian velocities as a function of the spatial correlation of Eulerian velocities and the local tensor of dispersion. The model leads to results which differ from earlier theoretical results. The convective-dispersion equation assumed valid at the local Darcy scale, was solved numerically by the method of characteristics in a rectangular domain where the hydraulic conductivity is a stochastic function of space (isotropic or anisotropic), for two different types of correlation functions already studied. The results of numerical simulations compare favorably with those obtained from the theoretical model. (See also W91-93754) (Author's abstract)
W91-03756

SENSITIVITY ANALYSIS OF '2D-FED,' A MODEL FOR SEAWATER ENCROACHMENT IN LEAKY COASTAL AQUIFERS.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W91-03757

MATHEMATICAL MODELS FOR LONG-TERM PREDICTION OF MOUNTAINOUS RIVER RUNOFF: METHODS, INFORMATION AND RESULTS.
Sredneaziatskii Nauchno-Issledovatel'skii Gidrometeorologicheskii Inst., Tashkent (USSR).
For primary bibliographic entry see Field 2E.
W91-03840

COMPARISON OF OBJECTIVE AND SUBJECTIVE PRECIPITATION PROBABILITY FORECASTS: THE SUFFICIENCY RELATION.
Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W91-03850

STORM WATER MANAGEMENT MODEL FOR URBAN AREAS IN KUWAIT.
Kuwait Univ., Safat. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-03852

DISTRIBUTED DYNAMIC WATERSHED MODEL.
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 2E.
W91-03854

RUNOFF VOLUME ESTIMATION USING GIS TECHNIQUES.
National Park Service, Denver, CO. Denver Service Center.
For primary bibliographic entry see Field 2A.
W91-03856

LINEAR PROGRAMS FOR NONLINEAR HYDROLOGIC ESTIMATION.
California Univ., Santa Barbara. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-03859

COMPARISON OF MODELS PREDICTING GROUND WATER LEVELS ON HILLSIDE SLOPES.
Stevens Inst. of Tech., Hoboken, NJ. Dept. of Civil, Environmental and Coastal Engineering.
For primary bibliographic entry see Field 2F.
W91-03860

OPTIMAL BATHYMETRY OF TYRRHENIAN SEA BY STOCHASTIC INTERPOLATORS.
Padua Univ. (Italy). Dipt. di Metodi e Modelli Matematici per le Scienze Applicate.
For primary bibliographic entry see Field 5B.
W91-03862

ADDITIONAL ANALYSIS OF PEAK-VOLUME RELATIONS AND STANDARDIZATION PROCEDURES.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-03863

PRACTICAL ACCOUNT OF INSTABILITIES IN IDENTIFICATION PROBLEMS IN GROUNDWATER SYSTEMS.
Australian National Univ., Canberra. Centre for Mathematical Analysis.
C. R. Dietrich, G. N. Newsam, R. S. Anderssen, F. Ghassemi, and A. J. Jakeman.
BMR Journal of Australian Geology & Geophysics BJAGDT, Vol. 11, No. 2/3, p 273-284, 1990. 2 fig, 23 ref, append.

Descriptors: *Data interpretation, *Mathematical models, *Model studies, *Numerical analysis, *Parametric hydrology, Algorithms, Aquifer characteristics, Aquifer systems, Geohydrology, Input-output analysis, Simulation analysis.

The construction of models requiring the identification of parameters, such as groundwater models, often leads to numerical instabilities. Errors induced by these instabilities may actually increase with improved data collection and model resolution. It is, therefore, important to properly understand the origin and nature of such instabilities, and to allow for their effect. There are important differences between the problems of identifying parameters or inputs of a geohydrological system from output observations, and the problem of simulating future outputs for given inputs and parameters. While both problems involve use of the mathematical model and gathered data to infer the form of some unknown physical quantity, there is a great difference in both the amount of information on the solution that can be gleaned from the model and data, and in the performance of numerical methods that do the gleaning. Therefore, in simulation, reasonably accurate knowledge of the data and model is enough to construct a reasonably accurate representation of the full solution. However, in most identification problems, while exact knowledge of the data and model is sufficient to reconstruct the full solution, in the presence of data or model errors an accurate reconstruction of the full solution is no longer possible. The data and model now only suffice to recover a finite component of the solution to within some specified accuracy. The complementary component is not identifiable from the available information; its determination requires knowledge from some other source. The identifiable component is likely to be smooth and slowly varying; it will not give accurate estimates of point values of the solution. Finally, the sensitivity of reconstructions to error requires that careful analyses be carried out before numerical solutions are calculated; they are essential for assessment of the reliability of the numerical results. (Fish-PTT)
W91-03901

EFFECT OF SENSOR ERROR ON INTERPRETATION OF LONG-TERM WATER-LEVEL DATA.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 7B.
W91-03918

ANALYSIS TECHNIQUE FOR MULTILEVEL AND PARTIALLY PENETRATING SLUG TEST DATA.
South Carolina Univ., Columbia. Dept. of Civil Engineering.
M. A. Widdowson, F. J. Molz, and J. G. Melville.
Ground Water GRWAAP, Vol. 28, No. 6, p 937-945, November/December 1990. 8 fig, 5 tab, 13 ref. EPA assistance agreement CR813647010.

Descriptors: *Aquifer characteristics, *Aquifer testing, *Finite element method, *Groundwater movement, *Numerical analysis, *Pumping tests, *Slug tests, Anisotropy, Confined aquifers, Data interpretation, Flow models, Hydraulic conductivity, Unconfined aquifers, Well construction, Well screens.

The multilevel slug test is a technique that provides data for determining the local value of hy-

draulic conductivity at a specific elevation. However, existing data analysis techniques developed for fully-screened and/or partially-screened slug tests and packer slug tests are not adequate for application to the general multilevel case. Through the application of a numerical flow model to the problem, a new means to analyze multilevel slug test data has been developed. Simulations performed for both confined and unconfined cases using a finite-element model yield values of dimensionless discharge for a complete range of multilevel slug test geometries. Effects of anisotropy and location of instrumentation relative to aquifer boundaries were also considered. The method allows for values of horizontal hydraulic conductivity to be determined directly from slug test data, and compares favorably with distributions inferred from single-well tracer test data and borehole flowmeter tests. An important consideration in multilevel slug testing is well design and construction; permeability of material around the borehole will influence hydraulic response either due to clogging or vertical channeling through the borehole. It is noted that the data analysis techniques will not compensate for the influence of these effects. (Author's abstract)
W91-03919

NUMERICAL GENERATION OF FLOW NETS--THE FLOWNS MODEL.
North Carolina State Univ. at Raleigh. Dept. of Civil Engineering.
W. Bramlett, and R. C. Borden.
Ground Water GRWAAP, Vol. 28, No. 6, p 946-950, November/December 1990. 3 fig, 1 tab, 10 ref. NSF Grant No. CES-8708959; EPA assistance agreement CR812808-01-0.

Descriptors: *Computer models, *Computer programs, *Finite difference methods, *Flow nets, *Groundwater movement, *Model studies, Anisotropy, Contours, Flow equations, Fluctuations, Heterogeneity, Hydraulic conductivity, Laplace equation, Mathematical equations, Numerical analysis, Simulation analysis.

A simple-to-use computer program (FLOWNS) has been developed for simply and efficiently generating flow nets for a wide variety of situations. The program uses a rectangular coordinate system and allows heterogeneous, anisotropic conditions with any combination of constant potential or constant flux boundaries. Internal no-flow boundaries can be approximated by setting the hydraulic conductivities at these locations close to zero. The FLOWNS code was compared with an existing analytical solution. This comparison demonstrated that the program can generate very accurate results, although a fine grid will be necessary when simulating heterogeneous conditions. The program is limited by computational speed for smaller personal computers. Simulations can be expected to require from less than a minute to several hours on an IBM 386 depending on the problem complexity. A contouring program is required to generate the final stream and equipotential lines. Details of the model structure, input and output formats, and example input files are provided in the program documentation, available on 5.25-inch diskettes. (Author's abstract)
W91-03920

8. ENGINEERING WORKS

8A. Structures

INTAKE STRUCTURE OPERATION STUDY: ELK CREEK DAM, OREGON.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. E. Howington.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report No. HL-90-16, September 1990. 51 p, 19 fig, 1 tab, 12 ref.

Descriptors: *Elk Creek Dam, *Hydraulic models, *Intakes, *Model studies, *Multipurpose reservoirs, *Reservoir operation, Flood control, Oregon, Reservoir fisheries, Rogue River Basin, Selective withdrawal.

Elk Creek Dam, under construction in Rogue River Basin, Oregon, will be operated for multiple purposes including flood control and fish and wildlife enhancement. Flood control will dictate the quantity of water released. Selective withdrawal will be used to control the dam's release water temperature, which is important to the anadromous fishery in the Rogue River. When selective withdrawal occurs through more than one level of intakes, the unique, single-wet-well intake structure will resemble an intake manifold in a density stratified fluid. To operate the structure effectively for release temperature, the site specific characteristics of selective withdrawal and simultaneous, multilevel withdrawal were required. A 1:20-scale physical model of the unique intake structure and near field topography was built and tested. The model was also employed to detect any hydraulic instabilities characterized by pressure fluctuations within the structure. The testing indicated no hydraulic instabilities and produced reasonable site-specific descriptions of selective withdrawal and simultaneous, multiple-level withdrawal. From these data, an existing one dimensional curve, mathematical reservoir model was modified to predict, from total discharge, a release temperature objective, and in-lake temperature distribution the intake gate openings that will achieve the desired release temperature. (Author's abstract)
W91-03012

NOGALES WASH AND TRIBUTARIES. FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT.
Army Engineer District, Los Angeles, CA.
For primary bibliographic entry see Field 4A.
W91-03030

RIVER INTAKE WORKS FOR A HYDROELECTRIC PLANT IN PAPUA NEW GUINEA.
Klohn Leonoff Ltd., Richmond (British Columbia).
P. S. McCreath, C. R. Neill, L. F. Sawatsky, and M. C. Mannerstrom.
Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 4, p 578-589, August 1990. 12 fig, 1 tab, 6 ref.

Descriptors: *Hydroelectric plants, *Intakes, *Mining, *Mountain streams, *Papua New Guinea, Design criteria, Diversion structures, Model studies, New Guinea, Performance evaluation, Weirs.

The Ok Tedi mining development in Papua New Guinea is served by a 50 MW hydroelectric plant completed in 1988. The plant draws water from a run-of-river intake on the Ok Menga, a torrential mountain stream in tropical rain forest subject to frequent flash floods and carrying substantial sediment loads. Design and construction of a diversion weir and intake posed a number of severe problems, such as difficult access, the torrential and flashy nature of the river flows, severe constraints on location due to unstable banks and substrata, and uncertain loads of sediment and debris. Site investigations of a hydrotechnical nature included monitoring of precipitation, streamflow and flood levels, sampling of suspended sediment, and special measurements of bed material and bed load. On the basis of these investigations, preliminary concepts were developed for a diversion weir and intake chamber. A hydraulic model was then constructed to examine alternative forms of weir construction and to study the hydraulic behavior of various intake chamber designs with special attention to exclusion and ejection of coarse sediment. The final design was based largely on the indications of the model study. Initial operating experience generally confirmed the validity of the design, although one or two problems arose that were associated with organic debris and with excessive inflow of coarse sediment due to inexperienced operation. Relatively minor changes were made in operational procedures and equipment to remedy these problems. (Author's abstract)
W91-03307

LOCAL OPTIMAL CONTROL OF IRRIGATION CANALS.
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
J. M. Reddy.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 5, p 616-631, September/October 1990. 7 fig, 10 ref, append.

Descriptors: *Automation, *Drainage engineering, *Irrigation canals, *Irrigation engineering, *Mathematical models, Continuity equation, Finite difference methods, Flow rates, Hydraulic gates, Momentum equation, Open-channel flow, Optimization.

Dependability of water supply can be achieved through improved operation of the primary and secondary canals. This improvement in operation can be brought about by partial or complete automation of irrigation canals. A local optimal control technique (control of an individual gate) for operation of an irrigation canal with a single reach has been developed. By using the concepts of control theory, an expression for an upstream gate opening of an irrigation canal reach operated based upon a constant-level control is obtained. In the derivation, the canal reach between two gates is divided into N nodes, and the finite difference forms of the continuity and the momentum equations are written for each node. The Taylor series is applied to linearize the equations around the initial steady state or equilibrium conditions. The linearized equations are then arranged to form a set of equations, called state equations in control theory jargon. The linear quadratic regulator theory is applied to derive an expression for the optimal gate opening to bring the system back to the equilibrium condition in the presence of known constant disturbances and found to be acceptable as long as the disturbances are less than 20% of the original flow rate in the canal reach. The results obtained from the optimal theory are currently being evaluated using an unsteady open-channel flow model. (Author's abstract)
W91-03421

DEVICE FOR REDUCING THE EFFECTS OF WAVE ACTION IN SHALLOW WATER.
Mount Allison Univ., Sackville (New Brunswick). Dept. of Biology.
For primary bibliographic entry see Field 2L.
W91-03487

DEVELOPMENT OF A NATIONAL HYDROPOWER INDUSTRY IN NEPAL.
BPC Hydroconsult, Kathmandu (Nepal).
For primary bibliographic entry see Field 8C.
W91-03512

SMALL AND MICRO HYDRO IN THE USSR.
Hydroproject, Moscow (USSR).
For primary bibliographic entry see Field 8C.
W91-03513

SMALL HYDRO DEVELOPMENT IN CHINA: ACHIEVEMENTS AND PROSPECTS.
Water Conservancy Hydroelectric Power Scientific Research Inst., Beijing (China).
For primary bibliographic entry see Field 8C.
W91-03514

SMALL HYDRO DEVELOPMENT IN ETHIOPIA.
Fichtner Development Engineering G.m.b.H., Stuttgart (Germany, F.R.).
For primary bibliographic entry see Field 8C.
W91-03515

REGULATION STORAGE FOR MINI HYDRO SCHEMES.
Tonkin and Taylor Ltd., Auckland (New Zealand).
For primary bibliographic entry see Field 8C.
W91-03516

DEVELOPMENT AND APPRAISAL OF MINI HYDRO IN REMOTE AREAS.
Duke Power Co., Charlotte, NC.
For primary bibliographic entry see Field 8C.
W91-03517

MATUTINAO SCHEME PRESERVES THE ENVIRONMENT.
Asia-Pacific Regional Network for Small Hydropower, Badian (Philippines).
For primary bibliographic entry see Field 8C.
W91-03518

ACCELERATING SHP DEVELOPMENT.
For primary bibliographic entry see Field 8C.
W91-03519

DEVELOPMENT AND EVALUATION OF A RUBBER 'DUCK BILL' TIDE GATE.
Freeman (Peter A.) and Associates, Inc., Berlin, MD.
P. A. Freeman, A. B. Forndran, and R. Field.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-188379. Price codes: E03 in paper copy, E03 in microfiche. Report No. EPA/600/2-89/020, May 1989. 88p, 37 fig, 7 tab, 4 ref. EPA Contract No. CR-807822.

Descriptors: *Hydraulic structures, *Sewer infiltration, *Sewer systems, *Tide gates, *Tidewater, Debris, Economic aspects, Installation, New York.

The inflow of tidal waters into combined sewer interceptor systems places a hydraulic loading on a treatment plant, and the salts contained in tidal water further aggravate treatment efficiency and accelerate sewerage system deterioration. Tide gates are installed in these systems to prevent tidal inflow. A prototype testing of an alternative tide gate design was accomplished in New York to explore improvements to conventional flap gate design. A unique 54 in diameter rubber 'duck bill' tide gate (RTG) was fabricated and installed in a typical NYC tide gate chamber. The operation of the gate was observed over two years. The RTG was very effective in preventing the inflow of tidal waters and generally showed equal or improved performance compared to a typical flap gate. Hydraulically, the RTG was supposed to open to release storm flows at a positive difference in upstream head of six in. and to remain closed preventing inflow at a downstream positive head up to eight ft during high tide. Only minor inflow was observed when debris was introduced into the RTG, however capability of self-cleaning was exhibited. Inflow would be significantly greater if similar size debris was lodged in the conventional flap-type gate. The maintenance crews observed no incident where the manual removal of debris was required. The existing chamber required minor modifications for the installation of the RTG. The method of adapting the RTG to an existing tide gate frame is critical to ensuring the reliability of the installation. The RTG was exposed on occasions to gale force winds and heavy rainfall during the two years of operation in New York City. Results of the project indicate that the RTG can provide low maintenance and reliable performance as a cost effective alternative to conventional tide gates. (Author's abstract)
W91-03603

8B. Hydraulics

VELOCITIES INDUCED BY COMMERCIAL NAVIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. T. Maynord.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report HL-90-15. September 1990. 137 p, 5 photo, 14 tab, 2 append.

Descriptors: *Flow velocity, *Hydraulic models, *Hydraulics, *Model studies, *Navigation, Boats, Flow pattern, Hydraulic profiles, Hydrodynamics, Propellers.

Studies were conducted to determine the velocities induced by commercial navigation on large inland waterways. The velocity-inducing mechanisms addressed in this study include propeller jets and the displacement effects of the vessel. Using flow visualization and model and prototype measurements, a better understanding of flow patterns near a moving vessel was obtained. Results illustrated that the propeller jet is not the only mechanism producing significant velocities at the channel bottom. The displacement effects of the vessel also create significant bottom velocities. While return velocities have long been recognized as an effect of the vessel displacement, this study shows that the displacement effects induce a velocity beneath the tow that is generally larger than the return velocity, and is not influenced by channel size except for relatively low blockage ratios. Predictive relations were developed for return velocities, propeller jet velocities, and displacement velocities. (Author's abstract)
W91-03009

SAN ROMAN BYPASS CHANNEL OVERFLOW WEIR CONTRA COSTA COUNTY, CALIFORNIA: HYDRAULIC MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. G. Davis.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report No. HL-90-14, September 1990. 64 p, 2 fig, 16 tab, 10 photos, 20 plates.

Descriptors: *Hydraulic models, *Model studies, *Overflow, *San Ramon Bypass Channel, *Weirs, California, Channel flow, Flow discharge, Flow models, Flow profiles, Hydraulic profiles, Mannings equation.

Tests were conducted on a 1:25-scale model of the San Ramon Bypass Channel, Contra Costa County, California, to develop an overflow weir to remove flows from the channel in excess of the 100-year frequency discharge. The overflow weir would remove flows upstream of the covered channel reach to maintain open channel flow conditions through the covered reach, and not to exceed channel capacity downstream of the covered reach. The model presented reproduced approximately 900 feet of the San Ramon Bypass Channel, 100 feet on the Sans Crainte Creek channel, and 400 feet of the catch channel. The model was constructed so that the slopes of the channels could be adjusted to reproduce various energy gradients equivalent to those resulting from different prototype Manning's n roughness factors. The slope of the high velocity channels were adjusted to reproduce the energy gradient resulting from a Manning's n roughness factor of 0.014 in the prototype. These tests were conducted with an overflow weir length of 125 feet and weir height of 13.25 ft. Water surface profiles and discharges over the weir were recorded with various channel discharges. The divider wall at the downstream end of the weir was streamlined by reducing the angle 15 degrees where the flow was being deflected, and placing a 3 inch radius on the nose of the divider to split the flow. This resulted in satisfactory flow conditions at the weir for all discharges tested. (Lantz-PTT)
W91-03011

INTAKE STRUCTURE OPERATION STUDY: ELK CREEK DAM, OREGON.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W91-03012

LOUISIANA SCOUR ANALYSIS MANAGEMENT SYSTEM (LASAMS).
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
R. Narasimhan, J. F. Cruise, D. P. Argialas, A. Strautmann, and K. Arora.
IN: Water: Laws and Management. American Water Resources Association, Bethesda, Maryland, 1989. p 11A-9--11A-19, 6 fig, 2 ref.

Descriptors: *Computer models, *Data interpretation, *Louisiana, *Louisiana Scour Analysis Management Sys, *Piers, *Scour, Bridges, Highway construction, Monitoring.

The scouring of the piers supporting highway bridges has come to be recognized as a major problem facing the highway engineer. It has become increasingly obvious that bridges that face possible scour situations must be monitored during their lifetimes. Much data will be collected during the monitoring phase. A computerized system for the storage, organization, analysis and display of field collected scour data is presented. The system accepts input from the user, and based on user specifications, allows the data to be organized and viewed in a variety of formats. These include cross sections from scour measurements at selected locations upstream or downstream of the bridge, longitudinal profiles through a selected pier, or the temporal history of maximum scour activity within a specified area near the bridge. The data may be viewed in tabular as well as graphical formats. In addition, the available scour data were analyzed and used to develop regression equations which relate long-term channel degradation to flow and geometric variables. These equations were incorporated into the computer system so that the user may input desired hypothetical discharges and stages so that the system can compute the resulting hypothetical long-term scour. This hypothetical value is then added to the scour activity graphs so that the hypothetical bottom elevation can be compared to the existing bottom and critical pier elevations. (See also W91-03032) (Author's abstract)
W91-03076

HYDRAULICS OF CULVERT FISHWAYS III: WEIR BAFFLE CULVERT FISHWAYS.
Alberta Univ., Edmonton. Dept of Chemical Engineering.
For primary bibliographic entry see Field 8I.
W91-03306

AUGMENTATION OF WATER RESOURCES IN CANAL COMMANDED AREA.
Roorkee Univ. (India). Water Resources Development Training Center.
For primary bibliographic entry see Field 4B.
W91-03357

EVALUATION OF OPTIMAL CONSTANT-VOLUME CONTROL FOR IRRIGATION CANALS.
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
J. M. Reddy.
Applied Mathematical Modelling AMMODL, Vol. 14, No. 9, p 450-458, September 1990. 11 fig, 14 ref.

Descriptors: *Flow control, *Irrigation canals, *Mathematical models, *Model studies, *Open-channel flow, Canal design, Flow rates, Hydraulic gates, Optimization, Water demand.

A significant benefit of a demand-based or user-oriented water supply system is that such a system should be easier to manage than other systems. A lumped-parameter model was used for simulating the dynamics of an irrigation canal using the concepts of optimal control theory. Using the state-space approach, the problem was formulated as a discrete optimal control problem, and the solutions for gate opening in the presence of known variations in water withdrawal rates were obtained by solving the algebraic Riccati equation. An example problem was considered, and the variations in the depth of flow obtained by using the optimal control theory were compared with the results obtained from an unsteady open-channel flow model. For small and slow changes in the flow rates, the difference between the two models in predicting the changes in water surface elevation was not significant. However, as the variations in withdrawal rates increased, the accuracy of the optimal control model (which is based upon small perturbations around the uniform flow) in predicting the

water surface elevations decreased. (Author's abstract)
W91-03413

WHY SEDIMENTS DEPOSIT IN LINED CHANNELS.
Irrigation and Power Research Inst., Amritsar (India).
For primary bibliographic entry see Field 2J.
W91-03419

HYDRAULICS OF INTERRILL OVERLAND FLOW ON A SEMI-ARID HILLSLOPE, SOUTHERN ARIZONA.
Keele Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-03552

ANALYSIS OF PORE PRESSURE BEHAVIOR OF A ROCKFILL DAM DURING RESERVOIR FILLING.
K. Nakagawa, and I. Matsui.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-753443. Price codes: A03 in paper copy, A01 in microfiche. 27p, 19 fig, 6 tab. Abkiko Research Laboratory Rep. No. U87008, (1988). English summary.

Descriptors: *Dam stability, *Doyoh Dam, *Japan, *Pore pressure, *Reservoir operation, *Rockfill dams, Finite element analysis, Stress, Water level.

The numerical analysis of the behaviour of Doyoh Dam which was constructed in 1986 by Chugoku Power Electric Co. Ltd is reported. The procedure uses a finite element analysis of the coupled process between the deformation of the dam and the pore pressure behavior in the core zone. This procedure was applied to the analysis of the behavior of the dam during construction, during reservoir filling, and during the operation to generate the electric power. Comparison of the primary prediction with the observation from the earlier period of construction required the inputed characteristics of the materials in the calculation to be revised. These characteristics turned out good agreement between the calculated results and the measured values of the dam behavior during construction. Therefore, this reexamination of the inputed characteristics is necessary to improve the reliability of the calculation for following dam behavior. It is predicted that reservoir filling influences the distribution of the residual pore pressure after construction but does not raise the maximum value. Calculations show that the change in dam water level during powerplant operation causes pore pressure movement in the core which is not serious enough to affect the stability of the dam. (Author's abstract)
W91-03591

8C. Hydraulic Machinery

NUMERICAL MODELING OF PRESSURE-REDUCING VALVES IN WATER DISTRIBUTION NETWORK SYSTEMS.
Lakehead Univ., Thunder Bay (Ontario). Dept. of Civil Engineering.
U. S. Panu.
Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 4, p 547-557, August 1990. 4 fig, 2 tab, 12 ref, append.

Descriptors: *Computer models, *Model studies, *Networks, *Pressure conduits, *Valves, *Water distribution, Flow rates, Friction loss, Hydraulics, Mathematical models, Numerical analysis.

There are difficulties in representing pressure-reducing valves (PRVs) in network-analysis models when using the Hazen-Williams friction factor because the specific dimensions of the PRVs are not taken into consideration. To evaluate the performance of the WATER model in representing PRVs, a test network was created in the form of a computer model. Various tests were conducted on each of three PRVs with different dimensions under both low and high differential head conditions. Results showed that within a certain range of head loss in all three PRVs, the WATER model allowed an excessive flow rate compared with the maximum allowable flow rate for each one of the actual PRVs. The use of modified frictions factors provided an adequate basis for representing pipes containing PRVs in network-analysis models. A significant reduction in computational effort was achieved with modified friction factors and the proposed modifications did not require any alteration to the model structure. The values of modified friction factors for any specified network representation containing an appurtenance are provided to the model through the input data files. When modified friction factors were applied to the Greater Victoria (British Columbia) Water District (GVWD) network, they reduced by half the number of trial runs required to calibrate the GVWD network system to specific flow rates and pressures. The use of modified friction factors also eliminated the need for continuous adjustments of the downstream set points of the PRVs when they had reached their full-wide-open condition. (Geiger-PTT)
W91-03305

RIVER INTAKE WORKS FOR A HYDROELECTRIC PLANT IN PAPUA NEW GUINEA.
Klohn Leonoff Ltd., Richmond (British Columbia).
For primary bibliographic entry see Field 8A.
W91-03307

DEVELOPMENT OF A NATIONAL HYDROPOWER INDUSTRY IN NEPAL.
BPC Hydroconsult, Kathmandu (Nepal).
G. A. Weller.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 10, p 16-18, October 1990. 3 fig, 1 tab, 1 ref.

Descriptors: *Developing countries, *Governmental interrelations, *Hydroelectric plants, *Nepal, *Water resources development, Hydroelectric power, International agreements.

Various organizations have been working with the Nepalese Government for 25 years towards the development of a national hydropower industry. Schemes with capacities of 1 MW and 5.1 MW have been implemented successfully, and work on a 12 MW scheme has begun. The beginning of His Majesty's Government of Nepal partnerships was the formation of a private power company in 1966 to design, construct and operate a 1 MW hydropower plant on the Tinau river in western Nepal. Private companies were chosen because they are able to operate outside the constraint of the strict routines of government, and so can experiment in construction and management. To institutionalize the skills acquired during the construction of the Tinau project, and to maintain the development impetus, a construction company was formed in 1986 based on the Tinau team which is now the leading Nepali contractor in the fields of hydropower and tunnelling. Another project was the 5 MW Andhi Khola hydropower project in western Nepal begun in 1982. The project was financed by Norwegian Government aid, which shares the government's aim to see a national hydropower industry develop. National capability to maintain and repair equipment for hydroplants is essential. Therefore, in 1986, an electro-mechanical company was formed to develop this capability. This group specializes in the design, manufacture and refurbishment of equipment for hydropower developments. All of these companies are working closely with the Nepalese government, the Norwegian government and private international companies, who realize the importance of the development of national hydropower expertise. The experience at Andhi Khola has encouraged the Norwegian Government to fund a 12 MW project on the Jhimruk river in west Nepal which is due for completion in 1993. (Mertz-PTT)
W91-03512

SMALL AND MICRO HYDRO IN THE USSR.
Hydroproject, Moscow (USSR).
L. Mikhailov, B. Fieldman, and V. Linjuchev.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 10, p 21-24, October 1990. 2 fig.

Descriptors: *Hydroelectric power, *USSR, *Water resources development, Hydroelectric plants, Rural development, Turbines.

Small scale hydropower development in the USSR is experiencing its third revival. The first small hydro stations were constructed during the last century. These stations provided isolated supply to industrial sites, towns and rural communities, but construction was not widespread, especially as small thermal powerplants became popular. The second phase of intensive small hydropower development came immediately before and just after the second World War. After this, the construction of small hydro stations dropped off sharply again because of advances in thermal, nuclear and large hydropower. In recent years, attention has again been focused on the well known power potential of small and medium rivers. At this stage in the USSR, the first priority is to establish, at a new engineering level, the manufacture of the well proven Kaplan and Francis turbines. It is important that the prospects for small scale development not be set against the large scale hydropower; the development of small hydro could not replace large scale schemes, but it would help to form a well balanced fuel and energy system for all regions in the USSR. Small hydro should be viewed as a fuel-saving resource, contributing to power supply reliability. (Mertz-PTT)
W91-03513

SMALL HYDRO DEVELOPMENT IN CHINA: ACHIEVEMENTS AND PROSPECTS.
Water Conservancy Hydroelectric Power Scientific Research Inst., Beijing (China).
S. Xiong.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 10, p 27-31, October 1990. 3 tab.

Descriptors: *China, *Developing countries, *Hydroelectric plants, *Hydroelectric power, *Water resources development, Rural development, Water resources.

In 1989, power generation by small hydro in China reached 36 TWh, corresponding to around one-third of the country's total agricultural consumption of electric power in rural areas. With a total installed capacity of 12,620 MW, small hydro accounted for 37.1% of the nation's total hydropower capacity. This represents a 48.5% increase since 1983. In terms of the number of small hydro stations in operation, their total installed capacity and their annual power generation, China ranks first in the world. Although the load factor is still low (around 2800 hours per year on average) and the surplus of seasonal energy is large, small hydro plays an important role in supplying electricity to the vast remote and mountainous rural areas. In 1989, on the basis of tentative development plans collected from all the provinces, the Department of Rural Hydropower prepared a small hydropower development program for the decade. This program sets two main targets. One target is to bring the nation's total small hydropower capacity up to 23.2 GW by the end of the year 2000, with an increase of 10,580 MW of installed capacity within the 11 years to come. In connection with newly added capacity, 400,000 km of transmission lines and a 46,400 MVA capacity of transformers will be completed and added to small rural power grids. The second target is to carry out the second national rural electrification campaign. With the experience obtained from the first campaign between 1984-1990, at another 500 counties, primary rural electrification is planned to be installed before the turn of the century. (Mertz-PTT)
W91-03514

SMALL HYDRO DEVELOPMENT IN ETHIOPIA.
Fichtner Development Engineering G.m.b.H., Stuttgart (Germany, F.R.).

H. Fitjer.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 10, p 33-38, October 1990. 5 fig, 1 tab, 4 ref.

Descriptors: *Developing countries, *Ethiopia, *Hydroelectric power, *Water resources development, Hydroelectric plants, Rural development.

Ethiopia, which has abundant hydropower resources in certain parts of the country, has embarked on a small hydropower development program to speed up electricity supply from renewable resources in remote areas. Small hydro development in Ethiopia has reached a point where planning can be covered largely with the country's own manpower, thanks to UN support during the past decade. Funding of project implementation continues to mark the critical path of the projects. Ethiopian Electric Light & Power Authority has developed its own construction capacity, so that it will be able to take over the execution of the civil works of future small hydropower projects. Foreign support is urgently needed to maintain the momentum of the development reached so far. Recently, interest in micro hydro development has also increased in Ethiopia, and the first concrete steps have been taken for the preparation of a rational approach to a micro hydro development program. Progress in this field is greatly dependent on foreign support. (Mertz-PTT)
W91-03515

REGULATION STORAGE FOR MINI HYDRO SCHEMES.
Tonkin and Taylor Ltd., Auckland (New Zealand).
M. D. Palmer, and J. N. Duder.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 10, p 40-43, October 1990. 4 fig, 2 tab.

Descriptors: *Design criteria, *Hydroelectric plants, *Hydroelectric power, *Water resources management, Hydraulic design.

At existing mini hydro stations where the rated capacity is not more than the peak load, it may be possible to achieve some enhancement of total energy yield and/or rated capacity by introducing storage for daily flow regulation. Similarly, it is possible in some circumstances to reduce the capital cost of the headrace in addition to obtaining enhanced output. The benefits of the provision of storage include making better use of extreme dry season flows, reducing the capacity/size of the low pressure condiut, increasing the period of the year when the plant can operate at peak capacity, using the capacity of the plant at lower plant factor, and increasing the energy available to the system. The maximum benefit is available for isolated schemes, for which the peak load is approximately equal to the yield from the catchment. The benefit decreases as system load increases, to the point where there is no apparent benefit in the case of a station where the capacity is less than the minimum daily system load, unless the station is run as a peak load station. Design procedures consist of optimizing the volume for the available topographical configuration, catchment yield and scheme capacity, together with selection of station capacity in relation to the flow duration curve and plant capacity factor to obtain the best benefit/cost ratio. Operation and maintenance will include training the operators to use the whole of the pond contents during the peak demand periods, to allow it to fill up between peaks and to take measures for sediment control. (Mertz-PTT)
W91-03516

DEVELOPMENT AND APPRAISAL OF MINI HYDRO IN REMOTE AREAS.
Duke Power Co., Charlotte, NC.
H. G. McKay, B. V. Rydbeck, W. D. Wright, and H. Erdmannsdorfer.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 10, p 45-51, October 1990. 4 fig, 2 tab.

Descriptors: *Hydroelectric plants, *Kenya, *Water resources development, Capital costs, Cost analysis, Cost-benefit analysis, Economic aspects, Foreign design practices, Hydroelectric power.

Methodology for the implementation of small scale hydro plants in remote areas of developing countries has been developed by a German turbine manufacturer; it has been used for the development of the Tenwek 320 kw powerplant in Kenya. The 320 kilowatt hydro plant installed at the Tenwek hospital has operated reliably since its commissioning in 1987. The construction project was a demanding effort for the volunteer engineers and missionaries. However, excellent communication and cooperation with the consulting engineer and the equipment supplier, coupled with the local labor force and its supervision, allowed the project to be completed successfully for a price of $830,000. This is $2600/kw installed for one unit. The powerhouse and intake have been designed to add another 320 kw unit at a later date. If the second unit is added, the cost for the total project is estimated to be approximately $1800/kw installed. The real justification for the project is born out by the fact that the hospital has reduced its operating costs by approximately $150,000, even in the first years of operation. This reduction in cost is directly attributable to fuel cost savings. The hydroelectric plant will thus pay for itself in approximately six to seven years. (Mertz-PTT)
W91-03517

MATUTINAO SCHEME PRESERVES THE ENVIRONMENT.
Asia-Pacific Regional Network for Small Hydropower, Badian (Philippines).
Z. A. Santos.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 10, p 61-62, October 1990.

Descriptors: *Hydroelectric plants, *Hydroelectric power, *Philippines, *Water resources development, Rural development, Social aspects, Social impact.

As an integral part of the Philippine Government's rural development program, a rural energy program was established in the early 1980s to produce cheap and reliable power to promote the productivity of small industries and agriculture. Fifteen mini hydropower stations have been completed so far. The first hydropower station in the Philippine-German Special Energy Program, Matutinao, is now under construction. It is a 720 kilowatt project at the village of Matutinao, in Badian, on the island of Cebu, about 110 km from Cebu city. About 2000 people live in the project area. The need to preserve nature as a whole in the valley of the Matutinao river was recognized. Construction work was reduced to a minimum, and the use of heavy equipment was banned. No access roads to the weir were constructed, and emphasis was placed on labor-intensive construction methods. A tunnel was designed instead of a headrace, and the weir and powerhouse were located at sites where they would not disturb the falls or the view of the area. Local people were hired as laborers. This increased their income and reduce the number of people migrating to other areas to work. The Matutinao mini hydro scheme in the Philippines is likely to serve as a model for future rural electrification schemes in the Philippines. It is an example of a project where the local community played an active role, and where the objective was not simply to produce electricity, but to improve the livelihood of the local people and to preserve the natural beauty of the surrounding area. (Mertz-PTT)
W91-03518

ACCELERATING SHP DEVELOPMENT.
M. Botejue.
International Water Power and Dam Construction IWPCDM, Vol. 42, No. 10, p 62-66, October 1990.

Descriptors: *Developing countries, *Hydroelectric power, *Public policy, *Water policy, *Water resources development, Rural development.

Regulatory constraints are preventing the optimal utilization of small hydropower (SHP) in developing countries. Liberalized policies that promote the development of independent small hydropower will help to increase interest and investment in such schemes. Small scale hydropower generation has largely been displaced by centralized electricity supply. Where opportunities for small hydro generation exist, there are a number of non-technical barriers that inhibit development. In developing countries where power generation is dependent on imported fuels, the optimal development of small hydro power should receive priority. Prior to implementing such policies long term development strategies for the region should be specified. Financial incentives should be created for harnessing small hydro generation and environmental and regulatory constraints should be addressed. Pay rates for power transfer and technical specifications and standards for connecting to the regional power grid must be established. With the regional grid opened as a carrier and a distributor of power, opportunities will be created for independent power generation. Plantation sector industries, irrigation districts, rural cooperatives and private investors will all be involved. The growth of such projects will open challenging opportunities for dynamic young engineers and managers. (Mertz-PTT)
W91-03519

8E. Rock Mechanics and Geology

SOLID-EARTH SCIENCE DATA BASES.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W91-03001

GEOLOGY FOR ENVIRONMENTAL PLANNING IN MONROE COUNTY, INDIANA.
Indiana Geological Survey, Bloomington.
For primary bibliographic entry see Field 6G.
W91-03646

HYDROLOGY OF LIMESTONE TERRANES: ANNOTATED BIBLIOGRAPHY OF CARBONATE ROCKS, VOLUME THREE.
International Association of Hydrologists.
For primary bibliographic entry see Field 2F.
W91-03656

PALYNOSTRATIGRAPHY OF THE CENTRAL WEST MURRAY BASIN.
For primary bibliographic entry see Field 2E.
W91-03904

STRATIGRAPHY AND SEDIMENTOLOGY OF MID-TERTIARY PERMEABILITY BARRIERS IN THE SUBSURFACE OF THE MURRAY BASIN, SOUTHEASTERN AUSTRALIA.
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 2F.
W91-03908

8G. Materials

SAN ROMAN BYPASS CHANNEL OVERFLOW WEIR CONTRA COSTA COUNTY, CALIFORNIA: HYDRAULIC MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W91-03011

DAM SAFETY: AN EVALUATION OF SOME PROCEDURES FOR DESIGN FLOOD ESTIMATION.
Salford Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W91-03845

8I. Fisheries Engineering

FISHERY FUNCTIONS AND VALUES OF FORESTED RIPARIAN WETLANDS.
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 2H.
W91-03084

HYDRAULICS OF CULVERT FISHWAYS III: WEIR BAFFLE CULVERT FISHWAYS.
Alberta Univ., Edmonton. Dept of Chemical Engineering.
N. Rajaratnam, and C. Katopodis.
Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 4, p 558-568, August 1990. 15 fig, 1 tab, 9 ref.

Descriptors: *Baffles, *Culverts, *Fish passages, *Hydraulics, *Weirs, Flow velocity, Mathematical studies.

The hydraulics of culvert fishways with weir-type baffles were studied in the laboratory. Weir baffles without slots would be less expensive to build than slotted-weir baffles and would resemble a pool-weir fishway. Baffles with heights equal to 0.15 and 0.1 times the diameter (D) of the culvert were studied with longitudinal spacings of 0.5D and 1.2D. Equations were developed to describe the relation between the discharge, slope, diameter, and the depth of flow. Using these equations it was possible to predict the barrier velocity that would exist at the baffles. The performance of the weir baffles was found to be as good as that of the slotted-weir baffles or slightly better by producing larger depths for smaller flow rates. A spacing of 0.6D was very effective, whereas a spacing of 1.2D appeared to be somewhat too large. During low flows, sediment may settle in the pools, but this might be eroded and transported by larger flows. A certain amount of maintenance of the culvert may be needed. (See also W90-03168) (Geiger-PTT)
W91-03306

EVALUATION OF THE FISHERIES OF THE MACKINAW RIVER BASIN IN CENTRAL ILLINOIS.
Illinois Dept. of Conservation, Aledo.
For primary bibliographic entry see Field 2H.
W91-03504

HABITAT RESTORATION FOR FISH AND WILDLIFE IN BACKWATER LAKES OF THE ILLINOIS RIVER.
Illinois State Water Survey, Peoria. Water Quality Section.
For primary bibliographic entry see Field 5G.
W91-03616

DEVELOPMENT OF THE LAKE ONTARIO SPORTFISHERY: SOCIOECONOMIC IMPACTS IN NEW YORK STATE.
New York Sea Grant Extension Program, Oswego.
For primary bibliographic entry see Field 2H.
W91-03700

BIOMANIPULATION: THE NEXT PHASE--MAKING IT STABLE.
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 5G.
W91-03762

FISH IN SHALLOW AREAS IN MORETON BAY, QUEENSLAND AND FACTORS AFFECTING THEIR DISTRIBUTION.
Queensland Dept. of Primary Industries, Brisbane (Australia). Fisheries Management Branch.
For primary bibliographic entry see Field 2L.
W91-03814

DEVELOPMENT OF AN INTERDISCIPLINARY PLANNING MODEL FOR WATER AND FISHERY MANAGEMENT.
New Mexico State Univ., Las Cruces. Dept. of Fishery and Wildlife Sciences.
For primary bibliographic entry see Field 6A.
W91-03855

CONSERVATION OF ENDEMIC RAIN FOREST FISHES OF SRI LANKA: RESULTS OF A TRANSLOCATION EXPERIMENT.
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
E. D. Wikramanayake.
Conservation Biology, Vol. 4, No. 1, p 32-37, March 1990. 1 fig, 3 tab, 23 ref.

Descriptors: *Conservation, *Environmental policy, *Fish conservation, *Fish populations, *Rain forests, *Sri Lanka, *Translocation, Ecosystems, Environmental protection, Forest watersheds, Species diversity, Stream fisheries.

Four potentially endangered species of rain forest fishes, Brabus cumingi, Barbus titteya, and Rasbora vaterifloris, endemic to streams of southwestern Sri Lanka, were translocated in 1981 into a depauperate stream system in the central hills. By 1985, all four species had established self-perpetuating populations in these streams, and had extended their range into adjacent streams. Barbus nigrofasciatus, was one of the most abundant species in these streams. It was widely distributed throughout the stream system and in the slower sections of the Mahaveli Ganga (Mahaveli River), and occupied a wide range of macrohabitat and microhabitat types. The other three species were more specialized in their habitat and diet, and thus were patchily distributed. The microhabitats occupied by B. cumingi, B. titteya, and R. vaterifloris resembled the specialized microhabitats they occupy in their native streams. Presumably because of their specializations, these three species were not as abundant as B. nigrofasciatus. Overall, the biology and distribution of the four species will enable them to survive spatially small-scale environmental perturbations. The results suggest that translocations are a feasible way of conserving other endemic fishes of Sri Lanka threatened with extinction. However, such translocations must be carefully planned, with consideration for the indigenous community as well as the ecological requirements and genetic integrity of the target species. (Author's abstract)
W91-03869

9. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

FISCAL YEAR 1988 PROGRAM REPORT (WYOMING WATER RESEARCH CENTER).
Wyoming Univ., Laramie. Water Resources Research Inst.
S. P. Gloss.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-217225/AS. Price codes: A04 in paper copy, A01 in microfiche. Program Report G1600-01, July 1989. 56p. USGS Contract No. 14-08-0001-G1600. USGS Project No. G1600-01.

Descriptors: *Information transfer, *Research, *Training, *Water resources Institutes, *Wyoming, Education, Projects.

Four research projects were funded under the FY88 program, as well as an information transfer program. Two projects funded through the WWRC state program were submitted as matching. A short statement identifying each project follows: (1) The mechanics of groundwater recharge and the influences of geologic structure and stratigraphy on this recharge were studied for western Wyoming foreland and thrustbelt environments. Three distinct types of groundwater storage were found to occur in these environments; (2) Uncertainty analysis and risk evaluation was performed on parameters of a dissolved oxygen (DO) water quality model. It was found that uncertainty in DO prediction depends on the classification of the stream and the use of a correct probability distribution for DO concentration; (3) Microorganisms which inhabit the rhizosphere are being studied to see if they play a major role in the modification of the bioavailibility of selenium. Results to date suggest that vesicular arbuscular fungi found on the roots of plants in seleniferous soils are important mediators of plant selenium uptake; (4) An evaluation of potential toxicity effects of saline discharges from oil production operations on a portion of a stream system in Wyoming has indicated to date that concentrations of Na(+), K(+), Cl(-), HCO3(-), and CO3(2-) from these saline discharges is significantly contributing to observed toxicity; (5) The hydrologic, geomorphic and biologic responses of conveying municipal water through an ephemeral watercourse are being measured and evaluated. A well defined channel has begun to form and aquatic habitat are beginning to establish themselves; and (6) The Wyoming Water Research Center operates and maintains a high mountain watershed observatory which is densely instrumented for the purposes of hydrologic, water quality, and climatologic research and educational instruction. It is presently being used by the U.S. Forest Service for atmospheric deposition studies in cooperation with the University of Wyoming. Information transfer was accomplished through field tours, professional papers, a newsletter, law journal publications, seminars and updating data and bibliographic information sources for the State of Wyoming on regional and state water issues. (USGS)
W91-02983

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

WASTE TREATMENT BY REVERSE OSMOSIS AND MEMBRANE PROCESSES: INDUSTRIAL (NOV 76-OCT 89). CITATIONS FROM THE COMPENDEX DATABASE.
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-853532/AS. Price codes: NO1 in paper copy, NO1 in microfiche. December 1989. 130p.

Descriptors: *Bibliographies, *Industrial wastewater, *Literature review, *Membrane processes, *Reverse osmosis, *Wastewater treatment, Chemical wastes, Dyes, Electrodialysis, Fluorides, Ion exchange, Metals, Nitrates, Pulp wastes, Radioactive wastes, Sodium, Steel mill wastes, Textile wastes.

This bibliography contains citations concerning the use of membranes to treat industrial waste water. Reverse osmosis, ion exchange, electrodialysis, and ultrafiltration processes are described. Removal of metals, sodium compounds, nitrates, fluorides, dyes, and radioactive waste using membranes is examined. Wastewater treatment for chemical, pulp, textile, and steel mills using this technology is included. (This updated bibliography contains 294 citations, 13 of which are new entries to the previous edition.)
W91-03568

TOXICITY BIOASSAYS: WATER POLLUTION EFFECTS ON AQUATIC ANIMALS AND PLANTS (JUN 86-FEB 90). CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-862798/AS. Price codes: NO1 in paper copy, NO1 in microfiche. March 1990. 94p.

Descriptors: *Bibliographies, *Bioassay, *Literature review, *Toxicity, *Water pollution effects, Aquatic animals, Aquatic plants, Growth, Mortality, Reproduction.

This bibliography contains citations concerning toxicity bioassay studies of water pollution effects on reproduction, growth, and mortality of aquatic animals and plants. Industrial and agricultural water pollutants such as metals, chemicals, pesticides, and herbicides are evaluated and tested. Standard fishes and algal assays are used to determine effects of potential toxicants. (This updated bibliography contains 145 citations, 51 of which are new entries to the previous edition.)
W91-03569

WASTEWATER AND WATER TREATMENT: ANION EXCHANGE (JAN 77-MAY 89). CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-862916/AS. Price codes: NO1 in paper copy, NO1 in microfiche. June 1989. 97p.

Descriptors: *Anion exchange, *Bibliographies, *Literature review, *Wastewater treatment, *Water treatment, Chromatography, Desalination, Drinking water, Membranes, Resins.

This bibliography contains citations concerning the theory, methods, and applications of anion exchange in the treatment of potable water and wastewater. Topics include anion exchange resins and membranes, desalination techniques, and process evaluations. Methods for anion analysis using chromatographic techniques are also considered. (This updated bibliography contains 165 citations, 35 of which are new entries to the previous edition.)
W91-03570

EFFLUENT TREATMENT IN THE PAINT AND COATING INDUSTRY (JAN 80-MAY 89). CITATIONS FROM THE WORLD SURFACE COATINGS ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-863583/AS. Price codes: NO1 in paper copy, NO1 in microfiche. June 1989. 43p.

Descriptors: *Bibliographies, *Industrial wastes, *Literature review, *Wastewater treatment, Activated carbon, Biological treatment, Filters, Hydrogen peroxide, Paints, Recovery systems, Solvents.

This bibliography contains citations concerning the analysis and treatment of effluents from the coating industry. Filters used for solvent absorption and recovery, activated carbon absorption of paint fumes, hydrogen peroxide treatment of wastes, effluent heat recovery, and biological treatments are discussed. (This updated bibliography contains 101 citations, 18 of which are new entries to the previous edition.)
W91-03571

EFFLUENT TREATMENT IN THE TEXTILE INDUSTRY: DYES (JAN 83-JUN 89). CITATIONS FROM THE WORLD TEXTILE ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-864359/AS. Price codes: NO1 in paper copy, NO1 in microfiche. June 1989. 80p.

Descriptors: *Bibliographies, *Industrial wastes, *Literature review, *Textile mill wastes, *Wastewater treatment, Adsorption, Bacterial treatment, Color removal, Dyes, Electrolysis, Flocculation, Manganese, Membranes, Ozonation, Ultrafiltration.

This bibliography contains citations concerning the treatment and reuse of textile industry effluents that contain dyes. Bacteria that absorb dyes, neutralization of dye effluents, color removal by ozonization and by treatment with manganese solid waste, flocculation treatment, and dye absorption methods and materials are discussed. Membrane treatment, electrolysis, and ultrafiltration methods of removing dyes from wastewater are also considered. Reuse of dye containing effluents are also considered. Textile effluents that do not contain dyes are discussed in another bibliography. (This updated bibliography contains 200 citations, 33 of which are new entries to the previous edition.)
W91-03572

ANIMAL WASTE POLLUTION AND ITS CONTROL (JAN 70-JUN 89). CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-865430/AS. Price codes: NO1 in paper copy, NO1 in microfiche. July 1989. 162p.

Descriptors: *Animal wastes, *Bibliographies, *Feedlot wastes, *Literature review, *Waste treatment, Anaerobic digestion, Animal processing wastes, Fertilizers, Manure, Runoff.

This bibliography contains citations concerning pollution effects and pollution control of animal wastes and animal processing wastes. Reports are included on feedlot waste pollution and control, pollution from manure used in fertilization, water runoff from farms, dairy and livestock wastes, rendering wastes, poultry processing wastes, ecological aspects, and hoghouse waste control. Also included in the reports are pollution control by anaerobic digestion of manures. (This updated bibliography contains 314 citations, 42 of which are new entries to the previous edition.)
W91-03573

GROUND WATER POLLUTION TRANSPORT: MODEL STUDIES (JAN 75-MAR 89).
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-858831/AS. Price codes: N01 in paper copy, N01 in microfiche. April 1989. 103p.

Descriptors: *Bibliographies, *Groundwater pollution, *Model studies, *Path of pollutants, *Simulation analysis, Geohydrology, Groundwater movement, Pollutant transport.

This bibliography contains citations concerning analytical and numerical simulations of the movement and distribution of contaminants in groundwater. Pollutant transport and dispersion, two and three-dimensional modeling in homogeneous and heterogeneous materials, and site studies in specific geohydrologic environments are among the topics discussed. Theoretical analyses and practical applications are included. (Contains 171 citations). (Author's abstract)
W91-03604

HYDROLOGY OF LIMESTONE TERRANES: ANNOTATED BIBLIOGRAPHY OF CARBONATE ROCKS, VOLUME THREE.
International Association of Hydrologists.
For primary bibliographic entry see Field 2F.
W91-03656

10D. Specialized Information Center Services

NATIONAL WATER INFORMATION SYSTEM USER'S MANUAL. VOLUME 2, CHAPTER 4. GROUND-WATER SITE INVENTORY SYSTEM.
For primary bibliographic entry see Field 7C.
W91-03013

GEOCHEMICAL COMPUTER CODES: A REVIEW, FINAL REPORT.
For primary bibliographic entry see Field 7C.
W91-03027

10F. Preparation Of Reviews

SEQUENTIAL PRECIPITATION SAMPLERS: A LITERATURE REVIEW.
Nebraska Univ. at Omaha. Dept. of Chemistry.
For primary bibliographic entry see Field 2B.
W91-03294

LIBRARY U. OF I. URBANA-CHAMPAIGN

SUBJECT INDEX

ABERDEEN PROVING GROUND
Hydrogeologic and Chemical Data for the O-Field Area, Aberdeen Proving Ground, Maryland.
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Heat and Mass Balance of an Ablating Ice Jam.
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ACID RAIN
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Adirondack Watershed Data Base: Attribute and Mapping Information for Regional Acidic Deposition Studies.
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W91-03670	7C	W91-03743	2C	W91-03816	2L	W91-03889	2F
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1991 Price Schedules for the United States, Canada, and Mexico

These prices are for customers in the United States, Canada, and Mexico; other customers, write for price list PR-360/4

Microfiche & Paper Copy Reports

Standard Prices

A01	$8.00
A02	11.00
A03	15.00
A04–A05	17.00
A06–A09	23.00
A10–A13	31.00
A14–A17	39.00
A18–A21	45.00
A22–A25	53.00
A99	*

"N" Codes

N01	$60.00
N02	59.00
N03	20.00

Exception Prices

E01	$10.00
E02	12.00
E03	14.00
E04	16.50
E05	18.50
E06	21.50
E07	24.00
E08	27.00
E09	29.50
E10	32.50
E11	35.00
E12	38.50
E13	41.00
E14	45.00
E15	48.50
E16	53.00
E17	57.50
E18	62.00
E19	69.00
E20	80.00
E99	*

Computer Products

Diskettes

D01	$50
D02	80
D03	130
D04	180
D05	230
D06	280
D07	330
D08	380
D09	430
D10	480
D11	530
D12	580
D13	630
D14	680
D15	730
D16	780
D17	830
D18	880
D19	930
D99	*

Magnetic Tapes

T01	$165
T02	220
T03	340
T04	450
T05	560
T06	670
T07	780
T08	890
T09	1,000
T10	1,110
T11	1,220
T12	1,330
T13	1,440
T14	1,550
T15	1,660
T16	1,770
T17	1,880
T18	1,990
T19	2,100
T99	*

* Contact NTIS for price

Prices effective January 1, 1991

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